

**National Natural
Science Fund
Guide to Programs
2020**

**National Natural Science
Foundation of China**

Brief Introduction

The *National Natural Science Fund Guide to Programs 2020*, in accordance with the *National Natural Science Foundation Regulations* and relevant documents on program management, details the reform of National Natural Science Funding System, gives instructions on the application requirement, and explains the definition of application quota and introduces the funding policies for various types of programs in 2020. It provides applicants with useful guidance on seeking support from the National Natural Science Fund. The *Guide* introduces the exploration, talent, instrument and convergence program categories in separate sections. It is an important basis for the allocation of the National Natural Science Fund, and also a must-read reference for applicants.

This book can be used as a reference for researchers in universities and colleges of higher education and research institutions, and for people working in areas of S&T management and policy research.

Editorial Committee

Chairperson

GAO Ruiping

Vice Chairperson

WANG Changrui

Members (in alphabetical order)

CHE Chengwei

CHEN Yongjun

DONG Guoxuan

FENG Wen'an

FENG Xuelian

HE Jie

LI Jianjun

LI Ming

LIU Ke

SUN Ruijuan

WANG Qidong

YANG Junlin

YANG Liexun

ZHANG Xiangping

ZOU Liyao

Editors (in alphabetical order)

HAO Hongquan

SUN Yue

ZHENG Zhimin

Foreword

In 2019, the National Natural Science Foundation of China (hereinafter abbreviated as NSFC), guided by President Xi Jinping's Socialism Thoughts with Chinese Characteristics for the new era, fully implemented the spirit of the 19th CPC National Congress and its Second, Third and Forth Plenary Sessions, earnestly complied with President Xi's important instructions on science and technology work and the spirit of the latest decisions and arrangements of the CPC Central Committee and the State Council. In accordance with the requirements of modernizing governance system and governance capabilities, NSFC systematically deepened the reform of National Natural Science Funding System, and upgraded the reform plan.

The upgraded reform plan adheres to the goal of building a science funding governance system with advanced concepts, standardized systems, and fairness and efficiency. With three major tasks (identifying funding categories, improving evaluation mechanisms, and optimizing layout of research areas) as the core, it strengthens three aspects (the integrity of the Party and clean government, academic atmosphere and scientific research integrity and ethics, organization and team building), improves six mechanisms (identifying scientific problems to address major national needs, identifying scientific problems to lead the world's scientific frontiers, project approval for major types of programs, research outcomes transfer, transdisciplinarity and convergence, and diversified investment), highlights two priorities (original exploratory program, upgraded talent funding portfolio), and continues optimizing seven areas of funding management (clarifying priority levels at all levels, deepening international cooperation systematically, continuously improving rules and regulations, continuously improving project management, continuously regulating fund management, continuing performance evaluation, and strengthening unit management), comprehensively deepening science funding reform, and strive to achieve major breakthrough in prospective basic research and cutting edge original works, and make more contributions to the goal of becoming world's leading science and technology power.

In 2020, NSFC will learn from the experience of the pilot reform and comprehensively implement the upgraded version of the reform plan, including:

expanding the pilot category-specific application and review to all the General and Key Programs, applying the "Responsibility + Credibility + Contribution" featured evaluation mechanism to more disciplines and types of program, launching new sets of application code in the Department of Engineering and Materials Sciences and Department of Information Sciences, piloting an original and exploratory program, upgrading the talent funding system, and implementing the action plan for promoting scientific spirit, culture and values as well as scientific integrity and ethics. We kindly ask researchers to pay close attention to science funding policy updates and reform measures in 2020 and give us precious comments and suggestions, so as to jointly ensure the healthy development of the National Natural Science Fund.

In order to reflect the principle of openness, fairness and justness and help scientists better understand NSFC's funding policies, the *Guide* is published to all applicants for selecting proper categories of programs, research topics, areas and directions when they apply for the NSFC funds. Applicants shall carefully read the 2020 NSFC Reform Measures, Information on Application, Application Limit, and application requirements for relevant types of programs. For General Program, in addition to the overall funding statistics, the general funding principles, requirements, information on application, as well as funding scope and requirements for relevant scientific departments or disciplines are also introduced. Any special requirements for any type of program are indicated in the main text of this *Guide*.

This *Guide* mainly introduces the application of various types of projects submitted during the concentrated reception period of 2020. Calls for proposals not released during the concentrated reception period will be announced on NSFC's website (<http://www.nsf.gov.cn>). Applicants and host institutions are advised to pay due attention.

NSFC will continue to strictly follow the National Natural Science Foundation Regulations and relevant guidelines for program management, standardize management procedures and optimize the peer review mechanism, strictly observe pertinent regulations on conflict of interest and confidentiality, and sincerely cherish the supervision from the scientific community and the general public.

All researchers are welcome to submit high-quality proposals for the National Natural Science Fund in accordance with the funding categories.

Editorial Committee
January 10, 2020

2020 NSFC Reform Measures

NSFC carefully studies and understands President Xi Jinping's important exposition on scientific and technological innovation and basic research, thoroughly implements critical requirements stated in a series of documents such as “Several Opinions of the State Council on Comprehensively Strengthening Basic Research”, “Opinions on Deepening Project Review, Talent Evaluation, and Institutional Evaluation Reform”, and “Notice of the State Council on Several Measures for Optimizing Scientific Research Management and Improving Scientific Research Performance”, and launches a series of reform measures in accordance with the upgraded version of the NSFC reform plan.

I. Expand the scope of pilot category-specific review

In 2020, NSFC will expand the scope of pilot category-specific review to all the General and Key Programs. For detailed requirements, please refer to Information on Application of this *Guide*.

II. Implement the original exploratory program

In order to further guide and motivate researchers to engage in original basic research and boost major breakthroughs in prospective basic research and cutting-edge original work, NSFC sets up Original Exploratory Program, introduces new project selection mechanism, and creates a good atmosphere conducive to originality.

For the application requirements and procedures of the program, please refer to the “Guidelines for Application of 2020 National Natural Science Fund Original Exploratory Program” issued by NSFC.

III. Adjust application limit

In order to implement the requirement that "in principle, a researcher shall only lead and participate as a key member no more than two projects of national

science and technology plan (special program, fund and etc.) during the same period" indicated in "Opinions on Further Promoting Scientific Spirit, Culture and Values" issued by the General Office of the CPC Central Committee and the General Office of the State Council, NSFC has made corresponding adjustments to the application limit, as detailed in the "Application Limit" section of this *Guide*.

IV. Optimize talent program portfolio

Foreign researchers of non-Chinese descent who meet the application requirements in the Regulations are allowed to apply for National Science Fund for Distinguished Young Scholars and Excellent Young Scientists Fund.

The pilot program of Excellent Young Scientists Fund (Hong Kong and Macao) will continue being open to researchers at host institutions in Hong Kong and Macao Special Administrative Regions for application, the funding pattern and evaluation criteria are consistent with those of Excellent Young Scientists Fund. For specific application requirements, please refer to the "Excellent Young Scientists Fund" section of this *Guide*.

NSFC is to strengthen the co-ordination of National Science Fund for Distinguished Young Scholars and Excellent Young Scientists Fund with other national science and technology talent programs to avoid duplicate funding. For detailed application requirements, please refer to "Excellent Young Scientists Fund" and "National Science Fund for Distinguished Young Scholars" sections of this *Guide*.

Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao is no longer available.

V. Pilot overall rationing system in the use of project funding

NSFC is to initiate trial implementation of "overall rationing system" in the use of project funding for the National Science Fund for Distinguished Young Scholars. Project funding is no longer divided into direct costs and indirect costs. When the applicant submits a proposal, there is no need to prepare a project budget. The person in charge of the project shall use the funds independently within the prescribed scope.

VI. Adjust the funding structure of some program types

After the trial of increasing the proportion of indirect costs of intelligence-intensive and purely theoretical basic research projects at 60 host institutions, starting from 2020, all host institutions will adopt the new funding structure for all the programs for Young Scientists Fund, Excellent Young Scientists Fund and Science Fund for Creative Research Groups awarded all relying units will be adopted to further increase the proportion of indirect costs. For details, please refer to the corresponding section in this *Guide*.

VII. Optimize application code settings

In 2020, the Department of Engineering and Materials Sciences and Department of Information Sciences will reorganize the primary and secondary application codes, and eliminate the tertiary codes. After selecting the correct application code, applicants may choose appropriate "research areas" and "keywords" in the online application system.

VIII. Further simplify requirements for application management

The scope of paperless application will be expanded to General Program and Fund for Less Developed Regions. In 2020, paperless application shall be submitted for the following types of programs: General Program, Key Program, Young Scientists Fund, Fund for Less Developed Regions and Excellent Young Scientists Fund. Applicants are still required to submit hardcopies for Excellent Young Scientists Fund (Hong Kong and Macao) application.

NSFC will further simplify the requirements for application materials, and fully utilize information technology to provide better services to researchers.

IX. Pilot the evaluation mechanism featuring "Responsibility + Credibility + Contribution" (RCC)

The RCC evaluation mechanism insists on positive guidance and incentives for reviewers. Based on a clear code of conduct for reviewers to be responsible, NSFC explores the approaches to assessing and accumulating reviewers' contributions (including contributions to funding decisions and applicants), encourages them to build long-term academic reputation by maintaining sense of responsibility in the process of evaluation, strive to

improve the quality of evaluation work and create a good academic ecosystem.

X. Strengthen scientific integrity

According to *Several Opinions on Further Strengthening Scientific Integrity* and *Opinions on Further Promoting Scientific Spirit, Culture and Values* issued by the General Office of the CPC Central Committee and the General Office of the State Council, NSFC will implement the action plan for promoting scientific spirit, culture and values, establish a scientific research integrity system that integrates "education, guidance, regulation, supervision, and discipline".

Information on Application

In applying for NSFC funds in 2020, applicants and their host institutions shall first read carefully the following documents: *the National Natural Science Foundation Regulations* (hereinafter referred to as the *Regulations*), this *Guide*, relevant guidelines for program management, *Regulations on National Natural Science Fund Management*, and notifications and announcements pertaining to application. Should there be any conflicts between guidelines for program management and *Regulations* and this *Guide*, *Regulations* and this *Guide* shall prevail. Applicants and their host institutions shall comply with the following provisions.

I. Eligibility of applicants and requirements on applications

i. Eligibility of applicants

1. As the principal investigator (PI), the applicant should comply with Article 10 Clause 1 of *Regulations*, i.e., the applicant shall have (1) the experience of undertaking basic research program(s) or other basic research activities; (2) a senior academic rank (title) or a doctoral degree, or recommendation from two researchers who are in the same research field and have a senior academic rank (title). Besides, those who apply for certain types of programs shall meet other specific requirements. (For more information, please refer to the text of this *Guide*.)

When an applicant not employed as a full time staff member at his or her host institutions submits the applications, he or she shall truthfully state his or her position, term of employment and annual working duration at the host institution in the application.

The applicants for the Fund for Less Developed Regions should be full-time employees in the specified host institutions (for more information, please refer to the chapter on Fund for Less Developed Regions in this *Guide*), or the technical personnel following national policy and sent by the Central Organization Department on the 3-year or longer aiding mission in Xinjiang and Tibet, who should provide the supporting materials of the aiding mission issued by organization or personnel department of the aided institutions. **If the unit**

that a researcher is working at for the aiding mission in Xinjiang or Tibet is not a registered host institution, he or she is allowed to apply for Fund for Less Developed Regions through the eligible host institutions in the aided autonomous regions. Part-time employees in the specified host institutions, technical personnel from the specified host institutions affiliated to Chinese People's Liberation Army or host institutions outside the regions are not qualified to apply for the Fund for Less Developed Regions.

2. When a researcher conducting basic research satisfies the requirements as prescribed in the preceding paragraph but has no employer or whose employer is not a registered host institution, on the condition that he or she has obtained the consent from a registered host institution, he or she is eligible to apply for the General Programs and Young Scientists Fund, but cannot apply for other programs.

Under this circumstance, the applicant shall fill in truthfully personal information in the basic information page of the proposal and research experiences in CV, and sign the agreement in written form with the host institution (for more information please refer to the *Guideline on Management of National Natural Science Fund Host Institutions*). **The hard copy of the agreement shall be archived at the host institution for future reference instead of submitting to NSFC.**

Researchers with overseas identity who are not employed in any host institution shall not apply for NSFC programs as researchers with no employer or whose employer is not a registered host institution.

3. Students pursuing the postgraduate degree (not obtained by the deadline for NSFC submission) cannot apply for any fund as the PI. However, with the supervisor's consent, in-service personnel can apply for certain categories of programs through the host institution. The applicant should submit the hard copy of application with the following attachments: signed certification of the supervisor's consent which explains the connection between the dissertation and the proposal, and the guarantee of working hours and conditions after the project starts, etc.

In-service personnel pursuing postgraduate degrees can apply for the following program types: General Program, Young Scientists Fund, and Fund for Less Developed Regions. But in-service personnel pursuing the master degree cannot apply for Young Scientists Funds.

4. Postdoctoral fellows can apply for the following programs only: General Programs, Young Scientists Fund and Fund for Less Developed Regions. When applying, they can flexibly choose the funding period based on the

duration of their employment; but cannot change the host institution after the fund is awarded.

5. An applicant whose host institution is one of the following eight universities, i.e., Hong Kong University, Chinese University of Hong Kong, Hong Kong University of Science and Technology, Hong Kong Polytechnic University, City University of Hong Kong, Hong Kong Baptist University, University of Macao, and Macao University of Science and Technology, can only apply for Excellent Young Scientists Fund (Hong Kong and Macao).

6. If a researcher has the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao projects, or the International (Regional) Joint Research project (including Key International (Regional) Joint Research Program and International (Regional) Joint Research Program under Agreements/MoUs) as the foreign PI, he or she cannot apply for other types of program as the PI before these projects are completed, vice versa. If an applicant has on-going projects other than these two types, he or she cannot apply for the Overseas Chinese Scholars and Scholars in Hong Kong and Macao Program or participate in the International (Regional) Joint Research project (including Key International (Regional) Joint Research Program and International (Regional) Joint Research Program under Agreements/MoUs) as the foreign PI.

7. To avoid duplication of funding, NSFC Department of Management Sciences and National Social Science Fund shall jointly limit applications. Please refer to page 52 of this *Guide* for detailed requirements.

ii. Requirements on applications

1. The proposal shall be prepared by the applicant in person and in accordance with the outline. The applicant and the main participants should fill in their CVs accordingly. Please note that any unlawful or confidential content shall not appear in the proposal. The applicant shall be responsible for the authenticity and legitimacy of the proposal submitted.

2. In accordance with program types, the applicant shall make correct choice of the “funding category”, “subclass introduction” and “annotation”. Content that requires “choosing” can only be chosen in the pull-down menu; content that requires “filling out” can be written in words; some program’s annotation attachments should be written strictly in accordance with this *Guide*.

3. In 2020, pilot category-specific application and review based on the four scientific natures of research will be adopted for all the General and Key Programs. When preparing proposals for the abovementioned Programs, applicants shall choose one out of the four scientific natures according to the

critical scientific problem they aim to solve and the research they hope to conduct, and justify their choice in the proposal. When the proposed research fits multiple scientific natures, applicants shall choose one that best describes the characteristics of their proposed research.

4. In 2020, applications for Key Program, Excellent Young Scientists Fund and Young Scientists Fund will continue to be paperless; and General Program and Fund for Less Developed Regions will be incorporated into pilot paperless application. In process of the submission, the host institution shall only confirm the online application and the attachments, without having to submit a hard copy. After the project has been approved, the signature and seal page of the application form shall be attached to the Project Plan and submitted. The signature and seal information shall be consistent with that of the electronic application.

5. In 2020, Letter of Commitment to Scientific Integrity will remain incorporated into the application. Only after the letter is signed by the applicant, main participants, host institution and cooperative institutions, can the application be submitted. For programs with pilot paperless application, the applicant shall sign the letter electronically and submit it online to the host institution, and the host institution shall sign the letter to confirm and submit the application to NSFC.

6. If the proposed research involves issues related to scientific research ethics and scientific and technological security (such as biosecurity, information security, etc.), the applicant shall strictly follow relevant national laws, regulations and codes of ethics, and provide corresponding materials as attachment in accordance with the requirements of relevant scientific departments (a scanned copy shall be attached to the electronic application).

7. Applicants shall choose the appropriate code from the “National Natural Science Foundation Application Code” in the appendix of this *Guide* in accordance with the research direction or research field. Particular attention shall be paid to:

(1) When choosing the code, try to select the full code including the last digit (six or four digits).

(2) "Application Code 1" is the reference for deciding NSFC's accepting department and selecting the panel experts. "Application Code 2" is supplementary. For some programs, applicants shall choose designated Application Code 1 or 2.

(3) Key Programs, Major Research Programs and Joint Funds Programs,

etc., have special requirements for the application code. For details, please refer to the relevant sections in this *Guide*.

(4) NSFC further promotes the standardization of “application code”, “research direction” and “key word”. Applicants should accurately select “Application Code 1” and the corresponding “research direction” and “key word” when filling out the proposal form.

(5) For any questions in regard to application code, please contact relevant scientific departments.

8. The hard copy of application should be signed by the applicant and main participants. For paperless application, the signed page of the hard copy of application shall be submitted after the funding is awarded.

For participants outside the host institution (including post-graduates), their work places are seen as cooperative research institutions whose information shall be included in the proposal’s basic information form and whose official seal should be included on the sign and seal page. The name of the institution and that on the seal shall be identical. The official seal shall be used, if the institution is registered at NSFC, and the corporate seal should be used if the cooperative institution is not registered at NSFC. The number of any proposal’s cooperative institutions shall not exceed two (unless specified otherwise). Overseas institutions will not be seen as collaborative research institutions.

If an overseas researcher who serves as a main participant is unable to sign in person, a paper document with the signature and stating his or her consent to participate and perform the related responsibilities shall be sent via mail or fax and submitted with the paper form proposal as attachments. For paperless applications, the applicant shall submit a scanned copy of the signed document as an attachment to the proposal.

9. Applicants and the main participants with a senior academic rank (title) shall indicate in the proposal if:

(1) They have more than one host institution when applying or participating in NSFC projects in one year;

(2) They have different host institutions for on-going NSFC projects.

10. If a research has received funding through other sources, the applicant should specify the funding details and their difference and connection with the current proposal. Applying for funding from different funding agencies for the same research content should be avoided.

If an applicant applies for different types of NSFC programs during the same year, he or she should specify in the proposal of the other NSFC program

applications, their titles and information, and the connection and difference with the current application.

11. The start time for research in proposal shall be January 1, 2021; the finish time shall be December 31, 20xx, depending on the funding periods (unless otherwise specified in this *Guide*).

12. The applicant and the main participants shall use the same and only document of identity for application.

When filling in names of oneself and main participants, the applicant shall make sure the names are in standard characters and exactly the same as the ones on documents of identity. Those who have received funds as applicants or main participants using other identification shall declare and provide details in the proposal. Host institutions are accountable for verification.

iii. About application reception conditions

According to the *Regulations*, the application for NSFC funds shall not be accepted under any of the following circumstances:

1. The applicant does not meet requirements stated in the *Regulations*, *Guide* and relevant management methods.
2. The application materials do not comply with conditions in this *Guide*.
3. The number of proposals does not comply with the Application Limit's conditions.

II. Requirements on scientific integrity

To enhance scientific research integrity, further strengthen basic information management and prevent scientific misconduct in science fund application, NSFC proposes instructions and requirements on scientific integrity to be followed.

i. About personal information

1. The science fund project shall be applied for by the applicant himself or herself. It is strictly prohibited to apply under another's name, or fabricate false applicants and main participants.

2. Applicants and main participants shall truthfully fill in the personal information and be responsible for its authenticity; at the same time, the applicant shall also be responsible for the authenticity of the personal information of all the main participants. It is strictly prohibited to forge or provide false information.

3. The academic degree information of applicants and main participants shall be consistent with that on the diploma. The time of degree acquisition shall be the same as on the diploma.

4. Applicants and main participants shall faithfully and accurately fill in the title information of their formal employment at host institutions. Forgery or providing false title information is strictly prohibited.

5. Applicants who are unemployed or whose employer is not a registered host institution shall truthfully fill in the work unit and the employment information. Giving false information is strictly prohibited.

6. Applicants and main participants shall faithfully and accurately complete their curricula vitae. It is strictly prohibited to forge or alter relevant information.

7. Applicants shall accurately provide the information of their postgraduate and postdoctoral (including visiting fellow) tutors, and fill in the names and titles separately.

ii. About research content

1. The applicant shall fill out the body part of the proposal in accordance with the *Guide*, instructions indicated in the online application system and requirements of the outline, and faithfully fill in relevant research work and research contents. Plagiarism or fraud is strictly prohibited. Violation of law and regulations, codes of ethics and regulations regarding S&T security is also strictly prohibited.

2. When filling in the research achievements such as papers, patents and awards, the applicant and main participants shall strictly follow the requirements of the outline, list the names of all authors (or inventors) of the research results following the rules for order, mark them accurately, and shall not alter the order of authors (or inventors), falsely mark first or corresponding authors, or omit marking co-first authors or corresponding authors.

3. Applicants and main participants shall strictly abide by the academic norms and codes of conduct recognized by the scientific community and shall not include research results that are generated from scientific misconducts such as forgery, tampering, plagiarism, entrusting “third party” to compose or submit the proposal, and peer-review fraud as the basis of applying for science funds.

4. Proposals with same or similar research contents shall not be submitted by different applicants through different host institutions to apply for different types of programs simultaneously. Projects that have already been funded are not allowed to be proposed.

5. If the research content has been funded through other channels or programs, applicants shall state the funding situation and the difference and connection with the proposed project in the application. Applicants shall not submit the same research content to different funding agencies.

iii. Other relevant requirements

1. Host institutions and cooperative institutions shall implement the requirements of the “Several Opinions on Further Strengthening Scientific Integrity” and “Opinions on Further Promoting Scientific Spirit, Culture and Values” issued by the General Office of the CPC Central Committee and the General Office of the State Council, establish and improve the education, management and supervision system for upholding scientific research integrity, examine and verify application materials more strictly, and eliminate exaggeration, falseness and fraud.

2. Applicants shall inform main participants of the relevant contents of the application and the scientific integrity requirements, so as to ensure that main participants fully understand the relevant contents of the application and are responsible for the authenticity, completeness and compliance of the contents involved.

3. Prior to submitting the proposals, applicants and main participants together with host institutions and cooperative institutions shall pledge not to be involved in any form of activities that will be likely to impact the fairness of review, and to strictly comply with their commitments in the process of application and review.

III. Responsibilities of host institutions

1. Host institutions should strictly abide by the *Regulations, Guide, Regulations on Fund Management of National Natural Science Fund Host Institutions*, other relevant notices and management methods and Funding Management Method, Budget Preparation Notes and Notes on National Natural Science Foundation of China Program Budget Form.

2. Host institutions shall implement “Several Opinions of NSFC on Further Strengthening the Science Fund Management of Host Institution”, seriously fulfill the responsibilities of management, and strengthen and standardize science fund management.

3. Host institutions shall establish a scientific research ethics and science and technology security review mechanism to prevent ethical and

security risks. In accordance with relevant laws, regulations and codes of ethics, host institutions shall establish and improve scientific research ethics and scientific and technological security management systems; strengthen ethical review mechanism, process supervision, and liability system for biosecurity, information security and other scientific and technological security; improve the sense of responsibility and legal awareness of scientific research personnel with regard to scientific research ethics, science and technology security, etc., through publicity, education and training.

4. Host institutions are held accountable for the eligibility of applicants, and shall examine and verify the authenticity and completeness of proposals. No confidential content shall be included in the proposal.

5. Host institutions that allow applicants without employer or whose employer is not a registered host institution as listed in Article 10 Clause 2 of Regulations to apply for funds via their institutions shall bear the responsibilities listed in Article 13 of Regulations, and sign the written contract. The written contract shall be archived at the host institution for further reference instead of submitting to NSFC.

6. When submitting hard copy of applications, host institutions shall also submit *Letter of Commitment to Scientific Integrity by Host Institution* that is signed by the legal representative and sealed, with the list of proposed projects enclosed. Proposed projects shall be listed separately as pilot paperless application and paper application. Incomplete application will not be accepted by NSFC.

IV. Accountability

1. Host institutions that neglect management and fail to perform the duties of examining the authenticity, completeness and compliance of the application materials, or host institutions and cooperative institutions violating commitments, shall be punished depending on the severity of the situation by NSFC in accordance with the *Regulations, Guide to Programs* and other provisions.

2. Applicants and main participants violating the requirements and commitments stated in this *Guide* or other scientific and technological activities, once discovered, shall be punished (such as termination of review) depending on the severity of the situation by NSFC in accordance with the provisions of the *Regulations* and the *Guide*. Suspected violations of scientific research integrity requirements will be transferred to NSFC Supervisory Committee for

investigation, and verified cases will be handled with seriousness.

3. Clues and whistle-blowing reports related to the violation of disciplines and laws will be transferred to relevant discipline inspection and supervision departments in accordance with management authority.

Application Limit

I. Application limit in general

1. Applicants shall only apply for one type of programs once in a year, excluding Integrated Program and Strategic Research Program in the Major Research Plan, Scientific Activity Program in Special Program and International (Regional) Exchange Program; for Joint Funds, the same type refers to the same program title.

2. Applicants shall not apply for the same type of programs if they received funding for General Program, Key Program, Major Program, Major Research Plan Program (excluding Integrated Program and Strategic Research Program), Program of Joint Funds (referring to the Joint Fund with the same name), and Fund for Less Developed Regions as the PI in the previous year.

3. For Special Fund for Research on National Major Research Instruments (department recommendation) or Basic Science Center Program, applicants shall only apply for one project in the same year.

4. Applicants and main participants shall only apply for and participate in one project for Funds for Creative Research Group or Basic Science Center Program in the same year.

5. The PI of an International (Regional) Joint Research Project shall not apply as an applicant for the same type of program.

6. For International (Regional) Joint Research and Exchange Program, each researcher shall apply for as applicant and undertake as PI only one project under the same Agreement/MoU.

II. One-year suspension from application after unsuccessful application for the General Program for two consecutive years

Applicants with unsuccessful application for the General Program both in 2018 and 2019 (including eligibility rejection) cannot apply for General Program as the PI in 2020.

III. Restriction on the total number of projects for researchers with a

senior academic rank (title) applying for and undertaking

Unless otherwise specified, projects whose funding period terminates in the year of application are not included in the total number for applying and undertaking.

i. Limit for researchers with a senior academic rank (title)

The total number of the following programs a researcher with senior academic rank (title) applies for (including as an applicant and a main participant) and undertakes (including as an applicant and a main participant) shall not exceed **two**: General Program, Key Program, Major Program, Major Research Plan (excluding the Integrated Program and Strategy Research Program), Program of Joint Funds, Young Scientists Fund, Fund for Less Developed Regions, Excellent Young Scientists Fund, National Science Fund for Distinguished Young Scholars, Key International (Regional) Joint Research Program, International (Regional) Joint Research Program under Agreements/MoUs with direct cost of more than 2 million yuan per project (only the PI are counted, main participants are not counted), National R&D Program for Major Research Instruments (including Special Fund for Major Research Instruments and Special Program of National Major Research Instruments), Basic Science Center Program, Original Exploratory Program, and Emergency Program and Special Program with funding period of over one year (unless otherwise specified; and except for the bureau (office) ad hoc task and soft research projects under Emergency Program, and scientific activities projects under Special Program).

The projects that were granted in 2019 or before and are undertaken by researchers with a senior academic rank (title) as main participants are not included in the total number. However, the projects that researchers apply for as applicants and main participants and those awarded to researchers as PI and main participants in 2020 and beyond are included in the total number.

ii. Limit for researcher without a senior academic rank (title)

1. The total number of projects a researcher applies for or undertakes as the PI should not exceed one.

2. Under the premise of adequate time and energy, the total number of projects a researcher applies for or undertakes as a main participant is not limited.

3. In case a researcher receives the senior academic rank (title), the projects he or she undertakes as the PI shall be counted into the total number whereas those a researcher undertakes as the major participant shall not.

iii. Special requirements for some types of programs

1. Excellent Young Scientists Fund Program and National Science Fund for Distinguished Young Scholars

At the stage of application, Excellent Young Scientists Fund and National Science Fund for Distinguished Young Scholars are not counted, but are counted before receiving NSFC's formal funding decision and after approval.

2. Basic Science Center Program

At the stage of application, Basic Science Center Program is not counted, but is counted before receiving NSFC's formal funding decision and after approval.

The PI and main participants shall not apply for any NSFC grants before the awarded project concludes except for National Science Fund for Distinguished Young Scholars and Excellent Young Scientists Fund.

The PI and main participants with senior academic rank (title) who is funded by Science Fund for Creative Research Groups shall not apply for Basic Science Center Program; however, application is allowed in the year of conclusion.

3. Special Fund for Research on National Major Research Instruments

Researchers with senior academic rank (title) shall apply (as applicant and main participant) for Special Fund for Research on National Major Research Instruments only once in the same year.

When funded, the PI shall not apply for any other NSFC funds other than the National Science Fund for Distinguished Young Scholars before the awarded project concludes.

The total number of Special Fund for Research on National Major Research Instruments (including Special Program on National Major Research Instruments) and the National Major Instrument Equipment R&D Program by Ministry of Science and Technology a researcher applies for (including as applicant and main participant) and undertakes (including as PI and main participants) shall not exceed one.

4. Original Exploratory Program

Projects under the Original Exploratory Program is not counted in the total number between pre-application and NSFC formal funding decision, but is

counted after the grant is awarded.

Researchers can only apply for one project under Original Exploratory Program (including pre-application) in the same year.

The PI of the ongoing Original Exploratory Project shall not apply for National Natural Science Fund as an applicant except for the National Science Fund for Distinguished Young Scholars and Excellent Young Scientists Fund Program.

IV. Limit on the PI for accumulated number of funding

1. For Young Scientists Fund, Excellent Young Scientists Fund, National Science Fund for Distinguished Young Scientists, and Science Fund for Creative Research Groups, the applicant can receive the funding only once.

2. Beginning from 2016, for Fund for Less Developed Regions, the applicant's accumulated number of funding cannot exceed three. Projects approved in and before 2015 are not counted.

V. Programs not subject to the total number limit

There is no number limit for Science Fund for Creative Research Groups, Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao, Tianyuan Fund for Mathematics, International (Regional) Joint Research Program under Agreements/MoUs with direct cost of no more than 2 million yuan per project, International (Regional) Exchange Program, Research Fund for International Young Scientist, ad hoc and soft projects by bureaus and divisions under Emergency Program, scientific activity projects under Special Program, other types of program with funding period of no more than 1 year, and other programs specified in this *Guide*.

Special notice

1. During the evaluation period (prior to NSFC's final decision), the application shall be counted in the total number, except for those under Original Exploratory Program.

2. In the case that applicants engaged in multiple host institutions apply for or undertake through different host institutions, the Limit is still applicable.

3. In case of an inconsistency between other management regulations and this Limit in terms of total project numbers, the latter shall prevail.

Contents

Foreword.....	i
2020 NSFC Reform Measures	iii
Information on Application.....	vii
Application Limit.....	xvii
General Program.....	1
Department of Mathematical and Physical Sciences	3
Division of Mathematics.....	5
Division of Mechanics	6
Division of Astronomy.....	7
Division I of Physics	8
Division II of Physics.....	9
Department of Chemical Sciences	10
Division I of Chemistry	12
Division II of Chemistry	13
Division III of Chemistry.....	14
Division IV of Chemistry.....	16
Division V of Chemistry.....	18
Department of Life Sciences.....	18
Division I of Biology	21
Division II of Biology.....	23
Division of Biomedicine.....	26
Division of Interdisciplinary Research.....	28
Division of Environment and Ecology.....	31
Division of Agriculture and Food Sciences	33
Division of Agricultural Environment and Horticulture	35
Division of Agriculture Animal.....	37
Department of Earth Sciences.....	40
Division I of Earth Sciences.....	41
Division II of Earth Sciences	42
Division III of Earth Sciences.....	44
Division IV of Earth Sciences.....	45

Division V of Earth Sciences	47
Department of Engineering and Materials Sciences	48
Department of Information Sciences	64
Division I of Information Sciences	65
Division II of Information Sciences.....	67
Division III of Information Sciences.....	68
Division IV of Information Sciences	69
Department of Management Sciences.....	70
Division I of Management Sciences	73
Division II of Management Sciences	74
Division III of Management Sciences.....	75
Department of Health Sciences.....	76
Division I of Health Sciences.....	81
Division II of Health Sciences	84
Division III of Health Sciences.....	86
Division IV of Health Sciences.....	88
Division V of Health Sciences	90
Division VI of Health Sciences.....	92
Division VII of Health Sciences	94
Division VIII of Health Sciences	96
Division IX of Health Sciences.....	98
Division X of Health Sciences	100
Key Program.....	103
Department of Mathematical and Physical Sciences	105
Department of Chemical Sciences	108
Department of Life Sciences.....	111
Department of Earth Sciences.....	114
Department of Engineering and Materials Sciences	118
Department of Information Sciences	123
Department of Management Sciences.....	127
Department of Health Sciences.....	130
Major Research Plan.....	137
Physics and Application of New Optical Field Regulation.....	139
Generation and Evolution of Turbulent Structures and Mechanism of Its Effect	140
Fundamental Theory and Key Technology of Coexisting-Cooperative-Cognitive Robots (Tri-Co Robots)	144
Scientific Foundation for High Temperature Materials, Advanced Manufacturing and Fault Diagnosis of Aero Engines	147

Young Scientists Fund	151
Department of Mathematical and Physical Sciences	153
Department of Chemical Sciences	154
Department of Life Sciences.....	155
Department of Earth Sciences.....	156
Department of Engineering and Materials Sciences	157
Department of Information Sciences	158
Department of Management Sciences.....	159
Department of Health Sciences.....	160
Fund for Less Developed Regions.....	161
Department of Mathematical and Physical Sciences	164
Department of Chemical Sciences	165
Department of Life Sciences.....	166
Department of Earth Sciences.....	167
Department of Engineering and Materials Sciences	168
Department of Information Sciences	169
Department of Management Sciences.....	170
Department of Health Sciences.....	171
Excellent Young Scientists Fund.....	173
Excellent Young Scientists Fund (Hong Kong and Macao).....	175
National Science Fund for Distinguished Young Scholars	179
Science Fund for Creative Research Groups	181
Basic Science Center Program.....	183
International (Regional) Cooperation and Exchange Programs.....	185
Key International (Regional) Joint Research Program	186
International (Regional) Cooperation and Exchange Programs under Agreements/MoUs	191
Asia and Africa	192
International Scientific Organizations.....	195
America and Australasia	197
Europe.....	200
Hong Kong and Macao SARs and Taiwan Region of China	205
Sino-German Center for Research Promotion	206
Research Fund for International Young Scientists	209
Programs of Joint Funds	211
Joint Fund for Regional Innovation and Development (the First Round).....	213
Joint Fund for Corporate Innovation and Development.....	242
NSAF Joint Fund	274

Joint Fund for Astronomy	276
Joint Fund for Large Scientific Facilities Research	279
Joint Fund for Aerospace Advanced Manufacturing Technology Research.....	281
Joint Fund for Civil Aviation Research.....	284
Joint Fund for Seismological Science.....	289
Joint Fund for Water Science of the Yangtze River	296
Joint Fund for Smart Grid	304
Joint Fund for Nuclear Technology Innovation	307
NSFC-Guangdong Joint Fund.....	311
NSFC-Yunnan Joint Fund	317
NSFC-Xinjiang Joint Fund	325
NSFC-Henan Joint Fund.....	328
Joint Fund to Promote Cross-Strait Scientific and Technological Cooperation.....	331
NSFC-Shandong Joint Fund	336
NSFC-Shenzhen Robotics Research Center Project.....	340
Tianyuan Fund for Mathematics	345
Special Fund for Research on National Major Research Instruments.....	349
Appendix.....	351

General Program

General Program supports scientists engaged in basic research on self-selected topics within the funding scope of NSFC to conduct innovative research and promote a balanced, coordinated and sustained development of all disciplines.

An applicant must meet the following qualifications/eligibilities:

(1) Have the experience of undertaking basic research projects or doing basic research;

(2) Hold senior professional position (title) or doctoral degree, or is recommended by two professionals with senior academic positions (titles) in the same research field. Full time post graduate students are not eligible to apply for the General Program, but on-the-job graduate students may apply through their employers if agreed upon by their supervisors.

Applicants should be familiar with the current situation of relevant research in China and the world, capable of leading a group to conduct research. Applicants should prepare proposals in accordance with the guideline. The proposed research should be of scientific significance and research merits, and have sufficient thematic basis, novel academic ideas, clear-cut objectives, reasonable and detailed research contents and feasible research schemes. The number of collaborative institutions for General Program projects should not exceed 2, and the duration is 4 years (except for PIs as in-site post-doctoral researchers, whose duration of the project should be determined based on the written commitment from their host institutions, and start time should be January 1, 2021 and finish time should be December 31, 20XX, they cannot change the host institution after the project is awarded).

In 2019, NSFC funded 18,995 General Program projects, with direct cost of 11 billion yuan. The average funding was 585,800 yuan per project. The number of funded projects increased by 48 over 2018 with an increase rate of 0.25%. The success rate was 18.98%, which is 2.13% lower than that in 2018 (20.46%). The funding of the General Program projects in 2019 is shown in the table below.

In 2020, the pilot review based on four natures of science topics will be implemented for the General Program. When preparing the application

for General Program, the applicant should select the nature of science topic based on the key scientific issues to be solved and the research content, and clarify the reasons for choosing the science nature concerned. In the case of multiple science features, the applicant should choose the science feature that best matches, and is most focused and characteristic. NSFC shall organize respective review by experts based on the science feature the applicant chooses.

In 2020, for the General Program, paperless applications are carried out. In process of the submission, the host institution shall only confirm the online application version and the attachments, without having to submit a paper form application version. Once approved, the signature and seal page of the application form should be submitted at the time of submitting the project plan. The signature and seal information should be consistent with that of the electronic application version.

The average funding intensity for direct cost for General Program is basically the same as that in 2019. Please refer to the sections of each department for detailed funding information about General Program. Applicants are advised to prepare their research proposals in line with the funding scale and the instructions by respective science departments.

Funding of the General Program Projects in 2019

Unit: 10,000 yuan

Departments	No. of applications	Awards				Success rate (%)
		No. of awards	Funding for direct cost	Average funding for direct cost	Share of NSFC total funding for direct cost (%)	
Mathematical and Physical Sciences	6,897	1,750	104,210	59.55	9.37	25.37
Chemical Sciences	7,954	1,675	109,120	65.15	9.81	21.06
Life Sciences	14,307	3,007	174,470	58.02	15.68	21.02
Earth Sciences	7,774	1,887	117,210	62.11	10.53	24.27
Engineering and Materials Sciences	17,893	3,261	195,669	60.00	17.59	18.23
Information Sciences	11,342	2,024	120,740	59.65	10.85	17.85
Management Sciences	5,258	807	39,160	48.53	3.52	15.35
Health Sciences	28,659	4,584	252,120	55.00	22.66	15.99
Total or average	100,084	18,995	1,112,699	58.58	100.00	18.98

Department of Mathematical and Physical Sciences

Mathematical and physical sciences (including mathematics, mechanics, astronomy, physics I and physics II) are important foundations of natural science, and the precursor and basis for the development of contemporary science. In their own development, mathematical and physical sciences also provide theories, methods and means for other disciplines. Research findings in mathematics and physics play a key role in promoting the progress of both basic and applied scientific disciplines. Disciplines in mathematical and physical sciences are peculiar in characteristics, such as big differences between or among disciplines, and pure theoretical research (such as mathematics, theoretical physics, etc.) and experimental studies. Many disciplines feature “mega-science”, such as high-energy physics, nuclear physics, astronomical physics, high temperature plasma physics, etc.

Mathematical and physical sciences have extensive interactions with other sciences, for example, with information science, life science and management science, physics with materials science, life science, information science and chemistry, astronomy with earth science, and mechanics with engineering science, materials science and earth science. The interactions produce a series of interdisciplinary and cross-boundary disciplines and new research areas have emerged, and at the same time research objects and areas in mathematical and physical sciences are also expanding.

The Department will continue to increase its support on basic research that takes as its primary goals advancing the disciplinary development, promoting original innovation and training talented researchers and meeting the needs of national long-term development, as well as interdisciplinary research within the Department and with other departments.

In 2019, the Department received 6,897 applications for General Programs, which is 353 more than that of 2018, increasing by 5.39%. 1,750 projects were funded, the success rate was 25.37%, and the funding budget per project was 595,500 yuan on average. The funding per project was 517,500 yuan for mathematics, 626,400 yuan for mechanics, 630,000 for astronomy, 627,300 for physics I and 627,400 for physics II.

According to the strategic needs of the development of mathematical and physical sciences and the overall plan of project funding, the Department has taken some measures in project funding performance and has strengthened macro guidance. In 2020, the Department will continue to pay attention to the following aspects:

(1) Emphasize on fostering outstanding young talents. In 2019, the PIs under the age of 40 in General Program projects reached 52.51%. In 2020, the Department will further increase funding for young researchers and expand funding scale for applicants under age 40, so as to have more young scientists funded and improve their research capability.

(2) Give more emphasis on creative research and disciplinary development. Multi-level funding to suit the needs of research will be adopted. More funding will be given to studies on developing experimental methods and techniques with innovative ideas aiming at the actual needs. Applicants are advised to pay attention to this policy.

(3) Strengthen macro planning, and give preferential support to basic problems in frontier areas and mathematical physics problems in areas of major national needs, so as to

promote sustainable development in these areas.

In 2020, preferential support will be given to the following areas:

- (i) Key scientific problems in new types of energy;
- (ii) Key scientific problems in deep space exploration, aerospace, and marine sciences;
- (iii) Innovative research in defense and military and civilian integration;
- (iv) Human health related problems in basic mathematics and physics;
- (v) Modeling, algorithm and analysis of big data and deep learning;
- (vi) Key technologies for physics and detection of gravitational wave;
- (vii) New computation method and standard software;
- (viii) Advanced method and key technology of experimental research and development of new instruments.

Funding for General Program Projects in Department of Mathematical and Physical Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Mathematic	Mathematics I	226	11,752	27.70	239	12,370	25.73
	Mathematics II	263	13,676	25.81	268	13,868	25.12
Mechanics	Basic problems and methods in mechanics	9	572	25.71	4	245	14.81
	Dynamics and control	67	4,236	26.48	70	4,406	25.18
	Solid mechanics	160	10,138	26.53	159	9,984	26.11
	Fluid mechanics	82	5,183	26.54	83	5,166	26.52
	Bio-mechanics	29	1,832	26.85	30	1,897	25.42
	Explosive and impact dynamics	36	2,286	26.47	38	2,357	22.75
Astronomy	Astrophysics	49	3,113	28.00	51	3,213	25.37
	Astrometry and celestial mechanics	54	3,391	25.84	50	3,150	25.13
Physics I	Condensed matter physics	220	13,924	26.54	229	14,396	25.33
	Atomic and molecular physics	45	2,836	26.63	45	2,828	25.57
	Optics	133	8,352	26.65	128	7,981	25.35
	Acoustics	40	2,526	27.03	36	2,271	25.35
Physics II	Fundamental physics and particle physics	96	5,707	28.07	94	5,647	26.26
	Nuclear physics, nuclear technology and its applications	97	6,175	26.15	99	6,255	25.26
	Particle physics and nuclear physics experimental facilities	74	4,840	25.52	64	4,113	23.88
	Plasma physics	63	4,101	27.04	63	4,063	25.82
Total or average		1,743	104,640	26.64	1,750	104,210	25.37
Direct cost per project		60.03			59.55		

Please indicate the research directions in the note section of the application form when applying for these projects, and choose the proper application code.

(4) As the governmental investment in the National Natural Science Fund is changing, the average funding for mathematical and physical research projects will also be changed accordingly. Please see the following table for average funding intensity for General Program projects for reference. The funding intensity for experimental research projects will be higher than that of theoretical research projects.

In 2020, the average funding per project for General Program will be the same as that of 2019.

Division of Mathematics

The Division encourages creative research on important issues in the mainstream and frontier of mathematics, explorations of new ideas, new theories and methods in mathematics and interdisciplinary applications, inter-crossing of different branch disciplines with mathematics, and applied mathematical research on practical issues. Applicants are required to have sound research background and capability. Proposal should be prepared based on deep understanding of the current status of the research involved, main issues and relevant research methods and available approaches. The Division encourages researchers to consolidate research team, foster talents and promote academic exchanges through the funded research projects. Research direction adjustment is allowable when needed.

For basic mathematics, the funding aims at maintaining stable development of research directions where China is traditionally strong and has comparatively large-scale research capability, promoting fast development of research areas that are within the mainstream of international mathematical research but relatively weak in China, and promoting interdisciplinary research among branches of mathematics. Focus is given to algorithm, grid theory and its algorithm, geometrical method in representation theory, comparative geometry and geometric analysis in non-smooth space, application in of modern harmonic analysis in number theory, associate geometry and geometric measure, random analysis method and application, and mathematical problems in quantum field theory.

The funding for applied mathematics and computational mathematics aims at improving applications in solving practical problems, and gives more emphasis on basic theory and new methods with strong practical background and sound potentials for application. NSFC encourages mathematical modeling of practical problems, analysis and computation, and statistical methods and theory for big data, supports research on mathematical physical logic, algorithm complexity, discrete probability modeling, optimal algorithm, and combinatorial algorithm. Focus is given to applied researches such as mathematical modeling and theory of new materials, uncertainty theory in data processing, coding theory and information security, mathematical modeling and analysis in environmental and energy sciences, bio-information and life system, pathogenesis and control of infectious disease, mathematical methods for complex bio-process and development of diseases, statistical methods in industry and medical science, statistical and optimization method in deep learning and artificial intelligence, modeling and analysis in

economic prediction and financial risk management, and mathematical theory and new method for industrial, medical imaging and image processing.

Division of Mechanics

The Division mainly supports research on basic problems and methods in mechanics, studies in areas of branches of mechanics such as dynamics and control, solid mechanics, fluid mechanics, biomechanics, explosion and impact dynamics. The Division supports projects with creative ideas in the frontiers of mechanical research on the one hand and projects closely related to the sustainable development of economy, society and national security, and the development of engineering and technology on the other hand. The Division supports interdisciplinary research and encourages experimental research using the available experimental facilities and key labs in China and advocates development of engineering software in computational mechanics.

Research on basic issues and methods in mechanics should focus on theoretical studies on mathematical methods, rational mechanics and physical mechanics, and strengthen the intercrossing with mathematics and physics.

Applications for research in areas of dynamics and control should pay attention to the theory and methods of nonlinear dynamics, strengthen research on vibration and control of complex systems, dynamic modeling and analysis of problems involving the coupling of solid, flexible bodies, fluid, and magnetic bodies, and promote development of non-smooth and multi-body system dynamics. The Division encourages studies on key issues of dynamics and control problems in major engineering projects, and encourages experimental studies on dynamics and control.

Applications in the area of solid mechanics should pay attention to international frontier and creative ideas, and give more consideration to intercrossing with physics, materials science, chemistry, information and biological sciences, and strengthen on proposing and studying topics in major engineering application, expand basic theory of continuum mechanics, and promote the development of multi-scale mechanics and multi-field coupled mechanics. Proposals in such areas will be encouraged as follows: the constitutive theory of materials at macro, meso and micro scales; the theory of strength, crack, fatigue and failure mechanism; the mechanical behavior of new materials and structures; experimental measurement techniques and representation methods, new theory and method in computation mechanics and high performance computational software; structural optimization, completeness evaluations, and the deformation, damage mechanism of rock and soil media and stability of rock mechanical engineering, etc.

Applications in fluid mechanics should pay attention to studies on the laws and mechanisms governing complex flows. The Division encourages researches on rarefied gas flow, hypersonic aerodynamics, aerodynamic noise, measurement techniques in experimental fluid mechanics, new methods in CFD and high performance computational software, especially theory, simulation and experimental studies on high temperature, high pressure and compressible turbulent flow, high speed hydrodynamics, multi-phase complex flow, and key fluid dynamic problems in aerospace, energy and ocean, environment and disaster, and transportation areas.

Applications in biomechanics should pay attention to bio-mechanical and mechanical biology problems related to human health and disease, life process, biomechanics and coupling with biology and chemistry in sports, mechanism and transformation medicine related to non-infectious diseases such as cardiovascular, bone joint and cancer, and encourage experimental studies on biomechanics.

Applications for explosive and impact dynamics should pay attention to frontier areas and major national needs, focusing on studies of the dynamic mechanical behaviors of materials, structural response to explosive impacts and detonation mechanisms, dynamic loading and diagnosis, strengthen mechanism of explosive energy release and encourage studies on dynamic response of material and structure in multi field coupling under extreme dynamic loading environment.

The Department continues to support studies on instruments, new experimental methods and techniques with innovative ideas. Applicants for this type of application should mark “Experimental Techniques and Instruments” in the application form. The Department will keep supporting projects in computational software development, giving stress on the integration and standardization research on the development of the computational mechanics software which may produce independent or shared IPR. Applicants for this type are requested to mark “Computational Mechanics Software” in the application form. Applicants of the above two types of projects should have relevant research background.

Division of Astronomy

The Division mainly supports researches on astrophysics, basic astronomy, astronomical instruments and technology. In accordance with the trend of astronomical development in the world and the present situation in China, the Division supports research proposals with emphasis on the development of technology and instrumentation. Studies based on existing observation apparatus or facilities to be built soon in China will be encouraged. The Division promotes the combination of innovative ideas, observation and theories, and studies on new technologies and methodologies for astronomy, especially those closely related to mega-science projects under construction in China. Interdisciplinary research is strongly encouraged so as to gradually build up research teams with special features and influence in international scientific communities. International cooperation and exchange will be given much attention.

In the General Program projects funded in recent years, a good balance has been achieved between astrophysics (including galaxies and cosmology, stellar and the Galaxy, solar and extra solar planetary system, and solar physics), basic astronomy (including astrometry and celestial mechanics) and astronomical technology and methods (including the history of astronomy). Young researchers have become the main force in astronomical research and more than half of the awardees are under the age of 40.

In 2020, in addition to strengthening continuous support for projects integrating theory and observation and projects conducted by young scientists, the Division will emphasize on interdisciplinary research with physics, space science, earth science and information science, etc., maintain support on research on advantageous directions, promote research related to using large observatory facilities in China, and foster research topics that

have the potential of making breakthroughs. The Division encourages research on basic physical process on celestial bodies, celestial chemical evolution, and celestial bodies in the solar system, extra solar system planetary system, infrared astronomy, space astronomical measurement, and astronomical research that addresses the national needs. The priority will be given continuously to researches in basic astronomy, astronomical technology and methods, and to relative small scaled astronomical research institutions.

In the next few years, the Division plans to give special support to pre-research around the research based on equipment that has already been built or being built, and conceptual studies on new technologies that are urgently needed for large-scale telescope and space exploration. For applicants in these research areas, please mark “Major S&T Basic Facilities Project” or “New Astronomical Technology” in the application forms.

Division I of Physics

The funding scope of the Division covers research on condensed matter physics, atomic and molecular physics, optics, acoustics and new research areas formed between these four disciplines and other disciplines.

According to the current status and requirements of disciplinary development, the Division pays attention to study on experimental methods and techniques motivated by creative ideas, encourages researches in new computational methods and simulation software closely related to experimental physics and exploratory types, key basic physical issues serving national needs, and new physical concepts and methods in interdisciplinary areas. We encourage especially in-depth and sustained studies on important physical problems that have not become hot topics, and researches in basic physical problems on devices, and new areas and directions.

For the funding in condensed matter physics, the Division will pay attention to quantum physics in electron related systems, macro quantum phenomenon, quantum phenomena and quantum effects in various low dimensional and small-scale systems, solid state quantum information and quantum computation, strengthen self-spinning and magnetism, topological state, physics and device physics and advanced technologies and methods of characterization, structural and physical properties of surface and interface physics in extreme conditions, and physical problems in energy transformation, transport, and storage, and expand physics and application of advanced functional materials. Encouraged areas include physical issues and experimental methods related to soft matters, biophysics, and artificial intelligence (AI). The Division pays special attention to creative studies on material, device and physics having important application prospects.

For areas of atomic and molecular physics and optics, the Division encourages researchers to pay attention to atomic, molecular and cluster structures and dynamics, cold atomic and molecular physics and interactions with optical fields, interactions of atomic and molecular systems, interactions between laser and atoms, propagation process of light in new media and its characteristics, quantum frequency markers, quantum metrology, quantum information, physics and methods of precision atomic and molecular spectra and precision measurement, strengthens basic and applied research on high resolution, high sensitivity laser spectrum, micro nano photonics, optical mechanics, and surface plasma

exciter, optical field regulation. The Division encourages research on frontier physical issues in photonics and optical electronics and interdisciplinary subjects.

In the area of acoustics, according to the major needs, studies on key fundamental acoustic problems will be encouraged. Physical acoustics and interdisciplinary research in marine acoustics, ultrasonic and acoustic effect, noise and control, new acoustic materials and devices, acoustic energy exchanger, and issues in information technology, etc., will be in priority.

Division II of Physics

The Division mainly supports research on fundamental physics, particle physics, nuclear physics, nuclear technology, accelerator physics and detectors, plasma physics, and synchronized radiation techniques and methods.

For fundamental physics, funding will be focused on original studies and interdisciplinary research with other disciplines. Stress will be given to important theoretical physical issue arising from scientific experiments and applications.

For particle physics and nuclear physics, the Division will support creative theoretical and experimental research, in particular, the combination of theoretical and experimental studies related to selected large-scale experimental facilities that are in operation, upgrading or to be completed soon both in China and abroad. Funding will be used to guide research towards the understanding of important physical rules related to the latest experimental results, such as the theory and experiments of phenomenology in particle physics and interdisciplinary research of nuclear physics under extreme conditions with nuclear astrophysics and other disciplines.

For support to nuclear technology, accelerator and detector, low-temperature plasma and synchronized radiation method and technology, it is expected that fundamental issues should be drawn from the disciplinary development, national demands and intercrossing with other disciplines, which may facilitate a deeper understanding of physical laws underlying the development of the disciplines and important applications at the same time. Emphasis will be laid on key technologies and innovative ideas in methodology and intercrossing with other disciplines. In addition, the exploration of mechanisms and rules governing the interaction of matter with instantaneous, high energy, high power and strong field radiation (such as charged particles, X/ γ , neutron and electromagnetic fields) are key areas for funding. Attention will be given to new acceleration principles, nanometer micro-beam, high power ion beam, strong current accelerators, plasma radiation source in accelerator and detector and plasma research, and physics and key technologies of all other advanced radiation sources. The Division gives strong support to new types of nuclear detection technology and method such as large area, high counting rate, high temporal resolution, low cost and weak signals, etc., and relevant studies on nuclear electronics.

For nuclear fusion and plasma physics, more attention will be given to the exploration of new diagnostic means related to large facilities which are in operation at present or will be built soon. In particular, basic research on advanced magnetic confinement fusion and new approaches to inertial confinement fusion and related fundamental physical problems, and computer simulation and experimental studies of

various kinds of plasma will be stressed.

In order to make more efficient use of limited funds, the Division encourages researchers all over China to make full use of big science facilities, small and medium equipment to conduct research, so as to achieve sustainable development in the research. The Division encourages experimental studies with innovative methods of high resolution diagnosis and detection, and, as well as the development of experimental facilities, detection and diagnosis devices which are important for the development of accelerators, detectors and gravitational wave detection. Applicants may increase the funding request in applications in these areas according to the actual needs. Projects with more young scientists involved in the research team under the same condition will be preferred.

In 2020, the Division provides special funding to support creative ideas on developing and improving instruments and equipment, advanced experimental technology and method, advanced method and key technology in nuclear exploration and nuclear electronics, and studies on radiation physics, radiation protection and environmental protection, etc.

Department of Chemical Sciences

Chemical science is to study the composition, structure, property, reactions and transformations of matters. It is the central science which is closely intercrossed and permeated with and into other disciplines. It is also the only basic subject that has industrial characteristics (chemical engineering) among natural sciences, which aims to accomplish the transfer and conversion of matters and energy by applying the principles of the basic disciplines, and to realize large-scale production and construct material basis which humans and society depend on for existence and development.

The mission of the Department is to improve the overall quality and international status of China's fundamental research in chemistry and chemical engineering, and foster creative talents and groups in chemistry and chemical engineering research with international impact. The Department supports multi-level and multi-scale research on the reaction, process and function at different levels of atoms, molecules, molecular aggregation and condensed state, as well as studies on the complex chemical system, in order to realize the precise control and logic cognition of chemical synthesis, process and function. In accordance with major scientific issues raised from the national economy, social development, national security and sustainable development, research on chemical sciences and chemical engineering is encouraged for exploring their role in fields of life, materials, energy, information, resources, environmental science and human health. The Department emphasizes the combination of microscopic and macroscopic research, static and dynamic states, theoretical research and empirical development of novel experimental methods and precise analytical technologies, and fundamental experiments and process engineering. It is also encouraged to introduce the latest theories, technologies and achievements from other disciplines into the research in chemical science and chemical engineering for facilitating the sustainable development of research, fostering innovation and interdisciplinary studies, and supporting the emerging frontiers in research.

Funding for General Program Projects in Department of Chemical Sciences in 2018 and 2019

Unit: 10,000 yuan

Disciplines	2018			2019		
	Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Synthetic Chemistry	301	19,584	23.39	268	17,478	21.04
Catalysis and Surface/ Interface Chemistry	176	11,470	22.95	172	11,181	21.10
Chemical Theory and Mechanism	116	7,561	22.22	113	7,377.5	21.20
Chemical Measurement	159	10,363	22.18	154	10,029	21.07
Materials Chemistry and Energy Chemistry	293	19,099	21.40	292	19,011	21.14
Environmental Chemistry	214	13,948	22.02	216	14,076	21.05
Chemical Biology	134	8,734	22.04	128	8,381.5	20.95
Chemical Engineering and Industrial Chemistry	344	22,421	21.92	332	21,586	20.97
Total or average	1,737	113,180	22.24	1,675	109,120	21.06
Direct cost per project	65.16			65.15		

In 2019, the Department selected General Program from all the disciplines to conduct classified application and category-specific review. 7,954 proposals for General Program were received by the Department (143 proposals and 1.83 % more than that of 2018). 1,675 proposals were funded with the success rate of 21.06 % and the average funding budget of 651,500 yuan per project. In 2019, the success rate decreased by 1.18 % compared to that of 2018 to guarantee the funding intensity by the Department. The proposals received and funded as well as their ratios in the main research orientations of chemistry and chemical engineering were at almost the same level to that of 2018. There was an increase in received proposals related to the interdisciplinary research areas such as materials and energy, life health and environmental resources.

The Department will continue to support high quality research in the cutting-edge fields, lay stress on in-depth and systematic research work, give priority to interdisciplinary research projects, and emphasize the diversity of research ideas, methods and contents to avoid the convergence and homogenization. Besides, the Department will take effective measures to support original, creative and risky research, so as to foster the breakthrough innovation, unblock the bottleneck of chemical research in China and achieve the transition from high-quantity to high-quality research. In the review process, scientific merit will always be the core concept, and the balancing, coordinating and sustainable development of all related disciplines will be thoroughly considered as well. In 2020, the average funding intensity per project will be at the same level as that of 2019.

Applicants should pay special attention to the proposals that have the same or similar research contents:

(1) Applicants should not repeatedly apply for the same project with different type of program or different supporting institution.

(2) The same project should not be applied by different applicants.

(3) The funded project should not be repeatedly applied in any way.

Division I of Chemistry

The Division supports research in the field of synthetic chemistry.

Synthetic Chemistry (B01)

Synthetic chemistry is the science of studying the methods of matter transformation and synthesis, which involves in the synthesis and assembly of inorganic, organic, or polymeric matters, and so on. By controlling selectivity in the process of molecular creation and substance transformation, synthetic chemistry gradually realizes the precise preparation and application of new substances with specific properties and functions. As the basis and core of chemistry, synthetic chemistry actively expands the cross-integration with related disciplines and fields, promotes the solution of major scientific problems, and boosts the national economic and social development.

Synthetic chemistry is oriented to the demand for new matters, new materials and new devices in chemical science, life sciences and health, materials sciences and engineering, information sciences and applications, energy and environmental sciences and engineering. The research focuses on the theoretical design, structural control, reaction process, synthesis and assembly methodologies with high efficiency and selectivity of function-directed substances. The tasks include but are not limited to: (1) to synthesize various of compounds with specific structures and functions; (2) to learn from the biosynthesis and transformation process of living systems; (3) to develop new synthesis strategies by combining research methods and technologies of disciplines such as physics; (4) to explore the mechanism and essential rules of the synthesis reaction and substance conversion process; (5) to establish relevant theoretical systems and experiment foundations. Synthetic chemistry takes green, economic, efficient and highly selective way as a goal, and makes the synthesis of new substances to be more precise and environmentally friendly. The development of synthetic chemistry will follow this trend and will pay more attention to human health, effective utilization of environmental resources and the sustainable development of society. The following directions are preferred: (1) synthetic chemistry driven by new reagents, new reactions, new concepts, new strategies and new theory; (2) synthetic methodology of atomic economy, green sustainability and precise control; (3) biological and biomimetic synthesis driven by chemical principles; (4) synthetic chemistry under unconventional and extreme conditions; (5) non-covalent synthesis based on intermolecular interactions; (6) molecular design and synthesis of novel function-directed materials; (7) controllable synthesis and high performance of macromolecules; (8) construction and function research of new compounds.

Synthetic chemistry sparkplugs the collaborative innovation of traditional disciplines such as polymer science, inorganic and organic chemistry. Original breakthroughs of basic research focusing on molecular creation and material transformation are encouraged in synthetic chemistry, as well as the original contributions to industrial applications.

Division II of Chemistry

The Division supports the research in the field of catalysis and surface/interface chemistry and chemical theory and mechanism.

Catalysis and Surface/Interface Chemistry (B02)

Catalysis and surface/interface chemistry are intended to study catalytic processes and the structure and properties of the surface/interface and reveal the physical and chemical basic rules of catalysis and the surface/interface.

The areas funded by the discipline include chemical catalysis, surface chemistry, colloid and interface chemistry and electrochemistry. These areas involve surfaces, gas-solid interfaces, gas-liquid interfaces, liquid-liquid interfaces, liquid-solid interfaces and solid-solid interfaces and gas-liquid-solid multi-phase interfaces.

Supports in the field of chemical catalysis are focused on developing new concepts and catalytic theory, discovering new catalytic reactions, creating new catalytic materials, promoting the cross-over and fusion between multiphase, homogeneous and biological catalysis, fostering the rational design and regulation of catalytic active sites, developing new catalytic characterization methods and technologies with the features of in-situ, dynamic and high temporal-spatial resolution, and the coupling and integration during the catalytic reactions.

Surface chemistry mainly supports research on chemical and physical processes related to solid surface interfaces, as well as their correlative characterization techniques and methods. Encouraged research orientations include: solid surface/interface structure, performance and control; dynamics and energy transfer theory in the assembly and reactions at surface/interface; the new characteristic methods for physical and chemical processes at surface/interface.

Colloid and interface chemistry supports the research on the following directions: (1) the usage of theoretical and computational methods, and advanced experimental techniques to reveal the essences of colloids and interface chemistry; (2) the design and synthesis of new surfactants and the construction of aggregation; the development of new dispersion systems; the understanding of assembly processes, interface adsorption and infiltration behaviors; (3) construction of a colloidal material with self-healing and outfield responsiveness; (4) the enhancement of basic research for applications of colloid and interface chemistry in the fields of materials science, life science and environment science.

Electrochemistry mainly supports the following research: (1) the construction and characterization of electrochemical interface systems; the methods of in-situ electrochemical spectroscopy with spatial and temporal resolution; the theory and simulation methods of electrochemical systems; (2) surface/interface process in the high-end manufacturing of electronics; (3) recognition and control of electric charge transfer, mass transport and conversion in electrochemical interface; (4) design, synthesis and characterization methods for electrocatalysts; (5) revealing of problems in the fields of electrochemical energy conversion and storage, electrochemical synthesis, bioelectrochemistry and photocatalytic and electrochemical engineering.

Chemical Theory and Mechanism (B03)

Chemical theory and mechanism aims to establish and develop new chemical theories and experimental methods to reveal the mechanism and basic rules of chemical reaction and its related processes.

The areas supported by the discipline include theoretical and computational chemistry, chemical thermodynamics, chemical kinetics and reaction dynamics, structural chemistry, photochemistry and spectroscopy, chemical reaction mechanisms, polymer physics and polymer physical chemistry, and chemical informatics.

Theoretical and computational chemistry focuses on the new methods of electronic structure theory, dynamics and statistical mechanics, conducting theoretical design and computational simulation of complex systems such as chemical system, material system, energy system and biological system, and the development of computational chemistry methods and software. For chemical thermodynamics, there is a need to develop theoretical and experimental methods suitable for complex systems, and to focus on the applications of chemical thermodynamics in biological systems/energy systems/material systems and other cross fields. Research in chemical kinetics and reaction dynamics focuses on the development and utilization of new experimental and theoretical methods to explore the substantive characteristics of the chemical reaction and the non-adiabatic process during the reaction as well as the chemical kinetics in extreme conditions. Applicants are encouraged to conduct research employing advanced coherent light source and focus on the work of ultrafast dynamics, microstructure and mechanisms of condensed phase. Structural chemistry focuses on the electronic structure and chemical bonding, surface/solution structure and solid structure, structural characterization of complex functional systems, controllable synthesis and assembly, dynamic bonding and transformation. Molecular electronics focuses on the design, construction, sensing and theoretical simulation of related devices. Research of photochemistry and photophysics should pay attention to the study of photochemical and photophysical mechanism of chemical system, material system, and life system. Spectroscopy focuses on the development of spatial resolved, time-resolved and energy-resolved new technologies and their new assembly methods. The research of chemical reaction mechanisms will be focused on exploring microscopic mechanism and basic rules of chemical reaction by means of theoretical chemistry, computational chemistry and experimental strategies. Polymer physics and polymer physical chemistry mainly focus on the chain behavior and interaction of macromolecules, the evolution mechanism and control over different scales of the structure, the essence of the connection between microstructure and macroscopic properties. For chemical informatics, it is encouraged to establish chemical database, develop and apply the artificial intelligence in chemistry.

Division III of Chemistry

The Division supports research in the field of materials chemistry and energy chemistry.

Materials Chemistry and Energy Chemistry (B05)

Materials chemistry is to study the design, preparation, structure, property and

application of materials. It is a bridge between chemistry and materials, energy, environment, life, medicine and information science. Material chemistry is the science basis of new material systems. Principles and methods of chemical sciences are used to design new materials at atomic and molecular levels and to develop preparation techniques and study the structure-activity relationships of materials. The preferred areas include: (1) to realize the control over the materials' micro/meso/macro-scopic properties by means of structure function transfer, integration and coordination at multi-scale and multi-level; (2) to study the creation of new high-performance and multi-functional materials as well as their applications in the fields of energy, health, environment and information.

Materials chemistry pays attention to the precise preparation of new materials with specific functions, accurate construction and control over the structure and properties of materials, the crossover and integration of multi disciplines, the correlation between structure and properties, and the investigation of the molecular basis of material systems using various characterization techniques. Material chemistry faces the major national needs and focuses on the deep utilization of characteristic resources in our country.

Material chemistry focuses on the development of functional materials, that have the characteristics of electricity, optics, magnetism, acoustics and thermology, and those related to biology, medicine and pharmacy. It needs to develop materials of wearable devices and microelectronic system devices. Attentions should be paid to the optimization of structure design of new advanced materials as well as their preparation process using artificial intelligence. And there is a need to develop material chemistry methods and principles in the processing of advanced materials.

Energetic material chemistry focuses on the basic problems in storage, release and application of high-density chemical energy, and developing methods in the design and preparation of novel energetic materials such as materials of all-nitrogen structure, ionic type and coordination type.

Energy chemistry is a science focusing on energy conversion, transmission, storage and utilization with chemical principles and methods. Its basic task is to investigate new energy conversion and storage mechanisms, design new materials, establish new theories and methods, develop new systems, and construct new devices to achieve efficient and clean utilization of chemical energy.

Energy chemistry pays attention to clean and efficient utilization of fossil resources, and strengthens the investigation on preparation chemistry of clean energies such as non-fossil liquid fuels and hydrogen energy, storage materials and their efficient energy conversion. Electrochemical energy focuses on various batteries with power and energy storage which pays attention to the innovative research of electrolytes, battery separators and electrode materials, and to the design and preparation of highly efficient solar cell materials, device assembly and integration. Energy chemistry pays attention to developing materials of energy conversion and storage and optimizing phase-changed energy storage materials. Basic problems of chemistry in important energy conversion processes such as photochemical energy, thermoelectricity, photoelectricity and optothermal as well as the conversion of biomass into energies and resources should also be paid attention to. The utilization of biomass should be focused on catalytic pyrolysis and conversion to high quality liquid fuels.

Division IV of Chemistry

The Division supports research in the field of chemical measurement, environmental chemistry and chemical biology.

Chemical Measurement (B04)

Chemical measurement aims to develop chemistry-related measurement and analysis theories, principles, methods and techniques, and to develop related instruments, devices and software to obtain the variation rules of the matter's composition, distribution, structure, properties and interactions.

The studies of chemical measurement emphasize interdisciplinarity, and focus on methodological research, instrumental creation based on new principles and development of key technologies. The funding scope of chemical measurement ranges from detection and analysis from macroscopic to microscopic systems with high throughput, high sensitivity and high specificity, aiming at establishing new theories, principles, methods and technologies, and broadening the application of existing technologies in important scientific fields. The research includes theory innovation, sample treatment and separation, spectroscopic methodologies and applications, chemical and biological sensing, chemical imaging, creation of instruments and the development of key technologies.

The priority funding areas for chemical measurement include: (1) processing, separation and identification methods for complex sample; (2) space-time resolved spectroscopy and chemical imaging; new spectroscopic principle and technology; (3) precise measurement of single atom, single molecule, single cell and single particle; (4) micro/nano analysis and devices; (5) structural and functional analysis of biological macromolecules; (6) in-vivo and real-time detection of living organisms; omics analysis; biomolecular recognition and probes; analysis technology for diagnosis of major diseases; (7) early warning, screening and traceability of public safety; (8) creation of miniature instruments and devices; chemical measurements based on big facilities.

Environmental Chemistry (B06)

Environmental chemistry studies the existence, characteristics, behaviors, effects of chemical substances in environment and the principles and methods for pollution control. It is one of important subjects in chemical science as well as environmental science.

Major funding areas of environmental chemistry cover the following branches: environmental pollution and analysis, pollution control and remediation, environmental toxicology and health, theoretical environmental chemistry, radiochemistry and radiation chemistry, chemistry safety and security.

Environmental chemistry encourages the applicants to identify the key scientific issues targeting the major problems in the protection of ecological environments. It is expected to study environmental chemical behaviors, ecological and healthy effects, and controlling principles and technologies of pollutants. All strategies including laboratory study, field experiment, theoretical simulation and new technologies and methods could be adopted. The priority funding areas include: (1) new principles and technologies in environmental catalysis; (2) characterization and analysis of pollutants in complex

environmental media; (3) tracing and behaviors of emerging contaminants on multi-media interface; (4) forming mechanism and control techniques of atmospheric combined pollution; (5) control, remediation and their mechanisms of soil contamination and water pollution; (6) treatment and recycling of solid wastes; (7) environmental exposure and health effects of new toxic pollutants; (8) environmental behaviors and toxicology of micro- or nano-materials; (9) formation and control of antibiotic resistance of microorganisms; (10) big data and intelligent analysis of environmental pollution; (11) prevention and control of radioactive pollution and recycling of radioactive nuclides; (12) key chemical issues in the prevention and control of hazardous chemicals and radiation.

Chemical Biology (B07)

Chemical biology accurately modifies and manipulates biological systems at the molecular level by means of exogenous chemical substance, interventional chemical methods or pathways. It not only develops new reactive technologies and molecular tools, but also provides new thoughts and concepts for research in the area of life science. It is playing an increasingly important role in the research of visual, controllable and creatable life processes (or function).

Chemical biology focuses on the processes and dynamic rules of important molecular events in life science, and gives full play to the characteristics and creativity of chemical science. The study focuses on: (1) to achieve, explore and regulate the living action in real-time, in-situ and in quantitative analysis by means of the construction and discovery of molecular probe; (2) to develop new biocompatibility reactions, achieve modification and labeling of biological molecules by means of the orthogonal and coupling technology and study the biological functions of biological macromolecules, such as protein, nucleic acid, polysaccharide, lipid compounds, as well as active molecular and ions; (3) to establish and optimize small molecule compounds library and screening technology to detect and interfere the biological process in cell, thereby to reveal unknown pathways and new life activities of interaction of biological molecules, promote the study of signal transduction and gene transcription based on active small molecules, and realize the identification of drug targets, discovery of biomarkers and development of leading compounds, reveal the bio-function of active molecular; (4) to analyze the biosynthesis mechanisms of substance in life activities, and to synthesize specific target molecule or complete special chemical reaction by using biosystem and/or basic parts; (5) to develop new theory for chemical biology, carry out chemical assembly and simulation of complex living system, reveal chemical essence of life activities, on the basis of creating and developing innovative chemical tools and techniques.

Chemical biology encourages original innovation and preferentially supports the themes as follows: (1) the discovery and construction of chemical molecular probe as well as its application on the study of molecular mechanism and functional regulation of important biological events and serious diseases; (2) research of solving biological and medical events by use of chemical means and methods; (3) basic research on the chemical reaction mechanism and theory of living systems for promoting intercross and cooperation between chemistry discipline, and biology and medicine. Young scientists are encouraged to conduct independent and original research. Proposals without discipline intercross will not be supported.

Division V of Chemistry

The Division supports research in the field of chemical engineering and industrial chemistry.

Chemical Engineering and Industrial Chemistry (B08)

Chemical engineering and industrial chemistry is to study the material flow, transfer, reaction and interrelation in the conversion processes of matter. The tasks include: (1) to recognize the transfer and reaction phenomena, rules in the conversion processes of matter, its mechanism on the process efficiency and properties of products; (2) to study the theories, methods and technologies for the green and high effective conversion of substances; (3) to develop new technologies, new processes and new equipment suitable for industrial production. Chemical engineering emphasizes the research on “engineering science” and the intercross with other disciplines such as chemistry, material, biology and information. Chemical engineering provides scientific basis for national major demands such as modern manufacturing industries, strategic emerging industries and life and health.

Major funding fields of chemical engineering and industrial chemistry cover chemical thermodynamics, transfer process, reaction engineering, separation engineering, chemical equipment and process enhancement, systems engineering and chemical safety, biochemical engineering and light chemical, fine chemical and green manufacturing, chemical engineering of materials and products engineering, energy chemical engineering, resources and environmental chemical engineering. In recent years, it has become a major trend to study the key scientific issues of application and new theories, methods and technologies in science and their intercross. New research directions are listed as follows: (1) the research is more focused on the regulation, measurement and simulation in micro-/meso-structure, interface and mesoscales, and great attention is paid to the reinforcement of processes and scale-up rules; (2) the research pays more attention to the uncommon and extreme processes as well as the relevant information and intellectualization research; (3) the research further expands from chemical engineering to the product engineering and intercrosses with new fields such as life and health, ocean, electronic information, new advanced materials and emerging energies.

Special and innovative research will be preferentially supported such as spatial and temporal dynamic structure at mesoscale; systems, synthetic and engineering methods; chemical big data and intelligent processes; system security in chemical engineering; transfer and reaction processes under unconventional conditions; green chemical engineering; product engineering as well as the fundamentals of chemical science related to energy, resources, environment and health.

Department of Life Sciences

The funding of the Department covers a broad spectrum including biology, agricultural sciences and basic medicine, which extends to various fields of resources, environment, ecology, population and health, etc. In 2019 the Department received 14,307

proposals, of which, 14,110 were accepted for General Program and 3,007 projects were funded, including projects of Small Fund for Exploratory Studies, with a success rate of 21.20%. The average direct cost is 580,200 yuan per project. In 2020, the average direct cost of funding will be roughly the same as that in 2019.

The Department has been encouraging researchers to carry out original study with innovative academic ideas, as well as novel technology and approaches, particularly for those playing a pivotal role of promoting the development of related disciplines with authentic ideas. Emphasis will be put on proposals with novel theories, firm hypotheses and the interdisciplinary importance based on previous research over a long period of time. The Department will pay attention to important frontiers and new emerging fields in life sciences in the future, while keeping a balanced and harmonious development among various disciplines. In line with the principles, **(1) funding creative and timely ideas to achieve excellence in science, (2) focusing on the frontiers of science in unique ways to lead the cutting edge, (3) supporting application-driven basic research to enable breakthroughs, and (4) encouraging transdisciplinary leading-edge research to promote convergence**, scientists are encouraged to aim at basic scientific issues both in the frontier of science and the major national needs. The Department implements the funding policy depending on the performance of previous funded project, and gives preferential consideration to applicants with good performance in their previous projects under equivalent conditions.

Considering the problems commonly occurring during the application and peer review processes in recent years, the Department reminds applicants to pay special attention to the following points when writing their proposals:

(1) In the explanation part of the General Program of the Department, as well as of all the disciplines, the funding scope is emphasized and the categories that will not be accepted have been clearly noted. Therefore applicants should read carefully according to their subject of application. It should be emphasized, that **the categories not to be funded by the discipline in the General Program apply to other types of programs within the same discipline.**

(2) Concerning applications related to operation with highly pathogenic microbe, applicants should abide by national regulations concerned, and perform under bio-safety qualified conditions.

(3) Projects involving animal experiments shall comply with relevant national regulations and requirements of animal ethics and welfare.

(4) The signature of both the applicant and all participants should be in regular script, and the signature should be the same as the one in printed form in the application.

(5) The applicants should note that the fund is filled in the unit of 10,000 yuan. Misfiling will cause errors in the budget, leading to a decline.

(6) Please fill in the research period according to the notes requirement for application in this guide. The research plan listed in the application should be consistent with the funding period. Otherwise, the grant will be declined.

(7) The application code should be specified to the final level. Applications fail to provide the detailed code will be declined. Please refer to the discipline guides for specific requirements on application codes.

In addition, the Department has made the following requirements for ethics-related research applications in biomedical research:

(1) To carry out research in the field of biomedicine, researchers must abide by the relevant provisions of the state, respect internationally recognized bioethical norms, and abide by the relevant requirements of the state for ethical research.

(2) Biomedical research involving human beings must provide the review opinions of the supporting unit's ethics committees or that of their superior departments in the application form.

(3) Applications involving multi-institution participation in ethical research should be supported by certification documents examined and approved by each participating institution or the ethics committee of the competent department at a higher level.

Funding for General Program Projects in Department of Life Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I of Biology	Microbiology	199	11,613	25.91	188	10,899	25.03
	Botany	216	12,627	26.77	211	12,249	24.68
	Zoology	147	8,587	32.89	143	8,305	26.38
II of Biology	Genetics and bioinformatics	146	8,517	26.35	147	8,549	25.13
	Cell biology	113	6,560	31.92	109	6,307	27.53
	Developmental biology and reproductive biology	84	4,840	30.00	75	4,338	29.41
Biomedicine	Immunology	84	4,862	26.84	80	4,660	28.88
	Neurosciences and Psychology	153	8,816	25.76	146	8,484	22.22
	Physiology & integrative biology	89	5,188	29.28	86	5,001	25.29
Interdisciplinary Research	Biophysics/Biochemistry	163	9,533	28.85	125	7,274	27.17
	Biomaterials/Imaging/tissue engineering	102	5,920	24.58	100	5,774	18.28
	Molecular biology/Biotechnology	—	—	—	69	4,030	26.74
Environment and Ecology	Ecology	195	11,352	24.28	190	11,029	22.70
	Forestry and grassland science	227	13,274	21.35	214	12,439	17.86
Agriculture and Food Science	Agriculture and crop sciences	240	14,000	21.13	238	13,775	17.56
	Food science	219	12,794	19.55	218	12,646	15.69
Agricultural Environment and Horticulture	Plant protection	156	9,082	21.25	153	8,874	19.29
	Horticulture and plant nutrition	166	9,691	21.64	174	10,090	18.69
Agriculture Animal	Animal husbandry	119	6,888	20.66	117	6,765	16.88
	Veterinary medicine	142	8,243	22.26	139	8,059	18.41
	Aquaculture	88	5,083	20.61	85	4,923	19.63
Total or average		3,048	177,470	24.07	3,007	174,470	21.02
Direct cost per project		58.23			58.02		

(4) When overseas institutions or individuals cooperate with domestic medical and health institutions to carry out research and declaration fund projects involving ethics, they shall issue certification documents for examination and approval by ethics committees provided by domestic relying units.

(5) For research projects that need to sign informed consent, the process and procedure of signing informed consent should be described in the application form.

(6) If the ethics-related fund project is approved and the research plan is changed during the implementation period, the review opinion certificate of the ethics committee after the change of the research plan shall be submitted to the fund committee again in accordance with the above requirements.

Applicants should follow the requirement of the *Guide* and the application syllabus when writing their proposals. Otherwise, the proposals will be rejected or not funded.

Division I of Biology

The funding scope of the Division covers three disciplines, namely microbiology, botany and zoology.

Microbiology (C01)

The Discipline supports basic research in the area of microbes, including fungus, bacteria, achaea, virus, prion and other microbes.

There is an obvious lack of balanced development of different branches in microbiology, according to observation based on previous years of grant application and funding situation. The number of proposals aiming at study on mycoplasma, rickettsia, chlamydia, spiroplasma, phage, prion, etc., is relatively small, indicating that the related research team needs to be augmented and intensified. The Discipline encourages researchers to carry out fundamental and authentic studies on resources, diversity as well as biological relevance in the fields listed above.

In 2020, the Discipline will continue to encourage studies with a combinational use of genome and big data and other modern technology together with traditional methods. Preferential funding will be given to areas in the taxonomy of microbes, especially rare and difficult to cultivate microorganisms. The Discipline will continue to promote the study of classification and phylogenetic taxonomy, as well as strengthening talent training.

The Discipline encourages the exploration of novel techniques and methodologies applied to basic research of microbiology, and especially welcomes scientists in mathematics, physics, chemistry, and information sciences to carry out interdisciplinary studies related to microbiology; encourages research based on single microbe cell, structural compositional research of microbe; encourage study on the enrichment, separation and cultivation of difficult-to-cultivate microorganisms; basic research in pathogenic microbe and marine microorganism, and functional research on microbe in complex system; systematic research to mechanisms of frontiers in life sciences applying microbe as model system is preferentially encouraged.

In order to promote the development of microbial research on the cutting-edge

theory, new technology and novel method, convergence of multi-field academic thoughts, research methods and technical tools as well as to break the traditional disciplinary barriers for solving of complex scientific problems, applicants with the background of mathematics, physics, chemistry and microbiology, information technology and engineering and other related disciplines are encouraged to apply.

Botany (C02)

The Discipline supports basic and part of applied basic researches on plants.

It can be seen from the applications accepted and funded in recent years that the development of each branching field within the Discipline is unbalanced. There are relatively more applications in areas such as plant phylogeny, plant hormone, growth and development, and resistance physiology, and therefore the research quality is relatively high. On the other hand, there are fewer applications in the fields such as paleobotany, biological nitrogen fixation, mineral elements and the metabolism, organic synthesis and transportation, hydrophytes and ocean plant and resources, etc. Applications that have research basis in the above-mentioned subjects will be encouraged. Systematic and creative research combined with structural biology, system biology and computational biology should be further strengthened henceforth.

The Discipline will pay close attention to natural variation and domestication mechanism of plants, environmental adaptation mechanism of plants, simulation of plant life processes and functions. Applicants are also encouraged to carry out their studies in the fields of Phytosystematics, introduction and plant germplasm conservation, plant cell totipotency, molecular basis of plant important traits, interaction between plants and other organisms, and plant response to environmental changes.

The Discipline will continue to give preferential support to plant taxonomy in 2020, especially to strengthen the support to young taxonomists. The Discipline encourages applicants to carry out research on species revision of certain families and genus on the world wide range and plant resources research in key areas and special environment. Application of novel technology to plant taxonomy is encouraged.

The interdisciplinary studies of botany with other related fields will be strongly encouraged, especially with mathematics, physics, chemistry, geosciences, information science and technology as well as social sciences. Development of new model plants with important evolutionary positions is encouraged in order to explore special biological phenomena. In order to achieve better use of local advantages, resources advantages, and talent training, the Discipline will encourage collaborations among applicants with institutions or groups having unique special advantages.

Special notice for applicants:

(1) Projects accepted under the plant-other-organism interaction code (C020405) do not include applications for research related to crops and other cash crops.

(2) Under the application code for Phytochemistry (C020604), it is encouraged to conduct in-depth exploration and functional research on important chemical components in plants, but applications with pharmacological research and structural modification or synthesis research will not be accepted.

Zoology (C04)

Zoology studies the life phenomena and principles in animal morphology, taxonomy,

physiology, behavior, ecology, evolution and genetics. The effective application of theory and techniques has greatly enriched the research contents of zoology. Studies on animal diversity, ontogeny and phylogeny, co-evolution and phenotypic evolution, animal behavior and adaptability have become cutting-edge research areas; whereas research on animal taxonomy, zoogeography and animal resource utilization, and conservation biology has been deepened and integrated continuously. Laboratory animal science has acquired more and more recognition.

Applications accepted by the Discipline in recent years have demonstrated that researches in some subjects have already formed their own features and acquired significant international impact. It can be also observed that not only the formulation of scientific problems as well as rationality of designs, but also the creativeness of academic thoughts of the proposals are greatly improved. However some problems still exist, for example, the excessive pursuit of hotspots without solid research basis, and the lack of justification for proposed research and feasibility of technical routes; insufficient experimental accumulation was provided by some of applications, or the description of detailed research progress and contents; some proposals were lack of scientific problem or hypothesis with explicit definition, or overstating research objectives; the budget for research is impractical in some proposals; repetitive applications still exist on a small scale.

In the future, the identification and description of unknown species of animals, and revised study of known species of animals will remain the key funding areas by the branching field of taxonomy. Taxonomy of ocean animals should also be highly valued. Key research areas currently focus on the animal phylogeny and zoogeography, as well as the life history around the evolution. The Discipline will encourage researches on animal physiology, animal behavior, and the establishment of model animals, etc. Support will be strengthened for researches on conservation biology for endangered animals, the sustainable utilization of important resource animals, and related biological researches for important alien invasive species and bio-safety. Basic research of zoology for specific species in China and fragility of western and remote areas will be continually encouraged. **The Discipline attaches great importance to the study of experimental animals and animal models, but does not accept the application of clinical medical diagnosis and treatment based on model animals.** In addition, the Discipline will pay more attention to basic research on zoology; encourage original studies and exploration based on animal resources and regional features in China and the application of new theory and technologies. Interdisciplinary studies will be encouraged.

Special notice for applicants: application for Applied Research Based on livestock and poultry will not be accepted.

Division II of Biology

The funding scope of the Division covers the following three disciplines: genetics and bioinformatics; cell biology; and developmental biology and reproductive biology.

Genetics and Bioinformatics (C06)

Genetics is to study the inheritance and variation of organisms on various levels of

molecules, cells, individuals and populations. Bioinformatics is an interdisciplinary field of biology and computing science, aiming at the exploration and improvement of methods and means to obtain, store, manage and analyze biological data. The Discipline encourages the combination of bioinformatics analysis and experimental verification, and encourages trans-disciplinary applying new theories, methodologies and technologies.

The genetics discipline will give priority support to the following fields: the study of genomic variation and evolution law of complex biological characteristics; study on the genetic and epigenetic basis of human diseases; studies on basic genetic laws and the molecular mechanisms of gene expression and regulation by using model organisms; the establishment of genetic operating system, new methods and technologies of phenomics and genetic breeding; basic researches on the genetic law of typical resources, major agriculture crops, microbe, etc.; and the molecular basis of genetics and variation of organisms under extreme or special environment; novel genetic fields such as genetic editing, chemical genetics, photo-genetics, phenotype-nomics, 3D/4D genomics, algorithms and methodology in biological big data, etc.

As for bioinformatics, future funding directions and key areas lie in the following fields: developing new theories, algorithms and analytical techniques of bioinformatics and computational biology; genomics and epigenomics, transcriptome and epigenomics, phenomics; integrating genomics data and system biology analysis; research on methods of integration, standardization and visualization of large biological data; machine learning and in-depth learning of biological data; curation; virtual Reality display of biological data; design and synthesis of molecular modules and networks; research of biological networks, etc.

In 2019, the numbers of applications received in areas of human and animal cellular genetics, microbe population genetics, network model of biological system and simulation and construction of biological loop were relatively small, whereas those fields are pivotal concepts in classical genetics or bioinformatics research. The Discipline will prioritize proposals with solid previous studies and novel scientific questions in the above branches. In 2020, the Discipline continues to encourage original studies on combination of bioinformatics analysis and bio-experimental verification. We will continue to support projects to further explore the basic mechanisms and laws of genetics and epigenetics, to support research methodology on multi-level data integration and analysis of the formation mechanism of complex traits, and research on efficient and high-performance computational genetics methods for genomic big data analysis.

Cell Biology (C07)

Cell biology is a fundamental and cutting-edge subject to study the principles and mechanisms of cell life activities. Cell biology is mainly aimed at revealing the structure, function, phenotypes and regulation mechanism at molecular, cellular and individual levels within organisms, as well as studies on cytological mechanisms of phenotype and functional abnormal occurrence of organisms.

Studies on the structure and function of cell and subcellular machinery have been the major aspects supported by the discipline. Applicants are encouraged to carry out integrated studies on the mechanisms of synthesis, modification, degradation, localization, and translocation of protein with the aggregation, dissociation, location of its components, and the activity diversification with time and space of protein complex during the process of cell

signal transduction with dynamic change mechanisms of life activities of cells. Highlight will be given to endeavors on solving important problems in basic cell biology upon using cell models or model systems, in combination with techniques and methods of genetics, developmental biology, chemical biology, and cell imaging technologies, etc.

Among the applications accepted in 2019, there were fewer applications in areas of cell fate and reprogramming, intercellular interaction, single cell study, whereas the above areas are pivotal in cell biology and have foundations in related researches in China. The Discipline will prioritize funding to applicants who present their proposals with scientific issues from their solid research background on these aspects.

In 2020, the Discipline will continue to emphasize on functional and mechanism issues, highlighting the utilization of various novel research technologies and methodologies in cell biology. The Discipline will actively promote the development of techniques in cell in situ and real time, dynamic and high-resolution analysis, and highly value integrated researches from molecular to cellular and individual levels, so as to reveal different molecular mechanisms closely linked with cell function and biological effect and regulation network.

In 2019, Cell biology was the pilot discipline in the Department for classified application and evaluation. Among the 386 general projects accepted by Department, 115 (29.8%) chose the category of "encouraging exploration, highlighting originality" with 14 projects approved; 205 (53.1%) chose the category of "focusing on the frontier, creating new paths" with 80 projects approved; 39 (10.1%) chose the category of "demand traction, breaking through bottlenecks" with 12 projects approved; and 27 (7.0%) chose the category of "common orientation, cross-linking" with 3 projects approved. From the application and evaluation of pilot projects in disciplines, it indicated that the accuracy of the applicant's understanding of the connotation of the four types of scientific issues is yet to be improved.

Developmental Biology and Reproductive Biology (C12)

Developmental biology and reproductive biology studies the basic biological laws in the process of formation, development, growth and aging of multicellular individuals.

The Discipline focuses on the basic laws of gametogenesis, fertilization, embryonic development, organogenesis, homeostasis, aging, damage repair and regeneration, identification, establishment, reprogramming, pluripotent stem cell induction and other important biological processes of human, animal and plant.

Among the proposals received in 2019, studies in organogenesis and development as well as the stem cell field could aim at the international forefront with relatively high starting point; studies in the field of plant developmental biology and reproductive biology are closely combined with the important scientific problems. Research in both basic and applied research reflects the trend of transformation of basic research to clinical medicine.

Modern developmental biology and reproductive biology emphasize on the continuity of development and dynamic process of change, emphasize the collaborative function of multi-cells and multi-genes, value the relationship of development and diseases, and encourage the exploration of molecular regulating mechanisms of development and reproduction by using model organisms. Applications will be encouraged on the creative development of research methods and systems, as well as the establishment of model diseases concerning development and reproduction, so as to provide basis for clinical

transformation. In the field of plant development and reproduction, applications of basic research which may provide theoretical guidance for modern molecular breeding will be encouraged.

In the future, the Discipline will continue to encourage applicants in the field of developmental biology and stem cell biology to carry out cutting-edge research. Basic research closely related with human needs for reproductive medicine is encouraged and preferential funding in reproductive biology will be delivered. The Discipline will also focus on the regulatory mechanisms of cell lineage and organ development, gametogenesis and maturation, and embryo development, the molecular mechanisms of plant sequential development, the regulation of pluripotent stem cells and their differentiation, innovative research system, and interdisciplinary fusion.

Division of Biomedicine

The Division covers the following three disciplines: immunology, neurosciences & psychology, and physiology & integrative biology.

Immunology (C08)

Immunology studies the structure and function of immune system. It has been a frontier and leading discipline, bridging biology to clinical medicine.

The Discipline mainly supports basic research aiming at the structure, development, function and abnormal mechanisms of immune molecules, cells, tissues, organs, and immune systems. The core funding areas include: (i) the differentiation, development, migration, tissue distribution of immune cells and sub-cells and their functional modulation, evolution and comparative immunity; (ii) gene expression and regulation, structure and function of immune molecules; structure basis of immune recognition; recognition, activation and effects of innate immunology; identification, response and regulation of innate and adaptive immune; (iii) molecular mechanisms of antigen presentation; structure, function and immune-pathogenic of cytokines and chemokines; immune heredity; genetic basis of immune-related diseases; epi-genetic regulation of immune response; (iv) cell and molecular mechanisms of immune tolerance; malfunction of immune tolerance; mechanisms of transplant immune tolerance; abnormal immune response and immunodeficiency; (v) molecular and cellular mechanisms of immune regulation; abnormal of immune regulation; nerve-endocrine-immune network; immune metabolism; (vi) the function and mechanisms of mucosal immunity and local immunity; (vii) immunological mechanisms of reproduction and pregnancy; cross-interaction between reproductive endocrine and immune system; (viii) infectious immunity; tumor immunity; self-immunity; hypersensitivity; initiation, progression and elimination of inflammation; mechanisms and intervention of non-infectious diseases; (ix) basic immunology problems during the manufacture of vaccine; (x) studies of antibody engineering, including scientific problems on the establishment of new techniques and methods and new research system of immunity.

It is clearly demonstrated from the applications in 2019 that there is a rapid progress of immunological research in China, with the proposals covering a wide range of subjects, and the quality of research contents improved obviously. Most of the proposals were based

on solid background and pre-studies; some applications analyzed the possibilities of technical failures and were able to provide alternative resolutions as backup plans; a few proposals were carrying out systematic cutting-edge studies based on novel hypothesis. However, there are problems such as lack of substantial subject intercrossing, etc.

In 2020, the Discipline will support applications with creative academic thoughts; encourage applicants to concentrate scientific problems from their former research and practice to carry out in-depth exploration of mechanisms targeting at specific scientific target; encourage the establishment of typical research system and techniques platform, and highlight the setting-up and application of various novel methods and techniques in immunological studies; encourage study in areas of systems immunology, immunomics and computational immunology; encourage basic research relating to the structure of immune system and abnormal function, and the close cooperation of scientists working in basic and clinic studies.

Neuroscience and Psychology (C09)

The funding scope of this Discipline includes neuroscience, psychology and cognitive science. The key scientific question of neuroscience research is to analyze the essence of human nervous activity, from primary sensation and instinctive behavior to advanced language, learning, memory, attention, consciousness, thinking and decision-making, etc. Psychology is the science of studying human psychology and behavior, aiming at clarifying law and mechanism of occurrence, development, expression and function of psychological phenomena such as personality, cognition, emotion, motivation, thinking, consciousness, and decision-making. Cognitive science studies the nature and law of cognition and intelligence including cognitive and intellectual activities at all levels and aspects including perception, attention, memory, reasoning, choice, consciousness and even emotional motivation.

In 2019, the largest number of the proposals submitted and projects funded are focused on molecular neurobiology, cellular neurobiology, behavior neurobiology, developmental psychology, medical psychology, social psychology, educational psychology, cognitive psychology, cognitive brain structure and neural basis, whereas there are fewer applications under the applying code of tactile neurobiology, chemosensory neurobiology, computational neurobiology, neuroinformatics, and cognitive simulation.

In 2020, the Discipline will continue to encourage the exploration of the neurobiological basis of cognition and behavior, through analysis at different scales, such as micro, mesoscopic and macro scales. Interdisciplinary studies will be encouraged to clarify the occurrence, development and mechanism of nervous system diseases at the molecular, cellular and body levels. Cross-species neuroscience research is encouraged for perform research or develop novel technologies and methods to solve bottleneck problems. Psychology and cognitive sciences will continue to support the dominant areas, while encouraging interdisciplinary integration, using modern neuroimaging, genomics, deep brain stimulation, big data analysis, longitudinal tracking, computational models and other technologies and methods to promote in-depth research on psychological activities and cognitive processes and their material basis, and to encourage the development of new theories, technologies and models.

Physiology and Integrative Biology (C11)

Physiology and integrated biology are the basic disciplines of biomedicine, which study the phenomena, laws and regulation of organism's life activities. The scope of funding includes the functions of various systems in physiological state and mechanism of their homeostasis maintenance, the structural, metabolic and functional imbalance of cells, tissues and organs in pathophysiological state, and innovative research on the interaction and functional integration of cells, tissues, organs and systems. The Discipline also encourages research on mechanisms of stress, adaptation and compensation for organisms in special environments or diseases.

The core funding areas include: (i) Physiological function of heart and blood vessel and its regulation mechanism; (ii) researches on blood pressure regulation, blood vessel malfunction and system, arrhythmia, and myocardial remodeling and function renovation; (iii) the area of respiratory physiology focus on respiratory dynamics; structure, function, regulation and abnormal in respiratory system; lung injury and repair; respiratory centers and respiratory regulation; pulmonary vascular smooth muscle and pulmonary arterial hypertension; (iv) investigation on the function of stomach, intestinal, liver, gallbladder and other digestive physiology; (v) urinary physiology cover regulation and control mechanisms of water-salt metabolize of kidney, renal fibrosis, and functional regulation of ladder; (vi) endocrine, and glucose metabolism, lipid metabolism, insulin resistance, trace elements (include calcium and phosphorus metabolism) nutrition, senescence, and biological rhythm as well as hemopathology; (vii) Neuroendocrine immuno-regulation, interaction of nervous system and peripheral organs; (viii) researches on the occurrence and fertilizing of germ cells, implantation of embryo, and the regulation and control mechanism of the placenta function; (ix) the physiology mechanisms of the health by exercise, and the prevention and treatment of diseases; (x) physiological and pathological mechanisms of aging; (xi) the area of human anatomy about basic research of applied anatomy; (xii) regulation mechanisms of embryo development, tissue damaging and regeneration.

In 2019, the numbers of applications under the code of circulatory physiology, metabolic physiology, sports physiology, and integrated physiology are relatively large. In 2020, the Discipline will especially encourage projects with original academic ideas with comprehensive application of traditional, cutting-edge and original technologies in order to carry out in-depth integrated research on the integrated system and other physiological levels aiming at addressing essential scientific questions such as new mechanisms of body function regulation, metabolic homeostasis maintenance, special environment adaptation, health promotion and aging. Cross integration research with related disciplines is encouraged, especially with the application of various novel technologies.

Please note in particular that applications concerning researches about plants, traditional Chinese medicine, wild animals (except comparative physiology) and livestock are not accepted in this Discipline.

Division of Interdisciplinary Research

The Division covers disciplines as follows: biophysics and biochemistry, molecular biology and biotechnology; and biomaterials, imaging and tissue engineering. The Division

encourages applicants to challenge the existing research paradigm, propose new research directions through transdisciplinary and interdisciplinary convergence, and generate subversive academic ideas; besides, the applicants are also encouraged to make innovations and breakthroughs in technology and methods based on multi disciplines and multi perspectives, so as to solve the existing important scientific problems in the field of life science.

Biophysics and Biochemistry (C05)

Biophysics is a cross discipline to investigate mechanisms of biological problems and phenomena, applying the theory and method of physics; biochemistry is a discipline to study chemical composition of living organisms as well as chemical changes during the process of life, and to research the life phenomena and activities of life process at the level of biological molecules.

Considering the contents of applications received in recent years, fields with more applications as well as more approved grants are the following: structure and function of protein complexes, interaction between macromolecules. Structural biology is an important research field in this Discipline, among which X-ray crystallography is still the most commonly used research method; due to the continuous improvement of cryoelectronic microscopy technology in recent years, the number and quality of applications in the field of Cry-EM have increased significantly; the application and research of biological macromolecular structure by using nuclear magnetic resonance spectroscopy and other methods were less funded; there are more and more higher quality applications on protein interactions and regulatory mechanisms; ribonucleotide-related applications represented by circular RNA and long-chain non-coding RNA are on the rise in quantity and quality; Proteomics-related projects are declining; Environmental biophysics projects including acoustic, photobiophysics and environmental biophysics are relatively less competitive. The number of applications for research projects in space biology is relatively small. The research of new methods of biophysics and biochemistry covers a wide range, but still lacks pioneering or cutting-edge methods.

The Discipline encourages cross-disciplinary research on biophysics and biochemistry, especially the application of real-time, dynamic and micro-detection of biological molecules, ultra-high resolution microscopy, single-molecule imaging, non-fluorescence imaging, monitoring of spatial and temporal dynamics of subcellular organelles in cells and quantitative systems of living molecules in vivo and in vitro. Due to rapid development of Space Science in China, the Discipline will also consider on research closely related to environmental biophysics and space biology. Meantime, free exploration and basic research aiming at solving major urgent national problems are also encouraged.

Special reminder to applicants: For high-resolution imaging, biomolecular labeling and other instrument investigation projects, please select the corresponding application code of molecular biology and biotechnology.

Molecular Biology and Biotechnology (C21)

Molecular biology is a discipline that studies the structure and function of bio-macro molecules at the molecular level to clarify the essence of life phenomena. Its main research fields include protein system, nucleic acid system, lipid system (i.e., biofilm) and sugar, etc. Biotechnology is a subject of research, development and application of life science

technology and methodologies, which provides powerful new technology and methods for the research and development of life sciences. The outstanding feature of molecular biology and biotechnology is the interdisciplinary fusion of biology, physics, chemistry and computer.

Funding scope includes new theory, new method, new technology and new system in molecular biology; synthetic biology; biomimics technology; biomolecule detection technology; gene editing and biological macromolecule manipulation; protein and vaccine engineering; single molecule and single cell technology; stem cells and tissue engineering technology; probes and labeling technologies as well as bioimaging technology; artificial intelligence and computational biotechnology; applied biotechnology and development of reagents and new instruments related to life science research.

In 2019, the Discipline received project applications for the first time, and most projects are focused on synthetic biology, histology technology, gene editing and biomolecular manipulation and application of biotechnology, while there are still lack of research on molecular biology, biomolecular detection technology, protein and vaccine engineering, single molecule and single cell technology, stem cell and tissue engineering, biological imaging, artificial intelligence biology, cutting-edge biotechnology, reagent development and new instrument development.

In 2020, the Discipline will continue to support interdisciplinary and original study, encourage applicants to carry out new technology, new methods and new application research in the fields of synthetic biology, gene editing, in situ and in vivo analysis of biomolecules, single molecule and single cell analysis of complex systems, multi-scale multimodal imaging, artificial intelligence and computational biotechnology. Meanwhile the subject focuses on the development of reagents and new instruments related to basic research of life science.

Biomaterials, Imaging and Tissue Engineering (C10)

The Discipline is a branch intercrossing of life science with other research areas. The funding scope covers biomechanics and biorheology, biomaterials, tissue engineering, biomedical electronics, bionics and nano-biology.

According to applications in recent years, there is an imbalanced development among the above five sub-disciplines. The field of biomaterials is currently focused on implantation, interventional biomaterials, genes, drug carrier biomaterials, material surface interface, biocompatibility, safety, etc. Crosstalk between materials science and biological science is encouraged. In tissue engineering field, most projects focused on bone and cartilage tissue engineering, oral tissue engineering, stem cell transplantation and tissue regeneration, but there were lack of proposals on other important organ tissue engineering, as well as novel methodology. In the sub-discipline of biomechanics, projects were mostly in such fields as biomechanics of cellular and molecular biomechanics, bone and other tissues and organs of the movement, while biomechanics studies on other organs were rare. In the biological image and bioelectronics devices sub-discipline, there was a lack of study on biomedical signal detection and analysis, biomedical sensing, biomedical detection and system applications. In the field of nano biology, only a few studies were proposed on nano-bio safety evaluation.

In 2020, the Discipline will continue to encourage applications to carry out systematic multidisciplinary research in fields of biomaterials, tissue engineering,

biomechanics and biorheology, bioimaging and biomonitoring, biomedical electronics, bionics and nano-biology. Researches should aim at key scientific issues in the process of important tissue/organ reconstruct engineering, as well as interdisciplinary studies, especially long-term, systematic and in-depth study in tissue/organ replacement and repair, engineering reconstruct and transformation of regeneration. In particular, the Discipline encourages and supports the basic research in tissue biomechanics basis and the practical application, other than bone/joint motion system, and cardiovascular system; study on interaction mechanisms and new effect features between biological materials and the body; the novel methods and new technology of tissue engineering; studies on bioelectronics and biological systems related to the study of bionics, and nano biodetection, nanometer biological safety evaluation and application of ethics. When it comes to the application research of biomaterials, the urgency of combining with the actual needs should be emphasized.

Special notes for applicants: biomaterial and bionic research other than biology/biomedical applications is excluded in this discipline.

Division of Environment and Ecology

The Division supports researches in areas of ecology and forestry and grassland science.

Ecology (C03)

Ecology studies the interaction between organisms or between organisms and the environment. It plays a pivotal role in solving the national ecological problems that are getting increasingly important.

In recent years, significant progress has been achieved in ecological study in China. Ecology in China has made important progress in the fields of system construction and monitoring of field observation stations and experimental platforms, ecosystem response to global change, evolution of important biological groups and conservation biology, whereas traceability research is still common and the overall quality of fundamental ecology needs to be improved. From the perspective of project applications accepted in 2019, the development of sub disciplines is unbalanced: there are more applications in the fields of ecosystem ecology, global change ecology, conservation biology and restoration ecology, physiological ecology, community ecology, pollution ecology, soil ecology, etc., while there is lack of applications in the fields of ecological theory and method, evolutionary biology, behavioral ecology, etc. For some projects, scientific questions are not clear enough. In a small portion of applications, there is a lack of innovative ideas.

In 2020 the Discipline will strengthen its support to applications with strong innovative ideas, multidisciplinary research and cutting-edge growing subjects, give priority support to proposals focusing on the basic research frontier of international ecology, closely connected with the national ecological and environmental issues, give preference to researches with possibility of making breakthrough in new theory and novel method, and strengthen basic research with long-term observation and experiment of field work, and encourage researches performing study on landscape and regional scale. It is encouraged to

perform research on theoretical ecology, species evolution and adaptation mechanisms, biodiversity and ecosystem functions. The Discipline also prefers to support research on ecological models, ecological prediction and evolutionary biology, and support basic ecological research on the protection, restoration and sustainable development of natural ecosystems. The discipline will also put emphasis on study in the structure, function and maintenance mechanism of ecological security barrier system in Tibet.

The content of research proposal should focus on key points with clear definition of scientific issues, and special attention should be paid to scientific aspect and feasibility of the research route and methods. Proposals regarding to the multidisciplinary and macro research should put enough emphasis on the combination of the theoretical study with the national need.

Forestry and Grassland Science (C16)

Forestry and grassland science is to reveal the essence and mechanisms of the biological phenomena by taking forest and grassland as its research objects, in order to carry out the cultivation, protection, management, and utilization of forest and grassland resources.

In recent years, there is a tendency of rapid growth of basic research on forest, but the unbalanced development among sub-disciplines remains the key issue. In 2019, the number of proposals submitted to branches such as wood physics and the chemistry of forest products is large, while there were much fewer applications to the more classical sub-disciplines like silviculture, forest soil science and forest management, indicating a trend of shrinking. The proposals failed to focus on important basic scientific issues in some important fields, such as silviculture and non-wood product forestry. Some applications in the field of forest genetic breeding on homologous gene cloning and function verification failed to carry out the research from the angle of biological characteristics of trees, as well as lack of close relation with forestry production.

In order to meet the needs of national strategic development, basic research on forestry and grassland science should focus on identifying and concreting key scientific issues in the practice of forestry and grassland industry. Most of the research objects of forestry science are woody plants, and the research period is relatively long, therefore it is particularly important to carry out continuous and systematic research. In the future, the Discipline will continue to support basic research in the fields of forest and grass cultivation, forest and grass health and forest and grass resource utilization, focusing on the major needs of the country. The Discipline will encourage under-forest resource cultivation, basic characteristics of timber and forest products, physiological ecology of important afforestation tree species and forage grass, forest nutrition, impact of forest soil on forest productivity, forest degradation and restoration mechanism, formation and maintenance mechanism of mixed forests, afforestation measures and timber properties, provenance selection and tree adaptation mechanism under climate change, disaster regularity and prevention of major forest disasters Control, exploitation and innovation of forest germplasm resources, formation mechanism of special traits of trees, genetic transformation of potential model tree species and verification system of gene function, conventional forest genetic breeding, degradation mechanism of economic forest varieties and biological basis of cultivation, garden plants and application, and efficient production and utilization of forage were explored. As for grassland science, there are more applications for grassland

science projects in the fields of grassland process and function, grass germplasm resources and genetic breeding, grass physiology and cultivation processing, and less in the fields of grassland protection and resource utilization, and turf science. The research of grassland process and function field based on diversified ecological function and diversified service function of grassland is slightly insufficient, and the basic research of grassland function, genetic breeding and grassland resource protection and utilization are not closely combined.

Therefore applicants should pay close attention to formulating the important and key scientific questions from the forestry and grass industry. In the future, the Discipline will continue to prioritize to support basic research in such core fields like silviculture, the health care, the efficient utilization of forest resources, etc. The Discipline will encourage researchers to carry out investigation in fields of advanced generation tree breeding theory and methods, multi-service function of forest and management, forming mechanism of wood superior traits, the analysis of the specific growth, silviculture, forest soil science, forest management, garden planning and landscape architecture and development mechanisms of trees, which meet the national strategic needs at the international frontier research fields. Tea tree science related projects should apply to the discipline of horticulture and plant nutrition.

In 2020, the Discipline does not accept applications from the following fields: (1) pharmaceutical functional verification of effective components targeting at animals; (2) animal nutrition and individual biology; (3) research and development projects for forestry machinery, wood cutting tools, road and bridge design, forest engineering machinery and equipment, forest engineering and civil construction in forest areas; (4) forest product chemistry field without forest biomass research.

Division of Agriculture and Food Sciences

The Division covers two disciplines: basic agriculture and crop science, and food sciences.

Basic Agriculture and Crop Science (C13)

The Discipline mainly supports basic and applied basic research on crops and their growing environment. In recent years, the research fields of this discipline focus on: agricultural informatics and interdisciplinary agricultural production system research, crop yield potential mining, cultivation physiological mechanism of quality improvement and resource efficiency collaborative improvement, crop germplasm resources research and the exploration and utilization of important factors, genetic control network of important traits of main crops, crop molecular design The theory and method of breeding.

It is reflected from the applications in 2019 that there was a climbing number of proposals with basic issues on topics meeting the national demand of agriculture, an obvious increase in interdisciplinary studies around basic agricultural issues. However, major problems remain as the following: (i) researches on crop genome are generally concerned, but more attention is yet to pay on further exploration of mechanisms of physiology and genetics; (ii) following-up work with the international frontier is increasing, but it should be performed in close combination with practical issues of national agricultural

production, so that to provide potent support of basic research to applied research; (iii) some of the applications are lack of systematic and sustainable studies; (iv) there are more applications in agricultural information, utilizing physical methods (such as spectrum, infrared, remote sensing, 3D photography, etc.) to acquire agricultural information, but there is a lack of in-depth theoretical study, and difficulty exists on actual utilization; (v) some of the proposals are not standardized with inaccurate information, such as untrue or incorrect contents in the resume part, especially in the order of authors for publications, or the list failed to present the real contribution of the applicant and others.

The Discipline encourages applicants to condense scientific issues from the reality of agricultural production in China, aiming at the frontier of the Discipline and the major needs of national agriculture; encourages the development of basic research by combining modern biotechnology with Crop Agronomic Traits improvement; encourages the development of germplasm resources mining and innovative research by using new technologies and methods; and encourages the development of high-yield, light cultivation and resources around crops; encourage crop cultivation regulation and tillage system based on efficient utilization; encourage research on characteristic small crops.

Applications to the Discipline should take crops and crop products as their research objects, and the interdisciplinary studies with other subjects should not depart from the principal object; proposals purely studying agricultural materials, agricultural machinery and facilities will not be accepted. The Discipline does not accept applications with research objects of agricultural animals, animal products, microbe, forest, vegetable, traditional Chinese medicine, algae, woods, and model plants of *Arabidopsis thaliana*.

Food Science (C20)

Food science studies basic research on food and food materials. In recent years, the Discipline focuses on the following research fields: the selection, regulation and fermentation of food microbial strains with independent intellectual property rights; the preparation of food enzyme expression system and food enzyme engineering; the changing and interaction mechanism of food nutrient components and their processing process; the biological basic research of organic food processing and comprehensive utilization; the regulation of food storage and transportation as well as post-harvest quality control mechanism; formation mechanism, detection methods and control mechanism of food harmful substances; and separation, analysis and formation mechanism of food flavor substances.

In 2019, the number of applications was relatively large under the following four application codes: food safety and quality control, food biochemistry, biological basis of food processing, food fermentation and brewing, while the number under the application codes of food storage and preservation, food nutrition and food raw materials was smaller. Generally speaking, most projects had innovative topics, clear scientific issues and in-depth research contents, but major problems existing in proposals accepted in 2019 include: (i) a small number of proposals excessively emphasized on the technology and product development; (ii) Incorrect or incomplete application code; (iii) the writing of proposals is not up to the required standards, especially with untrue or unprecise CV contents; (iv) lack of continuity for some of the applicants; (v) loose research contents, failing to concisely demonstrate their key scientific issues, etc.; (vi) some proposals were tracking up study,

lack of novelty or in-depth research.

The Discipline continues to encourage projects facing the major strategic needs of the country, bases on the scope of funding, with condensed scientific issues from the actual food production, especially the key technical issues that restrict the food industry in China. It is encouraged to adhere to the guidance of scientific issues, closely focus on the actual food production, and attach importance to traditional Chinese food, special food and food quality and safety. Applicants are encouraged to focus on interdisciplinary research with food science as the main body, integrate new theories, methods and technologies of other related disciplines, and analyze key scientific issues of food science; encouraged to carry out original, continuous and systematic basic research and applied basic research on the basis of their previous work.

The Discipline will not accept the following applications: (i) research on treatment to human diseases; (ii) research on product development of health products and medicines; (iii) research on the growth, development and metabolic physiology of animal and plant cultivation and aquaculture; (iv) as for research on food machinery, packaging materials and food processing technology, the aims should be to improve the quality and safety of food or to improve the flavor and quality of food. Research on machinery, materials and technology does not fall within the funding scope of this discipline.

Division of Agricultural Environment and Horticulture

The funding scope of the Division covers two disciplines: plant protection, horticulture and plant nutrition.

Plant Protection (C14)

The Discipline covers plant pathology, agricultural entomology, agricultural weeds, agricultural rats and other pest, plant chemical protection, biological prevention and cure, quarantine of agricultural pests, invasion biology, and biological techniques of plant protection, etc. Recently, the theory and technologies of genomics, proteomics, metabolic and molecular genetics are widely applied in the innovation of theory and techniques of pest control. However, basic research of plant protection in China is relatively weak, and especially there is a large gap between China and developed countries in the basic research on functional genomics of the interaction of important pests and crops, mechanisms of pest's virulence and crop resistance (sensibility), law of pest disaster, production and safe utilization of new pesticides with high efficiency, low poison, and environment-friendly property, etc.

The following problems existed in the 2019 applications: (i) for some of the researches, emphasis was not on the field study and verification; (ii) some applications simply traced or imitated researches related at home and abroad, or grafted one research method (or material) to another material (or method), with a lack of original ideas; (iii) in some of the applications, the research topics were over broadly laid out, with a lack of concrete of scientific problems, and the research contents were not precise, lack of in-depth studies and substantive subject intercrossing; (iv) some of the grants were inadequate of

working basis and lack of systematic continuity.

In 2020, the Discipline will continue to encourage the following fields: as for research contents, it is encouraged to carry out explorations of the reciprocity mechanisms of crop-pest-environment (biotic and abiotic) at either microscopic or macroscopic level; principles of disaster of hazardous organisms; monitoring, forecast, prevention and control of pests; and the basic and applied basic research of pesticide toxicology and its safe utilization. Special attention should be paid to new scientific issues, combining with the factors of the national crop of ecological features of different regions, to study the adjustment of industrial structure, improvement of cultivation measures, and the global climate change, etc. On the research approaches, emphasis should be put on the combination of new theory and new technologies with traditional methods, as well as integration of laboratory work with field experiment. For interdisciplinary studies, the specific aim of solving major scientific questions in the plant protection field should be elaborated. Preferential support will be given to continuous and systematic research.

Application to the Discipline should focus on the research object of crop pests, and take the prevention and control of pest hazards as the scientific goal, otherwise it will not be accepted. Applications taking woods or model organisms such as Arabidopsis and Drosophila as main research objects will not be accepted.

Horticulture and Plant Nutrition (C15)

The funding scope of this discipline covers two research subjects, namely horticulture and plant nutrition.

The funding scope of horticulture covers pomology, olericulture and fruit science, ornamental horticulture, horticultural facilities, post-harvest biology of garden crops and food mycology. In recent years, there has been a rapid development of basic research in horticulture in China. The quality and activity of research work have been much improved in the field of horticulture: the research objects have broadened and diversified, and research approach has been gradually transferred from traditional organism level and cell level to molecular level; studies based on -omics have been actively carried out in horticulture. Great achievement has been made in the study on basis of trait formation of horticulture crops, regulating measures, gene mining and function identifying, germplasm excavations and innovation, mechanisms and control of quality formation, response mechanisms to adversity, mechanisms of rootstock-scion interaction, the formation and regulation of unfavorable components of horticultural products.

The funding scope of plant nutrition covers the heredity of plant nutrition, physiology of plant nutrition, manure and fertilizer science, nutrient resources and recycling, crop-soil interaction and regulation, etc. In recent years, based on the frontier of subject development and the demand of agricultural resources, environment and green development in China, plant nutrition has made significant progress in the genetic mechanism of plant nutrition, nitrogen and phosphorus recycling and efficient utilization of soil plant system, and the creation and application of new fertilizers.

In 2019, common problems in both horticulture and plant nutrition laid in the following two aspects: the research content in some of the applications was too broad and lack of the precise layout of basic technique requirement for research approach and method. There were a large number of proposals pertaining to copying and tracing research. Major problems with the discipline of horticulture is that some projects relied too much on

high-throughput technology and reverse genetics research methods, not closely related to horticultural biology problems, and lack of biological significance mining for genomic data. Major problems with the discipline of plant nutrition lay in the following aspects: there were many researches on nitrogen, phosphorus and potassium, while few on medium and trace elements; there was a lack of coordination and interaction of elements; insufficient research on green new fertilizer and cash crops; few research projects on water fertilizer coupling mechanism.

In 2020, the Discipline will continue to encourage endeavors on scientific issues based on national agricultural practice and agricultural industry development, with a close combination of new approaches with traditional methods. Priority funding will be given to original, continuous and systematic and distinctive research. The discipline of horticulture will support proposals which take horticultural crops as their research objects, and address scientific problems on the features of horticulture crops, and production yield, quality, fastness, and constancy. Studies on the genetic, physiologic and molecular mechanisms of nutrient utilization of high efficiency, interaction between crop, soil and microbe and its control, and the coupling mechanisms of soil water and fertilizer, and its effectiveness to crops will be prioritized in funding. It is especially encouraged to apply for the experimental testification of laboratory research in the field and excellent proposals in “manure and fertilizer science”. Researches on the nutrient mechanisms of middle and trace elements will also be encouraged for an active promotion of healthy development of all branches in plant nutrition.

Applications using forest or model plant like Arabidopsis as its research objects will be not accepted by this Division. Application of medical health research will not be accepted by this Division.

Division of Agriculture Animal

The funding scope of the Division covers three disciplines: animal husbandry, veterinary science and aquatic science.

Animal Husbandry (C17)

Animal husbandry studies the germplasm resources, genetic breeding and reproduction, growth and development, nutrition and feed of livestock and poultry (including special economic animals).

Applications accepted and funded in 2019 covered all branches of this discipline, among which, the majority of applications focused their studies on mining excellent genes of typical excellent domestic animals of the country and their functional genome, molecular genetically breeding, reproduction and development model, molecular mechanisms of regulation, new theory and methods related to molecular nutrition, and the development of fine grass germplasm resources and fine variety cultivation, the livestock of low emission, and the interaction of animal husbandry development and its environment. Quite a few studies in the above fields have formed their features in many aspects. Moreover, researchers started to pay close attention to international and domestic cooperation and exchange, and endeavors have been put to the research which may acquire independent

intellectual property rights.

In 2020, the Discipline will give more priority to studies on excellent gene mining of typical livestock, poultry, grass, silkworm and bees of China, and cultivation of fine species; encourage basic research on nutrition of domestic animals, prolificacy of live stocks, and the genetic breeding of grazing; and the high efficiency utilization of feedstuff and forage resources. The Discipline will also give moderate preference to researches on the environment of domestic animals and pollution, behavior and welfare, mechanisms of the physiological adaptation of productivity, and grassland pasture, sericulture and apiculture, etc.

In 2020, the Discipline will continue to encourage research on the discovery of excellent genes, regulation mechanism and important scientific issues related to breeding of good breeds in livestock, poultry, silkworm and bee resources; encourage the basic research on Germplasm resources, genetic breeding, reproduction, nutrition and feed of livestock and poultry. Appropriate support should be given to the research on environment and pollution of livestock and poultry, facilities and equipment of livestock and poultry and bee and silkworm breeding, behavior and welfare, sericulture and apiculture. Applicants are encouraged to carry out original, systematic and continuous research on the basis of their previous work, and to give preference to the high quality of the completion of the pre-scientific fund projects.

Special notes for applicants are the following: (i) study object of the research should be livestock, poultry, grass, silkworm, or bee; interdisciplinary studies with other subjects are not allowed to depart from the main research aspect above; otherwise the proposal will be not funded; (ii) for research topic selection, please grasp the essence of key scientific issues in related fields, instead of simply following up the new research progress at home and abroad.

Veterinary Science (C18)

Veterinary science is to study the occurrence, development, diagnosis, prevention and cure of animal diseases. The Discipline covers the following branching: animal diseases, zoonoses, public hygiene, laboratory animals, veterinary medicinal industry, etc., as well as other related novel interdisciplinary research areas. The Discipline supports basic researches taking animal diseases as major objects on animal infectious diseases, zoonoses, most common diseases and comparative medicine.

Proposals accepted and funded in 2019 covered all subjects of this discipline. Among them, the majority of applications were focused on veterinary immunology, veterinary epidemiology, basic veterinary, clinical veterinary. Some of them were able to aim at the international frontiers, highlight the creativeness in the selection of their research themes, and actively prompt the international standard of research work. However, problems still exist as demonstrated here: some of the applications paid much attention on the international hotspot, but were lacking of enough concentration of scientific issues; there is not enough attention paid to the research on the major needs of the country. The number of applications in new application codes such as veterinary vaccinology, veterinary pharmacology and veterinary public health is relatively small. In the future, it is necessary to strengthen the research in these fields.

The Discipline is based on the national strategic needs of animal health, food safety, public health, human health and environmental and ecological security. The Discipline will

continue to encourage studies on the epidemiology, pathogenic biology, mechanisms of pathogenic infection and immunity about important animal epidemic diseases and zoonoses, meanwhile, strengthen researches on the basic veterinary immunology, the non-infectious disease of animal mass populations, food safety of animal source, and related research, and give moderate preferential support to studies on traditional Chinese veterinary, and animal (veterinary) pathology, etc.

In 2020, the Discipline requests applicants to take animal diseases as their main research objects and interdisciplinary studies should not deviate from the research objects. This Discipline encourages research for the development of national animal husbandry and veterinary science, aiming at defeating new and recurrent animal diseases.

Special note to applicants: when involving highly pathogenic microbes, the operation of the project must strictly abide by the relevant provisions of the state, with the biological safety of the appropriate conditions.

This Discipline does not accept research on animals, bees and silkworms.

Aquatic Science (C19)

Aquatic science is to study basic rules of the development, growth, breeding, genetics, physiology and immunology of aquatic organisms and their breeding ecology, breeding engineering, nutrition and foodstuff, control of diseases and pests, and the protection and utilization of aquatic resources, etc.

In 2019, most of proposals accepted and funded were in areas of immunity and control of diseases and pests of aquatic organisms, aquatic basic biology, genetic breeding of aquatic organisms, as well as aquatic resources and conservation, etc. Relatively in-depth studies were conducted on important economic traits of aquatic animals, molecular characters of important pathogens and their pathogenesis, etc., and some of studies have formed their own research features and superiority in some aspects. It can be seen from peer review and panel meetings that the creativeness of academic thoughts of proposals were obviously improved. However, only a small portion of applications were able to propose original research on the important scientific issues of aquaculture, whereas for most of the studies, concentration of specific scientific issues was yet to be improved.

In 2020, the Discipline will request applicants to focus their studies on research fields of aquatic science, and aim at the frontier and important demands of production. The interdisciplinary study on aquaculture subjectively with other disciplines will be encouraged. It will be strengthened to support proposals with original ideas. Applicants should choose topics based on new development of subjects concerned at home and abroad, and their research background, aim at scientific problems, focus on original innovation, and avoid over emphasizing on R&D for technology while lacking of key scientific issues. Research on model organisms should be based on aquaculture science. The Discipline will encourage cooperation of applicants with superior units and teams, so as to fully exert regional and resource priority, and enforce cultivation of talents. The Division will prioritize applications in the following areas: genetic rules and gene function of economic traits of important breeding organisms; epidemiology and pathogenesis of important aquatic organisms; host immunity and diseases prevention and treatment; molecular basis and regulation mechanisms of breeding and development of important aquatic organisms; regulation mechanisms of the utilization as well as metabolism of nutrient stuffs for aquatic animals. Moderate support will be provided in the following areas: basic research of aquatic breeding

and interaction with eco-environment, conservation of aquatic resource, new model and new techniques of breeding, etc.

Department of Earth Sciences

Earth sciences study the origin and evolution of the planet earth system, including disciplines of geography, geology, geochemistry, geophysics and space physics, atmospheric science and marine science, as well as the interdisciplinary of environmental geoscience.

The above disciplines are the core and foundation of the earth sciences. Through funding of General Program, the Department aims to promote the balanced, synchronized and sustainable development for all disciplines of earth sciences, facilitate original innovation and expand the frontier of research, and hence to establish a robust basis for the development of the earth science. In 2019, the Department received 7,774 General Program proposals submitted from 811 institutions, among which, 1,887 were funded with a total funding of 1.1721 billion yuan (direct cost, and hereinafter), with a success rate of 24.27% and an average funding of 621,100 yuan per project. Among the funded General Program projects in 2019, 1,199 (63.54%) were applied from universities and 656 (34.76%) from research institutes. The PIs of 1,376 projects (72.92%) were younger than 45 years old. There were 131 inter-department projects funded, and 268 projects supported by different divisions inside the Department.

In 2020 the criteria for the selection of General Program projects are still as follows: (1) Innovation and academic value of the overall research approach; (2) Research capability of the applicants; (3) Clearly-stated scientific issues and well-defined ideas; (4) Availability of necessary research basis and conditions. During the process of proposal selection, the Department pays close attention to the basic or traditional disciplines and fundamental data accumulation, maintain the international status of the privileged discipline or fields in China, promote the disciplines which are still weak or even “endangered” in China yet predominant in the world, encourage the intercrossing, integration, infiltration and synthesis among disciplines, improve the development of the frontier and basic sub-disciplines, foster the development of the sub-disciplines closely related to experiment, observation, data integration and simulation, and recognize the importance of the intercrossing of the earth science and other disciplines. While advocating innovations, the accumulation of research work should be emphasized. On equal condition, preferential support will be given to those applicants who have a good accumulation in previous studies and obtain high-quality results from their recent completed projects, as well as who apply for some continued studies. Applicants are required to address the relation between the proposed research work and their accomplished projects. In regard to the exploratory, unforeseeable and long-term running characteristics of basic research, special attention will be paid to the high risk, interdisciplinary and frontier research. Scientists will be encouraged to face the great challenging scientific issues and to carry out risky and exploratory research. In 2020 the average funding cost per project in General Program is expected to keep the same level as that in 2019.

Funding for General Program Projects in Department of Earth Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate ⁺ (%)	Projects	Direct cost	Success rate ⁺ (%)
I	Geography	382+2*	22,394	23.32	427	25,273	22.20
II	Geology	255+2*	16,746	28.02	327	21,453	23.36
	Geochemistry	76+1*	4,810	38.58	78	4,976	24.45
III	Geophysics and space physics	218+1*	13,692	29.90	216	13,620	27.17
	Environmental geoscience	549+2*	33,679	25.11	426	26,075	24.30
IV	Marine science	231+1*	14,378	26.80	230	14,389	24.47
V	Atmospheric science	184+1*	11,511	31.24	183	11,424	28.42
Total or average		1,895+10*	117,210	26.65	1,887	117,210	24.27
Direct cost per project		61.85(62.07**)			62.11		

Notes: *The number of projects of Small Fund for Exploratory Studies for 1 year; **Average funding for direct cost for individual projects with a full study period; +Success rates include the projects of Small Funds for Exploratory Studies.

Division I of Earth Sciences

Geography (D01)

The scope of funding includes physical geography, human geography, landscape geography, natural resource management, regional sustainable development, remote sensing, geographic information science, cartography and geodesy.

Geography is a subject to explore regional characteristics, spatial distribution and time evolution of natural and human elements or geographical complexes. The core of geography is the interaction mechanism of land surface system and human-land relationship. Geography owns the regional, comprehensive and intersectional characteristics, and focuses on the systematic research from the perspective of multi-dimension and dynamics, and its perspective always depends on tempo-spatial scale. Geography not only focuses on understanding the past, but also on serving the present and predicting the future.

Geography concentrates mainly on the following research fields: (1) Spatial variation rules, interactions and evolutionary processes of natural environmental elements (e.g., water, soil, atmosphere, biology, etc.) and geographical complexes (e.g., geomorphology, landscape, cryosphere, etc.) at different tempo-spatial scales; natural environment background of human evolution; evolution mechanisms of the “man-land” relationship and effects of the “man-land” interaction. (2) Spatial structure and evolution process of human elements (e.g., economic, social and cultural elements, etc.); resource and environmental background; evolutionary rules and the driving mechanism of spatial structure of human elements in region(s). (3) Theories and methods of cartography, geographic information science and mechanisms, and geo-analysis of remote sensing; applications of remote sensing and geographic information science on contemporary comprehensive

geographical research, especially on geographical interpretation and service driven by tempo-spatial big data. (4) Mechanism and strategy of sustainable development in the process of interaction between human and environment; ecosystem structure, processes and services, and sustainable natural resource utilization and management; the interaction and mechanism between hazard effect emerged from the evolutionary process of water, soil, atmosphere, biology and risk control; the interaction between environmental quality and economic development; man-land relationship system simulation, etc.

In 2020, the comprehensive, exploratory and prospective application will be continuously supported. Special encourage will be given to the simulation and prediction of complex human-land system which use the theories, method and technology of related disciplines. More funding opportunities will also be given to interdisciplinary research concerned on the key areas (such as urbanization, globalization, climate change, environmental change, civilization evolution, ecological and public security, disaster prevention and reduction, sustainable development, geographic intelligence system), which aimed at the national demand such as the ecological civilization construction, the Belt and Road Initiative, rural revitalization and spatial planning of national Land. Related researches on geopolitics, geoeconomics, cultural geography and country geography are also encouraged.

Division II of Earth Sciences

Geology (D02)

Geology is the knowledge about the composition, structure and evolution of the Earth. The aims of modern geology are to disclose the structure and composition of the Earth, to explain the mechanism controlling the transition of Earth materials, to elucidate the Earth's environment and life evolution recorded in these materials, to reveal the agents and processes which modify the Earth's surface, and to apply the knowledge of geology to explore the utilizable energy, mineral and water resources, to uncover the relationship between geological processes, life evolution and human activities, to protect the Earth environment, and to prevent (or give early warning) and mitigate geo-hazards.

The development of geology is based on the advancement of fundamental theory and cutting-edge technology. The introduction to plate tectonic theory has brought about revolutionary changes to the understanding of the Earth. The disclosing of complexity of continental dynamics and the tectonic schemes predating the plate systems are raising new themes for the advancement of plate tectonic theory. Due to the emerging new framework of Earth system science, the correlation between deep processes and surface impacts of the Earth has become the frontier for geological sciences. The enhancement of abilities to obtain and to analyze data has become a major driving force for promoting the development of geological sciences. The implementation of high precision, in-situ and real-time analytical methods for the composition and structure of Earth materials has enhanced the capability to constrain the composition and evolution of the Earth. The development of geophysical exploration, space-based observation, and geological drilling technology has increased the integrity and accuracy for the understanding of the Earth's structure. New high-tech approaches such as information system, internet of things and photoelectron

technology have helped to realize real-time monitoring of crustal movements, earthquakes and volcanic activities. The reproduction and predication of important geological processes have been made possible through the development of computer simulation and high-temperature/high-pressure experiments. This geological program encourages characterized proposals of basic research on fundamental theory based on field and site observations by using of the abundant materials and data recently acquired and accumulated by geology-related agencies and institutions. Multidisciplinary approaches, such as the application of theory, technology and methodology of mathematics, physics, chemistry, bioscience and computer science, are encouraged to study geological issues. International collaboration is also advocated for promoting geological researches and theory advancement with a global scientific view.

Geochemistry (D03)

Geochemistry is the science to investigate the chemical compositions, evolutionary processes and interaction of different spheres of the Earth, and the distribution, state, migration, transformation, cycle, and fate of the substances of the Earth surface system affected by anthropogenic and natural forcings, both in modern times and in Earth's history. It is based on the principles of element geochemistry and isotope geochemistry, and makes use of the tools of modern analytical techniques, theoretical calculations and experimental simulations.

Specifically, the research fields of geochemistry include the processes, mechanisms, impacts and regulation of the chemical compositions, chemical reaction and chemical evolution of celestial bodies (planets), rocks, sediments, soil, waters, atmosphere, oil and gas, living organisms, volatiles in Earth's interior and surface, etc.

The characteristics of modern geochemistry studies include: (1) In the field of research methods and techniques, dynamically quantitative simulation has gradually replaced statically qualitative descriptions. The advantages of in-situ micro-analytical techniques and high temperature and high pressure experiments have been valued. The rule of four-dimensional time-space evolution has been emphasized. The development and application of new isotopic systems have been paid great attention. (2) In the field of solid geochemistry, the research topics have expanded from the chemical compositions, structures and reactions of the materials in Earth's interior to the interactions of different Earth's layers and the corresponding effects of resources and environment. The relationship between these interactions and plate tectonics and global change has drawn much attention. The research objects have expanded from the Earth to the universe and celestial bodies. (3) In the field of Earth surface system geochemistry, it pays attention not only to the reconstruction of geologic events on long time scales, but also to the descriptions of physical, chemical and biological processes on short time scales and the prediction and simulation of environment changes in the future.

Geochemistry is not only a basic discipline to cognize the Earth and the universe, but also an applied discipline to solve the problems faced by human to survive and develop, such as natural resources, ecological environment and geologic hazards. The development of emerging inter-disciplines like planetary science and Earth system science, the advance of modern analytical techniques, and the longing for mineral resources, fossil energy, ecological safety and environment protection for human sustainable development have jointly promoted the development of the fundamental theories and the expansion of the

application of geochemistry.

Division III of Earth Sciences

Geophysics and Space Physics (D04)

The scope of funding includes geophysics, space physics and geodesy.

Geophysics and Space Physics are disciplines which are based on the theories and methods of physics and related disciplines, and combining observation and experimental means, to understand the basic laws of the space structure and evolution of the Earth and planets, to explore the internal resources of the Earth and planets, and to reveal the characteristics of the Earth and space environment, and draw out the variation of human livable residential environment.

Geophysics, through direct observation and experimental and theoretical studies on the basic physical fields of the Earth and planets, for instance, seismic wave, gravity, magnetic field, electric field, stress field, heat flow. It is to reveal the internal structures of the Earth and planets and their components and dynamic processes, to effectively understand the mechanism of earthquake and other natural disaster, and to develop the foundation of new methods and technology development of resource exploration, engineering exploration, earthquake prevention and disaster reduction.

Space Physics is based on space borne or ground-based detection and experiment, theoretical research and numerical simulation, to understand physical phenomena of upper atmosphere, ionosphere, magneto sphere of the Earth and planets, and interactions of solar atmosphere, heliosphere and interplanetary space, to provide scientific support for astronautic activities, communication and navigation.

Geodesy is based on the development of the ground- and space-based observation system and theories, to determine the precise location of the surface of the earth and its outer space point, to accurately measure the geometry and deformation of large buildings (structures), to obtain the shape and deformation field and gravity field of the Earth and planets, to understand the mechanisms of crustal deformation field and gravity which provide space, time and gravity datum for the national economy and national defense.

Geophysics and space physics attach importance to basic theoretical research, experiment and observation, continuous support to fundamental research, more efforts will also be given to new growth and pioneering studies. According to the development trend of earth science and space science, encourage will be focused on studies which belong to the deep cross-integration with other disciplines, and which to deepen research on core scientific issues. In order to provide technical support for the development of earth science and space science, attention will be given to develop new technologies and methods and detection instruments.

Environmental Geosciences (D07)

With the rapid development of the economy and society, environmental problems such as the shortage of water and land resources, the aggravation of environmental pollution, the degradation of ecosystems, and the frequent occurrence of disasters are becoming more and more severe, threatening the safety of ecological environment and the sustainable

development of human society. How to address the issues of resources, environment, ecology and disaster scientifically, poses new challenges to the research and development of environmental geosciences.

Taking the Earth's surface system as the object, basing on the theories of geoscience and environmental science, and adopting interdisciplinary research methods and means, environmental geosciences study the physical, chemical, biological processes and coupling mechanism of pedosphere, hydrosphere, surface lithosphere, atmosphere biosphere and their interfaces; reveal the variation of the geological environment and the formation and development of geological disaster; construct the environmental risk assessment and prevention and control method system; explore the law of regional environmental quality evolution, and environmental change prediction and response; reveal the environmental behavior, effect and mechanism of pollutants in multi/cross media; and elucidate the basic scientific issues of environmental remediation and ecosystem restoration.

Specific funding areas for environmental geosciences include: soil science, environmental water science, environmental atmospheric science, environmental biology, engineering geological environment and disaster, environmental geology, environmental geochemistry, behavioral processes and environmental effects of pollutants, quaternary environment, environmental change and forecast, and regional environmental quality and safety.

For national strategic needs, the Discipline encourages to conduct basic research work based on the consolidating scientific issues in cross-cutting and frontier areas; to apply the new theories, new ideas, new methods, and new technologies creatively, for cultivating new discipline growth points; and to lead major achievements breakthrough and promoting discipline development, for systematic scientific research on habitable earth system for sustainable development.

Division IV of Earth Sciences

Marine Science (D06)

The scope of funding includes marine science and polar science.

Marine science is a knowledge system that studies the natural phenomena and changing rules of the ocean and its interaction with atmosphere, lithosphere, biosphere, pedosphere, and cryosphere, as well as the development, utilization, and protection of the ocean and coastal estuaries. It is a comprehensive discipline which includes both the study of the Earth's natural processes and the study of marine social attributes. The study of the natural processes of the earth e.g., physics, chemistry, biology, geological processes, is the basis of the discipline. And the study of the social attributes of the ocean, e.g., resources, environment, economy, national defense, culture, international relations, etc., is an important expansion and growth point of the discipline. Meanwhile, marine science is increasingly integrated with marine engineering technology and marine space development and utilization. It has to be recognized that marine science integrates the aspects of science, technology, and sociology. There is emerging trend of extensive interdisciplinary studies of marine science guided by basic scientific issues and realistic needs. However, there is still insufficient attention to the comprehensive characteristics of marine science. It is urgent to

strengthen the interdisciplinary research and to improve the cognitive level of marine space.

Marine science is a data-intensive discipline based on observations, and the promotion of its academic thoughts and research abilities depends on long-term observation and data accumulation. To meet the demands of research projects in ocean observation, NSFC implemented the Ship-time Sharing Project (NSFC Open Research Cruise, NORC). For those who tend to join the Ship-time Sharing Project, it is required to elaborate the observation plan and content in field based on the technical route of their NSFC funded projects. The guidelines for the ship-time sharing project will be announced separately, and applicants are advised to pay close attention to the relevant notice from the Department.

Polar science is a discipline studying various natural phenomena, including the processes and changing rules peculiarly in polar region as well as its interaction with other components of the Earth system. It is a comprehensive discipline consisting of several sub-disciplines including polar biology and ecology, polar physical oceanography, polar geology, polar geophysics, polar geochemistry (including space physics), polar atmosphere science and climatology, polar geology, geophysics and geochemistry (including Antarctic meteorite), polar soil, polar cryosphere, polar atmosphere and climate, polar space physics, polar remote sensing, polar resource environment information system, polar observation and detection technology, polar engineering and environmental effects, polar protection, utilization and management, environment change relating to the three polar of earth, etc.

For the past few years, significant progress has been achieved in international polar research; however, it is still the weakest area in earth science. Aiming at the key scientific issues of current global change and sustainable development, the main development trend of earth science is to focus on the integrated research for the characteristics and interactions of the different spheres of earth system, as well as the interactions between the polar and other regions on earth.

In order to promote the research level of marine and polar sciences in China, it is necessary to improve the scientific funding structure, and expand cross-disciplinary integration, as well as promote the building of talents. It is encouraged that carrying out marine and polar research with coupled nature and social scientific aspects. To deepen the understanding of the earth system, we need integrate the researches of earth process and the resource and environmental effects. We need to provide stable and reliable support for the major research subjects of marine and polar science, e.g., physical, chemical, biological, ecological, and geological processes of the oceans and polar regions; interaction between marine systems and climate change; interaction between human activities and marine space utilization; environmental protection of marine and polar regions; processes of marine disaster and its prevention and mitigation; formation, evolution, development and utilization of marine energy resources; ecological security and sustainability of marine biological resources; land and sea coordination and global sustainable development; remote sensing and information sciences; observation and detection technology; data sharing of marine scientific investigation; marine and polar engineering and its environmental effects.

Division V of Earth Sciences

Atmospheric Science (D05)

The scope of funding includes meteorology, atmospheric physics, atmospheric chemistry, and the atmospheric environment.

Atmospheric science is the study of various phenomena and their changes in Earth's atmosphere and other planets' atmospheres so as to serve the mankind. The atmosphere is one of the most active spheres of the Earth system. Its changes are affected and controlled by other spheres of the system and celestial bodies such as the Sun. At the same time, changes in the atmosphere can directly impact oceans, the terrestrial surface, the cryosphere, as well as the ecosystem of the earth. The atmosphere plays an important role in the interactions among different spheres of the Earth system and regulates the functions of the Earth system and its interactions with the other spheres. Besides studying dynamical, physical, and chemical processes within the atmosphere, atmospheric science currently involves comprehensive investigations into the mechanisms underlying atmospheric variations and their interactions with the hydrosphere, lithosphere, cryosphere, biosphere, human activities, and global climate; the regularity of weather, the climate system and theories of climate change and its prediction and projection methods; technologies and measures affecting weather and climate; the impact of human activities on weather, climate, and environmental systems; and the impact of weather, climate, and environmental system changes on human society. Attention should also be paid to studying the occurrence, variation, mechanisms, and predictions of various disastrous events of weather, climate, and the environment; studying the issues of global climate and environmental changes and their impacts, adaptation, and mitigation; comprehensive understanding, integration and modeling of various processes; and interdisciplinary studies which could lay the scientific foundation for improving the quality of life and the sustainable development of society.

In 2020, the Division will continue to solicit proposals for exploratory, original and frontier studies in the following areas: the various phenomena, processes, and mechanisms of the atmosphere; physical, chemical, and biological processes taking place in the atmosphere; exchanges and interactions of energy and momentum between the atmosphere and other spheres by applying novel ideas, methods, and advanced observation technologies to study synoptic meteorology, atmospheric dynamics, hydrometeorology, atmospheric physics, atmospheric chemistry, the atmospheric environment, atmospheric in situ observations and remote sensing, the boundary layer, stratosphere, and mesosphere; climate change, extreme weather and major climatic events; new theories and methods for weather forecasting, climate prediction, assessment of various complex disasters; new theories and methods for numerical modeling and data assimilation; basic research on satellite and radar meteorology; analysis and applied studies on the data acquired from major scientific experiments and scientific initiatives that have been conducted and ongoing ones, as well as from large observation networks established in China and around the world; the principles and methods of meteorological observation, data analysis, and applications; interdisciplinary studies of such key national interests as defense, agriculture, energy, transportation, forestry, hydrology, health, economy, ecology, among others, as well as national strategic needs such as the Belt and Road Initiatives and support of major

engineering projects, serving the livelihood and sustainable development of society.

Note: In 2020, the Division will use a new code system. Applicants should read the *Guide* carefully and select the proper application code. For specific requirements about the supplemental material, please refer to the “Application writing outline” and the *Guide*.

Department of Engineering and Materials Sciences

Engineering and materials sciences deliver scientific and technical supports to national security, the improvement of people’s living standard and the sustainable development of the society and economy. Aiming at cutting-edge areas and meeting the national strategic demands of social and economic development, and starting from the organic combination of national goal orientation and frontier exploration, the Department promotes the combination of basic research and its engineering application, strengthens original innovation, commits to discoveries, inventions and innovations, enhances the sustainable development of interdisciplinary integration, so as to achieve a higher level of sustainable development and broad international impact in the field of engineering and materials.

The Department encourages interdisciplinary and cutting-edge researches, especially the original innovation researches which focus on extracting critic scientific issues and condense basic research content from the practice of engineering applications, with such great significance and relevance of our country's conditions that industrial development could be promoted and international competitiveness could be raised. Priority is given to researches with important scientific research value and potential application prospects, and potentials of being new knowledge growth points, and to researches that can lead the development of disciplines, and have the potential to obtain independent intellectual properties suitable for national conditions.

In 2020, the Department will earnestly implement the relevant initiatives of the NSFC reform in depth, in line with the guidelines of funding creative and timely ideas to achieve excellence in science, focusing on the frontiers of science in unique ways to lead the cutting edges, supporting application-driven basic research to enable breakthroughs, and encouraging transdisciplinary leading-edge research to promote convergence; establish an artificial intelligence-assisted category-specific peer review mechanism featuring "Responsibility, Credibility and Contribution", and optimize a discipline layout that conforms to the logical structure of knowledge system and promotes the integration of knowledge and application. The Department will further strengthen the construction of academic discipline and create a good academic ecological environment.

In 2020, according to the overall plan and road map for deepening reform as approved by the NSFC, with the goal of "building a new era of science funding system" and the task of "identifying funding categories, improving peer-review mechanism, and optimizing layout of funding systems", and the work guideline of "characteristic is first, weight is appropriate, dynamic optimization, serving the management", the Department

adjusted its discipline layout and optimized the application code, in the hope to integrate the fields of Engineering and Materials Science, to highlight the characteristics and development laws of engineering science and materials sciences, to promote the cross-integration of disciplines, to realize the organic integration of the discipline frontiers and the major national needs, to enhance the scientific funding management level and the funding productivity, to promote the high-quality development of basic research in engineering science and materials science.

In accordance with the NSFC requirements for the application code adjustment, the application code published by the Department contains only the first- and second-level application code, whereas the third-level application code was cancelled (i.e., the original six-digit application code). Applicants should carefully read the relevant instructions and be aware of the scope of funding, accurately select an appropriate secondary application code and the corresponding research direction and keywords.

Comparison of the First-Level Codes Before and After Adjustment

First-level code and the name after adjustment	Corresponding first-level code and the name before adjustment (Annotation included)
E01Metallic materials	E01 Metallic materials
E02 Inorganic non-metallic materials	E02 Inorganic non-metallic materials
E03 Organic polymer materials	E03 Organic polymer materials
E04 Mining and metallurgical engineering	E04 Metallurgy and mining science
E05 Mechanical design and manufacturing	E05 Mechanics and mechanical manufacturing
E06 Engineering thermophysics and energy utilization	E06 Engineering thermophysics and energy utilization
E07 Electrical science and engineering	E07 Electrical science and engineering
E08 Architecture and civil engineering	E08 Architecture, environmental and civil engineering(environmental engineering not included)
E09 Hydraulic engineering	E09 Hydro-science and water research, Hydraulic engineering and ocean engineering (Except Ocean engineering, Coastal engineering, Water environment and water ecology)
E10 Environmental engineering	E0804 Environmental engineering E0903 water environment and water ecology
E11 Ocean engineering	E0909 Coastal engineering E0910 Ocean engineering
E12 Transportation and Vehicle Engineering	New code
E13New conceptual materials and common science of materials	New code

In 2019, the Department received 17,893 proposals (343 rejected), increased by 6.11% in comparison with that in 2018, and among them 3,261 were supported with a total direct cost of 1,956,690,000 yuan. The average direct cost is 600,000 yuan per project and the success rate is 18.23% (18.97% in 2018). In 2020, the average funding per project for General Program is expected to be basically the same as that in 2019.

Applicants should fully pay attention to the following:

(1) The Department will support preferentially basic research with scientific merits and applicable prospects, with considerations to practical conditions and resource characteristics of China, which can either give an impetus to the development of relevant sciences or lead to independent intellectual properties. Proposals that meet the needs of national economy and sustainable development of the society will be encouraged.

Funding for General Program Projects in Department of Engineering and Materials Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Materials Sciences I	Metallic materials	250	14,989	18.23	251	15,052	17.76
	Organic polymer materials	240	14,374	19.26	246	14,744	17.85
Materials Sciences II	Inorganic non-metallic materials	341	20,473	19.77	351	21,063	18.46
Engineering Sciences I	Metallurgy and mining science	372	22,364	18.40	380	22,801	18.50
Engineering Sciences II	Mechanics and mechanical manufacturing	586	35,158	19.04	599	35,972	18.31
Engineering Sciences III	Engineering thermophysics and energy utilization	226	13,548	20.04	238	14,235	18.06
Engineering Sciences IV	Architecture, environmental and civil engineering	676	40,590	18.80	678	40,711	18.39
Engineering Sciences V	Electrical science and engineering	216	13,028	18.91	221	13,265	17.75
	Hydro-science and water research, Hydraulic engineering and ocean engineering	292	17,564	18.78	297	17,826	18.27
Total or average		3,199	192,088	18.97	3,261	195,669	18.23
Direct cost per project		60.05			60.00		

(2) Interdisciplinary researches will be encouraged so as to promote the progress of the cross disciplines involved. Applicants should put forward new conceptions and ideas as creative as possible with specific scientific issues.

(3) The fundamentality and innovation should be fully discussed in proposals. Applicants should pay attention to proposing key scientific issues, concentrating research contents and highlighting research focus. For different types of projects, please refer to the relevant project administrative policies, and put forward proposals according to the requirements.

(4) Applicants are required to provide the research achievements of the previous completed project(s), and list the scientific papers published in domestic or foreign academic journals. The provided information must be objective and accurate; otherwise it will be treated as a research integrity issue.

(5) Please refer to the funding amount of different projects, and put forward proposals with a reasonable budget plan according to actual demands of various expenses.

Metallic Materials (E01)

The Discipline supports fundamental researches on metallic materials.

Research proposals should present the merits of the proposed fundamental research clearly, including clear objectives and scientific significance of the project, and the

suitability of the methods to be employed. Proposals should target either to advance the materials science in cutting-edge areas or to promote development in the relevant areas that meet the national demands. The funding scope of the Discipline covers compositions, microstructures, phases, surfaces and interfaces, scales effect, impurities and defects in metals, alloys, metal matrix composites, inter metallic compounds, metal-like materials and metamaterials, and their influence on mechanical, physical and chemical properties and performance; basic issues in the preparation and processing of metallic materials, including heat treatment, casting, forging, welding and cutting; basic issues in the strengthening and toughening, deformation and fracture, phase transformation and alloy design; fundamentals in energy materials, environment-friendly materials, biomaterials, and materials in transportation, aeronautic and astronautic industries; interaction mechanisms of metallic materials and environment, damage, functional degradation and consequent failure mechanism, recycling mechanism and relevant fundamentals; theoretical fundamentals on metallic materials; development of theoretical methods, calculating methods, modern analysis and test methods, big data analysis and processing methods incorporating basic and applied basic researches of metallic materials.

In 2019, the Discipline received 1,413 proposals for the General Program, increased by 3.06% in comparison with that in 2018. Totally, 251 projects were granted with an average funding of 599,700 yuan per project and a success rate of 17.76%.

It is noticed that the areas of metastable metals and alloys, functional materials and surface engineering kept the leading place in term of the amount of proposals. It is hoped that researchers should pay attention not only to the frontiers and the hot areas, but also to other fundamental issues with scientific merits and creative ideas, especially those common key issues beyond materials systems. In addition, attention should be paid to the new understanding of classical issues in basic materials. Applications in the field of composites and surface engineering should focus on scientific aspects and proposing unique ideas. Applications with a cross-disciplinary background should focus on issues within the funding spectrum of the Discipline.

The Discipline will give more financial support to the selected areas that meet the national demands or are expected to achieve a breakthrough in the form of General Program project groups. In 2020, the Discipline will collaborate with the discipline of mechanical engineering (E05) and jointly support the research of basic scientific problems of key generic technology in high-end bearing manufacturing.

Inorganic non-metallic materials (E02)

The Discipline supports the fundamental and applied basic researches on various inorganic non-metallic materials. Along with the development of material basic theories and the innovation in fabrication technologies, lots of new inorganic non-metallic materials have continually emerged, including two-dimensional materials, smart materials, biomaterials, new energy materials, etc. The researches on inorganic non-metallic materials are becoming more and more active. At present, in the researches of inorganic non-metallic materials, functional materials are developing in the direction of high efficiency, high reliability, high sensitivity, smartness, and functional integration; and structural materials are improving in respect of toughening, functionalization, extreme environment endurance, eco-friendly fabrication, and high reliability. While developing new materials, conventional inorganic non-metallic materials are constantly being remolded, upgraded, and developed as well.

More attention have been given to the applications of inorganic non-metallic materials in various engineering sciences and technologies including information technology, life science, energy and environmental science, aerospace technology, and so on.

In 2019, 1,901 proposals for the General Program in this Discipline were received, increased by 10.20% compared with that of last year, and 351 projects were funded with an average funding of 600,100 yuan per project. The success rate was 18.46%.

For the proposals submitted in the past 3 years, the researches on inorganic non-metallic materials involve various areas with a broad interdisciplinary range. The number of applications have been increasing year by year. 54.6% of the proposals are for the researches on functional materials, which is the most active field and thus forms many subject hotspots including energy conversion and storage materials, low-dimensional carbon and two-dimensional materials, multiferroic and lead-free piezoelectric materials, photoelectric information functional materials, multi-functional composite materials, biomedical materials, and so on. Among them, proposals on energy conversion and storage materials (about 19.94% of the total in the year 2019) ranked above all the others. There were still many proposals in photoelectric information functional materials, low-dimensional carbon and two-dimensional materials, biomedical materials, but the innovations need to be further improved. The proposals in structural materials were relatively concentrated among a few institutions, and the corresponding number of proposals accounted for 11.3% of the total. There are also a large number of proposals for composite materials based on inorganic non-metallic materials, among which the number of the proposals on functional composite materials has increased compared with the past. However, in terms of the quality, quite a number of them were of follow-up, low-level repetition, lack of innovation ideas and features, lack of basic issues and research contents in inorganic non-metallic materials.

In 2020, a part of the 2nd-level application codes are adjusted for this Discipline. The previous E0201 artificial crystals and E020201 special glass materials were merged into the new E0201 artificial crystals and glass materials. The previous E0205 cements and refractories, E0212 ancient ceramics and traditional ceramics, and E020202 traditional glass materials were combined into the new E0202 inorganic non-metallic basic materials. The previous E0207 inorganic non-metallic photoelectric information and functional materials and E0209 semiconductor materials were combined into the new E0207 inorganic non-metallic semiconductor and information functional materials. The names of other application codes remain unchanged, while the number and order of corresponding application codes have been changed.

The Discipline supports the innovative researches, as well as substantive interdisciplinary researches of inorganic non-metallic materials cross-cutting with other related disciplines. The Discipline encourages and supports the following: exploration of new inorganic non-metallic material systems based on domestic resource status; new fabrication sciences and technologies, including new theories, effects, characterization technologies and methods; applied basic researches on novel inorganic functional materials and smartness materials, advanced structural materials, photoelectric information functional materials, low-dimensional carbon and two-dimensional materials, biomedical materials, novel energy materials, eco-environmental materials, etc.; researches on the surface, interface, and composite design of materials; basic researches on “structure-function” integrated composite materials; and applied basic researches on the improvement and

remolding of conventional inorganic non-metallic materials using new theories, new techniques, and new processes.

Organic Polymer Materials (E03)

The Discipline mainly supports the following areas in the field of organic and polymeric materials science: preparation chemistry of organic and polymeric materials; physics of polymeric materials; processing of polymeric materials; the implementation of high performance and functional properties of general polymer materials; polymer-based composite/hybrid materials; polymeric materials related to ecological environment; smart and biomimetic polymer materials; biomedical organic and polymeric materials; organic and polymeric materials with photo, electro or magnetic functions; functional organic and polymeric materials and organic solid materials; special polymer materials.

In 2019, the Discipline received 1,378 proposals for the General Program, with an increase of 10.60% compared with that in 2018. 246 applications were granted with an average funding amount of 599,300 yuan per project and a success rate of 17.85%.

The Discipline encourages interdisciplinary basic and applied basic researches involved with mathematics, chemistry, physics, life science, medical science, information science, energy, environment, mechanical and manufacturing science, transport and aerospace science, and oceanography, etc., which lead to creativity and innovation. To be specific, the researches in the following areas are encouraged: scientific issues in the preparation of polymeric materials, including high efficient and controllable synthetic methods of polymeric materials, synthetic chemistry of polymer materials with high performance, including new monomers, new routes and new technologies, the preparation of functional polymer materials, new method and theory in polymer processing, the relationship between the aggregation structures and the properties of polymeric materials and their composite materials; the method and theory in the implementation of the high performance and functional properties of general polymer materials; low-cost and green method in the preparation of functional organic and polymeric materials, the structure-property relationship and the implementation of their stability; performance-directed biomedical polymer materials and the evaluation method of their application; design and preparation of function-directed organic and polymeric materials with photo, electro, magnetic or information functions, and study on the implementation of high performance and the stability of their devices; new concept in the design theory and preparation method of smart and biomimetic polymer materials; the controllable preparation and assembly methods of supramolecules and polymer materials with multilevel structures and their functionalization, eco-environmental polymer materials, including the structures, properties and efficient utilization of natural polymers, as well as the design theory and preparation method of environment-friendly polymer materials, the recycling and utilization of polymeric materials; polymeric materials for environmental control and improvement in water, soil and air pollution, and the stability and aging of polymeric materials. The Discipline also encourages enhancing the design of polymer materials with the guidance of theories; basic research aiming at the difficult problems existing in the preparation, modification and processing of the main assortments of domestic polymer materials; basic research aiming at new organic and polymeric materials and new technologies in polymer processing for the national strategical objective; synthesis and preparation of polymeric materials by non-petroleum routes.

Mining and Metallurgical Engineering (E04)

The Discipline supports the fundamental researches on Mining and Metallurgical Engineering, which are mainly involved in natural resource exploitation, safety science and engineering, mineral engineering and separation science of substances, physical chemistry of materials and metallurgy, ferrous and nonferrous metallurgy, materials preparation and processing, ecology of mining and metallurgy, and resource recycling and utilization, etc.

The Discipline has completed optimization of layout and application code, and the scope of funding remains unchanged. Subject layout adheres to the principle of inheritance and development, and only the application codes with few applications and similar contents are merged and recombined. The main change is that the 2nd-level application code has been adjusted from 22 to 15, which has been reduced by 7. Please pay attention to the changes in the application code and choose the appropriate secondary application code, so as not to deviate from the scope and direction of funding for the Discipline. The Discipline received 2,054 research proposals in its General Program in 2019, with an increase of 1.58%. 380 of the proposals were granted, with an average funding of 600,000 yuan per project, and the success rate was 18.50%.

In recent years, benefited by continuous financial supports, and driven by major national needs, Mining and Metallurgy Engineering science in China have obtained great progresses through continuous innovations. The research capability has improved, and some researches have reached international frontiers. Many significant research results have been achieved. The main developmental trends of the Discipline include: (1) Discipline differentiation and extension. The theory of the Discipline is much deepened and improved by continuously assimilating novel methods and techniques from other disciplines during the transition from macro scales to micro scales. (2) Interdisciplinary and integration. The more disciplines are subdivided, the more their integrations are strengthened. New research areas have emerged one after another due to further development of interdisciplinary. (3) Relationship between fundamental research and application is getting closer. The applications, such as in the fields of mining and metallurgical equipment, system monitoring and control, metallurgical reaction engineering and systems engineering, and ecological technology of metallurgy, etc., heavily depend on theoretical innovation of the fundamental researches. The obvious characteristics include "process integration, technology integration and disciplinary integration". Therefore, it is getting faster and faster in integration, interaction and transformation of science and technology. Science and technology have also been integrated. At present, the Discipline is in the focal point of resource, energy and environment. Due to gap between demand and development, upgrading of traditional industries and improvement of ecological environment, the developmental concepts including "innovation, coordination, green, open, and sharing" should be put into practice in upgrading traditional industries and improving ecosystem to fulfill new meaning of industrial upgrading promoted by the fundamental research.

Hot research topics of the Discipline include complex oil and natural gas exploitation, intelligent green mines, environmental management and ecological restoration of mining and metallurgy, basic science of engineering safety, accurate control of mineral separation process, preparation of high value-added mineral materials, intelligent, greening, refinement of material metallurgical process engineering, material processing engineering, etc.

Focusing on engineering science, the Discipline emphasizes on quality sustainability

rather than guarantee of quantity. The Discipline will continuously enhance interdisciplinary research, explore new methods, pay close attention to new theory, concepts and methods, and their creative applications. The aim is to enhance the levels of basic research on promoting the core competitiveness in China's petroleum, mining industry, metallurgy, and materials preparation and processing by providing problem-oriented solutions to meet the major national needs. In the aspect of natural resources exploitation, research emphases will be focused on the intelligent, greenization, refinement of engineering and scientific issues, reengineering technology, recovery and safety and environmental-friendly through the source controlling, so as to achieve both economic and environmental benefits.

In the aspect of techniques, process, and equipment, emphases will be placed on structure optimization and adjustment, process intensification, the scientific law of engineering and basis research of big data and artificial intelligence application. Researchers are encouraged to conduct long-term research and boldly put forward their own hypotheses to form their own research features. Research teams and innovation groups are encouraged, and continuous support are provided to integrate talents in certain fields to solve technical bottlenecks and promote industrial upgrading in the main industrial chain, which can truly reflect the role of basic engineering science research. In terms of selecting research topics, priority should be given to the funding of the basic researches that have great theoretical significance, have potential applications and foresights, and are likely to become the growth point of new knowledge, and especially to the funding of youth scientific research projects with original ideas, and with cooperation at home and abroad.

The following research fields are encouraged: (1) new theory and method to enhance recovery of oil and natural gas; (2) theory of safe and efficient development in drilling, production, transportation and storage for complex oil and gas resources in deeper formation and deeper sea; (3) theory of gas hydrate and geothermal exploitation; (4) mining theory of mineral resource; (5) mechanical behavior of rock under multiple fields; (6) prevention and emergency of major disasters and accidents in the production process; (7) theory of material green separation; (8) clean and efficient extraction and application of mineral resources; (9) thermodynamic basis and metallurgical theory for the production of high quality metal materials; (10) formation, transportation and control of pollutants produced in the metallurgical process; (11) fabrication methods of high performance mineral materials; (12) compact process fabrication and fine forming of metals; (13) information acquisition and data processing of mining and metallurgy; (14) fabrication technology and principle of alloy powders; (15) intelligentization of material metallurgy process.

Mechanical Design and Manufacturing (E05)

The Discipline supports fundamental research in the fields of mechanical and manufacturing science.

Mechanical science is a fundamental discipline that involves the study of functional synthesis, quantitative representation, performance control for various mechanical products, and the development of novel design theories and methodologies by applying related knowledge and technologies regarding mechanical systems. It mainly includes robotics and mechanism, transmission and drive, mechanical system dynamics, strength theory for mechanical structures, mechanical tribology and surface technology, mechanical design, and mechanical bionics. Manufacturing science primarily involves studying theories, methods,

technologies, processes, equipment, and systems concerned with production manufacturing of high-efficiency, low-cost, intelligent, and high-performance. It mainly includes biomanufacturing, forming and machining, manufacturing systems and intelligence, mechanical measurement and test theory, and micro/nanomechanical systems.

3,272 research proposals for standard grants were received in 2019 with a 6.34% increase compared with the previous year. 599 proposals were funded, the average direct cost of funding was 600,500 yuan per project and the success rate was 18.31%.

The particular focuses of support in this Discipline are: (1) fundamental researches concerning national strategic priorities, the cutting-edge sciences of mechanics, and significant application potential for industrial applications; (2) researches aimed at the eco-friendly, resource-saving, and energy-efficient integration of sustainable design and manufacturing; (3) researches concerning innovative design, new manufacturing principles, and measurement theories for ultrahigh-precision, extreme loading, and in particular, large or heavy equipment and instruments, including processing mechanisms, prototyping theories and technologies; (4) methodologies for designing, manufacturing and testing under extreme working conditions involving, for instance, parameters ranging from conventional to extraordinary or extreme conditions, and scale ranging from macroscale to mesoscale, microscale, nanoscale, and multiscale. In 2020, priority funding will be provided under equal conditions by the General Program to groups in three areas, fundamental scientific problems of high-end bearing manufacturing key generic technology (E05), dynamic performance improvements and behaviors regulation principle of mechanism and robotics (E0501), and non-associated plastic constitutive relations under complex loading conditions (E0508). For the three types of proposals above, applicants should indicate the project group in the Explanatory Notes of application cover.

Based on the basic tasks of mechanical design and manufacturing, the Discipline encourages continual in-depth research in specific fields and high-risk exploratory research for original breakthroughs and disruptive innovation. The research that has yielded innovative achievements and is expected to achieve significant breakthroughs will be preferentially supported; moreover, substantial and profound interdisciplinary research is welcome, and note that applications should not deviate from the funding scope of the Discipline.

Applicants are specially reminded to pay attention to the following items:

(1) In order to express the connotation of the Discipline more clearly, the original application code has been partially modified and adjusted. Applicants are requested to carefully understand the discipline scope and choose the correct application code.

(2) It is suggested that applicants in charge of projects focus on the executing projects. If an applicant has been funded from the National Natural Science Foundation in recent two years, the new application in 2020 will be strictly considered.

(3) The Discipline insists on project performance evaluation. New applications from high-quality executed project leaders will be given priority funding under equal conditions; new applications submitted by the person in charge of a poorly executed project will be strictly controlled.

Engineering thermophysics and energy utilization (E06)

The Discipline supports fundamental research in fields of engineering thermo-physics and energy utilization that involves in engineering thermodynamics,

refrigeration and cryogenics and dynamic characteristics of thermodynamic systems, aerothermodynamics, heat and mass transfer, multi-phase flow, combustion, thermo-physical properties and measurement, and renewable energy utilization, as well as other fundamental and innovative researches related to engineering thermo-physics and energy utilization.

In 2019, the Discipline received 1,318 proposals for the General Program, increased by 16.84% compared with that in 2018. Totally, 238 proposals were supported with an average funding of 598,100 yuan per project and a success rate of 18.06%.

The main development trends of the Discipline are as follows: (i) research on the basic issues has been deepened from macro-level to meso-level and micro/nano-level, from isolated studies to coupled studies, from common parameters to parameters under ultra- or extreme conditions, from routine thermo-physical problems to random, unsteady, multi-dimension, multi-phase and complicated thermo-physical problems and intercrossing research in the Discipline; moreover, research becomes more quantitative and precise; (ii) research themes have been crossed over traditional disciplinary borders and integrated with related disciplines, for example, physics, chemistry, life science, information science, materials science, environment and safety. Researches in the following areas are active: the mechanism of new type thermodynamic cycles and non-equilibrium thermal dynamics, refrigeration and low temperature engineering, dynamics, optimization and control of complicated systems, turbulence properties of internal flows and properties and control of unsteady flows, porous media and micro-scale heat and mass transfer, radiation and heat exchange by phase transformation, clean, supersonic and micro-scale combustion, thermo-physical problems in the prevention of disasters, mechanism of interaction between phases and thermo-physical model in multi-phase flow, new principles and methods in thermo-physical measurement, and new thermo-physical principles in energy conservation, renewable energy transformation and utilization, energy and environment.

In 2020, encouraged research areas are fundamental issues on renewable energy utilization and fundamental issues on energy transformation and utilization under extreme conditions. If interested in these areas, applicants should focus the research on one of the above encouraged research areas in their proposals.

The Discipline will give priority to fundamental researches with theoretical significance, potential application and prior prospect, which might be the new fields for knowledge production, continuously promote interdisciplinary studies and the exploration of novel methods, and encourage original ideas and creations. The Discipline will continue supporting the researches with interdisciplinary nature, or international cooperation background or excellent achievements in the completed projects. It is expected to produce original research results with independent intellectual property rights in China, and to promote the continuous development of fundamental researches in the field of Engineering Thermo-physics and Energy Utilization.

Electrical Science and Engineering (E07)

Electrical science and engineering discipline includes two main fields: electric (magnetic) energy science and the interaction between electromagnetic field and matter. The key areas of funding include the basic research and applied basic research with objects or means of electric (magnetic) phenomenon and principle, the related scientific problems in electric (magnetic) energy generation, transformation, conversion, transmission and

utilization, as well as the mechanism and laws of the interaction between electromagnetic field and matter. This Discipline is based on electromagnetic field, circuit (electric network), electrical materials, and other fields of electrical science. It focuses on electric machine and its system, power system and comprehensive energy system, high voltage and insulation, electrical apparatus, pulse power, discharge plasma, power electronics, electric energy storage and application, superconducting electrotechnics, bio-electromagnetics, and other electrical engineering fields. Researches on new phenomena, new theories, new models, new methods, new devices and new equipment are encouraged.

In this Discipline, 1,245 proposals were received for the General Program in 2019, increased by 9.02% in comparison with those in 2018. There were 221 proposals funded with an average funding amount of 600,200 yuan per project and a success rate of 17.75%.

The areas of electromagnetic field and circuit mainly include: electromagnetic field, circuit (electric network), static electricity, electromagnetic measurement and sensing, new energy conversion and power transmission technology, electromagnetic environment, and electromagnetic compatibility. The areas of superconducting and electrical materials mainly include: superconducting conductor and magnet, superconducting power technology, engineering dielectrics, insulating materials and functional dielectrics, and other new electrical materials. The areas of electric machine and its system mainly include: analysis and design of electric machine, conversion and control of electric machine system, integration of electric machine system, and electric drive. The areas of power system and comprehensive energy system mainly include: power system analysis, power system control, power system protection, electricity market, electricity information, comprehensive energy system and energy internet. The areas of high voltage and discharge mainly include: high voltage and large current, electrical equipment insulation, overvoltage and its protection, arc and electric contact, electrical apparatus, pulse power technology, discharge plasma technology. The areas of power electronics include: power electronic device and its application, and power electronic system and its control. The areas of electric energy storage and application mainly include: principles of electric energy storage and conversion, as well as device, equipment and system of electric energy storage. The areas of bio-electromagnetic technology mainly include: bio-electromagnetic phenomenon and mechanism, biological effect of electromagnetic field, electromagnetic diagnosis and treatment of disease.

In recent years, there are three new trends in the development of electrical science and engineering discipline: (1) The scope of researches is constantly enriched. For example, the comprehensive energy system based on smart grid, independent power system, the electrical materials, devices and equipment under extraordinary environment and extreme condition and so on. (2) The application fields are expanding continuously. For instance, the electric machines used in robots and servo systems, electrified rail transit, electric vehicles, more electric ships and aircrafts, the power supply, storage, conversion, power transmission and drive (propulsion) in aeronautics and astronautics, electromagnetic launch, electromagnetic metallurgy, electromagnetic environmental protection technology, and etc. (3) The interdisciplinarity becomes more noticeable. For instance, electricity market, electrical safety, smart grid, information perception, electric energy storage, pulse power, plasma and bio-electromagnetic technology have been intercrossed deeply with the fields like physics, chemistry, materials, information, management and biomedicine.

For electrical science and engineering discipline, free exploration and

interdisciplinarity, tracking and leading the frontiers of the Discipline, and solving the scientific problems existing in the technical bottlenecks are encouraged, the researches about interdisciplinary basic theory and key technology, in aspects of electric (magnetic) energy applications, electrical equipment, power electronic devices, bio-electromagnetic technology and medical electromagnetic equipment, are particularly encouraged.

In 2019, the application codes of electrical science and engineering discipline were optimized. The applicants should fully understand the funding scope of this Discipline, and correctly choose or fill in the application codes, as well as the corresponding research areas and keywords.

Architecture and Civil Engineering (E08)

The Discipline's funding scope mainly covers Architecture and Civil Engineering. The development trend of architecture is to study the development of region, city and building, and the innovation of construction techniques from the viewpoint of human-environment relationship, as well as the basic theory, methods of planning and design, and construction technology innovation based on sustainable development strategy. Civil engineering stresses that studies should be closely combined with engineering practice to investigate basic theoretical issues and solve foresight key technological issues arising from engineering construction. The interdisciplinary interaction, application of advanced experiment and information technologies and adoption of new materials, new structure systems and new technologies are the major features in the development of these research fields.

In 2019, the Discipline received 2,893 proposals for the General Program, increased by 1.76% in comparison with those in 2018. Totally, 514 proposals were supported with an average funding of 600,500 yuan each and a success rate of 17.77%.

In the area of architecture, emphasis will be given to new scientific issues arising from urban construction, scientific method in urban planning and building design, and the exploration and innovation of new technologies and new methods. In the area of civil engineering, more attention should be paid to innovative research on design theories and methods of complex structures. Key scientific issues on the following seven topics are encouraged: engineering structure, engineering material, construction technology and system performance, geotechnical and foundation engineering, underground and tunneling engineering, transportation and railway engineering, disaster prevention engineering.

Hydraulic Engineering (E09)

This Discipline of Hydraulic Engineering includes two research fields: (1) hydro-science and hydraulic engineering, and (2) geo-mechanics and geo-engineering as well as hydro-power engineering. The funding scope covers engineering hydrology and water resources utilization, agricultural water conservancy and rural water conservancy, hydraulics and river dynamics, hydro-machinery and systems, geo-mechanics and geo-engineering, and hydraulic structures. The research content in the above funding scope includes not only the mechanics and physics process at different scales in the Discipline, but also their extension towards and combination with chemical and biological processes.

Applicants are advised to select the new second-level application code accurately according to the content and funding scope. Among the new codes, "engineering hydrology and water resources utilization" and "geo-mechanics and geo-engineering" of the hydraulic

engineering only change the names of the original 2nd-level application codes. Their content and funding scope remain the same as the original. Content and funding scope of "agricultural and rural water conservancy" are expanded according to the original. "Hydraulics and river dynamics" is combination of names of the two original 2nd-level application codes. The original "water environment and water ecology (E0903)" is merged into the new "Environmental Engineering (E10)". The original "coastal engineering (E0909)" and "ocean engineering (E0910)" are merged into the new "Ocean Engineering (E11)".

In 2019, the Discipline received 858 proposals for the General Program. Among them, 156 proposals were granted with an average funding of 600,500 yuan per project and a success rate of 18.18%. According to the application and funding statistics in the recent three years, more applications are submitted to "geo-mechanics and geo-engineering", while fewer applications are submitted to "hydro-machinery and systems".

Main trends in the Discipline development are summarized as follows. Trend in "engineering hydrology and water resources utilization" covers mechanisms and processes of formation, distribution and evolution of water resources at global, basin and regional scales. The associated technical approaches focus on flood and drought disaster prevention and control, allocation of water resources, sustainable exploitation and utilization of water resources. These studies aim to propose scientific solutions to address the imbalance between supply and demand of water resources under conditions of population growth, climate change and social-economic development. Trend in "agricultural and rural water conservancy" covers principles and methods of impounding, retaining, regulating, distributing and utilizing agricultural and rural water resources, improvement of the soil and water environment and agricultural eco-environment, technical measures for transformation and utilization of saline and waste water, planning on agricultural water division, irrigation and drainage system and water supply, prevention and control of salinization, swamping and soil erosion. Emerging studies are also carried out on modernization of rural water conservancy combined with big data, artificial intelligence and "3S" technology. Trend in "hydraulics and river dynamics" covers mechanical behaviors of liquid at static and dynamic states, transport and mixing of pollutants and organic matters in water, erosion, transport and deposition processes of sediment particles under gravity, water and wind forcing, formation and evolution of river systems, and river management engineering and integrated watershed management. Trend in "hydro-machinery and systems" covers the theories, experiments and numerical simulations on flow in hydraulic machinery, fluid-structure interaction, multi-field coupling, cavitation erosion and abrasion, multiphase flow, energy dissipation, thermo-elastic hydrodynamics, anti-wear materials, composite materials, scale effect. The trend also covers field investigations, fault diagnosis, situational awareness, intelligent control and structure experiments related to power and pumping stations. Trend in "geo-mechanics and geo-engineering" covers constitutive equations and associated numerical methods, laboratory testing technology and in-situ investigations on rock and soil. The trend also covers deformation and stability analysis, reinforcement or treatment technology for geo-structures, as well as the basic mechanisms of soil and rock mechanics related to hydraulic engineering such as dams, foundations, slopes, embankments, tunnels, underground spaces and underground structures. Effects of water permeability on environment under coupling multi-field conditions are also found in the trend. Trend in "hydraulic structures" covers static and dynamic performance, experiment,

observation and analysis, materials, construction and management, etc., for all kinds of engineering structures built for the development, utilization, control, allocation and protection of water resources on rivers, lakes and underground water sources, including structures of pivot projects, water diversion projects, dike projects, hydropower projects, navigation projects, fish pass projects, river regulation projects and other projects.

Environmental Engineering (E10)

Environmental Engineering is an emerging interdisciplinary developed on the basis of natural science, engineering science, humanities and social science, aiming at better understanding and solving environmental problems. Its main research targets cover the fundamental theories, technologies and management methods for environmental pollution control, remediation of contaminated environment, restoration of damaged ecosystem and recycling of wastes. With distinct problem-orientation and cross-discipline, the Environmental Engineering Discipline is of key importance for sustainable development of human society.

The application code and scope of the Discipline have been adjusted recently. The new discipline (E10) has been formed by merging the original environmental engineering (E0804) and water environment and ecological hydraulic engineering (E0903). Its research areas have been expanded to nine 2nd-level application codes, including drinking water supply and treatment, urban wastewater treatment and resource recovery, industrial wastewater treatment and reuse, urban and rural water system and ecological recycling, air pollution control, solid waste recycling and safe disposal, environmental pollution control and remediation, regional and urban eco-environment system engineering, and ecological and environmental risk control. It encourages the use of new theories, technologies and methodologies from other disciplines to address environmental engineering-related problems.

In 2019, this Discipline received 1,033 proposals for the General Program (5.95% more than that in 2018), among which 208 proposals were funded (success rate 20.14%). The average funding amount for each project was 600,500 yuan.

The Discipline emphasizes the identification, analysis and resolution of key scientific problems encountered in the environmental pollution control process; encourages the development of innovative fundamental theories and technologies for high-efficiency, low-cost pollution control processes, especially for the research fields of "urban wastewater reclamation and resource recovery" and "environmental quality improvement and ecological remediation".

Ocean Engineering (E11)

The Discipline includes four research fields of coastal engineering and ocean engineering, ship engineering, marine technology, navigation and maritime technology. Funding scope of the Discipline includes: fundamental theory of coastal and ocean engineering, port and waterway engineering, estuarine and coast and delta engineering, offshore and deep-sea engineering, polar engineering, marine resource exploitation and utilization; surface ships, underwater vehicles, unmanned vehicles, equipment and system; environment perception and target detection technology, positioning and navigation technology, maritime operation and information assurance, marine special materials and surface technology; fundamental theory of navigation and maritime, navigation and

maritime technology.

Applicants are requested to accurately select a new 2nd-level application code according to the content and funding scope of the Discipline. The "Ocean Engineering (E11)" has undergone major adjustments based on the original "Hydro-science and water research, Hydraulic engineering and ocean engineering (E09)", and the original "coastal engineering (E0909)" and the original "ocean engineering (E0910)" have been merged into the "Ocean Engineering (E11)".

In 2019, there were 528 proposals for the General Program in this Discipline. Among them, 97 proposals were funded. The average direct funding was 595,800 yuan per project, and the success rate was 18.37%. Judging from the application and funding of the past three years, the Discipline has become broader and more cross-cutting, and the number of project applications and funding has increased year by year. The fields with more applications and funding are coastal and ocean engineering, and ship engineering; the fields with fewer applications and funding are marine technology, and navigation and maritime technology. In 2020, it is planned to increase the funding intensity and encourage applications in the following two research areas: (1) smart ships and smart oceans; (2) exploitation and utilization of deep-sea resources. Applicants whose topics fall into the above two areas are requested to indicate the following in the first line of the application: "This application belongs to research areas encouraged in the General Program Project Guide".

The main development trends of the Discipline are: The trend in the field of coastal engineering and ocean engineering includes port and waterway engineering and underwater engineering, protection and utilization of coastal zone resources, disaster prevention, and mitigation in extreme cases, port, waterway and coastal engineering safety and smart operation; polar engineering equipment and technology, research and development of island and reef engineering equipment, deep-sea fishery equipment and technology, exploitation and utilization of new marine energy, development and design technology of deep sea engineering equipment, and key technologies of deep-sea space station. The trend in the field of ship engineering includes the design and manufacture of new high value-added ships, extreme environments and ship safety, ship intelligentization and informatization, unmanned marine vehicles, marine engineering and special power, special auxiliary devices and systems. The trend in the field of marine technology includes marine environmental characteristics, marine special sensors, acoustic and non-acoustic environment perception and target recognition, communication, positioning and navigation, marine operations and information assurance, marine special materials. The trend in the field of navigation and maritime technology includes navigation and maritime management, maritime warning and rescue salvage, maritime safety and environmental protection, and ship intelligent navigation.

Transportation and Vehicle Engineering (E12)

This Discipline mainly supports fundamental researches in the fields of transportation engineering and vehicle engineering.

Transportation engineering mainly focuses on multi-modal transportation systems consisting of transportation participants, vehicles, infrastructure and environment, as well as their interactions and influencing mechanisms, towards a safe, convenient, efficient, green, economic, and intelligent transportation system. The scope mainly covers theoretical modeling and analysis of transportation systems, transportation planning, traffic design,

traffic control, traffic safety and environment, etc.

Vehicle engineering mainly focuses on road vehicles, non-road vehicles, railroad vehicles, and aeronautical and aerospace vehicles, as well as their interactions with participants, infrastructure and environment, aiming to achieve a safe, reliable, energy-efficient, environment-friendly, comfort and intelligent mobility system. The scope mainly covers vehicle design fundamentals, vehicle system dynamics, vehicle intelligence, and vehicle operations engineering, etc.

This newly established discipline is interdisciplinary and in response to the revolution of vehicular technologies and transportation systems. The priorities of the Discipline are to support fundamental research that is theoretically significant, visionary and exploratory. The cross-discipline research between transportation engineering and vehicle engineering is particularly encouraged.

This Discipline does not support projects purely in product development or management science.

New Conceptual Materials and Common Science of Materials (E13)

The Discipline mainly supports research in the areas of new methods of material design and characterization, new material preparation technology and digital manufacturing, multi-functional integration of materials and devices, new composite and hybrid materials, new conceptual materials, key materials of advanced manufacturing, key engineering materials, etc.

With the rapid development of materials science, new theories and technologies emerge constantly, and the research and application of materials are no longer limited to the existing material system, which requires continuous improvement of material properties and functions. Therefore, the development of new conceptual materials and cross fusion of different material systems is becoming a development trend. In the paradigm of basic research of materials science, it is urgent to solve the common scientific problems of new materials, such as design, preparation, characterization, performance control and fracture characteristics. At the same time, many key bottlenecks in national major engineering need to be solved by developing new conceptual materials and coordination of multi-material systems. Therefore, based on the strong demand of national major industrial technology for pure, high, special and new materials, this Discipline will focus on the key common science issues of materials science, as well as the major scientific issues leading the new concept materials of future technology and the key materials of revolutionary technology, and advance the integrated development of materials and engineering technology.

This Discipline supports cross and fusion of different material systems, and substantive cross research with life, medicine, information, energy, environment, manufacturing, transportation, aerospace, ocean and other related branches. The Discipline encourages basic research and application basic research in the following fields: new principles and methods of material design and characterization; new material preparation technologies such as precise preparation, high-throughput preparation, digital and intelligent preparation; multi-functional integration and device of new materials; new key materials facing high-end manufacturing, information and intelligence era; design, preparation, and structure and performance control of new multi-scale and multi-functional composite materials and high-performance hybrid materials; artificial design and construction of future materials; new materials under special environment; revolutionary materials and their novel

characteristics; key engineering materials and their fracture characteristics facing the requirement of national major strategies.

Department of Information Sciences

The Department funds researches in areas of the generation of signals, acquisition, storage, transmission, processing and utilization of information. Based on the trends of disciplinary development and social progress, the following priorities are set for funding: new generation of mobile communication theory and technology, internet theory, air land and sea coordination theory and technology, marine information acquisition, high performance detection imaging and identification, interactions of electromagnetic wave and complex targets, information security, cyber space security, new system software design method, social media big data analysis and processing, new types of storage and computation, analysis and control of complex system modeling, advanced navigation technology and system, intelligent robot theory, technology and system, intelligent optimal manufacture theory and technology, automation using artificial intelligence, semiconductor photoelectric devices, integrated circuits, inferred and tetra hertz technology, quantum information, new types of laser, cognitive science and artificial intelligent, etc. Preferential support will be given to basic researches that meet national demands and have far-reaching importance in promoting the national economic and disciplinary development.

Scientific and technical issues in information sciences are increasingly interdisciplinary in nature. Therefore, the Department pays great attention to proposals for interdisciplinary researches between information science and mathematics, physics, chemistry, life sciences, medical sciences, materials sciences, engineering, geo-sciences and management sciences, and so on. The Department encourages cooperative research among scientists with different backgrounds and knowledge to put forward cross-disciplinary research proposals in smart city, health, service and education information technology sciences. It also encourages scientists to combine theory with practice and explore basic theory and key technical issues that have important application potentials for national economy and security. Encourage research on basic theory and key technology driven by national need, and promote deep integration of industry and research. The Department will continue to encourage scientists to conduct substantial international cooperative research with scientists abroad in frontier areas of information sciences.

As NSFC is deepening its reform to optimize discipline management, the Department is adjusting application code according to the principle of “based on logic structure of knowledge system to promote integration and application”. The new application codes are revised based on extensive discussions among experts in all related disciplines. Please pay attention to the new application code when applying in 2020.

In 2019, the Department received 11,342 applications for General Program, increasing 7.43% from that in 2018, and funded 2,024 projects with a total direct cost funding of 1.20740 billion yuan. The average direct cost funding is 596,500 yuan per project, and the success rate is 17.85%. Some projects are related to interdisciplinary areas with mathematics and education. In 2019, 163 applications for the projects of interdisciplinary research between Information Sciences and Mathematical Sciences were

received and 20 projects were funded with average direct cost funding of 588,000 yuan per project and a success rate of 12.27%. 310 applications for the projects of education information sciences and technology were received and 45 projects were funded with average direct cost funding of 500,000 yuan per project and a success rate of 14.52%.

In 2020, the Department encourages creative basic research that is different from traditional research ideas, and welcomes researchers to conduct discussions and studies on new concepts, new theories, new methods and new technologies. The PIs of those projects making important progress will be given preferential support towards their new applications. The average direction cost funding will be about the same as that in the last year.

Funding for General Program Projects in Department of Information Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Electronics and technology	182	11,040	20.04	183	10,954	18.43
	Information and communication system	158	9,477	20.15	157	9,376	18.47
	Information acquisition and Processing	138	8,237	19.91	141	8,472	18.36
II	Theoretical computer science, computer software and hardware	122	7,231	21.11	124	7,429	18.40
	Computer applications	174	10,411	21.14	179	10,665	18.51
	Network and information security	164	9,893	20.97	159	9,526	18.45
III	Control theory and control engineering	363	21,939	19.78	343	20,536	17.70
	Systems science and system engineering	231	13,908	17.47	256	15,332	17.69
	Artificial intelligence and intelligent systems	38	1,724	7.85	45	2,250	14.52
IV	Semiconductor science and information devices	179	10,719	18.76	180	10,792	17.49
	Information optics and photoelectric devices	116	6,940	18.77	110	6,595	17.43
	Laser and technical optics	142	8,518	18.64	147	8,813	17.54
Total or average		2,007	120,037	19.01	2,024	120,740	17.85
Direct cost per project		59.81			59.65		

Division I of Information Sciences

The Division mainly funds basic research in areas of electronic science and technology, information and information system, information acquisition and processing and related interdisciplinary areas.

Researches funded include areas of circuit and system, electronic science and technology, magnetic field and wave, as well as electronics and applications. Funding areas mainly cover the design, test and verification of circuits and system, diagnosis, reliability, micro-nano circuit and system design theory, methods and technology and low energy

consumption design method, power, radio electronic circuit and system design theory and method, circuit and network theory, modeling, simulation and circuit design method for new devices, electromagnetic theory and computational methods in electromagnetic fields and waves, characteristics of electromagnetic field and waves in new types of media, scattering and back-scattering, mechanism of interaction between electromagnetic field and wave and objects, electromagnetic compatibility and electromagnetic environment, theory and technology of millimeter wave and micro wave, acquisition and transport of electromagnetic energy, electronic wave transmission and antenna, micro wave optics, tetra hertz science and technology, transient electromagnetic field theory and application, vacuum electronics, surface and membrane electronics, superconducting electronics, quantum electronic theory and device, plasma electronics, molecular and nano electronics in physical electronics, magnetic electronics, electromagnetic effect in bio-electronics, bio-chips, medical imaging, medical information detection and processing, medical imaging navigation and key medical instrument technology; information processing and analysis in bio-informatics, analysis of bio big data, detection and identification of cell and bio-molecular information, information network and analysis in bio-systems, modeling and simulation of bio-system functions, methods and technology of bionic information processing; sensitive electronics and physical, chemical, bio-and bio-chemical sensors, wearable sensors, properties of new types of sensitive materials and sensors, and sensor theory and technology, mechanism and key technology of noninvasive brain machine interface.

Researches funded also include the theory and key technologies for information transmission, exchange and application in field information of and communication. The main funding areas include informatics, signal coding, channel coding, network service theory and technology, information system modeling and simulation, information system and communication network security, wireless connection security, cognitive wireless in information theory and information system; wireless, spatial, underwater, multimedia, optical, quantum, computational, transducer network communication theory and technology, body network, new network access technology, mobile wireless internet technology, and basic mobile communication theory and network, future information network theory and transmission mechanism, network communication theory and system, etc.

Researches funded as well include information acquisition and processing related to the theory, methods and applied technology of information sensing, acquisition and processing. The main funding areas include signal theory and signal processing, the processing of multidimensional signals and array signals, and processing of radar, sonar, remote sensing and voice signals; mathematical theory and methods in information acquisition and processing, and information acquisition mechanism and technology, weak signal detecting and processing, detection and imaging system in information detection and processing, image processing and interpretation, integration of multi-detector signals, multimedia information processing and presentation, space information acquisition and processing, marine information acquisition and processing, disaster information acquisition and processing, and applied basic research in mobile network big data, etc.

Application codes under the category of F01 are revised. Please check before making applications.

In 2019, the Division received 2,611 proposals for General Program, and funded 481 projects. The success rate is 18.42% and the average direct cost funding is 598,800 yuan per

project.

In 2020, the Division will continue to support researches in areas of basic theory and key technologies that are significant to the national security in areas of new method of circuit and system design, millimeter wave antenna and system integration, acquisition and transport of electromagnetic energy, micro wave photon radar, new sensor mechanism and design method, bio-data analysis, medical image processing, space, sea and land information network, mobile internet, vehicle internet, idea driven communication network, positioning of outdoor targets, optical communication, communication system security and wireless connection security, underwater communication and sensor network, electromagnetic vortex communication, new principle and method of radar, detection and imaging, remote sensing image processing, multimedia information processing, space information acquisition and processing, underwater information acquisition and processing. The innovative and cross-disciplinary research and exploratory studies with good prospects will be supported; preferential funding will be given to the projects which have scored outstanding achievements in previous research. Preferential support will be given and encouraged to the combination of theory and practice to focus on innovation and to study and solve basic problems in important application areas, so as to improve China's research capabilities in this discipline.

Division II of Information Sciences

The Division mainly funds researches in areas of basic theories, basic methods and key techniques related to computer science and technology and relevant interdisciplinary areas.

Computer science and technology is one of the most active, fast-growing and widely influential areas in information sciences. The important trend of computer science and technology development is to obtain super speed, large storage, high performance, high reliability, easy interaction, intelligent, networking, universal and mobile applicability. Applicants are recommended to pay attention to these new features in this Division.

The Division supports researches on the theory of computer science, software theory and engineering, system software and data base, industrial software and service computation, system architecture and hardware, computer graphs and virtual reality, image and audio video processing, big data processing and analysis, man machine interaction and coordination, information searching and social computation, bio-information computing and digital health, information security, network and system security, computer network and internet of things, etc. The Division also stress on funding of studies on theoretical method of network and system security, new system and software design method, form verification, social media big data analysis and processing, man machine interaction and coordination.

Application codes under the category of F02 in the Division were revised, please check before making applications.

In 2019, the Division received 2,503 proposals for General Program, and funded 462 projects. The success rate is 18.46% and the average direct cost funding is 597,800 yuan per project

It should be noted that such problems as lack of creative ideas, lack of clear

scientific topics, too many research contents, lack of specific research scheme, lack of reviews on existing research results, lack of clear research goals and preparations still existed in proposals received in 2019. We suggest applicants do better in preparing proposals, and select more meaningful, creative and reasonable topic of research to conduct original, basic, farsighted and interdisciplinary research.

The Division will continue to support collaborations with researchers in areas of life sciences, medical sciences, mathematics, earth sciences, management and economics and social sciences to make joint explorations on new theories, new method and technology in interdisciplinary areas so as to promote the mutual development of computer science and other sciences. **The Division gives priority to support on research in block chain, 0day error diagnosis, code theory based on super lattice mechanism.** The Division especially encourages and supports scientists to focus on strategic national goals and address those basic issues that are well known internationally for their complexity and significance and of strong exploratory nature, so as to increase the level and international impact of computer science research in China.

Division III of Information Sciences

The Division mainly funds basic research and far-sighted research for the national economy and national security in areas of automation, artificial intelligence, and information science in interdisciplinary areas.

Application codes under the category of F03, F06 and F07 in the Division were revised, please check before making applications.

Research funded in the area of automation (F03) includes control theory and technology, control system, system modeling and emulation, system engineering theory and technology, bio-medical information analysis and technology, automatic detection techniques and devices, navigation, guidance and control, smart manufacturing and automation system theory and technology, robotics and intelligent system, and automation driven by AI technology.

In 2019, under this application code the Division received 1,938 proposals for General Program, and funded 343 projects. The success rate is 17.70% and the average direct cost funding is 598,700 yuan per project.

The AI area (F06) will focus on key scientific issues and technology in AI research, encouraging original, fundamental, far-sighted and interdisciplinary research. The Division encourages research on basics of AI, complexity science and intelligent system theory, machine learning, machine sensing and vision, pattern recognition and data mining, natural language processing, knowledge representation and processing, intelligent system and AI security, cognitive and neural science induced issues. The Division supports close cooperation between AI researchers and those in other disciplines and humanities and social sciences to explore new concepts, theory, method and technology. The Division especially encourages researches to explore basic issues of great difficulties and great impacts.

In 2019, the Division received 1,447 proposals for General Program under this application code, and funded 256 projects. The success rate is 17.69% and the average direct cost funding is 598,900 yuan per project.

For education information science and technology F0701, the Division focuses on knowledge generation, cognition laws and learning mechanism, and original, fundamental, far-sighted and interdisciplinary research, encourage research on basic theory and method of AI driven education, online and mobile learning environment, virtual and enhanced reality learning, visual representation of knowledge education cognition tools, education robot, education AI bodies, education big data analysis and application, learning analysis and evaluation, self-adaptive personalized learning assistance, and education for targeted groups, etc. Explore new concept, theory, method and technology to solve education problems in China.

In 2019, the Division received 310 proposals for General Program under this application code, and funded 45 projects. The success rate is 14.52% and the average direct cost funding is 500,000 yuan per project.

Division IV of Information Sciences

The funding scope of the Division covers two disciplines, namely, semiconductor science and information devices, and optics and photo-electronics.

The main scope of funding for semiconductor science and information devices includes semiconductor material, design of integrated circuits, semiconductor photo electric devices and integration, semiconductor devices and integration, semiconductor physics, integrated circuit devices, fabrication and packaging, micro and nano mechanical and electrical devices and control system, and new types of information devices including nano, molecular, super conducting, quantum functional information devices.

The main funding scope for optics and photo-electronics includes two parts, namely, information optics and photoelectric devices, and laser technology and technical optics. The information optics and photoelectric devices mainly support optical information acquisition, display and processing, photon and photoelectric devices, transmission and exchange photonics, inferred and tetra-hertz physics and technology, photon integration technology and devices. The laser technology and technical optics mainly support nonlinear optics and quantum optics, laser, spectrum technology, applied optics, optics and photoelectric materials, space optics, atmospheric and marine and environmental optics, biomedical photonics and photonics, energy and lighting photonics, micro nano photonics and interdisciplinary issues in astronomy and advanced manufacturing,

Application codes under the category of F04 and F075 in the Division are revised. Please check before making applications.

In 2019, the Division received 2,498 proposals, and funded 437 projects with a success rate of 17.49% and an average direct cost funding of 599,500 yuan per project.

In recent years, along with the development of information sciences, the above areas are now having more and more interactions with physics, chemistry, materials sciences and life sciences and medical sciences, and many new research directions are emerging. Similar to 2018, among the major branch areas, applications remained the same in the following areas: semiconductor photoelectric devices, IC design and test, semiconductor materials, photon and photoelectric devices, transmission and exchange photonics, optical information acquisition and processing, nonlinear optics and quantum optics, laser and applied optics,

etc. Applications are steady in such areas as semiconductor electronic devices, semiconductor micro nano mechanical electronic devices and system, IC manufacturing and packaging, semiconductor physics, inferred physics and technology, biomedical photonics, optics and photoelectric materials, spectroscopic technology, etc.

The Division will give priority to researches on high performance light source, low power consumption integrated circuit and radio frequency chips, new types of sensor materials and devices and technology, tera hertz devices, micro and nano device and technology, new types of optical field control technology and devices, quantum optics and quantum devices, quantum communication and quantum computation, optical information processing and display technology, photon electronic devices and photonic integration, wide gap semiconductor materials and devices, semiconductor integrated circuit system, energy photonics, new types of laser technology and devices, new optical imaging method and technology, biomedical optics, new spectrum technology, and space and astronomical optics, environment and marine optics, etc. In order to solve the bottleneck issues of devices in various fields in China, the Division will encourage studies to improve device performance (both yield and reliability) including scientific issues in device physics, structure and technology development.

In 2019, semiconductor science and information devices, and optics and photo-electronics of the Division will use experiment on the new method of category-specific review. For general programs, percentage of number of applications in category A, B, C and D are 7.57%, 42.03%, 42.07% and 8.33%, respectively. The detailed success rate can be seen in the following table.

Applications in the general program for Division VI

Category of problem	Applications	Funded	Success rate (%)
A	189	29	15.34
B	1,050	212	20.19
C	1,051	168	15.98
D	208	28	13.46
Total or average	2,498	437	17.49

Note: A: exploratory and original; B: frontier and novel; C: demand driven and breakthrough; D: mutual interests and interdisciplinary

Department of Management Sciences

The Department mainly supports research on improving the understanding of objective law in management and economic activities. The research findings can provide theory and method to optimize the utilization of limited resources. The Department consists of three divisions, handling and reviewing proposals of four disciplines, which are Management Science and Engineering, Business Administration, Economic Sciences, and Macro-Management and Policy.

During the 13th Five-Year Plan, the Department will be more active to encourage original studies, give preference to proposals discovering and exploring universal scientific

issues based on Chinese management practices, so as to broaden the knowledge of Management Sciences.

The Department emphasizes applying “scientific methods” to explore the objective laws of management sciences, and therefore ordinary management research will not be supported. The Department supports experimental research that observes and discovers the new management phenomena based on data obtained from experiments, observations and measurements. The Department also supports theoretical research that aims at addressing management issues by analyzing and explaining management phenomena through modeling, computation, induction and deduction. The Department will offer higher funding support than the average funding level for experimental research projects that do need long-term and large-scale data collection, data processing, and field investigation, and high performance computing and experiments.

The Department encourages and supports scientists from diverse academic backgrounds to take an active part in management science research and contribute to the development of Management Sciences, which is a comprehensive interdisciplinary science. However, applications focusing on humanities and social science, as well as those within the funding scope of other scientific departments of NSFC, will not be accepted by the Department. Applicants are advised to propose their research topics from the perspective of management science research.

All the applications for the Department should highlight one of the four different natures of scientific issues, and state the relevant reasons, so that to be in favor of the category-specific review.

General requirements for applications in 2020 are as follows:

1. No repetitive funding with the National Social Science Fund

To optimize the allocation of the National Natural Science Fund and to ensure that project leaders invest adequate time and energy in their on-going national projects, the Department will decline proposals by the following applicants in 2020 (except for the applications of National Science Fund for Distinguished Young Scholars):

(1) Applicants who were supported by the National Social Science Fund as a project leader within the past 5 years (from January 1, 2015), and have not yet got the project completion certificate awarded by the National Planning Office of Philosophy and Social Science until the deadline of this year’s fund application.

Note: if an applicant has gained the project completion certificate from the National Planning Office of Philosophy and Social Science, and is applying for an NSFC project with the application code starting with G in 2020, he/she must provide a copy of the certificate with an official signature and seal of his/her home institution. For the paperless application project, the applicant needs to submit the electronic version of this certificate online.

If the applicant has submitted the project completion certificate for the NSFC in the previous year, he/she will be not requested to submit again in this year.

(2) Applicants who apply for National Social Science Fund as a project leader in the year of 2020.

2. Accuracy and integrity of information

Applicants are responsible for the accuracy, integrity, and reliability of the contents of their applications, and their home institutions are obligated to undertake serious check on the relevant information. The following requirements should be complied with when

applicants prepare and submit the project proposals:

(1) Applicants are required to give a detailed description on their previous research work related to the project proposals, as well as the publications in previous work. The five representative works should be journal articles or monographs that have already been published. When filling out the information of the representative works, the applicant should carefully read the requirements for filling in the representative works of application template, and must comply with it.

(2) The Department treats it unacceptable that applicants submit the same proposals to more than one science funding agency. Applicants who propose new research topics based on their previous NSFC projects are required to describe the progress of the previous NSFC project and clarify the relations and differences between the newly submitted proposals and the previous ones. For applicants who are undertaking projects funded by other agencies, such as Ministry of Science and Technology, Ministry of Education, National Social Science Fund or local science funding organizations, they are required to clarify the similarities and differences between their on-going projects and the new proposals submitted to NSFC.

3. Special requirements for project leaders starting NSFC projects in recent years

To ensure that project leaders invest adequate time and energy in their on-going projects, the applicant in 2020 who has been approved any kind of NSFC projects as a project leader in recent two years, 2018 or 2019, will be reviewed and assessed through stricter procedures. The project leader approved in 2019 will be more attentions.

4. Consideration of the performance of accomplished projects

The Department conducts performance evaluation for all General Program projects, Young Scientists Fund projects, and Fund for Less Developed Regions projects one year after completion of these projects. The evaluation results will be released to the public on the NSFC website. Researchers with excellent performance evaluation results will be given priority for funding when they apply for new projects. However, researchers with poor performance evaluation results will undergo stricter review procedures when they apply for new projects.

In 2020, the average funding for direct expenses of General Program projects will be the same as that in 2019.

Funding for General Program Projects in Department of Management Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Management science and engineering	235	11,280	19.90	228	11,064	17.77
II	Business administration	200	9,600	18.57	196	9,511	16.23
III	Economic sciences	153	7,344	16.28	162	7,861	13.64
	Macro-management and policy	215	10,320	16.28	221	10,724	14.00
Total or average		803	38,544	17.77	807	39,160	15.35
Direct cost per project		48.00			48.53		

Division I of Management Sciences

Management Science and Engineering (G01)

The Division mainly supports basic research on theories, methods and techniques in the field of management science, which includes management theory and research method, operations management, decision-making theory and method, game theory and method, evaluation theory and method, forecast theory and method, management statistics theory and method, management psychology and behaviors, management system engineering, industrial engineering and management, logistics and supply chain management, service science and engineering, system reliability and management, information system and management, knowledge management, risk management, financial engineering, engineering management, and transportation management, etc.

The orientation of this Division is more focused on theoretical basis and frontier research, emphasizing innovative research on management theory and method integrated with China's management practices. The Division encourages interdisciplinary research and international frontier research.

In 2019, the Division received a total of 1,283 applications for General Program and funded 228 projects. The success rate was 17.77%.

For the past few years, the Discipline has experienced rapid development in China. Its performance and reputation in the international scientific society has been unceasingly raised up in many research areas. However, the number of application and funded applications varied significantly across different research areas. The application amount of Transportation management, logistics and supply chain management, information system and management, optimization and management, and financial management was relatively large, while the number of applications in the field of basic theory and method on Management Sciences was relatively small, including the management theory and research method, game theory and method, management statistics theory and method, etc.

In 2020, the Division will continue to encourage and support original research on basic theories on Management Sciences, innovative studies based on China's management practices, pioneering research to explore the frontiers of Management Sciences and innovative research findings with international influence. Meanwhile, the Division will give priority to the proposals to combine theoretical research and practical issues, solve the scientific issues generated from management practices in China and the management theory and methods with Chinese characteristics. In our division, researchers are strongly encouraged to do frontier research and solve the problems related with important national demand, especially for the issues of Management Sciences behind the technical problems of "neck-lock". The Division also encourages integrations of Management Sciences with Mathematics, Economics, Behavior Sciences, Information Sciences, as well as other disciplines, and supports studies of seeking breakthroughs of theories, methods, and practices though multi-interdisciplinary.

Division II of Management Sciences

Business Administration (G02)

The Division mainly supports basic research and applied basic research on management theories and new management techniques and methodologies, taking micro-level organizations (all types of industries, enterprises, institutions, and nonprofit organizations) as research objects. The funding areas of the Division include 14 disciplines, which are strategic management, organization theory and organization behaviors, enterprise technology management and innovation management, human resource management, financial management, accounting and auditing, marketing, production and quality management, enterprise information management, e-commerce, operation management, project management, entrepreneurship, international business and multi-culture management, etc.

In 2019, the Division received a total of 1,208 applications for General Program and funded 196 projects, with a success rate of 16.23%.

In 2019, the number of applications in the fields of financial management, marketing, accounting and auditing, enterprise technology management and innovation management, operating management, and organization theory and organization behaviors was relatively large, and correspondingly, the number of funded projects in these fields was also larger than the one in other fields. On the other hand, the number of applications in the fields of project management, production and quality management, international business and multi-culture management, and e-commerce was much smaller, and the number of funded projects in these fields was relatively small. In general, the proposals on exploring new methods and new technologies have shown certain innovativeness, and the number of applications focusing on new issues and China's practical needs was steadily increasing. From the perspective of funding structure, a balanced distribution of funding areas has been almost formed.

In 2020, the Division will continue to support basic research on innovative and cutting-edge scientific issues, encourage theory theoretical innovation and new knowledge discovery and creation. The Division will give priority to the proposals with scientific accumulation and discovery by integrating empirical analysis, case studies, and observation experiments, focusing on scientific issues derived from China's management practices that have potential social application values, and those researches with substantial international cooperation. The Division advocates scientific spirits, encourages exploration, and supports original basic research.

In order to promote the balance within the discipline, the Division will give priorities to basic research frontier in areas of strategic management, organization theory and organization behaviors, enterprise technology management and innovation management, human resource management, financial management, accounting and auditing, marketing, enterprise information management, e-commerce, and operation management. Preference will be given to areas of international business and multi-culture management, project management, entrepreneurship, service management, e-commerce and business intelligence, etc. Meanwhile, the Division will give priority to theoretical innovation and original research based on Chinese management practice.

Division III of Management Sciences

The Division supports two basic research areas: economic sciences and macro-management and policy.

Economic Sciences (G03)

The Discipline mainly supports the basic research on explaining economic phenomena, unveiling rules of economic activities and deriving economic theories through scientific research methods, such as empirical study, quantitative study, and behavior study, etc. The funding areas covers the basic research in Game Theory and Information Economics, Behavior Economics and Experimental Economics, Econometrics and Economic Computation, Economic Development and Trade, Monetary and Fiscal policy, Financial Management, Population, Resources and Environment Economics and Labor Economics, Agricultural and Forestry Economics and Management, Regional Economics and Industrial Economics, etc.

In 2019, the Economic Sciences discipline received a total of 1,188 applications for General Program, with a 26.38% increase comparing to 970 applications in 2018. Meanwhile, the Economic Sciences discipline began to pilot reform of category-specific application and review for the General Program. There were 56 applications for the category of “funding creative and timely ideas-excellence in science”, 218 applications for the category of “Focusing on frontiers of Science in unique ways-leading the cutting edges”, 794 applications for the category of “supporting application-driven basic research-enabling breakthroughs”, and 120 applications for the category of “Encouraging transdisciplinary leading-edge research-convergence”. After the review, there were 162 applications approved with a success rate of 13.64%.

In recent years, there have been a large number of applications and funded projects in the fields of Agricultural and Forestry Economics and Management, Economic Development and Trade, Financial Management, Population, Resources and Environment Economics and Labor Economics, Regional Economics and Industrial Economics. On the contrary, applications in some fields are much less, including Game Theory and Information Economics, Behavior Economics and Experimental Economics, Econometrics and Economic Computation, etc. It implies the significant difference on the research teams and their scale for different fields. Meanwhile, many applicants concentrated on hot topics associated with China’s economy, and submitted high-quality research proposals.

In 2020, the Discipline will pay more attentions to those research proposals on the topics of macro-economic analysis, game theory and information economics, econometrics and economic computation, behavior economics and experimental economics, fintech, fiscal policy, income distribution, industrial economics, regional development, and so on. In addition, it will encourage and give priority to the proposals focused on the high-quality development of China, including China’s economic structural adjustment under the background of international economic structure change, deepening the reform and raising the openness at high-level, productivity and innovation development, population and labor force, resource and environment, income distribution, etc.

Macro-Management and Policy (G04)

The Discipline is a group of disciplines that study the behaviors of governments and related public sectors in formulating macro policies and implementing comprehensive governance policies, in order to achieve the social and economic development goals. It covers basic research on public administration, public policy, non-profit organization management, science and technology management and policy, health management and policy, education management and policy, culture and leisure industry management, public security and crisis management, social welfare management, environment and ecology management, resource management and policy, regional development and urbanization management, information resource management, e-governance, etc.

In 2019, the Discipline received a total of 1,579 applications for General Program, increasing 19.53% comparing to 1,321 applications in 2018. There were 221 projects funded with a success rate of 14.00%.

In recent years, there are many more applications in the areas of public health management and policy, resource management and policy, environment and ecology management, regional development management, education management and policy, and innovation management and policy. Plenty of applicants concentrated on hot topics associated with macro-management and policy practices in China, and submitted high-quality research proposals. In 2020, the Discipline will pay more attention to research proposals in the fields of public policy, scientific ethics and management, social governance, innovation management, green development, risk prevention and control, etc.

In 2020, through funding research projects, the Division aims to facilitate discipline development, promote academic innovation, and support talent scientists and research teams. In particular, the Division encourages researchers to provide scientific support and evidences for macro policy makers while developing theories and methods. The applications should take China's practical management issues as the main research objects, and bring up scientific theoretical issues from the research objects accurately. The scientificity and normativeness of research methods should be paid special attention to. Applicants are advised to differentiate management science research and practical management work. In the field of public health management and policy, there are many applicants often obfuscates these two different issues. In addition, the applicants should also pay attention to the difference between an NSFC project and a humanity and social science project in terms of research methods. Several other requirements are listed as follows: The scope of the research topic should be appropriate; the research goal should be concentrated and clear; the research content should be specific and concrete; the research topic, objective, content should match and be adapted with the methods; the research methods and technology roadmap, as well as how to address the key scientific issues, need to be clearly clarified in the application.

Department of Health Sciences

In order to improve China's medical scientific research, the Department mainly supports the basic research aimed at scientific issues in disease prevention, control and treatment, and focused on the structural, functional, developmental, genetic and immune

abnormalities of human body, as well as the occurrence, development, outcome, diagnosis, treatment and prevention of disease.

Basic research is the research to innovate and resolve scientific issues, and realize natural phenomena and disclose the course of nature. The Department encourages research areas as follows: innovative theoretical and methodological research aimed at the scientific issues emerging from medical practices; systematic and indigenous study on key scientific issues emerging from medical disciplines; translational medicine through combination of basic research and clinical research; integrative medical research on the occurrence, development and regression of diseases at various levels from molecular, cellular, tissue level to organ, individual and population level by using new multidisciplinary and comprehensive techniques or methods; in-depth systematic and innovative study based on existing accumulated researches; interdisciplinary research integrated in other fields; the development of new animal models of human diseases; substantive international joint research and exchange. The Department will give priority to basic research on major key diseases closely related to the national welfare, human livelihood, major emergency event of public health, and common or frequently encountered diseases that severely affect human health. The Department will also highlight research on rare diseases based on existing accumulated research work and other weak research areas in an effort to keep the balance and coordinative development of various disciplines.

1. Specific instructions for applicants

(1) Applicants are encouraged to carry out in-depth basic research toward scientific issues, especially the original research. Applications with unique academic ideas or solid previously accumulated research work are encouraged to carry out further systematic research. Applicants tracking others' without innovative scientific ideas, or those merely pursuing new high-technology rather than scientific novelty will not be in consideration for grant.

(2) Applicants are expected to elaborate the scientific values and potential clinical applications of the anticipated research results in detail. Applicants are suggested to propose a defined scientific issue or a specific hypothesis based on analysis of the relevant latest literatures and research progress in the field. Furthermore, elucidation of theoretical as well as applicable value of the research is needed.

(3) Applicants are expected to elaborate whether the proposed research will possibly solve the specific scientific problems or verify the hypothesis, and the proposed research is supposed to be specific, feasible and logical. Furthermore, applicants are expected to propose adequate research content, detailed research design, clear research method and reasonable budget.

(4) Applicants are expected to provide detailed information about relevant previous research. In case of extension of previously funded project, the innovative ideas and further scientific problems of the research are expected to be elaborated in detail. Besides, all the relevant published papers are expected to be listed, and relevant unpublished results including experimental data, tables or graphics, etc., are suggested to be provided.

(5) Applicants are expected to provide true and accurate information in their applications, including the resume of applicant and major participants, previous grant information and relevant publications. Patents and awards should also be listed according to the guideline.

Applicants are requested to pay special attention to: for publications, please

write it in accordance with the instructions and guidelines of the application form and the writing outline in this *Guide*, in the meantime to refer to the requirements of scientific integrity in the guidance notes. Detailed information including the names of all authors (in the same order in which they appeared in the publication), the article and journal title, book title, volume number, page number, and year of publication (abstracts or meeting proceedings should be specified) are required. The first author and corresponding author should be noted in accordance with the instructions and guidelines of application form. Accepted manuscripts should be listed along with an attached acceptance letter, unaccepted submitted manuscripts or manuscripts in preparation should not be included. Conference papers should not be listed either. Applications with incorrect ranking and labeling of authors will be submitted to the meeting review panel due to the scientific integrity.

(6) Applicants are expected to provide a signed institutional certification or approval (the scanning copy should be attached to the electronic proposal) to meet the related ethical or informed consent requirement if applications involve special medical research objects such as human subjects. Applications that do not provide certification or approval as required above will not be funded.

(7) Applicants are expected to follow all appropriate guidelines for the use and handling of pathogenic microorganisms, including the guideline of “Bio-safety Administrative Rules of Pathogenic Microorganism in Lab” released by the State Council of China and the ethical and bio-safety regulations by other governmental agencies. If applications were involved in human genetic resources, applicants should strictly follow “Regulations on Management of Human Genetic Resources”. Additionally, a commitment letter to guarantee bio-safety should be provided by the research institutions when applications were involved in the study of highly pathogenic microorganisms. Applications that do not provide certification or approval as required above will not be funded.

(8) Applicants with good performance records in their previous grants will be given priority consideration on equal conditions.

(9) Applicants are expected to notice that: in 2020, the Department will generally not give further funding to applicants who either have got intensive funding in 2019 from NSFC (such as Key Program, Major International and Regional Joint Research Program, Major Program, Major Research Plan, Key Program of Programs of Joint Funds, Special Fund for Research on National Major Research Instruments, etc.), or are applying for repetitive or similar research to their ongoing national scientific projects funded by other governmental agencies.

(10) Applicants are expected to provide PDF copies of no more than 5 representative papers (PI’s papers only) in their electronic applications.

(11) Applicants are expected to refer to the specific requirements for various programs via the website of the Department (<http://health.nsf.gov.cn>).

2. General overview of applications in the Department in recent years and instructions to research institutions

The number of applications has been increasing in the Department ever since its establishment. As of December 4th, 2019, the number of applications was 73,715 from 1,054 research institutions, accounting for 29.46% of the total applications in NSFC, including 28,659 General Program projects which account for 28.63% of the total applications of General Program in NSFC. To enable the healthy, stable and sustainable

development of both science foundation and medical research in China, the research institutions are required to further strengthen their management in the process of NSFC grant applications, and make efforts to further improve the scientific quality of applications (rather than increasing the number of applications) under the guidance of “Requirements of NSFC for Institutions to Improve Management of Scientific Projects”.

3. Specific explanations on application codes

The application codes of the Department are composed of 31 primary application codes (H01 to H31) and many relevant secondary codes. The basic characteristics of the application codes are as following: (1) the primary application codes, which are mainly arranged in the order of organs or systems, include research areas relevant to both basic and clinical research, in an effort to ensure that applications on similar scientific issues from different disciplines are reviewed in the same reviewing system; (2) the secondary application codes, which are arranged in the order from basic to clinical research and from structural, functional and developmental abnormalities to diseases, cover both basic and clinical research relevant to the given organ or system.

The applicants are expected to carefully choose the primary application code and the relevant secondary one. For more details, please refer to the following contents in each division of the Department.

Special instructions for applicants are as follows:

The Department sets up the oncology discipline separately. Please select the corresponding secondary application code under Oncology (H16) for all kinds of tumor-related medical scientific researches except for hematological tumor, tumor epidemiology, oncological pharmacology, tumor imaging medicine and tumor traditional Chinese medicine. The proposals on hematological tumor should be submitted to the corresponding secondary application code under Hematological System (H08); the proposals on tumor epidemiology should be submitted to the Epidemiology of Noncommunicable Diseases (H2610); the proposals on oncological pharmacology should be submitted to Anti-tumor Pharmacology (H3105); the proposals on medical imaging and biomedical engineering of tumor should be submitted to the corresponding secondary application code under Medical Imaging and Biomedical Engineering (H18); the proposals on traditional Chinese medicine tumor research should be submitted to Traditional Chinese Medicine (H27), Chinese Materia Medica (H28), or Integrated Chinese and Western Medicine (H29).

The funding scope under radiomedicine (H22) is given to basic research in radiation damage and repair, radiation toxicology and pathology, radiological hygiene and protection, and radiological therapy for non-tumor disease. The discipline of radiomedicine (H22) does not support applications for Radiology or tumor radiotherapy, the former should be submitted to Medical Imaging and Biomedical Engineering (H18) and the latter to Tumor Physiotherapy (H1610) under Oncology (H16).

The funding scope under Gerontology (H25) mainly covers studies focused on the pathophysiological mechanisms of aging and aging-related diseases. Applications that focus on age-associated diseases that do not involve pathophysiological mechanisms of aging should be submitted to other proper divisions.

Applications that focus on neonatal diseases should be submitted to Reproductive System/Perinatology/Neonatology (H04).

Applications that focus on sexually transmitted diseases should be submitted to

Medical Pathogens and Infection (H19).

4. Instruction on projects related to rare diseases and lymphatic system

(1) Etiology and prevention study of human rare diseases

The Department will continuously give special support to research aimed at studying the development and prevention of human rare diseases. The rare diseases show characteristics of varied species, uncommon single type, and high morbidity in total. Applicants are expected to take advantage of rich genetic resources in China, and to carry out in-depth research on prevention, diagnosis, and drug development of rare diseases, in order to make achievement with own proprietary intellectual properties, and high international impacts. Meanwhile, case studies of major key rare diseases are highlighted in an effort to advance the understanding of pathogenesis underlying the development of major key diseases, thus providing theoretical bases for their novel diagnostic and therapeutic strategies. **The applicants are expected to choose the proper secondary application code**

Funding for General Program Projects in Department of Health Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate ⁺ (%)	Projects	Direct cost	Success rate ⁺ (%)
I	Respiratory system, circulatory system, blood system	490+ 22*	28,045+ 550*	18.13	521	28,705	17.13
II	Digestive system, urinary system, endocrine system/metabolism and nutrition support, ophthalmology, otorhinolaryngology head and neck science, oral and craniomaxillo-facial science	603+ 24*	34,470+ 600*	17.88	639	35,196	16.65
III	Neurological and psychiatric diseases, gerontology	388+ 13*	22,152+ 325*	17.73	412	22,687	16.91
IV	Reproductive system/ perinatology/neonatology, medical immunology	255+ 11*	14,584+ 275*	19.11	274	15,060	17.49
V	Medical imaging and biomedical engineering, special medicine, forensic sciences	244+ 12*	13,929+ 300*	15.97	257	14,134	15.04
VI	Orthopedics and sports medicine, emergency and intensive care medicine/trauma/burns/plastic surgery, rehabilitation medicine, medical pathogenic microorganisms, laboratory medicine	411+ 21*	23,476+ 525*	16.46	436	23,962	14.87
VII	Oncology (leukemia not included)	826+ 29*	47,160+ 725*	16.48	867	47,686	15.39
VIII	Skin and appendages, preventive medicine, epidemiology, occupational medicine, radiomedicine	246+ 10*	14,127+ 250*	22.24	262	14,400	20.81
IX	Materia medica and pharmacology	262+ 11*	14,925+ 275*	18.81	275	15,099	19.04
X	Chinese medicine, Chinese materia medica, integrated Chinese and western medicine	610+ 27*	34,752+ 675*	14.00	641	35,191	13.36
Total or average		4,275+ 180*	4,335+180*	247,620 +4,500*	4584	252,120	15.99
Direct cost per project		55.84 (57.12**)			55.00		

Note: *One year program; ** One year program not included; + One year program included.

attached to the primary application codes (H01 to H31), and write “Mechanism underlying rare diseases (including case studies) and their prevention and treatment” on the annotation column of the application form.

(2) The development and function of lymphatic system

Researches aimed at the regulation mechanisms underlying the generation, maturation and homeostasis of lymphatic system, the relationship between lymph and blood, the roles of lymphatic system on lipid metabolism, the immune defense function of lymphatic system, and the pathogenesis of major key diseases related to lymphatic system, are all encouraged. **The applicants are expected to choose the application code H0218, and write “Mechanism underlying rare diseases (including case studies) and their prevention and treatment” on the annotation column of the application form.**

Specific annotation of the above general programs should be specified in the annotated column of the application form. Otherwise, these applications would not be treated as such classifications. The above applications are limited to General Program.

5. Funding plan and budget for General Program

The funding of direct cost for each project of the General Program in the Department in 2020 is expected to be the same as that in 2019. Doubled funding will possibly be given to excellent innovative research built upon previous strong background in some specific areas (please refer to Division V of Health Sciences in this *Guide*). Applicants shall reasonably apply for funds according to the actual needs of the research and fill out the fund budget form. The scope of funding of each Division, and an overview of the award number, funding, and success rate of the General Program in 2018 and 2019 in the Department are listed in the table below.

Division I of Health Sciences

The Division supports basic research on the diseases of respiratory, circulatory, and hematological systems.

Respiratory System (H01)

The Division mainly supports the basic research that focus on the pathogenesis, pathophysiological changes and treatment strategies of diseases such as lung, airway, pulmonary circulation, mediastinum, pleura, thoracic cage, and diaphragm. The funding areas mainly involve studies on the abnormalities of lung and airway; respiratory regulation and respiratory mechanics; airway reconstruction and lung transplantation; alveoli and air-blood barrier; lung fluid transport and pulmonary edema; respiratory infections and host-pathogens interactions; sleep-disordered breathing; airway inflammation and asthma; diffuse panbronchiolitis; chronic obstructive pulmonary diseases; bronchiectasis; pulmonary diseases and coagulation-fibrinolysis; lung injury and repair; pulmonary circulation and pulmonary vascular diseases; interstitial lung diseases; pulmonary lymphangiopathy; atypical hyperplasia and pulmonary nodules; granuloma, sarcoidosis; pleural diseases; new methods (such as assisted ventilation, inhalation therapy, interventional therapy, rehabilitation and nutrition, etc.) and animal models of the respiratory system diseases.

At present, proposals received and funded in the respiratory system mainly focus on

the areas of respiratory inflammation and infection, asthma, chronic obstructive pulmonary diseases, pulmonary circulation and pulmonary vascular diseases, interstitial lung diseases, lung injury and repair, sleep-disordered breathing. The number of applications in other areas is relatively low. The Division will encourage studies in the areas of lung injury, infection of respiratory system and host-pathogen interactions, atypical hyperplasia and pulmonary nodules. In the recent years, public attention has focused on the impacts of emerging and out-breaking infectious diseases, and inhalable particles (such as smoking and air pollution, etc.) on the respiratory system. Therefore, the Division also encourages studies in these areas: environmental pollution and/or pathogen-induced respiratory system damage, immune system dysfunction and airway remodeling; inflammatory microenvironment regulation and respiratory diseases, tissue damage repair and pulmonary fibrosis; bronchial or alveolar epithelial cell dysplasia and nodular lesions; lung stem cells and lung regeneration studies; the pathogenesis and treatment strategies of rare respiratory diseases; the studies on animal models, especially humanized animal models; and the establishment of new technologies and methods for respiratory research.

At the same time, the Division will continually encourage studies in the following fields based on preliminary work: extra-pulmonary organ damage related to sleep-disordered breathing; biological treatments of respiratory diseases; new methods of precise treatment; and potential molecular markers and treatment targets.

Circulatory System (H02)

The Division mainly supports basic researches in cardiac and vascular (including lymphatic vessels) diseases, as well as microcirculation and shock. In recent years, the number of applications in the field of cardiac/vascular injury and protection was the highest, followed by atherosclerosis, coronary heart diseases, arrhythmia and heart failure. In addition, there were numerous applications related to non-coding RNA, but the innovation and unique characteristics of those projects were insufficient. Applicants are encouraged to carry out original basic research, through the cooperation with clinicians, developmental and genetic biologists, regenerative medicine specialists and other related disciplines to study on the mechanisms in the development and therapeutic strategy of cardiovascular diseases. In the cutting-edge fields of cardiovascular diseases, researchers are encouraged to establish international collaborations, to propose innovational hypothesis based on their own research data, and eventually gain achievements with independent intellectual properties. Researches on the regulatory and damage mechanisms of the biological active substances on the heart and vessels are encouraged, and further screening the potential biomarkers for diagnosis, therapeutic targets and innovative treatment technologies are supported. Studies on the molecular etiology, regulatory network and intervention targets of the metabolic disorder related cardiovascular diseases are encouraged, and the effects of other systemic diseases on the cardiovascular system are also encouraged. Infectious cardiovascular diseases, immune related circulatory system diseases and lymphatic circulatory diseases are still the comparatively weak fields in cardiovascular system, and relevant researches are encouraged. Studies on cardiovascular diseases in children are required to be strengthened. Researches and applications of new techniques, new methods and new materials in the cardiovascular field are supported. The basic and applied basic applications for important clinical issues in the circulatory device implantation and perioperative period of cardiovascular surgery are encouraged.

Hematological System (H08)

The Hematological discipline mainly supports original basic research in the areas of hematopoietic cell/organ formation and development, hematopoietic stem/progenitor cell, bone marrow microenvironment and hematopoiesis regulation, erythrocyte and its related diseases, leukocyte and its related diseases, platelet and its related diseases, aplastic anemia and bone marrow failure, myelodysplastic syndromes, myeloproliferative diseases, blood system diseases and infection, bleeding, coagulation, thrombosis and embolism, leukemia, hematopoietic stem cell transplantation and its complications, basic research of hematological mesenchymal stem cells and its related applications, blood typing and transfusion medicine, blood products, hereditary hematologic diseases, lymphoma and lymphoproliferative diseases, myeloma and plasma cell diseases, research related to new technologies and methods for diagnosis and treatment of hematological diseases.

Currently, most applications and funding are concentrated in the fields of leukemia, lymphoma, myeloma, stem cell transplantation and hematopoiesis regulation. Applications in other areas are relatively low in number, such as in the areas of structure and function abnormality of hematopoiesis related organs (liver/spleen/thymus), hematological diseases and infection. The Division thus encourages research applications in the fields of: hematopoietic microenvironment and disease occurrence, the clonal evolution in hematologic malignancies from the perspective of cellular heterogeneity, and the precision diagnosis and medicine for hematologic diseases, biotherapy in hematology field, including HSC transplantation, immunotherapy, gene therapy, especially for basic and applied basic research using gene editing and new immuno-technologies, basic research projects based from clinical perspective(including translational research fully utilizing clinical data resource), big data mining from omics data derived from hematologic disease samples.

At the same time, applicants are also encouraged to propose projects based on their preliminary work in the following fields: hematopoiesis regulation and hematopoietic microenvironment, interaction between hematopoietic cells and leukemic cells with their microenvironment under the disease condition, immuno-abnormality and hematological diseases, biological and immunological issues for hematopoietic stem cell transplantation and its complications, hematological disease omics, hematologic biomarkers and their functional validation, the mechanism for leukemic stem cell maintenance and its clinical correlation, drug resistance and targeted therapies for hematological diseases, in vitro regeneration and expansion of functional blood cells, the interaction and mechanisms of blood cells, coagulation factors, blood vessels, and thrombus formation.

As for the applications related to pulmonary circulation and pulmonary vasculature studies, applicants should choose the application codes of either Respiratory System (H01) or Circulatory System (H02), depending on their specific scientific questions. The application in hematological fields now includes all hematologic malignancies (H0818: Lymphoma and Other Lympho-proliferative diseases; H0819: Myeloma and Other Plasma Cell Diseases). Please refer to the General Description section of proposal guidance from the Department for non-hematologic malignancies applications.

Division II of Health Sciences

The Division mainly supports basic researches on digestive system, urinary system, endocrine system/metabolism and nutrition support, ophthalmology, otorhinolaryngology, head and neck science, as well as oral and craniomaxillo-facial science.

Digestive System (H03)

This section mainly supports the studies on the related various non-communicable and non-neoplastic diseases of the digestive system. The number of applications for projects in the field of digestive system research in 2019 increased by 16.27% over 2018. There were more applications for projects related to liver diseases, among which liver fibrosis, liver cirrhosis and portal hypertension were the most (12.67%). Other research topics in hepatology include liver metabolic disorders and related diseases (10.10%), liver regeneration, liver protection, liver failure, artificial liver (9.65%). In the gastrointestinal-related diseases project, the top three numbers of applications were gastrointestinal environmental disorders, mucosal barrier disorders and related diseases (10.67%), gastrointestinal immune-related diseases (9.65%), abnormal gastrointestinal motility and functional gastrointestinal diseases (5.18%). There are few applications in the fields of vascular and circulatory disorders of digestive system, abnormal endocrine and neurohumoral regulation of digestive system, abnormal structure and function of abdominal wall/peritoneum, abnormal gastric acid secretion and acid related diseases. Together, they accounted for 4.03% of the total number of projects. The research fields of liver fibrosis, liver cirrhosis, metabolic liver disease, inflammatory bowel disease and intestinal mucosal barrier disorder are still hot spots. The relationship between intestinal homeostasis and digestive system diseases and its role in the occurrence, development and treatment of diseases are concerned in recent years. We encourage the basic and clinical research on the key frontier issues in the above-mentioned fields. We also encourage the research in the role of the interaction among the various organs of the digestive system in the pathogenesis of digestive diseases.

Urinary System (H05)

This section is to focus on the structural and functional disorders of the kidney, ureter, bladder, prostate and urethra, not including tumor research. The number of applications received in 2019 increased by 20.92% compared with that in 2018. Popular research topics are still in areas of the prevention and treatment of acute kidney injury and chronic kidney diseases, under the code of H0503 (the injury and repair of the urinary system, 21.88%), followed by H0510 (the secondary renal diseases, 16.39%), H0511 (the renal failure, 11.03%), and H0509 (the primary kidney disease, 9.76%). The number of proposals related to kidney transplantation, urinary urolithiasis and urodynamics in 2019 was similar to that in 2018. The research on urinary tract infection, dysfunction of renal substance transportation and renal endocrine function is less and deserves more attention. The NSFC will support the continuous and innovative research in these fields.

Endocrine System, Metabolism, and Nutrition (H07)

This section mainly supports studies on endocrine organ structure and/or function under normal or pathological conditions and on non-tumor endocrine diseases. Supported areas include classical or non-classical endocrine tissue function and pathogenesis, metabolic disorders, clinical malnutrition, and therapeutic treatment for endocrine diseases. The total application number increases by 12.23% in 2019 relative to 2018, but the distributions of major research areas remain unchanged. The majority of the proposals (45.40%) are still centered on diabetes and diabetes-related diseases, followed by the projects investigating energy metabolism/obesity (19.17%), bone disease (12.21%) and thyroid diseases (4.98%). In contrast, there are few proposals on water/electrolyte metabolic disorders, acid-base imbalance, amino acid metabolic abnormality, aberrant adrenal gland development and/or structures, thyroid or parathyroid transplantations, or dysregulation of calcium-phosphorus metabolism. These minor areas will continue to be emphasized and considered preferentially or funded in the future. Similarly, research on clinical discoveries, new clinical problems, and innovative approaches/designs will be encouraged.

Ophthalmology (H12), Otorhinolaryngology Head and Neck Science (H13), Oral and Craniomaxillo-Facial Science (H14)

This section mainly supports non-neoplasm diseases of related fields. Ophthalmology, mainly supports researches that focus on inflammatory, immune related, hereditary, as well as degenerative and neo-vascularized eye diseases. Among the proposals received in 2019, fundus diseases remained to be the most concentrated area, accounting for 33.81% of all applications, followed by corneal diseases (16.60%), glaucoma, optic nerve and visual pathway related diseases (15.09%) and optometry diseases (9.95%). Diabetic retinopathy, retinal/choroidal neovascular diseases, refractive error and age-related macular degeneration remain to be the hot topics of ophthalmic research. Otolaryngology Head and Neck Science mainly supports the study of new technologies and new methods for non-neoplastic diseases and functional reconstruction caused by abnormal regional structure and function. Head and Neck Science focused on hearing abnormality and balance disorders (40.44%), diseases of the anterior skull base (27.78%), diseases of the throat and neck (9.82%), genetic and development-related diseases of Otorhinolaryngology (8.79%) in 2019. Hearing related diseases and balance disorders as well as their therapeutic interventions will continue to be key issues in otology, which include genetic and molecular mechanisms underlying the pathogenesis for various types of deafness and the signal pathways related to hearing impairments. Pathogenesis of rhinitis and sinusitis, and its immunotherapy will be hotspots in the field of rhinology. Proposals focusing on respiration disorders, parathria and functional repair will be encouraged. Proposals for throat diseases will be encouraged to focus on laryngopharyngeal reflux. Research on the mechanism and intervention of auditory development and degeneration, tinnitus, acoustic sensitivity, vertigo and olfactory disorder is an important research direction, which will be funded continuously. Artificial intelligence, new imaging technology, biomaterials, biomechanics, 3D printing technology, mathematical algorithms and other fields of cross-cutting research began to attract much attention. The reconstruction techniques of otorhinolaryngology-related dysfunction such as nerve injury, olfactory disorder, respiratory disorder, dysphonia and swallowing disorder need to be paid more attention.

In areas of oral and craniomaxillo-facial science, there were more proposals on the periodontal and oral mucosa diseases, accounted for 20.15% of total proposals in 2019, followed by oral and maxillofacial tissue biomechanics and biomaterials (14.40%), as well as repairing and correction of tooth defect, loss and dental malformation (13.54%). The studies in osteogenesis, applications and mechanisms of odontogenic stem cells and exosomes, tissue biomechanics and biomaterials were hot fields.

Division II does not support researches on drug design and pharmacology. Please submit the related proposals to Division IX of Health Sciences (H30, H31). Proposals on the male reproductive system and male sexual dysfunction are not included in code H05, so please submit related proposals to Division IV (H04). It is specially noted that the proposals on teeth repair and implant material should use code H1409, and the proposals on craniofacial bone, cartilage tissue in the field of oral medicine should use code H1402. Other proposals related with characters of oral orthodontic and repair should submit to code H1408. Division II does not support cancer research. All applications on cancer research in those areas please refer the general introduction of proposal guidance from the Department.

Division III of Health Sciences

The Division provides financial support primarily for basic research in the areas of neurological diseases, psychiatric disorders, and geriatrics.

Neurological Diseases and Psychiatric Disorders (H09)

Under this code, the Division offers a wide range of funding opportunities for both basic and applied research on the etiology, pathogenesis, diagnosis, treatment, and prevention of various non-neoplastic diseases of nervous system. The Division provides research funding for common neurological disorders (e.g., cerebrovascular diseases, cognitive dysfunction, neurodevelopmental disabilities, injury and repair of brain and spinal cord, neurodegenerative disorders, epilepsy, pain and analgesia), as well as rare nervous system diseases. The Division also supports diagnostic, pathogenic and therapeutic research on inherited metabolic, autoimmune and infectious diseases in the nervous system. In addition, the Division encourages research aiming at etiology and clinical investigations on comorbidity of neurological diseases and psychiatric disorders.

In recent years, funded projects in the field of neurology were predominantly focused on cerebrovascular diseases, cognitive dysfunction, injury and repair of brain and spinal cord, pain and analgesia. In 2019, there have been significant increases in the number of applications for research on glia, RNA, pyroptosis, autophagy, and exosomes in neurological diseases. However, most of the applications were follow-up studies and/or lacked originality. The Division promotes and prioritizes to support key scientific issues which are found in clinical problems and clinical cohort studies, and original researches performed with advanced methods. The Division will continue to fund studies on rare neurological hereditary diseases using genetic techniques, especially studies of individualized diagnosis and treatment based on molecular typing and its mechanism research in future. At the same time, studies using animal models such as non-human

primates, drosophila, or zebrafish, etc., will be encouraged. Studies in cerebrovascular diseases require standard protocols of clinical research, and will highlight basic research around clinical concerns, especially early intervention for neurovascular injury, revascularization, functional recovery, and application and effects of precise diagnosis and treatment in acute stroke and neurotraumatic patients. Research on the mechanisms underlying pain, especially the mechanisms, transformation and intervention of chronic pain, need to be strengthened through the collaboration of basic and clinical studies. Research on neurological and psychiatric diseases and disorders of the nervous system in children has been an ongoing concern of the Division, but the research in this field in China is relatively weak. Related research in this field will be encouraged to carry out. In addition, the Division will work to balance its support among applications from neurology, neurosurgery, and psychiatry, as well as related fields such as pediatrics and anesthesiology. Clinicians and researchers in basic neuroscience are encouraged to apply jointly for collaborative funding to carry out significant multifaceted investigations.

One of the defining characteristics in the spectrum of modern human disease is the rapidly increasing prevalence of psychological and psychiatric diseases. In order to achieve early detection, objective diagnosis, and targeted treatment, the core problem in these fields is to identify and/or classify the biological bases associated with specific disorders, and to elucidate the etiology and pathogenesis. Compared with research funding requests from previous years, most of the applications in 2019 remained focused on depression and schizophrenia, though there has been a mild increase in applications for studies of psychiatric disorders in children and adolescents, neurosis, autism and stress-related disorders, organic mental disorders, sleep disorders, rhythm regulation, and psychological measurement and evaluation of mental illness, etc. Despite the growing need, the number of applications that focus on personality disorders and psychological crisis intervention remained very low. In the future, research on the role of interaction between genetic and environmental factors in the development of mental disorders should be strengthened, potential causes and intervention targets should be discovered, and in vivo biological markers that can monitor the occurrence, development and prognosis of psychological disorders and mental illness should be established, psychological and behavioral inspection techniques to achieve early detection and diagnosis of psychological disorders and mental illness should be optimized. Furthermore, in order to reduce the incidence of mental disorders in our population, much more attention should be paid on the early intervention and treatment through medicinal or non-pharmacological means.

Gerontology (H25)

The funding scope under this code mainly covers studies on the pathophysiological mechanisms of aging and aging-related diseases. The Division encourages research on pathophysiological changes during aging and their effects on organs, tissues and cells. Common mechanisms of various diseases related to the aging process are encouraged. The studies are also encouraged that exploring the effects of factors such as genetics, metabolism, damage, stress, and inflammation on organ and tissue aging and occurrence of aging-related diseases, regulation of stem cell senescence and its association with organ function and maintenance, new techniques and methods in aging study, and molecular mechanism of anti-aging approaches for healthy aging including calorie restriction, exercise, and small molecule drugs, etc.

Applications for senile diseases in organs or systems that are not related to the aging mechanism will not be funded. For such projects, please select the application code of the corresponding system. The Division does not provide funding for research concerning tumors. Please refer to the General Description section of proposal guidance from the Department.

Division IV of Health Sciences

The Division mainly supports basic, translational, and clinical research in the areas of reproductive system/perinatal medicine/neonatal and medical immunology.

Reproductive System/Perinatal Medicine/Neonatology (H04)

This section mainly supports basic research on the structure/function/development abnormalities of the reproductive system, injury and repair, inflammation and infection, the endocrine abnormalities and related disease, hereditary reproductive diseases and other non-neoplastic reproductive system related diseases, germ cell occurrence and fertilization, embryo implantation and fetal development, prenatal diagnosis, placental structure/function and development abnormalities, pregnancy and pregnancy related diseases, neonatal related diseases, mammary gland structure/function and development abnormalities, contraceptive/birth control and termination of pregnancy, female infertility and assisted reproduction, reproductive medicine engineering and the related research about developing new diagnosis/treatment technologies in the areas of reproductive system/perinatal medicine/neonatal related diseases.

Key research areas are as follows: establishing new characteristic research systems and multidisciplinary technology platform (i.e., targeted molecular therapies, *in vivo* tracking therapies and primate/other large animal models) to study the molecule and cell basic of human genetic and developmental diseases, the gametogenesis and the regulation of reduction division, the regular rule and abnormalities of human sperm-ovum recognition and fertilization, the regular rule and abnormalities of embryonic stem cells and early embryo development, the physiology regulation of pregnancy establishment/maintenance and the pathomechanism of related diseases, fertility preserve, the remodeling of germ cells, reproductive tissues, organs, including artificial gametes, uterus and placenta; exploring the new mechanisms of dysgenesis diseases; the study about pathogenesis and early diagnosis/treatment of congenital malformation, congenital metabolic diseases, single/poly gene genetic diseases and chromosomal disorders based on the superiority of Chinese genetic and disease resources; the research about assisted reproduction and related safety evaluations based on novel advances in biomedicine; the basic and applied basic research for treatment of reproductive system diseases applying the novel techniques such as stem cell cultivate and directional differentiation, and the novel advances in tissue materials engineering etc.; the research about the effect of in/out utero environment on the pregnancy outcome and descendant health; the basic/applied basic research and translational clinical studies on reproductive system/perinatal medicine/neonatology related areas using real-time imaging techniques, advanced sequencing and histology or other new technology, etc.

In 2019, the applications and funded projects were more focused on the following

areas: pregnancy and pregnancy associated diseases (H0420), the female reproductive endocrine abnormalities and related diseases (H0404), sperm development abnormalities and male infertility (H0424), endometriosis and adenomyosis (H0406), etc. The major problem of those projects is lack of pre-experiment which may not support the hypothesis and lack of discussion and exploration on the mechanism.

The following research directions suggest that applicants could pay more attention in the future: in the reproductive system related areas, it is recommended to focus on the puberty onset, the physiology and pathogenesis change of menopause and the occurrence of related diseases, hereditary diseases of male and female reproductive system, female sexual dysfunction, male reproductive system inflammation and infection, the abnormal of breast development or perinatal breast structure/function disorders, reproductive system aging, fertility preservation of tumor patients, etc.; in the perinatal medicine areas, it is recommended to focus on the study of the interactions between maternal nutrition/environmental/genetic factors and maternal diseases on pregnancy outcomes and descendant health; the risk of advanced parental age; the etiology and mechanism of recurrent pregnancy loss; the mechanism of parturition, the normal development of fetal organ systems and mechanisms of abnormal fetal organ defects as well as early diagnosis and treatment of congenital defects; in the neonatology related areas, it is encouraged to focus on the research of neonatal critical care, the neonatal chronic organ damage related diseases, etc.

Reproductive system/perinatal medicine/neonatology (H04) does not support the research related to tumor. For the project related to tumor, please refer to the general description section of proposal guidance of the Department.

Medical Immunology (H10)

This section mainly supports the basic research and translational research on the morphological, structural, functional and developmental abnormalities of immune cells, tissues, organs and systems, as well as the mechanisms of immune pathology, the mechanism of immune regulation and tolerance, immune prevention, immune diagnosis and immunotherapy of various diseases. The areas of the supported researches are as follows: the novel immune cell subtypes and the regulatory mechanisms in diseases, stem cells and immunity, manipulation of immune cells in vitro; epigenetic modification on immune cell differentiation and functions; the interaction between metabolism and immunity; the microbiota and mucosal immune regulation in the respiratory, digestive and urinary tract; regional immunization and diseases; extracellular vesicles and immune-related diseases; differentiations and functions of immune cells and the role in diseases; the mechanism of immune recognition and response in diseases; infectious diseases/inflammatory diseases/hypersensitivity diseases/autoimmune diseases/tissue injury and repair/immunodeficiency diseases/transplantation immunology and organ transplantation (such as long-term survival of organ transplantation patients with immune status and immunosuppressive diseases) and related basic and clinical research, new biological agents and vectors for immunotherapy, and the mechanism of effects of vaccines and adjuvants, etc.

In 2019, the majority of proposals mainly focused on autoimmune diseases (H1008), inflammation, infection and immunity (H1005), immune related factors and the body's immune response to diseases (H1003), organ transplantation and the transplantation immunity (H1006), immune recognition/tolerance/immune dysregulation (H1004), and

other research fields. The major problem of those projects is lack of pre-experiment which may not support the hypothesis and lack of discussion and exploration on the mechanism.

We suggest that applicants should pay more attention to the researches on genetic defects and phenotypic changes of primary immunodeficiency diseases, rare autoimmune diseases, neuro-endocrine immune regulatory mechanisms, mucosal immune structures and functions, mucosal immune tolerance and regulatory mechanisms in the future. The suggestions are included as follows: strengthening the research on the general principle of human immune-related diseases through the establishment of unique research systems and targeted technology platforms (such as the search for targeted molecular technology, the establishment of unique cell models and animal models, etc.); strengthening the interdisciplinary study of systematic immunology; perform in-depth studies on the immune informatics, immunomics, immune cell library and computational immunology in order to comprehensively understand the characteristics of immunology disease spectrum; strengthening the close cooperation between basic and clinical immunologists; taking advantage of Chinese disease resources and genetic resources; performing medical immunology research based on clinical practice; supporting the researches on disease-related immune systems and immune response by using new technologies, including high-resolution magnetic resonance imaging, real-time dynamic imaging, mass spectrometry and flow cytometry, and single-cell sequencing.

Division V of Health Sciences

The Division mainly supports basic research and basic clinical research in the fields of medical imaging, biomedical engineering, special medicine, and forensic medicine.

Medical Imaging and Biomedical Engineering (H18)

Medical imaging and biomedical engineering are characterized by interdisciplinary work between multiple subject areas, including medicine and mathematics, physics, chemistry, information science, engineering and materials, life sciences, and so forth. The Division supports researches in the areas of medical imaging, imaging information and biomedical engineering.

In the field of medical imaging, the Division mainly supports the research of medical imaging and its application to solve scientific problems related to medicine, including diagnostic radiology (magnetic resonance imaging, X-ray imaging and computed tomography imaging), ultrasound medicine, nuclear medicine, interventional medicine, and so forth. Meanwhile, explorative interdisciplinary studies in the scientific forefront of these fields, including the areas of multimodal imaging, molecular imaging, functional imaging, intelligent imaging, precision interventional medicine, theranostics, and translational medicine, are also encouraged. In addition, the researches involving new imaging techniques on the pathogenesis, early diagnosis and treatment, prognosis and therapeutic effect evaluation of various diseases, are also supported.

In the field of biomedical engineering, the Division mainly supports researches on medical engineering associated with disease prevention and early-warning, disease detection and diagnosis, disease treatment and rehabilitation, as well as the basic researches

related to regenerative medicine and nanomedicine, including processing/analysis of biomedical signals and images, biomedical sensors, biomedical photonics and magnetics, chips and micro-nano systems, biomedical system modeling/simulation, medical information system, rehabilitation engineering, neural engineering and brain-computer interface, treatment planning and navigation technology, robotics-assisted therapy, biomedical instruments and medical equipment, gene/drug delivery materials and transport systems, medical biomaterials, tissue engineering, regenerative medicine, artificial organ, and so on. Research on neural interface/regulation technology, bioMEMS, biomedical intelligent materials, 3D-printing and tissue/organ construction, medical virtual reality and augmented reality, cell and immune therapy, construction and application of tissue-like organs, medical artificial intelligence and big data mining in healthcare are particularly encouraged.

Special Medicine (H21)

Special medicine is aimed at the special health care needs from the population under different special circumstances, to solve various special medical problems, so as to provide theoretical and technological support for major national strategic needs. These studies will aim at understanding the physiological and pathological changes and related mechanisms, on the level of molecules, cells, tissues, organs and the entire human body. In this area, the Division mainly supports researches on the analysis of pathophysiological phenomena and the prevention/cure of diseases under special circumstances, such as aeronautic, astronautic or space, nautical, submersible, plateau, polar region and other special or extreme conditions. The Division encourages the application in medicine, physics, chemistry, biology, and modern engineering technologies to perform thorough and systematic work on specific medical issues and explore new technologies and methods to maintain and enhance brain function and physical function of the body under special environmental conditions. Interdisciplinary studies within special medicine, or between special medicine and other natural sciences are also supported.

Forensic Medicine (H23)

In the field of forensic medicine, the Division mainly supports the researches on resolving the medical problems in the judicial practice with the studies of human body and other relevant human biological samples. The funding fields mainly include the identification of death cause, the estimation of postmortem interval, mechanism and identification markers of stress injury and death, mechanism and assessment of body damage caused by environmental pollution, the pathophysiological changes caused by abuse of and dependence on drugs and poisons, detection technologies for poisons and their metabolites, the forensic evidence associated with the mechanism of injury and damage, the estimation of wound age, the identification of the level of disability and loss of the working ability, the objective evaluation of the legal capacity of people with mental disorders, the determination of individual characteristics, individual identification from difficult samples, paternity identification, identification of the tissue origin and ethnic origin, etc. Systematic research in the above aspects using the theories and techniques of physics, chemistry, biology, medicine, legal science and informatics, and so forth, is encouraged. Interdisciplinary work between forensic medicine and medical imaging, biomedical engineering, and other disciplines is also supported.

In 2019, there were in total 1,703 applications in the areas of medical imaging, biomedical engineering, special medicine and forensic medicine, and the success rate was 15.09%. In the fields of medical imaging, there was a significant increase in the number of applications in MRI (H1801, H1802 and H1803) and ultrasound (H1805), but tracking research work took the majority. For biomedical engineering, the application number increased significantly in processing and analysis of medical imaging data (H1809) and nanomedicine (H1819). Researches relating to key clinical problems and techniques will be encouraged and interdisciplinary work will further be strengthened. The application number and distribution in the fields of special medicine and forensic medicine did not show obvious changes. To further promote the rapid development of medical imaging, biomedical engineering, special medicine and forensic medicine disciplines, the Division will continue to encourage multidisciplinary research and cooperation between scientists with different scientific backgrounds, with more emphasis on original research work and researches involving clinical application and translation. At the same time, preferential supports will be provided to young investigators. **The Division will fund 1 proposal with high-intensity funding respectively in the field of aerospace medicine in special medicine and in the field of identification of complex genetic relationship in forensic medicine.**

The Division does not accept applications on radiation oncology or radiation prevention, which should be submitted to Division VII (H16) or Division VIII (H22) in the Department, respectively. The applications on pharmacology and drug administration should be submitted to Division IX (H30, H31) in the Department.

Division VI of Health Sciences

The Division supports basic research and clinical basic research in the fields of abnormalities and diseases of locomotor system, emergency and critical care medicine, trauma, burns, plastic surgery, rehabilitation medicine, medical pathogens and infection, as well as laboratory medicine.

Abnormalities and Diseases of Locomotor System (H06)

The Division mainly supports the research on the abnormalities in structure, function and development of the bone, joint, muscle and ligament, and the research in the etiology, pathogenesis, diagnosis, prevention and cure of the musculoskeletal diseases including the genetic diseases, the immune-related diseases, inflammation and infection, injury and repair, grafting and reconstruction, fatigue and recuperation, degenerative disorders, sports injury, deformity and correction, and non-neoplastic diseases. Meanwhile, the researches on the emerging scientific issues such as precise medicine and medical biomaterials development in musculoskeletal fields are highly encouraged. In 2019, the submitted proposals were mainly focused on the research fields in the musculoskeletal damage and repair (H0605), and the degenerative diseases of bone, joint and soft tissue (H0609). Research projects on intervertebral disc degenerative disease, osteoarthritis and biomaterials have been hot spots in this field. In contrast, research applications in musculoskeletal fatigue and recuperation filed (H0608) were still at quite low volume. The research projects focusing on the biological mechanisms in the interaction between locomotor system and other organ

systems based on the emerging medical phenomena and clinical problems are preferentially encouraged.

Emergency and Critical Care Medicine/Trauma/Burns/Plastic Surgery (H15)

The Division mainly supports researches on the pathophysiology, pathogenesis, diagnosis, treatment and prevention in the field of emergency and critical care medicine, trauma, burns, and plastic surgery. Key funding areas of emergency and critical care medicine include pre-warning, diagnosis and treatment, monitoring and evaluation, mechanisms of dysfunction of vital organs, as well as function support and protection. Key funding areas of trauma/burns/chimatlton include pathogenesis, treatment and prevention of complication, tissue repair, as well as functional reconstruction. Key funding areas of plastic surgery include wound healing and scar management, repair, regeneration and reconstruction against malformation and defect of surface tissues and organs. Meanwhile, the interdisciplinary research coupled with biomedical engineering, or AI is highly encouraged. In recent years, the researches on sepsis, organ injury, wound healing and regeneration are hot topics, while original research needs to be further improved. Therefore, researches on cardiopulmonary-cerebral resuscitation should be paid more attention.

Rehabilitation Medicine (H17)

The Division mainly supports the researches on the structure, function, activity and mechanisms in obstacle, rehabilitation evaluation, rehabilitation treatment and rehabilitation prevention caused by the diseases of musculoskeletal system, nervous system or other relevant organ/systems. At the same time, attention is paid to the mechanisms of physical factors on the body. It is conducive to the original basic research of rehabilitation assessment and treatment technology breakthrough to encourage interdisciplinary research with dysfunction as the core and rehabilitation needs as the guide.

Medical Pathogens and Infection (H19)

The Division mainly supports the researches on medical microbiology and parasites, including etiology, pathogenic biology, pathogenic mechanism of pathogens, mechanism of drug resistance and host immune response, epidemic characteristics of nosocomial infection, discovery and biological characteristics of pathogenic vectors, and so on. The genetic variation and evolutionary processes, drug resistance and the interaction with the host of the pathogen are the important scientific issues and research hot topics in pathogenic biology and infectious disease. The Division encourages original basic research on the above scientific issues, and encourages the development of related biomedical research on new and neglected pathogens.

Laboratory Medicine (H20)

The Division mainly supports researches on new target markers, new theories, new technologies and new methods for disease screening and diagnosis, treatment and prognosis evaluation. Key funding fields include discovery and identification of novel biomarkers, rapid and accurate laboratory medicine techniques and theories. The laboratory medicine researches on rare and hereditary diseases, interdisciplinary researches coupled with

chemistry, physics, biosensing and artificial intelligence (AI) are highly encouraged.

The Disciplines of **Abnormalities and Diseases of Locomotor System (H06)** and **Emergency and Critical Care Medicine/Trauma/Burns/Plastic Surgery (H15)** do not support the tumor-related researches, which should be referred to the funding area of Division VII (H16). **Rehabilitation Medicine (H17)** does not support projects without any direct correlation of rehabilitation mechanism, treatment and evaluation, solely on mechanism of the occurrence and development of diseases; please refer to other according codes. **Laboratory Medicine (H20)** does not support researches on solely clinical laboratory reference system and standardization, nor solely pathogenesis and regulation pathways of diseases. In addition, researches involving **highly pathogenic microorganisms** must provide evidence and commitment to biosafety facilities from the supporting unit or partner. **Any use of human or animal materials** in the study must provide an ethical approval certificate.

Division VII of Health Sciences

The Division mainly supports basic research and translational research in oncology.

Oncology (H16)

The Division provides major funding for the basic research on tumor initiation, development and outcome, including the etiology, pathogenesis, diagnosis, treatment and prevention of various tumors. The funding covers the following research areas: tumor etiology, tumor initiation, tumor genetics and epigenetics, tumor immunology, tumor prevention, tumor recurrence and metastasis, tumor stem cells, tumor diagnosis, tumor chemotherapy, tumor physiotherapy, tumor biotherapy, comprehensive treatment of tumors, tumor rehabilitation (including psychosocial rehabilitation) and new techniques for the tumor research system, as well as tumors in various systems/organs (except the hematologic and lymphatic systems) covering respiratory system, digestive system, nervous system (including special receptors), genitourinary system, breast and endocrine system, bone and soft tissue, head and neck and maxillofacial region, together with skin, body surface and other parts of the human body.

Cancer research involves different tissues and organs. On the one hand, it emphasizes basic research on the unsolved common problems of tumors, focusing on the molecular basis of tumor biologic behaviors such as cell proliferation, differentiation, metastasis, autophagy and apoptosis, aimed at exploring the mechanism and laws of tumorigenesis, tumor development, metastasis and recurrence, thus laying the foundation for tumor diagnosis, treatment and prevention. On the other hand, it highlights the distinct characteristics of tumors from various systems and organs, aiming to conduct the clinical practice of tumor management by carrying out translational research based on the observation and analysis of clinical phenomena as well as problems raised in clinical practice.

Proposals related to the common scientific questions of tumor should select corresponding application codes for tumor etiology, tumor initiation, tumor genetics and epigenetics, tumor immunology, tumor prevention, tumor recurrence and metastasis, tumor

stem cells, tumor diagnosis, tumor chemotherapy, tumor physiotherapy, tumor biotherapy, comprehensive treatment of tumors, tumor rehabilitation (including psychosocial rehabilitation) and new techniques for the tumor research system (H1601 to H1614). Proposals related to the distinct characteristics of tumors from specific systems/organs should choose application codes of corresponding systems/organs (H1615 to H1626). Application codes should be carefully selected in accordance with the scientific fields.

Oncology research is one of the most active fields in medical sciences. With the rapid development and integration of cell biology, developmental biology, genetics and immunology, cancer research has been focused on tumor epigenetics, tumor stem cells, tumor immunology, and tumor systems biology. Recently, research on cancer epigenetics has emerged as a rapid emerging field, especially the studies on RNA-involved epigenetic regulation in tumorigenesis and tumor progression. In the field of tumor microenvironment, studies on the interaction between tumor cells and the surrounding microenvironment have gained increasing attention, for it emphasizes not only the regulation of tumor cells' biological characteristics by the tumor microenvironment, but also the modification of microenvironment by tumor cells per se and various cancer therapies. As for studies on tumor metabolism, special interests have been aroused in the mechanisms of metabolic reprogramming of cancer cells and microenvironment, the association between specific metabolic patterns of tumor cells and their biological behaviors, the roles of metabolites, metabolic enzymes, and metabolic-associated molecules in tumorigenesis and tumor development, the crosstalk among different signaling molecules and its effects on tumor microenvironment and tumor immunity. The other proposals have also stressed the translational values of metabolic factors in regulating tumor biological characteristics. For example, studies exploring the effects and mechanisms of some agents regulating the metabolism of glucose, lipids and nuclear acids in tumor cells may provide experimental evidence for the new application of traditional drugs in cancer treatment. Additionally, the exploration of tumor stem cells is deepening and interpenetrating with other frontiers fields, which include molecular mechanisms underlying the stemness maintenance of tumor stem cells, abnormal metabolism of tumor stem cells, relationship between epithelial-mesenchymal transition (EMT) and tumor stem cells, formation and mechanisms of vascular mimicry, interaction between microenvironment and tumor stem cells, tumor dormancy, tumor heterogeneity, and therapy resistance, etc., Meanwhile, tumor chemoprevention has aroused increasing attention. By screening natural or synthetic compounds, new targets for cancer prevention were identified, which is of great significance to reduce the incidence of cancer and improve the survival chances of cancer patients. Moreover, psychological impact on tumor development has become a wide concerned issue. The immunological and neuroendocrine alterations caused by mental stress may play a role in the processes of tumor metastasis and therapy resistance. It could also be an important etiological factor in tumorigenesis. The development of new technologies and methods for cancer research, for example, the establishment of organoid models and related techniques, is also encouraged.

In recent years, the quality of proposals in the field of oncology research has been significantly improved, which is manifested by the solid preliminary experimental data, the well-reasoned scientific hypothesis, as well as the complete and thorough research contents. Proposals derived merely from literature reviewing without preliminary experimental data, or descriptive and correlative studies lacking in-depth mechanism exploration are declining

each year, and are also uncompetitive in gaining the approval of reviewers.

Applicants are encouraged to discover and refine scientific questions from preliminary research and clinical practice, and to systemically investigate the mechanisms of malignant tumors for translational research and clinical improvement of cancer diagnosis and treatment, as well as to develop new technologies and methods for cancer research. Integrated research proposals taking advantage of the clinical resources in China and studies focusing on common and frequently-occurring tumors in Chinese population are also encouraged.

Applicants should note that the proposals on tumor epidemiology should be submitted to the Division VIII of Health Sciences (H26), and proposals on hematologic and lymphatic system tumors should be submitted to the Division I of Health Sciences (H0818, H0819). Proposals related to the distinctiveness of tumor from specific systems/organs should carefully choose the application codes of corresponding systems/organs. Proposals submitted with the wrong application codes would be rejected.

Division VIII of Health Sciences

The Division supports basic researches in fields of skin and its appendages, radiomedicine, endemiology, occupational medicine, and preventive medicine.

Skin and its Appendages (H11)

The funding scope mainly covers the basic research in the abnormality of structure, function and development of skin and its appendages, as well as hereditary, immune-mediated and infectious skin diseases. Based on the analysis of project application and funding in recent years, the basic research on skin diseases has developed well, but the cross-cooperation with basic medicine, life science and other disciplines still needs to be strengthened. Studies on skin appendages began showing good momentum. Basic research on diagnostic and therapeutic technique and epidemiological research on skin diseases should be strengthened.

Radiology (H22)

Radiomedicine supports basic research on radiation injury and intervention, radiation toxicology and radiopathology, radiological hygiene and protection, and normal tissue damage and its prevention in tumor radiotherapy. In recent years, the funded projects mainly focus on radiological injury and radiopathology. Basic research on the early diagnosis and prevention of radiation damage should be further strengthened. The research of radiation medicine should strengthen the cross-study with physics, chemistry, basic medicine and life science.

Endemiology (H2401)

Endemiology supports basic research on the pathogenesis and prevention of natural focal diseases, biogeophysical and biogeochemical diseases, and special diseases related to occupation or lifestyle. The small quantity of the proposals recently indicates relevant

research has not got the attention it deserves. NSFC will continue to focus on the progress of endemic disease research.

Occupational Medicine (H2402)

This filed supports basic research concerning diseases due to exposure to occupational hazards. The application project should have the obvious occupation characteristic. Research is encouraged on the mechanisms of health injury caused by traditional and new occupational hazards.

Preventive Medicine (H26)

The funding scope covers the basic research in environmental health, occupational health, human nutrition, food hygiene and safety, maternal and child health care, children and adolescent health, toxicology, hygienical analytical chemistry, infectious disease epidemiology, epidemiology of non-communicable disease, epidemiological methods and medical statistics. It is encouraged to carry out interdisciplinary and integration of disciplines and expand discipline areas and research directions. Population-based data accumulation and collection and analysis of biological samples are encouraged.

In the scope of **skin and its appendages (H11)**, oncology-related researches are not accepted, which should be applied to Division VII (H16). Applications involved in cancer radiotherapy are not accepted in **Radiomedicine (H22)**, and may refer to categories under Division VII (H16); Applications for medical imaging and radiological diagnosis are not included, and may refer to categories under Division V (H18). Applications of disease projects without geographical features are not accepted under the category of **Endemiology (H2401)**. For related applications, please select the application code of the relevant disease system. **Food Hygiene (H2604)** does not support the study only on food processing, and relevant divisions of Life Science (C20) are recommended for application on food processing. Applications for studying gynecologic diseases and pediatric diseases are not accepted in the field of **Maternal and Child Health Care (H2605)** and **Children and Adolescent Health (H2606)**. The former may refer to categories under Division IV (H04), and the latter depends on the classification of body system. Applications on drug toxicology are not supported by **Toxicology (H2607)**, and applicants may refer to categories under Division IX (H31). Researches on clinical test are not included in the category of **Hygienical Analytical Chemistry (H2608)**. Applicants may refer to categories under Division VI (H20). Pharmaceutical analyses are also excluded from H2608 and applicants may refer to Division IX (H30). The category of **Epidemiology (H2609, H2610)** does not fund purely laboratory research projects that are not population-based. **Epidemiology of Non-communicable Disease (H2610)** and **other issues in Preventive Medicine (H2612)** do not accept applications for health economics and policy, hospital administration, and other health management-related projects. Applicants may refer to related categories under the Department (G04). **Epidemiology of Infectious Diseases (H2609)** and **other scientific issues in Preventive Medicine (H2612)** do not fund applications for non-population-based studies of pure etiology, treatment and prognosis. Applications should be made under other relevant codes of the Department of Health Sciences.

Division IX of Health Sciences

The Division mainly supports the basic and clinical basic researches in the fields of materia medica and pharmacology for diseases therapy..

Materia Medica (H30)

The Materia Medica provides funding for researches in a variety of categories, including synthetic medicinal chemistry, natural medicinal chemistry, microbial drugs, biotechnological drugs, marine drugs, special drugs, drug design and pharmaceutical informatics, pharmaceuticals, pharmaceutical materials, drug analysis, and drug resources. It develops the multidisciplinary basic researches on the discovery of innovative drugs and their druggability.

The funding on the synthetic medicinal chemistry focuses on the researches on active molecules based on new targets, novel mechanisms and new structures. The funding on the natural medicinal chemistry, microbial drugs, and biological medicines (including therapeutic antibodies, vaccines, proteins, nucleic acids, saccharides, and cells, etc.) supports researches on the discovery of candidate drugs from animals, plants, and microbes or generated via new biotechnology and methods, and the exploration on the new theories, new techniques, and new approaches. The funding on the marine drugs encourages the chemical, pharmaceutical, and ecological studies on rare marine organisms and deep-sea microbes. The funding on the special drugs supports the researches on drugs acting under aerospace, deep-sea, radiology, military, and special environments, etc. The funding on the drug design and pharmaceutical informatics supports the researches in the fields of new theories and approaches for drug design and druggability prediction, and on the discovery of lead compounds for new targets. The funding on the pharmaceuticals supports the researches on physical pharmaceuticals, biopharmaceuticals, molecular pharmaceuticals, industrial pharmaceuticals, including the studies on new drug delivery and release systems, formulations modeling, and new theories, new techniques and new approaches; design of delivery systems for nano-drugs and the druggability. The funding on the drug materials mainly provides supports for the basic researches on the design, construction, in vivo process, and safety evaluation of new pharmaceutical excipients and medicinal carriers. The funding on the drug analysis supports the creation of new analytical technologies and methods for new ingredients, drug targets, effector molecules and their interactions, being available in solving analysis related scientific issues in Materia Medica and Pharmacology; and exploration on the integration of various Omics related new technologies with researches on critical scientific issues as drug targets and biomarkers. The funding on the drug resources supports studies on the important scientific issues such as discovery and excavation of new medicinal resources, sustainable use of resources, and resource conservation.

Pharmacology (H31)

This funding opportunity aims to support the researches on discovery and confirmation of new drug targets, including those on action mechanism and/or drug resistance, drug metabolism and pharmacokinetics, drug toxicology, and clinical

pharmacology of therapeutic drugs, drug candidates and bioactive substances.

Pharmacology focuses on the study of etiology of human diseases using techniques and methods of modern life science, to reveal the molecular mechanisms and targets of drug action.

The application for pharmacology projects should lay more emphasis on discovery and confirmation of new drug targets, specificity of pathogenesis and sensitive molecular markers; discovery and mechanisms elucidation of new characteristics of drugs or bioactive substances; strategies to overcome drug resistance, and in-depth researches on new targets, new drugs and new patterns for drugs combination by systems biology, epigenetics and bioinformatics. More emphasis should also be placed on the basic researches on network regulation of complex diseases, drug intervention mechanism and new treatment regimes, and researches on new models, new methods and new technologies that highlight the characteristics of pharmacology.

The researches on drug metabolism and pharmacokinetics should aim to establish new approaches and models; strengthen the integrated researches with drug targets, efficacy, toxicity and clinical rational drug use; strengthen the researches on the regulatory mechanism of nuclear receptor and enzymes/transporters for drug metabolism; strengthen the kinetics study on the combination of drugs and target molecules in target tissues/organs/cells; focus on the systematic study of human intestinal micro-ecology on drug absorption, metabolism, efficacy and drug interaction; focus on the study of the interactive regulation of metabolic disposal between drugs and endogenous active molecules.

Clinical pharmacological research should tend to explore the rule of interaction between drugs and human body and investigate the individualized medication, especially concern the problems associated with clinical medication and the rational medication for special groups (such as children, pregnant women, high-risk populations, etc.) to present unique characteristics.

The researches on drug toxicology should strengthen the exploration of molecular mechanism, intervention strategy of drug toxicity, toxicity mechanism of metabolites, and new model and new method for drug safety evaluation.

Priority will be given to applications for innovative basic researches and systematic in-depth researches. Given the significant role of translational medicine in improving the clinical application, the basic researches on innovative new drugs, clinical therapeutics and diagnostics orientation should be strengthened, in the hope that new drug therapeutic targets and diagnostic biomarkers will be discovered in the process of exploring the pathogenesis and development of diseases, and that academic and experimental basis can be accumulated for developing innovative new drugs, new treatment schemes and diagnostic regime and agents with independent intellectual property rights.

The regular researches oriented for approval of new drugs (including pharmaceutical techniques, pharmacodynamics and safety assessment) are not accepted in this division. For innovative basic researches with prospects for new drug development, the applicants should provide chemical structures or backbone of candidate compound, simultaneously strengthen intellectual property protection and handle properly the relationship between project application and confidentiality. Some key concepts or technologies like the structure of the compounds, if inconvenient to be revealed in the application document, can be directly mailed to our division through

confidential files and at the same time state specifically in the proposal. If the research is related to the project of the previous tutor, or is a follow-up research on a previous postgraduate project, the applicant should receive the approval of the previous tutor, and attach an approval letter from the previous tutor in the document.

Division X of Health Sciences

The Division identifies its role as advancing the theories of Traditional Chinese Medicine (TCM) including traditional medicine of various ethnic groups (the same below) while highlighting advantages of the heritage. It provides funding to basic research and clinic-based research programs in TCM, Chinese Materia Medica (CMM) and Integrated Chinese and Western Medicine (IM).

Traditional Chinese Medicine (H27)

Funding areas: (1) Fundamental theories of TCM: Essence of Viscera, Qi-Blood-Body Fluid, Body Constitutions, etiology and pathogenesis, basis of TCM Syndromes, Therapeutic Principles and Methods, Prescriptions and Diagnostics in TCM; (2) Basic research in clinical medicine: Internal Medicine, Surgery, Orthopedics and Traumatology, Gynecology, Pediatrics, Ophthalmology, Otorhinolaryngology, Stomatology, Geriatrics, and Health Preservation and Rehabilitation in TCM; (3) Acupuncture and moxibustion, Tuina and massage: Meridians, Collaterals, and acupoints, acupuncture, moxibustion and Tuina and massage; (4) ethnomedicine of minority.

Chinese Materia Medica (H28)

Funding areas: (1) Chinese Materia Medica: Resourceology, Identificology, pharmacodynamics substance, quality evaluation, processing, pharmaceutics of CMM, and theories in the properties of Chinese herbs; (2) Pharmacology of TCM: Neuropsychopharmacology, cardiovascular and cerebrovascular pharmacology, anti-tumor pharmacology, endocrine and metabolic pharmacology, anti-inflammatory and immune pharmacology, antiviral and anti-infective pharmacology, respiratory pharmacology, digestive pharmacology, urinary and reproductive pharmacology, pharmacokinetics, and toxicology in CMM; (3) Ethnopharmacy of minority.

Integrated Chinese and Western Medicine (H29)

Funding areas: (1) Fundamental theories of IM; (2) Basic clinical research of IM; (3) Methodological or technical innovations in TCM research.

In recent years, the funded projects in the field of TCM, CMM, and IM have exhibited the following features: (1) based on TCM theories and clinical effects of TCM, and conducted from both macroscopic and microcosmic levels, the projects explored the holistic rules of human life and the integrating regulatory effects of TCM; (2) through introducing cutting-edge theories, methods and techniques exerted in the modern medical science and other sciences, incessant innovation of research thoughts and methods, dynamic integration of TCM and new emerging disciplines, the projects have particularly been promoting the TCM development; (3) these projects have also paid more attention to the

clinic-based research of functional disorders, age-associated diseases, metabolic diseases, immunological disorders, and viral infectious diseases treated by TCM and/or Ethnomedicine of minority and the underlying mechanisms.

The Division's top priority is to support the best projects that discover the key scientific issues of TCM, the inner-connections between TCM and biomedical sciences. The Division will continue to encourage the integration of different disciplines, focus on scientific issues in this field, particularly original research using multidisciplinary concepts, methods, techniques and approaches under the guidance of TCM, and emphasize normative and rational applications of science and technology as well as methods, and thus promote the inheritance, insistence, development, and innovation of TCM fundamental theories.

In light of the current TCM research, the Division in 2020 will continue to value and support researches on the followings: biological basis of Visceral Manifestation Theory (visceral function), animal models of combining disease and syndrome, regularity in herbal combination of classical formulas, pharmacodynamic material basis, combination of macrocosmic and microcosmic syndrome, mechanisms for therapeutic effects of TCM on preponderant diseases, methodology in clinical therapeutic evaluation of TCM, specificity of acupoint, regularity in acupoint formulas and acupuncture manipulation, mechanisms underlying the therapeutic and preventive effects of acupuncture, Tuina and rehabilitation on diseases; methodology of big data mining based on ancient documents and clinics; basic theory, diagnostic and therapeutic regularity, mechanisms for the effects of prevention and treatment of integrative TCM and western medicine on major, refractory, rare, emerging and infectious diseases, specifically like cancer, cardio-cerebrovascular disease, diabetes mellitus, infectious diseases, senile dementia and antibiotic resistance, etc.; innovative techniques and methods in TCM and CMM researches; ecological planting, natural farming, bionic cultivation of CMM, substitute of rare or endangered CMM, CMM identification techniques and methods, methods and mechanisms for quality evaluation of CMM, regularity and mechanisms of CMM processing and preparation, technical principle of CMM preparation and new formulation with overall efficacy, CMM properties, material basis for effects, physiological disposition and the related regulation, pharmacological effects and mechanism of CMM, CMM toxicity, correlation between toxicology and toxicity-effect, ethnomedicine such as Mongolian medicine, Tibetan medicine, Uyghur Medicine, Dai medicine, Korean medicine, Zhuang medicine and so on.

The Division will not support any proposal which is not associated with TCM and Ethnomedicine. Any pharmaceutical proposal which is not associated with TCM or Ethnomedicine should be submitted to the division of Pharmaceutics (H30) or Pharmacology (H31). Medical proposals which are not associated with TCM or Ethnomedicine should be submitted to other medical divisions (H01 to H26). Any proposal without natural science feature will not be supported. Any proposal containing TCM or acupoint formulas which cannot be shown openly should be sent to the Division directly by confidential mails, and specifically explained in the proposal, or it will be unacceptable.

Key Program

The Key Program supports researchers engaged in basic research to conduct in-depth, systematic and innovative research in directions with sound research basis or where new growth points of scientific disciplines might emerge, so as to promote disciplinary development and breakthroughs in important areas or scientific frontiers.

Key Program projects should follow the principle of limited objectives, limited research scope and focused goals, pay attention to intercrossing disciplines, make effective use of existing major scientific research bases at national and ministerial levels, and conduct substantive international cooperation and exchange.

An applicant must meet the following qualifications:

- (1) With the experience of undertaking basic research projects;
- (2) Have senior professional position (title).

Post-doctors, full-time postgraduate students and people without host institution or whose institutions are not registered at NSFC are not qualified for application as PI.

Key Program lists its research areas or directions in the *Guide*. Applicants should prepare proposals in accordance with the *Guide* and the outline of application, identify scientific issues within the research fields and directions, define project title according to research content, and avoid using research area as project title.

In general, one Key Program project is conducted by only one research institution. If necessary, two institutions at maximum are allowed to work as collaborators. The funding duration of a Key Program project is 5 years.

Special notice to the applicants:

(1) In 2020, for the Key Program, NSFC implements the category-specific application and review based on 4 natures of science topics. When preparing the application for Key Program, the applicant should select the nature of science topic based on the key scientific issues to be solved and the research content, and clarify the reasons for choosing the science feature concerned. In the case of multiple science features, the applicant should choose the science feature that best matches, most focused

and characteristic. NSFC shall organize respective review by experts based on the science nature the applicant chooses.

(2) In 2020, for Key Programs, paperless applications are carried out. In process of the submission, the host institution shall only confirm the online application version and the attachments, without having to submit a paper form application. Once approved, the signature and seal page of the application form should be submitted at the time of submitting the project plan. The signature and seal information should be consistent with that of the electronic application.

In 2019, NSFC funded 743 projects under the Key Program, with a total funding of 2.2184 billion yuan, and the average funding for direct costs is 2.8957 million yuan per project. The funding of the Key Program in 2019 is shown in the table below.

Funding of the Key Program Projects in 2019

Unit: 10,000 yuan

Departments	No. of applications	Awards				Success rate (%)
		No. of awards	Funding for direct costs	Average funding for direct costs	Share of NSFC total funding for direct costs (%)	
Mathematical and Physical Sciences	334	90	28,090	312.11	12.66	26.95
Chemical Sciences	321	75	22,500	300.00	10.14	23.36
Life Sciences	635	115	34,500	300.00	15.55	18.11
Earth Sciences	555	98	29,500	301.02	13.30	17.66
Engineering and Materials Sciences	595	105	31,500	300.00	14.20	17.65
Information Sciences	384	105	31,500	300.00	14.20	27.34
Management Sciences	143	30	7,080	236.00	3.19	20.98
Health Sciences	758	125	37,170	297.36	16.76	16.49
Total or average	3,725	743	221,840	298.57	100.00	19.95

Please refer to the respective sections in each department for research areas and orientations of the Key Program projects.

Department of Mathematical and Physical Sciences

In 2019, the Department announced 123 areas for Key Programs, and received 334 applications. 90 projects were funded with direct cost funding of 280.90 million yuan and about 3.1211 million yuan per project. The success rate was 26.95%.

In 2020, the Department plans to fund about 90 Key Program projects. The average direct cost funding will be about 2.6 million yuan per project for mathematics, and 3.4 million yuan for mechanics, astronomy, physics I and physics II. The funding will be 5 years. Please provide with the proper application code when applying.

To ensure the high quality of projects, applicants are required to have presided over national projects, with relatively large research teams.

Please give the proposed research directions in the note section of the application form, otherwise the application will be not accepted.

In 2020, the main research directions are as follows:

- 1. Several problems in arithmetic algebraic geometry**
- 2. Analytical method in modern number theory**
- 3. Basic mathematics in modern cryptography**
- 4. Algebraic structure and representation**
- 5. Geometry and homology method in algebra**
- 6. Algebraic and transcendental method for algebraic clusters**
- 7. Convex geometry analysis**
- 8. Riemann geometry and related theory**
- 9. 3D manifold and geometric group theory**
- 10. Modern theory and application of multi complex variable functions**
- 11. Real variable theory and application in harmonic analysis**
- 12. Modern variation method and applications**
- 13. Non exchange analysis, geometry and related theory**
- 14. Geometric structure and complexity of dynamical systems**
- 15. Invariant and asymptotic properties of differential equation**
- 16. Mixed and degraded partial differential equation theory**
- 17. Modeling and analysis of applied partial differential equations**
- 18. Geometric method in topological quantum field theory**
- 19. Riemann-Hilbert problem in integrable system**
- 20. Differential system in random environment**
- 21. Statistical analysis in complex structures**
- 22. Statistical basis of causality analysis**
- 23. Statistical analysis of complex structured data**
- 24. Mathematical theory and method of AI**
- 25. Optimization theory and method**
- 26. Problem driven optimization modeling and efficient algorithm**
- 27. Mathematical method in modern control theory**

28. Mathematical theory and algorithm in new generation of information technology

29. Mathematical theory and application in biology and medicine

30. fractal geometry theory and analysis

31. Theoretical computer science and uncertainty mathematical theory

32. Mathematical method and theory in social economic systems

33. Theory and application of combination mathematics

34. Key problem, algorithm and application in graph theory

35. Basic algorithm and theoretical analysis

36. Computable modeling and simulation

37. problem driven science and engineering computation

38. algorithm realization and software

39. Theory and method of physical mechanics

40. Theory and experiments of multi degree of freedom nonlinear system dynamics

41. Modeling, analysis and control of complex system dynamics

42. Vibration characteristics of complex structures and advanced control method

43. Mechanism of damaging and strength of materials and structures

44. Solid deformation and constitutive relations

45. Mechanical theory and experimental method for new materials and structures in multi-field environment

46. Soft matter mechanics and flexible structure design method

47. Structural optimization theory and design method

48. Light material and structure mechanics and theory and method of mufti-functional design

49. Unsteady complex flow mechanism and control

50. Hydro dynamics of marine vessels and structures

51. Aerodynamics and thermodynamics of aircraft

52 Theory and method of bionic fluid dynamics

53. Bio-mechanical problems in human health and medicine

54. Multi-scale multi-field coupled mechanical bio-problems

55. Mechanical behavior of materials and structures in dynamic loading conditions

56. Mechanism of energy release and damage in energy containing material explosion

57. Methods and high performance computation software

58. New methods and technology in experimental mechanics

59. Theory and method of fluid solid coupling mechanics

60. Key mechanical problems in environmental evolution and catastrophe

61. Key mechanical problems in advanced manufacturing

62. Key mechanical problems in high end manufacturing

63. Key mechanical problems in extreme conditions

64. Key mechanical problems in new energy and resources areas

65. Basic mechanical problems in propulsion system

66. Nature of dark matter and dark energy and physical process in evolution of

cosmos**67. Galaxy evolution and impact of surrounding environment****68. Structure, formation and evolution of large mass black holes and active galaxies****69. Structure, composition, integration and evolution of the Galaxy****70. Formation of molecular cloud and stars, internal structure and evolution of stars and high energy process of dense celestial bodies****71. Planet system formation, exploration and dynamics****72. Solar atmosphere, magnetic field and activities****73. High precision astronomical measurement and time frequency****74. Solar system dynamics and celestial bodies****75. Measurement, determination of precise orbit and dynamics of fast moving celestial bodies****76. Optical and inferred key technology****77. Key technology of radio astronomy****78. Key technology for space astronomy****79. Quantum information and quantum computation****80. Physics of advanced functional materials and devices****81. Surface and interface physics****82. Physics of confined quantum systems****83. Strong correlated system and superconductivity****84. Quantum self-spin liquid****85. Physics of soft matter and biophysics****86. Computational solid state physics and method****87. Topological matter state****88. Solid magnetism and multi field regulation****89. Physic in extreme conditions****90. Extrinsic semi-conductor physics****91. Structure and impact dynamics of atoms and molecules****92. Physics of atoms and molecules in outer field****93. Cold atoms and molecules****94. Precision spectroscopy and precision measurement****95. Ultra-fast, ultra-strong light physics and interactions with matter****96. Optical field regulation and interference control****97. Physics in photo electric thermo-acoustic transfer process****98. Photonics and optical physics in complex media and structure****99. Phononics, acoustic field regulation and acoustic physics in complex media****100. Complex acoustic field and acoustic information processing****101. Acoustic sensing physics and devices****102. Frontier problems in basic theory of quantum physics****103. Frontier problems in basic theory of statistical physics and physical systems****104. Frontier problems in theory of gravitation, cosmology and dark matter****105. Precision verification of standard models and new physics beyond standard models****106. New method in quantum field, high precision computation and**

measurement in particle physics

- 107. Studies on the internal structure of hadron and strong interactions**
- 108. Quantum chromo dynamics and quark gluon plasma**
- 109. Novel structure and decay spectroscopy of unstable nuclei**
- 110. Heavy ion nuclear physics, nuclear astrophysics and laser nuclear physics**
- 111. New techniques of neutron physics, reactors and scattering**
- 112. Applied basic research in the application of nuclear technology in new materials and energy**
- 113. Basic research on nuclear technology and applications in life and environmental sciences**
- 114. Studies on key problems in radiation physics and radiation protection**
- 115. Accelerator physics and its advanced technology**
- 116. Mechanism, method and technology of radiation detection**
- 117. Particle detection mechanism and method based on large facilities**
- 118. Technology and method of nuclear electronics**
- 119. Inertia confined fusion and plasma physics, experiments and diagnosis**
- 120. Magnetic confined fusion plasma physics and advanced experimental and diagnosis technology**
- 121. Low temperature plasma physics, experiment and diagnosis**
- 122. Studies on advanced technologies and experimental methods of synchrotron radiation and free electron laser**

Department of Chemical Sciences

In 2019, the Department funded 75 Key Program projects with 225 million yuan and 3 million yuan of average funding per project (direct cost). The duration of each project is 5 years.

In 2020, the Department announces guidelines for Key Program projects and accepts proposals in 87 research areas, and the average direct funding will vary from 2.5 to 3.5 million yuan for each project. In principle, no more than 2 projects will be funded in a single research area except for the Key Program projects group. In order to further improve the quality of projects, proposals from those groups and teams with excellent research resources and innovative ideas are preferred, and proposals for interdisciplinary cooperative research carried out by teams which have strong background are encouraged.

When filling in the application form, the applicants must indicate the selected research area in “the column of note”, and select the proper discipline code marked in brackets of the research area.

In 2020, the research areas for Key Program projects funded by the Department are listed as follows:

- 1. New methodologies/mechanisms of inorganic synthesis (B01)**
- 2. Precision synthesis of function-directed solid materials (B01)**
- 3. New reagents in organic synthesis (B01)**
- 4. Synthesis and application of organo-metallic/organo-elementary compounds**

(B01)

5. Metal organic catalysis (B01)
6. Novel synthetic strategies for natural products and complex pharmaceutical molecules (B01)
7. New methodologies for polymer synthesis (B01)
8. Synthesis of polymers with novel topological structures (B01)
9. Function-directed new primitives and assembly new methods (B01)
10. Chemical synthesis and mechanism under extreme conditions or external field regulation (B01)
11. Creation of special structure/function molecules (B01)
12. New chemical synthesis based on green chemistry principle (B01)
13. Synthesis-inspired by cross-integration of biosynthesis and chemistry (B01)
14. Dynamic characterization and theoretical research of surface/interface in catalytic process (B02)
15. Basis for high-efficient catalytic reaction (B02)
16. Adsorption, assembly, activation and reaction regulation of surface/interface molecules (B02)
17. Novel systems and new methods of colloid and interface chemistry (B02)
18. Colloid and interface chemistry in complex systems (B02)
19. Accurate regulation of functions of electrochemical system (B02)
20. Electrochemical basis of advanced electrolyte (B02)
21. Surface/interface chemistry of photoelectric functional materials and devices (B02)
22. Theory and methods of electronic structure (B03)
23. Experimental methods and applications of chemical dynamics (B03)
24. New methods and applications of spectroscopy (B03)
25. Design and mechanism of functional material structure (B03)
26. Structure evolution mechanism of polymer aggregation states (B03)
27. Photochemistry and photophysics of condensed phase and functional materials (B03)
28. Chemical thermodynamics of complex systems (B03)
29. New chemical imaging methods (B04)
30. Micro-nano analysis and devices (B04)
31. New theory and mechanism of chemical measurement (B04)
32. Separation and analysis of complex systems (B04)
33. Single cell measurement and analysis (B04)
34. Chemical measurement based on modern analytical methods and technologies (B04)
35. In-vivo chemical measurement (B04)
36. Intelligent sensing and measurement (B04)
37. In situ real-time online analysis method and new technology (B04)
38. New methods and techniques for diagnosis of major diseases (B04)
39. Spin regulation in molecular quantum materials (B05)
40. Chemical design and regulation of inorganic solid materials for energy conversion (B05)
41. Material chemistry of polymer and composite under extreme service

conditions (B05)

42. Multifunctional organic materials and devices (B05)
43. Porous material chemistry for separation and transformation of small molecules (B05)
44. Material chemistry of flexible devices (B05)
45. Molecular science of insensitive high energy density materials (B05)
46. Chemistry of key materials in solid-state battery (B05)
47. Efficient non-platinum catalysts and membrane & electrodes assembly for fuel cells (B05)
48. Large-area photovoltaic device and its stability (B05)
49. Materials and clean chemical conversion of oil and gas (B05)
50. Material chemistry of soft matter (B05)
51. Biomaterial chemistry of tissue adaptation (B05)
52. Synthetic chemistry of ammonia under mild conditions (B05)
53. New techniques for pollutant detection in complex environmental media (B06)
54. Fundamental chemistry of new functional materials in polluted environment remediation (B06)
55. The environmental interface behavior and chemical transformation mechanism of typical pollutants (B06)
56. Exposure and toxicity research of pollutants (B06)
57. Fundamental study of microorganisms in pollution control and bioremediation (B06)
58. Fundamental study of environmental catalysis in pollution control (B06)
59. Intermediates of environmental pollutant transformation and their reaction mechanisms (B06)
60. Effects of environmental particles on neural behavior and function and their mechanisms (B06)
61. Environmental computational chemistry and computational toxicology (B06)
62. Application of big data in environmental chemistry research (B06)
63. Bioactive small molecules and targets validation (B07)
64. Chemical regulation of immune processes (B07)
65. Discovery and functional studies of novel naturally occurring molecules (B07)
66. Chemical biology approach to understand intercellular communication (B07)
67. Biomolecule-ligand recognition and interaction mechanism (B07)
68. Drug targets nonclassical function discovery and regulation by small molecules (B07)
69. Metals and trace elements in chemical biology (B07)
70. Design, catalytic mechanism, applications of novel artificial enzymes (B07)
71. The production and mechanism of natural products from symbiotic system (B07)
72. Precise measurement and simulation of essential data for chemical engineering (B08)

73. Chemical reaction engineering and reactor (B08)
 74. Transfer process of non-conventional system (B08)
 75. Intensification and separation of typical reaction process (B08)
 76. Methods for chemical process intensification (B08)
 77. Biosynthesis engineering and biorefinery (B08)
 78. Design and green manufacturing of fine chemicals (B08)
 79. Science and chemical engineering basis of efficient and clean utilization of chemical resources (B08)
 80. Chemical engineering and key technologies of new energy system (B08)
 81. Atomic economy and green chemical engineering process (B08)
 82. Chemical engineering foundation for industrial biocatalysis and efficient utilization of biomass (B08)
 83. Engineering science fundamentals for chemical safety (B08)
 84. Engineering fundamentals of new materials for chemical engineering (B08)
 85. New materials for industrial catalyst and catalyst engineering (B08)
 86. Big data of chemical engineering and intelligent process (B0X)
 87. Application of artificial intelligence in chemistry (B0X)

The last two research areas listed above are the Key Program projects/Key Program project group driven by the disciplinary frontier. The applicant may organize the collaborative research teams to apply for one of them accordingly. The General Office of the Department will accept and handle the proposals. When filling in the application form, the applicants should select the corresponding code based on the research contents (for code B0X, please select code from B01 to B08).

Department of Life Sciences

The research fields funded by the Department cover biology, basic medicine and agricultural sciences. According to the orientation of key projects, funding of key projects is carried out in line with the principle of "limited objectives, limited scale and prominent focus". In 2019, the Department received 635 applications, among which 613 projects were accepted. There were 115 projects funded with a success rate of 18.11%.

In 2019, NSFC started pilot operation on Key Program projects, which allowed category-specific application and review process based on the nature of scientific issue. Among the 613 projects accepted by Department, 109 (17.78%) were of the category of "encouraging exploration, highlighting originality" with 18 projects approved; 281 (45.84%) were of the category of "focusing on the frontier, creating new paths" with 63 projects approved; 194 (31.65%) were of the category of "demand traction, breaking through bottlenecks" with 30 projects approved; and 29 (4.73%) were of the category of "common orientation, cross-linking" with 4 projects approved.

In 2020, the Department will continue to observe the following principles:

- (1) Funding creative and timely ideas to achieve excellence in science;
- (2) Focusing on the frontiers of science in unique ways to lead the cutting edge;
- (3) Supporting application-driven basic research to enable breakthroughs;
- (4) Encouraging transdisciplinary leading-edge research to promote

convergence.

After carefully untangling of the frontier directions of various disciplines with close attention to the scientific problems in the major needs of the country, Key Program in 2020 is proposed to encourage scientists to aim at the frontier of science, select fundamental and global scientific problems and carry out systematic innovative work, form key project groups in important research directions of disciplines, and promote the development of fields. Meanwhile, more emphasis will be put to "curiosity-driven disruptive research" and trans-disciplinary study dealing with grant challenges is encouraged. In 2020, based on the overall arrangement for the Key Program of NSFC, the Department will arrange a total direct cost budget of 300 million yuan, to support similar number of Key Program projects as that of 2019. The funding intensity is roughly the same as that in 2019. Applicants should put forward reasonable budget according to the actual financial needs of their research. The duration of the Key Program project is 5 years.

In order to apply for the Key Program, applicants should read the application requirements, special notes, and the funding plan of the Department in this chapter carefully. Moreover, since the research areas in the Department cover a broad spectrum from fundamental biological sciences and basic medicine to agricultural science, the designated areas of Key Program in each discipline is closely correlated with the funding areas of the discipline. **Please note that applicants should correctly apply for the Key Program according to the funding areas. Those categories, which are not within funding areas as described in the General Program part of this Guide, are not applicable to Key Program.**

The requirements for application to the Key Program projects of the Department are as follows:

(1) Applicants should propose research topics and compose every parts of the proposal following the guidelines of designated areas issued by the Department in 2020. In the column of Annotations on the basic information table of the application form, applicant should fill in the applied research area; with the corresponding application code lined out in each discipline's designated areas correctly.

(2) Applicants for the Key Program of the Department are required to attach the first pages of five representative research articles (published in recent five years) closely related to the proposal (as the attachment with application) .

The designated areas of the Department in 2020 are as follows:

1. Interaction between microorganism and environment and its metabolic regulation (C0105)

2. Analysis, design and construction of microbial pivotal life processes (C0102)

3. Interaction adaptation and evolution of plant to environmental (C02)

4. Regulation of plant growth and development (C02)

5. Animal diversity and animal resources (C0409)

6. Biological basis of animal adaptation (C0401)

7. Theoretical and application study on bioinformatics and biological big data (C0607)

8. Analysis, function and mechanisms of genetic and epigenetic regulation to important traits (C0606)

9. Molecular regulation of important activities and plasticity to cell life (C07)

10. Subcellular structure, function and dynamic regulation (C07)
11. Molecular mechanisms of germ cell generation, fertilization and embryo development (C12)
12. Regulation mechanism of organogenesis, homeostasis and stem cell regeneration (C12)
13. Recognition and new discovery of immune organs, cells and molecules (C08)
14. Immune recognition, response, regulation mechanisms in diseases (C08)
15. Neurobiological mechanisms of sensation or behavior (C0901)
16. Development, degeneration and plasticity of nervous system (C0901)
17. Psychological and brain mechanisms of cognition (including social cognition) and emotion (C0902)
18. Tissue/organ reconstruction and molecular regulation in physiological and pathological processes (C11)
19. Steady state regulation of physiological structure, function or metabolism (C11)
20. Synthesis, modification and activity regulation of biomacromolecules and bimolecular complexes (C05)
21. Aggregation and phase separation of biomacromolecules (C05)
22. Mechanisms of tissue repair and regeneration (C10)
23. Advanced technology research on biomaterials and drug delivery (C10)
24. Novel principles and methods of biological imaging (C10)
25. Biomacromolecule and genome design, synthesis and manipulation (C21)
26. High spatiotemporal resolution molecular event detection (C21)
27. The formation and maintenance of biodiversity and its response to global change (C03)
28. Ecosystem evolution and restoration and reconstruction of damaged ecosystem (C03)
29. Foundation of forest resource conservation and efficient utilization (C16)
30. The basis of grassland resources cultivation, protection and utilization (C1615)
31. Exploitation and utilization of excellent crop germplasm resources (C1304)
32. The mechanism of crop yield, quality formation and resistance to abiotic stress (C13)
33. Biological studies in food storage, processing and biomanufacturing (C20)
34. Basic research on food quality, nutrition and food safety control (C20)
35. Interaction mechanism between crops and harmful organisms (C14)
36. Harmful mechanism and regulation of crop pests (C14)
37. Biological basis and regulation mechanisms of excellent characters formation in horticultural crops (C15)
38. Nutrient requirement rules of crops and the mechanism of effective utilization of nutrient elements (C15)
39. Genetic basis and breeding regulation of good traits of livestock, poultry and bee silkworm (C17)
40. Biological basis of healthy livestock and poultry breeding (C17)
41. Pathogenesis and host resistance of important diseases in livestock and poultry (C18)

42. The mechanism and control of mutation and drug resistance of important pathogens in livestock and poultry (C1807)

43. Mechanisms of nutritional metabolism of important aquatic products and pathogenesis of diseases (C19)

44. Formation mechanism of economic characters of important aquatic products (C1902)

Moreover, considering common problems in the past years, the Department particularly reminds applicants of avoiding the following listed mistakes. Otherwise, proposals may be rejected during the preliminary checking procedure:

(1) Applications do not specify the title of designated research areas in the column of “Annotations” on the basic information table in main body of the application text;

(2) Applications do not fill in the corresponding application code specified by this guide;

(3) Applications to Key Program, without submitting the 5 representative publications within 5 years (since 2014) as first author or corresponding author.

(4) Applications indicate the designated areas in the “Annotation” column, but the actual research contents do not match the scope of funding;

(5) Applications submitted by applicants who are still holding a full time position abroad, or who cannot ensure necessary time and efforts for implementing the proposed research in China.

For other issues to be noted for proposal preparation, please refer to the guide to the General Program of the Department.

Department of Earth Sciences

Earth sciences is a fundamental discipline to understand the Earth, including Geography, Geology, Geochemistry, Geophysics and Space Physics, Atmospheric Science, Marine Science, Environmental Geoscience, and the interdisciplinary research among related disciplines. The main purpose is to explore all kinds of phenomenon, processes, and interaction, change and causality among these processes existed in the Earth system, and thus to provide scientific basis and technical support for key issues, such as resource supply, environmental protection, and disaster prevention and mitigation. Through innovation study earth sciences will keep on improving the new knowledge about the Earth system, updating the hierarchy about the origin and evolution of the Earth and planet. Scientists, not only from different branches of earth sciences, but also from mathematics, physics, chemistry, biology, medicine, materials sciences and engineering, informatics and management sciences, should be encouraged to apply Key Program of the Department jointly, and note the application codes for interdisciplinary studies in the application form.

The relevance and academic contribution to the specific priority themes must be stated in the proposals. To avoid duplication in funding, applicants shall state clearly the relations and differences between the application and related projects funded by other national agencies.

The application codes for Key Program should be filled in the application form upon the applicant’s selection.

In 2019, the Department received 555 Key Program proposals, and 92 were funded with a total funding of 295 million yuan as direct cost. The success rate was 17.66% and the average funding was 3.0102 million yuan per project. In 2020, 85 projects will be funded with an expected funding of 3.5 million yuan per project and a research period of 5 years.

Special notes for applicants:

In 2020, the 8 Key Program fields are listed as follows:

- (1) New theories, techniques and methods of the Earth and planet observation;
- (2) Habitability and evolution of planets;
- (3) Deep Earth processes and dynamics;
- (4) Ocean processes and polar environment;
- (5) Earth system process and global change;
- (6) Weather, climate, and associated sustainable development;
- (7) Human activities and environment;
- (8) Formation mechanism and supply potential of resources and energy.

Applicants must fill in “Annotations” of the proposal sheet one of the above 8 fields in the pull-down menu. Proposals with incorrect “Annotations” or without “Annotations” will not be accepted.

Applicants may decide the title, content, and research plan for their own proposals according to the key themes listed in the 8 fields based on the previous research work and new scientific problems, as well as new research approaches.

1. New theories, techniques and methods of earth and planet observation

Scientific objectives: Oriented with the frontiers of the Earth and Planetary sciences, novel theories, and techniques and methods, related with the basic theory, experimental simulation, observation and information extraction in the Earth and Planetary sciences research, shall be developed to push the complex application of advanced technology, such as long-distance in situ detecting technology about the physio-chemical properties of objects through earth system observation (ground-based observation, satellite observation, remote sensing detection, deep ocean and continent observation system and deep space detection and sampling), and material structure detection technology from micro-nano scale to atomic scale.

Preferred research themes:

- (1) Observation theories, techniques, and experimental methods and mathematical computation and simulation related with material physio-chemical properties and processes of the Earth and Planet.
- (2) Integrated theories and methods of detection techniques oriented by deep space, deep earth, deep time, deep ocean and habitable Earth strategy.
- (3) Analysis, assimilation, fusion and sharing of earth sciences big data;
- (4) Establishment and techniques of earth observation system and multi-sources data fusion platform.

2. Habitability and evolution of planets

Scientific objectives: to study the transportation, conversion, coupling and evolution processes of the matter and energy in planetary multi-layer systems, to understand the historical changes of the inner structure and multi-layer of planets, to explore the origin and early evolution of life, to understand the formation and evolutionary processes of planetary habitable environments. This research field is dedicated to investigating the historical changes and coevolution of Earth’s environment and life, to understanding or solving some

major fundamental scientific issues (e.g., the origin and evolution of solar system, climate change, the origin and evolution of life, the origin and reversal mechanisms of Earth's magnetic field), to serving the national strategy of deep-space exploration, promoting the development and innovation of planetary science.

Preferred research themes:

- (1) Origin and evolution of cosmos and solar system;
- (2) Solar-Earth interaction;
- (3) Planetary atmosphere and its effects on habitability;
- (4) Origin and volatile evolution of the matter on habitable planet;
- (5) Key geological processes constraint of the evolution of planetary habitability.

3. Deep Earth processes and dynamics

Scientific objectives: Adhering to the views of Earth and planetary sciences, using multi-disciplinary methods of geology, geophysics, and geochemistry to obtain information about the deep materials, architectures and kinematics of the Earth, this field is aimed to decipher how the solid Earth operates, to characterize the interactions among multiple spheres of the Earth, to disclose the coupling relationship between deep Earth and surficial processes and to promote development and innovation in Solid Earth science.

Preferred research themes:

- (1) Characterization and detection of deep materials, architectures and kinematics of typical regions in a global scale;
- (2) Technology and methodology for accurate elucidation of tempo-spatial trajectory of plate material movements;
- (3) Controlling mechanism of Earth's deep processes and evolution on natural sources and environment;
- (4) Interactions between deep Earth and surficial processes.

4. Ocean processes and polar environment

Scientific objectives: Constructing a theoretical framework for multi-scale motion in the ocean, revealing the mechanisms of material-energy cycle in the multispheres of the ocean, clarifying the interaction mechanism of marine dynamic processes with biological and chemical processes, and the dynamic ocean floor evolution, and exploring the regulation mechanism relating to the variation of the earth system in the deep sea, polar regions, and land-sea interaction zone, revealing the formation and evolution mechanism of the oceanic lithosphere from nascent to extinction, and providing scientific and technological support for national coordination of land and marine development, blue economy, marine sustainable development, and deep sea and polar national strategies.

Preferred research themes:

- (1) Ocean dynamics and its coupling with biogeochemical and ecological processes;
- (2) Rapid changes in polar environment and multispheric interactions;
- (3) The multispheric cycle of energy and materials in deep ocean and its resource effects;
- (4) Driving and response of the processes in high and low latitude oceans responding to global change;
- (5) Multi-interface coupling process and sustainable development in offshore and coastal zones.

5. Earth system process and global change

Scientific objectives: to conduct research on systematic evolution and operation rules

of spheres in earth surface systems; to understand the co-evolution and coupling relationship among the earth's various spheres (e.g., biosphere, hydrosphere, atmosphere and lithosphere on the earth's surface); to unveil resources and environment responses for the evolution of the earth system; to acknowledge the interactive relationship between earth surface processes, climate changes and development of earth bio-system and human society; to provide scientific geological evidence and theoretical foundation to forecast earth surface processes, biodiversity, variation tendencies of resources, environment and environmental changes in future.

Preferred research themes:

- (1) Interaction process and environment among the earth's various spheres;
- (2) Co-evolution mechanisms between biology and environment;
- (3) Coupling dynamics of the man-land system;
- (4) Hydrologic cycle, carbon cycle and global change;
- (5) Numerical simulation of earth system processes.

6. Weather, climate, and associated sustainable development

Scientific objectives: To investigate physical and chemical processes in the atmosphere and their interactions with adjacent spheres; to reveal the principles and mechanisms of the evolution of and variations in weather, climate, and the atmospheric environment; to develop high-performance numerical models; and to improve the theories and technologies for forecasting and predicting weather, climate, and the atmospheric environment. Provide scientific support for the sustainable development of the economy and society by focusing on national needs, thus enhancing our capabilities in disaster prevention and adaptation to global climate changes.

Preferred research themes:

- (1) Physical and chemical processes in the atmosphere and the mechanisms underlying their interactions;
- (2) Atmospheric energy and composition cycles, interactions among the spheres of the earth's climate system, and their impacts on weather, climate, and the atmospheric environment;
- (3) Mechanisms, forecasting, and prediction theories and technologies for weather, climate, and atmospheric environmental variations;
- (4) Research and development of atmospheric models and Earth system models;
- (5) Meteorological disaster, climate change, and sustainable development.

7. Human activities and environment

Scientific objectives: Facing the complex human-earth system, to reveal evolution process of the earth environment and its influencing factors; expound the interference and alteration effect of human activities on the earth environment factors such as water, soil, atmosphere, biology and surface rock; and provide theoretical support for understanding the formation mechanism of surface environment habitability and the coupling relationship of various factors.

Preferred research themes:

- (1) Environmental pollution process, control and remediation;
- (2) Environmental quality evolution, prediction and sustainable management;
- (3) Disaster-causing mechanism, early identification, warning and prevention and control of geological and engineering disaster;
- (4) Environmental risks and health effects of pollutant;

(5) Regional human activities and resource environment.

8. Formation mechanism and supply potential of resources and energy

Scientific objectives: to aim at realizing the secure supplies of resources and energy and supporting the high-quality development of China. Centering around the basic and cutting-edge scientific issues on the full chain of the utilization of resources and energy, theoretical and experimental studies will be conducted on the efficient exploration of conventional oil and gas, the finding of "sweet spots" of unconventional oil and gas, and the enrichment of strategic and scarce mineral resources, through which to consolidate the foundation for independent scientific and technological innovation in the resource and energy fields in China.

Preferred research themes:

- (1) Mechanisms of resource formation and enrichment;
- (2) Theories and technologies of oil and gas exploration;
- (3) Theories and technologies of gas hydrate exploration;
- (4) Organic-inorganic interactions in Earth's interior and their resource effects;
- (5) Material cycling among different spheres of the Earth and mineralization.

Department of Engineering and Materials Sciences

In 2019, the Department received 595 proposals for the Key Program, and among them, 105 proposals were funded in 89 fields with a success rate of 17.65%. The total direct cost was 315 million yuan and the average direct cost was 3 million yuan per project for five years.

The Department will earnestly implement the relevant initiatives of the NSFC's reform in depth. The applicants of Key Program are required to implement the scientific intension of the guidelines of funding creative and timely ideas to achieve excellence in science, focusing on the frontiers of science in unique ways to lead the cutting edges, supporting application-driven basic research to enable breakthroughs, and encouraging transdisciplinary leading-edge research to promote convergence; and pay attention to the condensation of scientific problems, to the realization of the organic integration of the discipline frontiers and the major national needs, to the originality of basic research in frontier areas, and to the interdisciplinary integration. The Department will further strengthen the construction of academic discipline, and strictly check and scrutinize the representative works provided by the applicants.

In 2020 about 100 projects will be supported in 95 fields with an average direct cost of 3 million yuan per project for five years.

I. Key priority funding areas of the Department in 2020

The Department plans to fund a Key Program Cluster in the research field of "Basic scientific problems of key generic technology in high-end bearing manufacturing" in 2020, including 6 projects. The Key Program Cluster is aiming at the demand for high-end bearings in major equipment such as large shield machines, high grade computer numerical

control machine tools and aero-engines, and based on the requirements and challenges of low speed/large scale/heavy duty, high speed/high accuracy, high speed/high temperature/high reliability, the Department plans to fund in-depth researches on generic basic scientific issues in the design, manufacturing and application of high-end bearings, especially through the interdisciplinary integration of materials and machinery, expound the failure mechanism in service, to make breakthrough of technical bottleneck in domestication of high-end bearing. Priority will be given to the team with an interdisciplinary background of metallic materials (E01) and mechanical engineering (E05), and applicants are encouraged to take full account of lubrication factors in their proposals.

The applications to the following four research fields should be labeled “Basic scientific problems of key generic technology in high-end bearing manufacturing” in the Annotation area of the front cover. The General Office of the Department is responsible for the administration process.

(1) Relationship between service life of bearings with microstructure evolution of rare earth bearing steel during preparation and processing (E01);

(2) Low cost additive structure forming and defect control of extra-large bearing components (E01);

(3) Formation, evolution, damage mechanism and control technology of microstructure in load bearing areas of bearings in manufacturing process (E05);

(4) Design and manufacturing technology of high-end rolling bearing based on material damage mechanism (E05).

II. Other Key priority funding areas of the Department in 2020

Applications of Key Program should be aiming at the needs for supporting the socio-economy, human society and national security, strengthening the ability to refine core scientific issues from the critical needs of the country and the “bottlenecks” of technology, with clear objectives, focused direction, centralized content, and emphasis on the development trend of AI and green technology, to promote the application of basic research results.

1. Key issues in the design, manufacture, processing and application of ferrous metals (E0101, E0102, E0103, E0104)

2. Key issues in the design, manufacture, processing and application of non-ferrous metals (E0101, E0102, E0103, E0104)

3. High temperature alloys, intermetallic compounds and metal matrix composite materials (E0101, E0102, E0103, E0104, E0105)

4. Metastable and nano-structured metallic materials (E0106)

5. Magnetic and information metallic materials (E0107, E0109)

6. Energy, environmental and catalytic metallic materials (E0108)

7. Biomedical, intelligent and biomimetic metallic materials (E0110)

8. New phases, new functions in metals and new materials with metallic properties (E01)

9. Characterization of structure, surface and interface of metallic materials (E0101, E0103)

10. Mechanical properties and service behavior of metallic materials (E0103, E0104)

11. Basic research on application-oriented high-performance lead-free

piezoelectric ceramics (E0206), plan to support 3 to 5 projects in this field as a key project group

12. Fabrication science of large-size and high-performance ceramic components (E0204)

13. Fundamental research on multifunctional high-temperature structural ceramics (E0204)

14. Research on frontier scientific issues of inorganic non-metallic materials (E02)

15. Research on the basic issues in bottleneck technologies of inorganic non-metallic materials (E02)

16. Structure/property directed chemistry of polymeric materials (E0301)

17. Manipulation of the aggregation structure of polymeric materials and its influence on properties (E0302)

18. New theories and methods for the processing (including micro-nano processing and additive manufacturing) of polymeric materials (E0303)

19. Basic issues on biomedical polymeric materials (E0308)

20. Basic issues on optoelectronic organic polymeric materials and devices with high performance (E0309)

21. Basic research on polymeric materials related to energy, ecological environment and resources (E0306)

22. Basic research on structure/function design, preparation and properties of polymer composites (E0305)

23. Basic research on the major problems & challenges existing in the fields of polymer materials those fulfill the requirements for the national strategical objective (E03)

24. Basic research on theory, simulation and characterization method and technology of polymeric materials (E0302)

25. Fundamental theory and key technology for artificial intelligence in oil and gas exploration (E0401, E0402)

26. Basic technology in the efficient development of ultra-high pressure and ultra-deep gas reservoir (E0402)

27. Foundational research on the intelligent supply for massive complex oil and gas pipeline networks (E0403)

28. In situ mining mechanism of deep metal ore (E0405)

29. Basic theory of intelligent rapid roadway tunneling (E0404, E0405, E0406)

30. Intelligent ventilation theory and key technology in deep mine (E0406, E0408)

31. Safety structure theory and its application (E0408)

32. Basic research on monitor, prediction and rescue of major disasters (E0408)

33. Pollution control & depollution processes during rare metal extraction (E0409, E0414)

34. Valorization of metallurgical solid wastes (E0410, E0411, E0414)

35. Multi-component, multi-phase equilibrium and phase diagrams of rare & noble metals (E0410)

36. Electrode materials and electrochemistry of high energy density rechargeable (secondary) batteries (E0410)

-
37. Fabrication of high-performance rare-earth doped cathodes (E0412)
 38. Directional solidification of refractory oxides: process control (E0415)
 39. Advanced steel materials: basics of solid-phase welding and manufacturing (E0415)
 40. The interaction and evolution laws of topology-change, cross-scale, and multi-morphology of robots and mechanisms (E0501)
 41. High dynamic performance/High accuracy/High power-density transmission mechanism (E0502)
 42. Dynamic characteristic and parameter matching for mechanical equipment (E0503)
 43. Mechanical structural strength design for reliability-oriented manufacturing (E0504)
 44. Mechanical surface/interface behavior and control under special operating conditions (E0505)
 45. Forward design theories and methodologies for complex equipment (E0506)
 46. New principles and methods for bio-and bionic design and manufacturing (E0507)
 47. Manufacturing foundation and equipment of composite components (E0508)
 48. Precise forming manufacturing principle and method of complex components (E0508)
 49. Theories, technologies, and methods for high-efficiency, precision and ultra-precision machining (E0509)
 50. Novel principles, equipment, and applications for nontraditional energy-field-based and additive manufacturing (E0508, E0509)
 51. New principles, operation modes, systems, and equipment for intelligent manufacturing (E0510)
 52. Theories, methods, and technologies of cross-scale nano-precision measurement (E0511)
 53. Testing and characterization of multi domain coupling effect in micro/nano devices and systems (E0512)
 54. Thermodynamic system analysis, control and optimization for energy conservation and environmental protection (E0601)
 55. Turbulent flow mechanism and flow control in fluid machinery (E0602)
 56. Fundamentals on mass and heat transfer in energy conversion and utilization (E0603)
 57. Combustion theory and combustion new technique of gas and liquid fuel (E0604)
 58. Mechanism of combustion, pollution and emission reduction of solid fuel (E0604)
 59. Fundamentals on multi-phase flow in power systems (E0605)
 60. Principles and methods of measurement for complex thermo-physical quantity and field (E0606)
 61. Key thermo-physical issues on the utilization of new energy and renewable energy (E0607)
 62. Basic theory and key technology on high efficiency high quality electric

machine system and its control (E0703)

63. Basic theory and key technology on comprehensive energy power system (E0704, E0706)

64. Basic theory and key technology on advanced electrical materials, equipment and system (E0701, E0702, E0705)

65. Basic theory and key technology on power electronic devices, equipment and system (E0706)

66. Basic theory and key technology on electromagnetic-biological interaction and medical application (E0708)

67. Basic theory and key technology on pulse power and discharge plasma (E0705)

68. Basic theory and key technology on electric energy storage (E0707)

69. Basic theory and key technology on advanced electric-magnetic energy transmission (E0701, E0706)

70. Modern architectural theory and technique based on the Chinese traditional construction thought (E0801)

71. Urban and rural planning theory and method in the context of land and space planning system (E0802)

72. Theory and method of local urban and rural landscape planning (E0802)

73. New theory and method of built environment control and energy saving (E0803)

74. Frontier scientific issues of high-performance material and structure (E0804, E0805)

75. Key scientific issues of smart construction in civil engineering (E0804, E0806)

76. The design theory and method of new structural system (E0805)

77. Key scientific issues to guarantee urban infrastructure service (E0806, E0810)

78. Key scientific issues of geotechnical and tunneling engineering on extreme environment (E0807, E0808)

79. Design theory and method of whole life cycle of environmental friendly pavement (E0809)

80. Key scientific issues of urban earthquake-resistant resilience (E0810)

81. Basic research on major demand in the field of hydrology and water resources (E0901)

82. Evolution law and regulation technology of basin water and soil environment (E0901, E0903)

83. Fundamental research on modern agriculture and rural water conservancy (E0902)

84. Mutual feedback mechanism between hydrology and water ecological environment (E0903, E0901)

85. Mechanism and key technology of efficient dredging for river, lake and reservoir (E0903)

86. Mechanism and regulation technology of water disaster in mountainous or urban areas (E0903)

87. Theory and technology of disaster prevention for key geotechnical

engineering (E0905)

88. Theory and technology of safety control for key hydraulic structures (E0906)

89. Ecological characteristics and pollution control of reservoir-type water source (E1001)

90. Mechanisms of wastewater reclamation and resource recovery in urban areas (E1002)

91. Fundamentals of innovative technologies for industrial wastewater treatment (E1003)

92. Fundamental research on coastal development or coastal underground space development (E1101)

93. Advanced technology and theory of experiment of ocean engineering (E1101)

94. Key scientific issues of ship navigation safety (E1102)

Department of Information Sciences

In 2019, the Department announced 99 areas and several non-specified areas meeting the major national demands for the application of Key Programs, and received 384 applications (260 in the specified areas and 124 not in the specified areas), of which, 105 projects (83 announced areas and 22 non-specified areas) were funded with direct cost funding total of 315 million yuan, and average direct cost funding of 3 million yuan per project. The success rate is 27.34%.

In 2020, the Department will announce 2 groups of Key Program projects in 2 priority areas, and 89 areas for Key Program projects.

In 2020, the Department will fund 10 projects in 2 groups of Key Program and 75 Key Program projects with average direct cost funding of about 3 million yuan per project for 5 years. Applicant should follow the guidelines for research directions in relevant areas, in accordance to the trend of development in the research area and basis of their research team and the actual research object or process, propose key scientific problems and conduct systematic and in-depth theoretical studies or experimental verification. Apart from high level papers, research results should be verified in experimental system or in practical applications.

In 2020, the Department will continue to accept free application for Key Program project on a trial basis, in areas of marine information acquisition and transmission, target and environment composite scattering, network and system security, block chain, information security, intelligent autonomous system, basic theory and key technology for intelligent system in industrial manufacturing process, brain machine interface, optical bio-regulation, large array focal plane multicolored imaging. In 2020, the Department plans to fund about 15 non specified area type Key Program projects in areas of major need, with funding of 3 million yuan per project for 5 years.

For non-specified areas project applications, please provide proper application code in the application form. Please see NSFC's website for details.

The deadline for proposing areas of Key Program for 2020 is April 30, 2020; please

see the department website (<http://www.nsf.gov.cn/cen/oo/kxb/xx/tztg.htm>).

In 2019, the Department experimented new method of application and evaluation. For detailed information, please see the following table.

Applications in the Key Program for the Department of Information Sciences

Category of problem	Applications	Funded	Applied rate (%)	Success rate (%)
Exploratory and original			4.30	2.86
Frontier and novel			27.60	35.24
Demand driven and breakthrough			57.29	55.24
Mutual interests and interdisciplinary			10.68	6.67
Total	384	105		

In 2020, the priority areas of the Department are as follows:

1. Basic theory, method and technology of ubiquitous system software

Software is the soul of information technology, and operating system, or system software in a broader sense, is the soul of software. This project group will focus on related basic problems general system software on the platform integrating man, machine and things, so as to provide ways and method for developing general system software integrating man, machine and things. It will have 5 research directions, and plans to fund 5 projects.

- (1) Unified understanding and characterization of heterogeneous resources in ubiquitous computing scenarios;
- (2) Method of computing abstraction and software definition in man, machine and things merged scenarios;
- (3) System software design method, structural model and operating mechanism for software and hardware coordination;
- (4) Construction and adaptive mechanism of software driven by application scenarios;
- (5) Autonomous adaptation and learning mechanism for ubiquitous system software.

2. Basic theory and general key technology for underwater robots

Intelligent sensing and autonomous operation in shallow sea environment such as weak and changing lighting condition, dynamic water current, complex sea bed is a big problem for intelligent robots. Addressing the problems in near shore development and sea rescue, this project aims at basic theory and mutual technology development in areas such as intelligent sensing and understanding, robot stability and flexible control and positioning, efficient autonomous operation system and coordination, trouble shooting and tolerant mechanism of multiple robots, and integrated design based on sensing, transport and control for underwater target detection. It will have 5 research directions, and plan to fund 5 projects.

- (1) Diagnosis and error tolerant control technology for underwater robots;
- (2) Theory and key technology of underwater target detection based on sense, transport and control integrated design;
- (3) Autonomous sensing of environment and positioning for underwater robots;
- (4) Autonomous operation of underwater robots;

(5) Coordination and control of multiple underwater robots.

In 2020, the Key Program project areas funded by Department are as follows:

- 1. Tetra hertz communication theory and key technology for mobile coverage**
- 2. Vortex electromagnetic wave communication and sensing**
- 3. Drone group remote survey and communication network for real high capacity business**
- 4. Underwater wireless optical transmission**
- 5. Efficient algorithm and chip architecture for super high definition video coding**
- 6. High density optical network for super E class computing**
- 7. Theory and teleology of quantum key distribution group network**
- 8. Multiple send and reception magnetic lens integrated radio system**
- 9. Sea and air target information acquisition for air land mixed wave transmission**
- 10. Detection and identification of drone groups**
- 11. High sensitivity multiple spectrum micro light scattering imaging**
- 12. Measurement of multiple parameter 3D imaging for combustion in confined space**
- 13. High resolution stable hydro acoustic imaging**
- 14. Evaluation of mobile imaging quality**
- 15. Acquisition and computation of high resolution dynamic optical field**
- 16. Theory and technology of antenna for efficient electric wave coverage by mobile carrier in open and confined space**
- 17. Theory and technology of large array antenna with pilot channel of same diameter**
- 18. Wireless transmission of information through cavities**
- 19. Sensitive mechanism and devices for MEMS electric field sensors**
- 20. Research on sensors identifying nitrogen marker of disease in human breath gas**
- 21. Information processing and verification of crops gene type and characteristic data**
- 22. Medical imaging processing for integration of interpreting technique and model**
- 23. Imaging of coronary artery integrating dynamic spectrum and personalized modeling**
- 24. Complexity of shallow model in quantum computing**
- 25. Grid computing design optimization and applications**
- 26. Controllable mechanism for novel neural network based on bio-computing**
- 27. Virtual core technology for operating system in cloud computing environment**
- 28. Security system modeling and verification method in open environment**
- 29. Configuration and evolution of cognitive service for uncertain demands**
- 30. Modeling and optimization of parallel programming for E class computing**
- 31. High performance secured and sustained memory organization and techniques**

32. New storage system architecture for machines learning
33. Generation and identification of video content
34. Deep learning theory and technology for 3D object analysis and generation
35. Cancer model mining based on multi-omics data
36. Trust management and privacy protection in crowd sourcing perception
37. Network system architecture and routing mechanism driven by machine learning
38. Immune mechanism and key technology for unknown threat in cyberspace
39. Data acquisition and service computing in novel group perception
40. Prediction of air pollution by urban mobile sources
41. Data merging and smart decision making for ubiquitous power internet of things
42. Resources optimization and control of network systems
43. Monitoring and smart operation service for key components in high speed trains
44. Micro nano sensor array and system for on-site fast detection of drug trafficking
45. Micro resolution and super sensitive temperature imagine based on low field magnetic nano frequency shifting
46. Real time smart detection of high speed rail damaging
47. Vision measurement and information integration of position for autonomous landing of drones
48. Reliable management and smart dispatching for manufacture cloud service
49. Coordinated optimization control in industrial manufacturing process of new battery materials
50. Precise control of micro nano manufacture process of 3D bio-tissues
51. High dimensional coarse big data analysis for areas
52. Structural optimization for deep neural network
53. Strengthened deep learning for multiple intelligent systems
54. Visualized analysis techniques for multiple scenario video understanding across different equipment
55. High resolution video imaging interpretation for marker loss situations
56. Intermediate interpretable analysis and reasoning for domain-oriented big data
57. Cognition mechanism and computing model for language understanding
58. Robust machine translation theory and method in noise environment
59. Urban traffic evolution and prediction driven by multiple data sources
60. Real time deduction of unexpected fault for large ship and airplane support
61. Deducible strengthened learning for multiple tasks
62. Brain motion perception based on machine learning
63. Data driven behavior learning modeling, analysis and evaluation for education
64. Mechanism and laws of evolution for coordinated man machine learning supported by group intelligence
65. Memory and computing integrated devices for scientific computation
66. Tetra hertz semiconductor device modelling and circuit verification

-
- 67. High efficiency silicon based tetra hertz dispatcher chips
 - 68. Large angle large aperture silicon based MEMS optical deflecting mirror
 - 69. GaN based high power ultraviolet laser (larger than 360 nanometer)
 - 70. Signal processing chips for embedded nerve regulation
 - 71. Silicon based hetero node efficient solar cells
 - 72. 2D material vertical structure low power high gain devices
 - 73. EDA rear end design method and technique for machine learn aide
 - 74. Super high speed optical array process
 - 75. Gbps key distribution mechanism and key technology
 - 76. Tetra hertz single photon hetero dyne detection mechanism and key technology
 - 77. Nonlinear noise mechanism and damage alleviation for Mode group diversity multiplexing
 - 78. Silicon based high performance quantum point laser compatible with CMOS technology
 - 79. Optical fiber electro chemical in situ detection for energy storing devices
 - 80. Dynamic high resolution computation of holographic display
 - 81. Basic physical problems and optical field regulation for on chip topological photon crystals
 - 82. Liquid crystal micro structure controllable assembled optical devices and applications
 - 83. Life tumor micro environment regulation by optical imaging meditation
 - 84. Kilo watt single frequency optical fiber laser
 - 85. Electronic pump quantum point single photon source and micro cavity laser
 - 86. High heavy frequency energy medium inferred pemtosecond laser
 - 87. High precision high stability microwave atomic clock
 - 88. Wide band super high resolution multiple optical comb spectrum
 - 89. Long translation high precision displacement monitor for large area grating manufacturing

Department of Management Sciences

In 2019, the Department received a total of 143 Key Program applications, and funded 30 projects. The average funding for direct cost was 2.36 million yuan per project.

During the 13th Five-Year Plan period, the Department will release funding fields of Key Program annually, and release funding fields of Key Program clusters and fundamental database construction programs timely. The Key Programs should be focused on (1) scientific frontier issues that can promote discipline development, obtain great innovative achievement, and generate international impacts; (2) important theoretical and application issues regarding economy development, society development, reform and opening-up, and the improvement of China's comprehensive competitiveness, which need to be addressed immediately, and are possible to be addressed; (3) systematic and in-depth innovative research, which explores management theories and laws for Chinese characteristic and has sound research background or good potential for discipline development.

The funding priority areas described in this *Guide* outline the main contents and scopes. Please note that the title of application is not required to be exactly the same as the area titles of the following listed Key Programs. Applicants are required to possess solid research experiences and abilities in the areas that they are applying for. Applicants are encouraged to exploit their full advantages, present deep academic thoughts in their applications, make the research goals clear and concrete, emphasize the key points of their application, focus on one or several key scientific issues of the research and actually address them, and have theoretical breakthroughs. In addition, applications are required to integrate theories with practice, discover key scientific issues from important practical management issues and perspective of China's actual conditions, conduct in-depth research, and provide new approaches to address practical management issues. Applicants should focus on the guidance of scientific methodology, emphasize on the application of scientific approaches, take real data and actual cases as the fundamental information of their research, and make sure not to be subjective.

Note that the requirements given in the general description section of the General Program of the Department in this *Guide* are also applicable to the Key Programs, please read these items carefully.

Key priority areas of Key Program of the Department in 2020

Applicants who apply for Key Program of the Department should choose the codes noted after the areas of the Key Program in this *Guide* as the first application code, and fill the name of the corresponding areas in the Appendix of the application. Applications that fail to do so will not be accepted.

In 2020, the Department proposes priority areas for Key Program as follow and plans to support 40 Key Program projects. The funding for direct expenses will be 2.2 to 2.8 million yuan per project, and the implementation period of the Key Program projects will be 5 years.

- 1. Intelligent programming method for complicated management tasks (G0102)**
- 2. Intelligent operation and optimization of port cluster (G0102)**
- 3. Evolution of game behavior and management experiment (G0104)**
- 4. Human-computer synergy mechanism and the implication on management decision (G0110, G0114)**
- 5. Supply-chain management and risk management on the operation and maintenance of oversea key infrastructure (G0111)**
- 6. Supply-chain risk prevention and intelligent management for key core-products (G0111)**
- 7. Information disclosure and product/service operation management for online platform (G0111, G0112)**
- 8. Resources organization and optimization for shared services (G0112)**
- 9. Data security and risk prevention for smart cities (G0116)**
- 10. Design of enterprise's financing mode and operational risk management based on block-chain technology (G0116, G0117)**
- 11. Strategy management theory of intelligent manufacturing companies (G0201, G0214)**
- 12. Company's digitization and adaptive reform on management (G020201)**
- 13. Composition and development of data-driven enterprise dynamic capability**

(G0203)

14. Theory of coordination among internal organizations within companies and the management strategy (G0204)

15. Quality of financial information and companies' financial decision based on big data (G0206)

16. Customer-made strategy and management based on digitalization (G0207)

17. Optimization on quality assurance management and after-sales service operation for equipment products in the environment of Internet of Things (G0208, G0211)

18. Mechanism on jointly created value by platform's ecological system and business mode innovation (G0209)

19. Operational management theory and method in the environment of Internet plus and big data (G0211)

20. Influence and mechanism of entrepreneurship network on the development of new-established companies (G0213)

21. Theory, methods, and application of big data modeling in the Economics Sciences (G0303)

22. The trade regular pattern under the structural changes of international economic (G0304)

23. Driven mechanism and policy for development of consumption in the New Era (G0304)

24. Debt cycle model, debt risk analysis and control measures (G0306)

25. The development of universal and sustainable social security system (G0307)

26. The modernization of livestock farming and sustainable development in China (G0308)

27. Cities' High-quality development driven by switch of old and new growth engines (G0309)

28. The establishment of social service system at the primary level in urban and rural and community governance (G0401)

29. Establishment and operational mechanism on socialized service system for the elder (G0403, G0406)

30. Establishment and operation of Innovation ecosystem under the national regional development strategy (G0405)

31. Management theory and method on the technological risks induced by natural disaster (G0409)

32. Endogenous motivations and policies on the sustainable development of poverty alleviation area (G0409)

33. Management theory, method and policy on coupling of multi ecological environment elements (G0411)

34. The operational system of synergy for multi-energies with complementarity and its effects (G0412)

35. Labor migration and social influence under the background of emerging technologies and divergence of social demand (G0413)

36. Theory and experiment on market design (Key Program Cluster)

This Key Program Cluster aims at the relationship between government and market in the development of socialist market economy of China, focuses on issues related with

institutional reform that improves socialist market economy of China, and systematically and deeply studies the fundamental theory on market design based on the practices of Chinese economy. It should develop and apply multiple approach, such as laboratory experiment, field experiment and computer stimulation, etc., and finally explores the market design rooted from the Chinese practice.

This Key Program cluster prepares to fund five Key Program projects:

- (1) Theory on market design (G0301);
- (2) Laboratory experiment on market design (G0303);
- (3) Field experiment on market design (G0303);
- (4) Computer stimulation and experiment on market design (G0303)
- (5) Market design application for China (G0301).

Department of Health Sciences

A total of 758 applications for the Key Program in 40 thematic areas were received in 2019, 125 of which were funded with a total funding of 371.7 million yuan (direct cost) and an average budget of 2.9736 million yuan (direct cost as well) per project. **In 2020, the funding plan for the Key Program will still fall into two categories: approximately 95 applications will be funded in the listed areas and 20 applications will be funded in “macroscopic areas”; the funding of direct cost is expected to be 3 million yuan per project, and the duration is 5 years.**

According to the major national needs, combining the discipline development strategy and the priority funding direction in the field of medical science, 38 thematic areas for solicited Key Program were confirmed by the Department in 2020 through extensive investigation and expert demonstration. Please see the following for details. To apply for the Key Program in the thematic areas listed by the Department, applicants are expected to give the titles of their own specific project, research contents and research plans according to the listed areas. **Application code 1 should be selected from the code indicated after the name of thematic areas for Key Program in this *Guide*, the funding category should be selected as Key Program, and the notes should be indicated in the corresponding field name published in this *Guide*.**

The Department will continue to set up “Macroscopic Areas” for the applications of Key Program in order to support key scientific issues facing the major national needs and facing the world’s scientific frontiers timely. **The applicants who have made original discoveries or important progresses in the occurrence, development, outcome, diagnosis, treatment and prevention of major diseases but the research content to be carried out is not within the 38 listed areas of Key Program published by the Department this year are encouraged to select the research direction freely to apply for the Key Program in Macroscopic Areas, and choose the corresponding code according to the research content. The notes should select “Application for the Macroscopic Areas”. In addition to write the application in accordance with the conventional requirements for Key Program, an 800-word "Statement of the Important and Innovative Progress" should be added in front of the body part of the application. Applications without “Statement” will not be accepted.**

Applications with note and code indicated incorrectly in accordance with the above requirements will not be accepted.

Detailed requirements for applications for the Key Program are described in the general requirement for the Key Program of NSFC in this *Guide*. Special attentions should be paid to the following requirements:

(1) **The applicants are requested to refer to the requirements for General Program in the Department in this *Guide* which are also applicable to the Key Program**, including the Department will not support the applicants who either have been intensively funded in 2019 from NSFC (such as Key Program, Major International and Regional Joint Research Program, Major Program, Major Research Plan, Key Program of Programs of Joint Funds, Special Fund for Research on National Major Research Instruments, etc.), or are applying for repetitive research programs similar to their ongoing national scientific projects funded by other governmental agencies.

(2) Applicants are required to attach PDF copies of 5 relevant representative papers to the electronic proposals.

Applications for Key Program fail to write and provide relevant materials as required above will not be accepted.

The thematic areas for solicited Key Program in the Department in 2020 are listed as follows:

1. The mechanism and intervention of chronic airway diseases (H01)

The Key Program will encourage studies focusing on the regulatory mechanisms of neuro-endocrine-immunity, and the new targets for cell-cell interactions and interventions, underlying the inflammation and immune responses in the pathogenesis of chronic airway diseases. These studies will provide fundamental evidence for understanding the molecular mechanisms and developing novel treatment strategies of chronic airway diseases.

2. Vascular cell heterogeneity in the pathogenesis and intervention of angiopathy (H02)

The priority research areas will focus on the heterogeneity of vascular parietal cells in the pathogenesis of angiopathy, and analyze the key regulatory network, signal pathways, as well as regulatory factors of vascular cell heterogeneity transformation, in order to enrich the understanding of pathophysiological mechanisms in the vascular disease and provide theoretical basis and novel intervention targets for its prevention and treatment.

3. Novel strategy for myocardial injury and repair in ischemic heart disease (H02)

The priority research areas will focus on the role and regulatory mechanisms of cardiac microenvironment and cell interactions in the damage and repair of cardiac structure and function, to reveal new mechanisms of myocardial injury and repair in ischemic heart disease, and provide theoretical basis for the novel intervention strategy of myocardial injury and repair.

4. The regulation of platelets and their role(s) in the initiation and development of hematological diseases (H08)

The proposal should mainly focus on the regulation of platelets such as platelet life span, platelet generation and platelet destruction, as well as the role and mechanism of platelet regulation in the initiation and development of blood-related diseases. Emphasis should be given to the effect of platelet functional changes and the associated-blood

diseases in order to provide new theory and target for the prevention, diagnosis and treatment of the blood-related diseases.

5. The role and mechanism of “Gut-Liver Axis” in gastrointestinal diseases (H03)

The research should focus on gut microbiome and metabolites, nutrition, neurotransmitter, gastrointestinal hormones, and bile acid, especially their interaction with the gastrointestinal tract or liver-localized immune cells/factors to mediate a series of functional role. Further elaborate on the "gut-liver axis" and its role in gastrointestinal disease mechanism to establish novel diagnostic and therapeutic strategies.

6. Mechanism and therapeutic strategy of AKI to CKD transition (H05)

To study the molecular mechanism driving the transition of acute renal injury to chronic kidney disease, particularly focusing on the regeneration and repair of renal intrinsic cells after injury, renal interstitial microenvironment and the fate of fibrosis effector cells (such as myofibroblasts) in order to identify novel potential intervention targets, and/or new biomarkers to predict AKI-CKD transition.

7. Nutrition sensing dysfunction and mechanism of metabolic diseases (H07)

The present project supports the study on the role and mechanism of endocrine hormones, cytokines or key secreting substance in nutrition sensing and metabolic disorders through cross-talk between tissues and organs. The project aims to investigate the pathogenesis of metabolic diseases and provide scientific evidence for discovery of potential intervention targets.

8. Studies on pathogenic molecular mechanisms and intervention of neurological or vascular factors in eye diseases that cause blindness (H12)

The applications need to focus on the pathological role and mechanisms of the neurological or vascular factors in eye diseases causing blindness, explore the key molecular regulatory mechanisms of the above-mentioned pathogenic factors, discover the novel biomarkers and new therapeutic targets, and elucidate the neurological or vascular pathological changes related to the blindness development and intervention of severe ocular diseases.

9. The mechanism of dysaudia and a new intervention strategy (H13)

The investigation should focus on pathogenesis, pathological basis and intervention strategy of dysaudia caused by birth defects, aging, physical and chemical factors.

10. Blood-brain barrier abnormalities and central nervous injury (H09)

The projects will focus on pericytes and astrocytes, clarify the regulatory mechanism of blood-brain barrier (BBB) structure formation and function maintenance, and explore the role of BBB destruction in central nervous injury, with a view to find a way to rebuild BBB and offer new ideas and potential targets for central nervous injury treatments.

11. The mechanism of abnormal neuroelectric activity (H09)

The research will focus on the role and mechanism of abnormal neuroelectric activity in the occurrence, development and outcome of neuropsychiatric diseases (epilepsy, sleep disorders, autism, etc.), analyze the basis of abnormal neural networks of diseases, and find the key intervention strategies and drug targets for diseases.

12. Effects and underlying mechanisms of reproductive and endocrine systems on aging (H25)

On the basis of multi-system and multi-disciplinary research, the effects of reproductive and endocrine systems on the occurrence and development of aging in the

body and its regulating mechanism are emphasized. The projects will establish the early warning and evaluation systems, and explore the strategies and methods for intervention of aging and aging-related diseases.

13. Epigenetic regulation of spermatogenesis, sperm maturation, and male reproductive dysfunction (H04)

The research should focus on uncovering the molecular mechanism of DNA, RNA and histone modification in the regulation of spermatogenesis and sperm maturation, as well as clarifying the role of this epigenetic modification in male reproductive dysfunction.

14. Pathogenesis of recurrent pregnancy loss (H04)

The research should focus on the pathogenesis of recurrent pregnancy loss at different stages of pregnancy, uncovering the effect of heredity, immunity, infection and metabolism on pregnancy progression and outcome, and exploring feasible preventive and interfering methods against pregnancy loss.

15. Molecular mechanism and epigenetic regulation of immune microenvironment in major diseases (H10)

The research should focus on the immune microenvironment of major human diseases, including the elucidation of crucial epigenetic modification that regulates immune homeostasis which affects disease progression (such as nucleic acid and histone modifications), clarifying the relationship between epigenetic regulation and immune microenvironment, highlighting specific epigenetic modification in major diseases, and exploring novel immunotherapeutic for targeting epigenetic modifications in major diseases.

16. Identification of novel pathway in immunotherapy and the elucidation of their molecular mechanism (H10)

The research should focus on exploring a novel pathway of immune cells (i.e., T cell, NK cell, NKT cell, etc.) and uncover their molecular mechanism in disease-specific microenvironment *in vivo*, or through artificially-designed disease microenvironment (i.e., PDX or tumor organoids) *in vitro* and *in vivo*.

17. Innovative ultrasound or nuclear medicine imaging technology (H18)

With the application of new ultrasound or nuclear medicine imaging technology, research should be carried out about visualized monitoring, evaluation, diagnosis and differential diagnosis, early warning, and clinical decision-making on critical diseases through non-invasive *in vivo* imaging of physiological and pathological changes in the living body.

18. Intelligent materials, devices and systems for diagnosis and treatment of vascular diseases (H18)

Aiming at the prevention and treatment of cardiovascular events caused by heart, brain and peripheral vascular diseases, research should be conducted on smart materials, devices and systems for key scientific issues during the process of vascular repair, regeneration, and inhibition.

19. Mechanism and protection of physiological damage in special environments (H21)

For the physiological damage caused by long-term exposure to special environments such as aerospace, space, navigation, deep diving, plateau, and polar regions, changes of physiological systems, tissues, organs and cellular molecules are analyzed to reveal the regulatory mechanism of body's internal environment in damages with special causes and

develop intervention and protection measures based on new ideas and technologies.

20. Mechanisms of body damage and death caused by new toxicants and their molecular temporal changes (H23)

Systematic studies should be carried out on the interaction between new toxicants, drugs, and exogenous psychoactive substances and the body, as well as the mechanism of the structural impairment, functional damage, and death of cells, tissues, and organs caused by these substances. Through analyzing these toxic substances' catabolism pattern and exploring their phase characteristics and markers, which are relatively stable, detectable, and identifiable in common biological samples, are screened.

21. Repair mechanism for bone and joint injury (H06)

The research should focus on studying the regulatory mechanism of the occurrence and development of bone and joint injury, and on this basis, exploring new targets for intervention, exploring new methods of repair by means of regenerative medicine, and developing new treatment strategies.

22. Mechanism of rehabilitation intervention to promote the recovery of dysfunction of heart, brain and lung diseases (H17)

The research should focus on the rehabilitation mechanism of dysfunction caused by heart, brain, lung disease or injury, and the mechanism of rehabilitation intervention by means of rehabilitation training, physical factors, rehabilitation engineering and others.

23. Characteristics and pathogenic mechanism of human non-viral pathogens (H19)

The research should focus on genetic variation and evolution, drug resistance and transmission mechanism, pathogenesis and interaction with the host of human important pathogenic bacteria, fungi and parasites.

24. Investigations on new laboratory medicine technologies of serious illnesses (tumors excluded) (H20)

The Division mainly supports the research on molecular markers of serious illnesses (tumors excluded), meanwhile, new laboratory medicine methods and technologies are expected to be discovered and developed, which provide technological means and theoretical basis for early-phase disease diagnosis and treatment.

25. Tumor heterogeneity and treatment resistance (H16)

The research should discover the key factors of treatment resistance related molecular heterogeneity of tumor cells and its formation mechanism, during chemotherapy, radiotherapy, targeted therapy or immunotherapy, and illustrate the interactions among different types of heterogeneous tumor cells and to interpret the molecular mechanisms, so as to provide new targets for overcoming the treatment resistance caused by tumor heterogeneity.

26. Mechanism of cell malignant transformation during tumorigenesis (H16)

The research should investigate the molecular mechanism that regulates tumorigenesis, and elucidate the key genetic, epigenetic or environmental factors, that drive cell proliferation and malignant transformation in vivo, and reveal the potential strategies for early diagnosis and treatment.

27. Tumor metabolic reprogramming and protein modification (H16)

The research should discover the key interactions and the molecular mechanisms between post-translational modification of proteins and metabolic reprogramming of tumor cells, elucidate the precise regulatory mechanisms of protein modification on tumor cells

and the metabolic reprogramming of tumor microenvironment, and investigate the strategies for targeted treatment of tumor metabolic reprogramming by post-translational modification of proteins (e.g., enzymes), as well as methylation, acetylation, phosphorylation, ubiquitination of important proteins and new modification of important biological functions.

28. Mechanism of tumor recurrence and organ preferential metastasis (H16)

The research should investigate the key causes of organ preferential metastasis of tumor, illustrate the key signaling pathway and regulatory mechanism during organ preferential metastasis, taking anatomical factors, microenvironment factors and characteristics of tumors, etc., into consideration and find the key predictive markers or marker groups and potential treatment targets for organ preferential metastasis.

29. Mechanisms of environmental factors and microorganisms in the development of skin diseases and related preventions (H11)

The research should focus on the mechanism and main targets of environmental physical and chemical factors such as temperature, humidity, ultraviolet rays and microbial factors such as fungi, bacteria, viruses on the occurrence and development of skin diseases, and through the intervention of the above factors to explore the mechanism of treatment of skin diseases.

30. Mechanisms of dietary nutrients in human health and disease prevention (H2603)

The research should explore the mechanism of dietary nutrients on human health, the research focuses on the correlation between dietary nutrients and the occurrence and development of diabetes, cardiovascular disease, non-alcoholic fatty liver disease, neurodegenerative disease and other major diseases, and further investigation into the preventive effect of dietary nutrients.

31. Research on the mechanisms of environmental factors on the occurrence of chronic non-communicable diseases (H2610)

Through large-scale population study, the research should focus on the mechanism of social and psychological factors, physical and chemical factors and biological factors on common chronic non-communicable diseases.

32. Study on the lead compounds discovery based on protein degradation mechanisms (H30)

The research should focus on studying original new drugs targeting major diseases including malignant tumors, autoimmune diseases or neurodegenerative diseases, etc., in view of ubiquitin-proteasome or autophagy-lysosome pathway related protein degradation mechanisms.

33. Membrane receptor target discovery and drug intervention in major diseases (H31)

The research should focus on exploring the role of GPCRs and their biased ligands in the occurrence, development and the molecular mechanisms of cardiovascular and cerebrovascular diseases, neurodegenerative diseases or tumors, etc., by means of systems biology, chemical biology, gene editing model animal, or big bioinformatic data; feasibility verification of the membrane receptors and their biased ligands as novel targets; screen of targeted drugs and exploration of *in vivo* and *in vitro* effects.

34. Novel target discovery and rational medication based on the nuclear receptor-drug metabolizing enzyme/transporter system (H31)

Mechanism exploration of PXR, FXR, AHR and other nuclear receptors in

regulating drug metabolizing enzymes and transporter systems in pathological states, as well as drug interventions of diabetes, liver disease, obesity and other diseases related to metabolic homeostasis disorders; reveal of the molecular mechanisms of the nuclear receptors on the selective regulation of drug metabolizing enzymes, transporter system and metabolic homeostasis; illumination of academic basis for clinical safe and rational drug use and novel target identification.

35. Biological basis of traditional non-medicine rehabilitation and recovery of injured nerve (H27)

Under the guidance of Traditional Chinese Medicine (TCM) rehabilitation theory, the research should focus on biological basis of dysfunction induced by nerve injury, and mechanisms for the function remodeling of injured nerve facilitated by traditional non-medicine rehabilitation employing multidisciplinary techniques including functional imaging, optogenetics, chemical genetics and epigenetics, etc.

36. Systems biological basis of blood stasis syndrome (H27)

Under the guidance of theory of qi and blood in TCM, using techniques and approaches of systems biology including multi-omics, bioinformatics and computational biology, etc., the study should focus on major disease which is closely related to BSS and supported by evidence-based medicine to explore pathological mechanisms of BSS and its evolution, and mechanisms responsible for effects of formulas for promoting blood circulation and removing blood stasis on BSS in the manner of combinations of diseases and syndromes.

37. Discovery and the mechanisms of the efficacy related substances of Chinese Material Medica (H28)

Under the guidance of the theory of Traditional Chinese Medicine and the clinical practice, with combined chemical and biological approaches and methods, using chemical biology, systems biology, network pharmacology and computational biology and so on, the research will focus on commonly clinical effective herbs to explore the relationship of the efficacy related substances, pharmacological activity and clinical efficacy and elucidate the effective substances and the underlying mechanisms at the whole and molecular level, and thus provide scientific evidence for the clinical application of Chinese Material Medica.

38. Mechanisms for the prevention and treatment of malignant tumors by Integrated Traditional Chinese and Western Medicine (H29)

The research should focus on the positive therapeutic effects of therapies, formulas and preparations with the features of Integrated traditional Chinese and Western Medicine on cancer with high morbidity and mortality, and further explore the mechanisms in different phases, such as inflammation-cancer transformation or tumor metastasis, and thus provide the new target and strategy for the cancer prevention and treatment by Integrated traditional Chinese and Western Medicine, and provide the evidence for clinical translation.

Major Research Plan

Major Research Plan is designed to be a program cluster which contains a number of projects with relatively unified objectives and orientations by focusing on critical scientific issues in accordance with major national strategic demands and key scientific frontiers, strengthening the top-level design, encapsulating scientific goals and gathering advantageous research resources, so as to facilitate crossing and convergence of multiple-disciplines, foster innovative talents and teams, promote the original innovation ability of the basic research in China and provide scientific support for the national economy, social development and national security.

The Major Research Plan follows the principle of “definite objective, stable support, integration and promotion, and leap-forward development”. The funding period for Major Research Plan projects is 8 years in general.

An applicant must meet the following eligibilities:

- (1) Have the experience of undertaking basic research projects.
- (2) Have a senior professional position (title).

In-site post-doctors, or graduate students, or researchers without a research institution or whose host institutions have not been registered at NSFC cannot apply as the Principle Investigator.

An applicant may submit no more than one proposal in the same year, and grantees of the Major Research Plan program are not allowed to apply for this kind of programs in the following year, excluding Integrated Program and Strategic Research Program.

The Major Research Plan consists of three subcategories, namely, the Fostering Program, Key Program and Integrated Program, of which each one is open to application. Proposals shall be prepared in accordance with the requirement for the Major Research Plan and outlines of application, highlighting definite objective and key breakthrough, featuring interdisciplinary research, emphasizing on the contributions to solving critical scientific issues and fulfilling the overall goals of the Major Research Plan. Applicants should select “Major Research Plan” for the column of the funding type in the application form of proposal, and Fostering Program, Key Program, or Integrated Program for the column of sub-type, and input the title of the Major

Research Plan in the annotation.

Generally speaking, the duration for Fostering Program project is 3 years, for Key Program project is 4 years, and that for Integrated Program project is determined by the Steering Committee of each Major Research Plan based on the actual need. For Fostering Program project and Key Program project, the collaborative institutions involved may not exceed 2 in number. The number of collaborative institutions involved in one Integrated Program project may not exceed 4. The main participants must be the actual contributor to the Integrated Program project, and total number of main participants may not exceed 9.

Regulations on managing and sharing of data and information should be observed in order to implement the overall scientific objectives and multi-disciplinary integration of the Major Research Plan. During the progress of project, attention should be paid to the supporting relationship among various programs.

Annual academic seminar on funding projects of the Major Research Plan and aperiodic academic symposium on relevant research area should be held, so as to strengthen academic exchange, achieve research on the overall scientific objectives and cross and integration of multi disciplines. The PIs of the granted projects are obliged to participate in these activities.

For details of each Major Research Plan, please refer to the relevant sections of introductions on Major Research Plan in this *Guide*.

Program Guidance for other Major Research Plans will be released successively on the NSFC website.

Physics and Application of New Optical Field Regulation

This major research plan aims at obtaining new type of optical field with specific multi-dimensional time space structures (polarization, phase, frequency, and pulse width and module field) by precise control of the physical process of the interaction of optical field and matter, studying the regulation of systems such as atomic, molecular, electron and artificial nano micro structures by the new type of optical field, discovering new phenomena and physics, and promoting application of optics in information science, chemistry, live sciences and materials sciences.

I. Scientific Target

Main target of this major research plan is to study the construction, propagation, measurement and phase interference of new types of optical field, explore new physical concepts and related method of multi-dimensional optical field regulation required in research in physics, information processing and communications, materials, chemistry and life sciences, discover new phenomenon and effects through research in the interaction of new types of optical field and matter, develop related new techniques, and by implementing this research plan, meet the need of national importance, provide knowledge for sustainable development and national security, foster high level research team and leading scientists of international importance.

II. Key Scientific Problem

This major research plan mainly funds research focusing on multi-dimensional regulation physics and application of new types of optical field, multi-dimensional precision configuration, regulation and characterization of new type of optical field, and key problems in new physics, new effect and new applications related to the interaction of new type of optical field and matter.

III. Funding for 2019

In 2019, we received 127 applications, among which, 29 for Key Projects, and 98 for Fostering Projects. After evaluation, 8 Key Projects and 21 Fostering Projects were funded. The total funding was 47.34 million yuan.

IV. Funding Plan for 2020

In 2020, it is planned to fund 15 Fostering Projects with strong emphasis on exploration. The funding will be 800,000 yuan per project for 3 years. We also plan to fund 4 to 5 Key Projects for applications with good research background and potential to make breakthrough. The funding will be 4 million yuan per project for 4 years.

V. Funding Areas for 2020

In 2020, it is encouraged to develop research method using interdisciplinary studies.

Research contents include multi-dimensional construction, regulation and characterization of new types of optical field, the generation and regulation of ultra-fast optical field, interaction of light and mass beyond the diffraction limit, etc. Key areas of support are:

1. Far field and wide field non-marker dynamics high resolution imaging (with wide field larger than 100 micrometer, spatial resolution better than 100 nanometer, imagine rate higher than 1000 frame per second);
2. Super-fast dynamics and regulation for atomic, molecular and complex systems;
3. Application of regulated optical field in chemistry, life and material sciences;
4. Micro-nano photoelectric integrated chips for new generation of information and biomedical technologies.

VI. Principles of Selection

All applications should focus on new principles of new types of optical field regulation, focusing on 1 or 2 key problems.

1. Exploration in frontier areas is encouraged; and priority will be given to original research;
2. Research focusing on discovering new phenomena, new physics, novel technologies and potential of applications is encouraged;
3. Interdisciplinary research, especially intercrossing with information, chemistry, life and materials sciences is encourages;
4. Integration of theory and experiment is encouraged.

Generation and Evolution of Turbulent Structures and Mechanism of Its Effect

This major research plan, the generation and evolution of turbulent structures and mechanism of its effect, is needed in research in aeronautics, space, navigation and atmospheric science, and related disciplines in turbulent research. Based on turbulence structural dynamic theories, using numerical method, experimental measurement and data processing and analysis, this research plan studies the generation and evolution of turbulent structures and mechanism of its effect under various conditions. It is encouraged to combine physical mechanism and applied research, new ideas, new theories, new method and new technologies, to develop high precision numerical method and fine measurement technology, to reveal the generation, evolution and interaction mechanism, to develop turbulent model theory of high spatial temporal accuracy based on turbulent structures, and verify theory and model, and make accurate prediction and control of turbulent drag, heat flux rate and turbulent noise in major engineering project. It is hoped that the original research results can provide scientific theory and method in major engineering areas such as development of large carrier equipment in aeronautical, space navigation industries, and control of atmospheric pollution.

I. Scientific Target

Main target of this major research plan is to obtain original results in developing new

ideas, new theories, new methods and new technologies, solve several key difficulties in major engineering applications, so as to promote innovation capabilities, and provide scientific theories for technology development. The Plan also aims at fostering outstanding talents in turbulent research, developing several interdisciplinary research platforms in turbulent research, developing basic and applied basic research in complex problems in turbulence, and a school of turbulent research with Chinese characteristics. Breakthroughs are expected in the following 4 aspects.

1. New ideas based on turbulent structures, exploring disruptive ideas;
2. New theories based on structural unit, new models based on spatial temporal coupling and physical constraints;
3. New method of characterizing turbulent structures based on Lagrange views, and computational and experimental method for near boundary 3D turbulent structures with spatial temporal analysis of high precision efficiency;
4. New technology of flow control, and drag reduction, thermal protection and noise reduction, new design based turbulent structure, and improvement on turbulent software.

II. Key Scientific Problem

1. Dynamics of turbulent structure generation in different conditions: study transitions from the view of turbulent structure generation, and propose transition theory based on dynamics of turbulent structure generation by breaking the current framework stability theory.

2. Dynamics of multi-spatial temporal scales: study the evolution of turbulent structures from spatial temporal coupling, break theoretical framework of turbulent energy level process develop turbulent theory, computation method and experimental techniques based on multi-spatial temporal scale dynamics.

3. Mechanism and principles of controlling the impact on mechanical, thermal and acoustic transport by turbulent structures: by fine description of turbulent structures, hence break the traditional framework of viscous vortex model, and make accurate prediction and control of drag, heat flow and flow noises.

III. Funding Plan for 2020

We plan to fund about 6 fostering projects; average funding is about 1 million yuan per project for 3 years. We plan to fund about 4 key projects and the average funding is about 4 million yuan per project for 4 years.

IV. Key Funding Areas for 2020

In 2020, the Plan funds projects in the form of fostering projects and key projects, and start to fund integrated projects. The fostering projects will be of the exploring and novel type, and key projects will be of the type having originality, solid research accumulation, and hopes of making breakthrough. The integrated projects are for very important and very hopefully making breakthrough projects. The Plan encourages participation of different disciplines such as mechanics, mathematics, physics, atmospheric science, engineering thermal physics and information sciences.

i. Fostering projects and key projects

The following research directions will be funded:

1. Generation and evolution of complex turbulent structures

Study the effect of curved boundary on transition, and develop model of predicting flow transition under the influence of system rotation and curved boundary; study flow transition, separation and laminar mechanisms and models of prediction in high speed rotation conditions; develop hypersonic transition models (both physical and mathematical), and study the effect of Mach number, boundary temperature, boundary vibration, and roughness on hypersonic instability and transition; study mechanism of turbulent structure generation caused by high compressible flow and high temperature; develop physical and mathematical models turbulence formation in high temperature and high pressure conditions; explore transition mechanism of complex media flow; study instability, transition and aerothermodynamic mechanisms during spacecraft re-entry; conduct studies on multiple physical interface instability and turbulent mixing structures and lower dimensional simplified models; and study mechanism of mixing flow transition with density variation.

2. Multi-time space scale interactions of turbulent structure evolution

Explore methods of identification, characterization and tracking of turbulent structure evolution; study fine description of turbulent structure in various conditions such as rotation, magnetic field, buoyancy, etc.; develop unified model of multi-phase turbulent flow dynamics and kinetics, study the effect of polymer, bubble and particles on turbulent structure; reveal the mechanism of interaction of wake and free surface in moving boundary; study the mechanism and evolution of interaction between internal and external flows, shock wave and turbulence, shock wave and boundary layer for typical aircraft; develop method of turbulent analysis and modeling based on artificial intelligence and physical constraint; develop model theory based on evolution of turbulent structures, RANS-LES mixing model and LES models; study nonlinear and memory properties of large scale turbulent structure, develop reduced dimension model for turbulent structure evolution, and conduct effective control method for large scale turbulent structures; reveal flow field features of turbulent flow around complex marine engineering structures and develop related computation models; develop models of multi-scale interaction in air fluid two phase flows; explore new concept, mechanism and flow control method for drag reduction.

3. Mechanism of the impact of turbulent structure on mechanical, thermal and acoustic properties

Conduct studies on controls of typical unsteady flow separation; explore active and passive control method for moving boundary transition and turbulent drag reduction; study the effect and mechanism of multi-scale turbulent structure on mass and heat transfer in various physical conditions such as rotation, magnetic field and buoyancy; study mechanism of interaction between turbulent structure and aerothermodynamics in hypersonic flow, and principles of heat protection for key component of hypersonic aircraft; study physical mechanism of coupling, evolution, scattering and radiation of acoustic, wave, vortex caused pulses in turbulent boundary layer and fluid interface, propose models and prediction method for flow caused noises; study modeling and testing method for radiated acoustic spectrum by jet and fan noises; explore mechanism of sound generation control method for turbine blade noise; study mechanism of noise generation and control principles for 3D curved boundary layer transition flows; study mechanism and method of noise reduction for underwater crafts traveling in high Reynolds number based on flow structures, study the mechanism and modeling of cavity induced noise and erosion caused by cavity, the interactions between cavity and turbulence; and study the evolution of wake vortex in stratified sea water media.

4. High precision computation of turbulent flows and high resolution experimental techniques

Develop high precision robust numerical method for multi-phase flows in extreme conditions; develop high precision simulation and turbulent computation model for aircraft in large angle of attack turbulent flows; develop high precision experiment method for turbulence boundary layer structure and hypersonic boundary layer aerothermodynamics; develop time resolution measurement technology for highly unsteady, extreme velocity, temperature and pressure conditions; conduct studies on flight and ground testing technology for hypersonic aircraft; study synchronized test and experimental method for turbulent structure and multiple physical parameter fields; study high precision experimental measurement method and technology for flow field in rotating, magnetic field and buoyancy conditions.

ii. Integrated projects

The following areas are planned to be fund:

1. Heat protection for hypersonic aircraft

Research objectives: using turbulent structure, to find key scientific problems, and make breakthrough in heat protection and drag reduction, achieve major research results and applications using typical application by demonstrations.

Research contents: effect of typical shape of hypersonic aircraft on physical structure of flows during transition; quantitative correlation between structure of flows and friction drag, and aerodynamic heating; high precision flow numerical and experimental method; new concept and control method in heat protection and drag reduction.

2. New theory, new method and new technology of turbulent flow

Research objectives: using innovative ideas in theory, numerical computation, experimental technique and methods of data processing and analysis, explore the generation, evolution and functions of turbulent structure, so as to achieve important original results in developing new theory, new method and new techniques.

Research contents: turbulent theory based on structure elements in different flow and different flow forms; turbulent models based on temporal and spatial relationship and physical constraints; precise and efficient computation and experimental measurement methods with temporal and spatial analysis of the 3D near boundary turbulent structure; flow control, drag reduction, heat protection and noise reduction techniques, and design ideas based on turbulent flow structure, and improvement on the accuracy and practicability of turbulent application software.

V. Basic Principles of Selection

This major research plan requires that

1. Research should meet the requirement outlined in this *Guide*;
2. Exploratory research is encouraged; priority is given to new concept, new theory, new systems and new method of turbulent structure evolution and models;
3. Interdisciplinary research is encouraged;
4. International cooperation is encouraged.

Fundamental Theory and Key Technology of Coexisting-Cooperative-Cognitive Robots (Tri-Co Robots)

Tri-Co Robots refer to robots that can interact naturally with the working environment, human, and other robots, adapt themselves to complex dynamic environments autonomously, and cooperate with each other. The Tri-Co robots are characterized as with flexible and reconfigurable structure, multi-modal perception, as well as distributed and autonomous cooperation. This Research Initiative aims at developing fundamental theory and key technology for Tri-Co robots in terms of robotic structure, perception and control to meet the challenges in intelligent manufacturing, rehabilitation and national security, and laying down the foundations for the nation's robotic technology development, commercialization, and applications.

I. Program Objectives

This major research plan aiming at international robotic research frontiers, centered on fundamental theory and design method of Tri-Co (human-machine-environment) robots by enhancing disciplinary crossing and integration, seeks to (i) make innovative achievements in rigid-flexible-soft coupled structure design, multi-modal and dynamic environmental perception with human-machine cooperation, and distributed robotic systems with swarm intelligence, (ii) foster internationally high-impact academic scholars and leaders, and (iii) improve the international impact and overall innovation capability of our nation's robotic research.

II. Major Research Topics

1. Kinematics and controllability of the integrated rigid-flexible-soft robots

Rigid-flexible-soft robot design and mechanical behavior analysis, dynamics and stiffness control for robot-human-environment interaction.

2. Multi-modal perception of human-robot-environment and autonomous interaction

Multimodal perception and scene understanding in unstructured environment, bio-signal-based behavioral perception and human-robot autonomous interaction.

3. Swarm intelligence and related software systems

Mechanism of individual autonomy and swarm intelligence, multi-model distributed framework of swarm robot operating system.

III. Major Research Directions in 2020

In 2020, the program funding will be provided in the form of Key Projects and Integration Projects. Funding period will be 4 years, and the research period in the application form should be filled as "January 1, 2021 to December 31, 2024". The average direct funding of Key Projects is 3 million yuan/project, and 2 projects will be supported.

The average direct funding of Integration Projects is 12 million yuan/project, and 2 projects will be supported.

i. Key Projects

Key Project mainly supports research on the structure, perception and control of Tri-Co Robots with potential applications in the fields of intelligent manufacturing, medical rehabilitation, national security, etc. The specific funding directions are as follows:

- 1. New conceptual human-machine collaboration system.**
- 2. New principles of precision drive and transmission for robots.**

ii. Integration Project

Integration Project mainly supports research that has achieved important progress under the support of previous Key Projects, and through integration and sublimation, it is expected to make a major breakthrough in resolving the needs of industries and major national applications. The specific funding directions are as follows:

1. Aiming at the requirements for advanced human-robot cooperation in complex tasks with certain skills, new principles and methods of human-robot collaborative operation should be investigated.

The project focuses on solving key problems such as the bioinspired integrated design of mobile dual-arm collaborative robot, dynamics and cooperative control of human-robot-environment interaction system, task intention comprehension and human-robot co-adaptive cooperation technique, efficient human to robot skill teaching and robotic skill enhancement, the assessment of the human-robot collaborative status, and safe operation mechanism. In addition, it is also required to perform technical verification and demonstration of the human-robot coexisting cooperation in typical applications such as industrial precision assembly and flexible line production.

2. Aiming at the requirements for innovative manipulation mode and equipment for the exploring, monitoring, and operating tasks in extreme environments (such as deep sea, the space, and polar), this project investigates new principles of the environment adaptive mechanisms in rigid-flexible hybrid robot, the hybrid actuating system and the manipulation methods with sensor fusion.

The project focuses on the design of rigid-flexible coexisting mechanism with environmental adaptability, the structural design and control methods of the hybrid actuating mechanism, and the manipulation methods with sensor fusion for complex tasks. Demonstration and validation will be carried out for the practical exploring tasks under extreme environment.

IV. Major Selection Criteria

To ensure that the overall goal can be achieved, it is required that all proposed research should strictly follow this guideline, and all proposals will be evaluated based on the following criteria:

- (1) Encourage exploratory research in frontier fields and priority will be given to the new research directions;
- (2) Encourage interdisciplinary research and strongly support biomedical-engineering cross-disciplinary research with substantive medical studies for rehabilitation programs;

(3) The research with substantive international cooperation will be considered with high priority;

(4) Proposals submitted by junior scholars will be considered with high priority;

(5) Integration Program needs to reflect the inheritance and major improvement of the research results from the previous funded program, and meanwhile must have leading research goals and standards. In principle, the research group should be composed of people from multi-disciplinary backgrounds to conduct research jointly and form an innovative research model and mechanism of cross-integration;

(6) The proposals not consistent with the objectives of this program and not related to Tri-Co robots will not be considered.

V. Application Guidelines

(1) Please read this guideline carefully before filling in applications. This major research plan aims to guide research directions strategically and integrate advantages in related fields, then to build a project cluster with a unified research goal or direction. Proposals should focus on specific key topics and relations with the most relevant topics to the guidelines should be illustrated clearly. The contributions to solving core issues and to the overall research objectives of this major research plan should be illustrated in the proposals as well. If the applicant has undertaken other national science and technology projects related to this major research plan, distinction and relationship between the proposed project and other related undertaken projects should be declared in the “Research Background” in the proposals.

(2) In order to enhance academic exchange of the major research plan, promote the programs spreading out with the major research plan objectives and multi-disciplinary integration, there will be an annual academic conference for the funded projects each year, and other academic seminars in relevant fields irregularly. If funded, the project leader is obliged to participate in the above academic activities.

(3) Regulations on sharing of data and information should be followed in order to achieve the overall scientific objectives and multi-disciplinary integration of the Major Research Plan.

(4) During the implementation period, the research group should participate in the “Integration Robot Challenge” at least once.

(5) Choose funding category of “Major Research Plan” and sub-category of “Expletory Program” or “Key Program” in your application. Explanation of “Research on Fundamental Theory and Key Technology of Coexisting-Cooperative-Cognitive Robots/Tri-Co Robots” should be indicated. Application code should be chosen according to your specific research topic.

(6) The application should be submitted to the Department of Engineering and Materials Sciences in NSFC.

Scientific Foundation for High Temperature Materials, Advanced Manufacturing and Fault Diagnosis of Aero Engines

Aero engines are among the most important technologies for the country and are crucial both economically and technologically regions. Any breakthrough in this area will lead to considerable advancements of the aero engine industry. An aero engine works in the conditions of exceedingly high temperature, high pressure, high speed and variable loads. As such, design and manufacturing of the key components of aero engines require advanced technologies of high complexity as well as advanced materials. Furthermore, due to the extreme service conditions, the operation monitoring is also extremely important for safety concerns. However, the inadequacy in relevant basic scientific research has greatly limited the development of aero engines in China. The major research plan focuses on the investigations in high temperature materials, advanced manufacturing and operation malfunction diagnostics, in the hope to overcome the bottlenecks and to provide the fundamental innovative think tank and scientific supports.

I. Scientific Target

The major research plan is to meet the nation's strategic needs. It will especially focus on the investigations of high temperature materials, advanced manufacturing and operation malfunction diagnostics. It will attempt to advance the aeroengine industry of China via fundamental researches of multidisciplinary efforts and profound integrations. Under the stable and intensive support, the initiative will cluster and build an international level team on the fundamental research of aero engines.

II. Key Scientific Problems

1. High temperature materials for aero engines—property optimization and long-term stability in service

Composition design, phase structure optimization, microstructural evolution in service conditions and their relation to the high temperature properties; initiation and development of defects in the high temperature materials during processing and service, and their multiple-scale characterization and tailoring; search for new high temperature materials for aero engines.

2. Mechanism of synergistic control of surface precision and performance of the key components of aero engines

Mechanisms of manufacturing and precision control of aeroengine key components, mechanisms of the interaction of non-traditional/hybrid energy field with high-temperature materials, evolution and control of machined surface states for aeroengine key components.

3. Principle of state information sensing and intelligent diagnosis/prediction for aero engines

The theory and methodology for information sensing and monitoring of aero engines;

artificial intelligence and big data methodologies for fault diagnosis; fault-tolerant control and sparse sensing fault prediction methodologies for aero engines.

III. Funding Research Directions in 2020

The support will be in the forms of Fostering Program, Key Program and Integrated Program. For Fostering Program, the direct cost will be on average 650,000 yuan/3 years. For Key Program, the direct cost will be on average 3 million yuan/4 years. For Integrated Program, the direct cost will be no more than 15 million yuan/4 years.

Fostering Program

1. High temperature materials

- (1) Compositional design and microstructure optimization, and their effects on properties;
- (2) Correlation between microstructural evolution and the stability of properties during processing and service;
- (3) Multi-scale characterizations of the properties and structural defects in service conditions.

2. Advanced manufacturing

- (1) Governing rules for the relationship between processing and component quality as well as performance of the component;
- (2) Mechanisms of the effects of non-traditional/hybrid energy field on the materials of the aeroengine components;
- (3) Data driven process modeling and optimization and processing control.

3. Fault diagnosis

- (1) Damage identification for aeroengine blades, high pressure turbine bladed-discs;
- (2) Dynamic sensing, testing, fault isolation and fault-tolerant control for high temperature components;
- (3) Multi-information fusion and intelligent prediction.

4. Other frontier researches on new concepts, new principles, and new methodologies closely related to the scientific objectives of the major research plan.

Key Program

Priority support will be given to the researches related to: composition design of high temperature materials for aero engines, microstructure tailoring and characterization, long service life and its stability, influences of manufacturing process on macro/micro geometry and performance of components, evolution and control of machined surface states for aeroengine components, and mechanism and characterization of the faults for aero engines.

Integrated Program

Priority will be given to the proposals that target key components of aero engine, focusing on the three scientific issues, including multi-scale strengthening and toughening design and long-life service stability of high-temperature materials, the impact mechanism of manufacturing on key component performance and quality assurance, fault information perception and state intelligent prediction, aiming at the very important and promising direction of the major research plan, so as to identify objectives, gather resources, and carry

out integrated research to achieve leapfrog development and support the breakthroughs of key technologies.

IV. Basic selection criteria

In order to ensure that the overall goals can be achieved, it is required that all proposed research efforts should strictly follow the Notes to Applications. All proposals will be evaluated based on the following criteria:

(1) Encourage frontier and exploratory research on new concepts, new theories and new methodologies; priority will be given to original research;

(2) Joint efforts between aero-engine enterprises and institutes are strongly encouraged;

(3) Interdisciplinary proposals are encouraged;

(4) The proposals not consistent with the objectives of this Initiative and not closely related to the materials, manufacturing and diagnosis of aero-engines will not be considered.

V. Notes to applications

(1) Please read the Notes to Applications carefully prior to filing in applications. This major research plan aims to guide research directions strategically and to integrate advantages in related fields so as to build a project cluster with a unified research goal or direction. Proposals should focus on the key topics specified in the Notes to Applications. The contributions to the focused scientific topic and to the overall research objectives of this major research plan should be clearly stated in the proposals. Proposals not complying with the Notes will not be considered. If the applicant has undertaken other National Science and Technology Projects related to this major research plan, distinction and relationship between the proposed project and other related undertaken projects should be declared in the “Research Background” in the proposals.

(2) Choose funding category of “major research plan” and sub-category of Fostering Program, Key Program or Integrated Program in the application. Explanation of “Scientific foundation for high temperature materials, advanced manufacturing and fault diagnosis of aero engines” should be indicated. Application code should be chosen according to the specific research topic.

(3) The application should be submitted to the Department of Engineering and Materials Sciences.

Young Scientists Fund

The Young Scientists Fund supports young scientists to freely select their research topics within the funding scope of NSFC to conduct basic research, particularly focus on fostering the ability of young scientists to independently undertake research projects and conduct creative research, stimulates their creative thinking and trains backup talents for basic research.

An applicant must meet the following qualifications:

(1) Have the experience of undertaking basic research projects or doing basic research;

(2) Have senior professional title or doctoral degree, or are recommended by two professionals with senior academic positions (titles) in the same research field.

(3) By January 1 of the year of application, male applicants must be younger than 35 (born on or after January 1, 1985) and female applicants must be younger than 40 (born on or after January 1, 1980).

On-the-job doctoral students who satisfy the above criteria may apply through their employers with the consent of their supervisors. Those who are the PIs of ongoing project of Young Scientists Fund or have undertaken it, including one-year Small Fund for Exploratory Studies, and terminated or withdrawn projects, cannot apply again.

For Young Scientists Fund, the creative potential of the applicant is mainly evaluated. Applicants should compose proposals in accordance with the outlines of application for Young Scientists Fund. The project duration is 3 years. (except for PIs as in-site post-doctoral researchers, whose duration of the project should be determined based on the letter of commitment from their host institutions, and start time should be January 1, 2021 and finish time should be December 31, 20XX, and they cannot change the host institution after the project is awarded).

Special reminders to the applicants:

(1) Participants are no longer listed in Young Scientists Fund.

(2) In 2020, for Young Scientists Fund, pilot paperless applications are carried out. In process of the submission, the host institution shall only confirm the online application and the attachments, without having to

submit a paper form application. Once approved, the signature and seal page of the application form should be submitted at the time of submitting the project plan. The signature and seal information should be consistent with that of the electronic application.

(3) In 2020, the Young Scientists Fund projects are funded in fixed amounts, the direct cost is 80,000 yuan and the indirect cost is 20,000 yuan per project for each year.

In 2019, a total of 17,966 Young Scientist Fund projects were funded. The direct cost was 4.2 billion yuan. The average funding was 234,200 yuan per project, with a success rate of 17.90%, which is a decrease of 2.64% over that of 2018 (please refer to the table below for the funding situation).

Funding of the Young Scientists Fund Projects in 2019

Unit: 10,000 yuan

Departments	No. of applications	Awards			Share of NSFC total funding for direct cost (%)	Success rate (%)
		No. of awards	Funding for direct cost	Average funding for direct cost		
Mathematical and Physical Sciences	6,774	1,800	45,000	25.00	10.69	26.57
Chemical Sciences	8,015	1,566	39,260	25.07	9.33	19.54
Life Sciences	13,519	2,428	58,240	23.99	13.84	17.96
Earth Sciences	7,481	1,727	43,220	25.03	10.27	23.09
Engineering and Materials Sciences	16,460	3,121	78,011	25.00	18.54	18.96
Information Sciences	8,837	2,134	52,154	24.44	12.39	24.15
Management Sciences	5,817	865	16,230	18.76	3.86	14.87
Health Sciences	33,473	4,325	88,680	20.50	21.07	12.92
Total or average	100,376	17,966	420,795	23.42	100.00	17.90

Please refer to the respective sections of the General Program of various departments for the funding scope of the Young Scientists Fund. Funding situations in recent years and relevant requirements of the Young Scientists Fund are introduced in each department at this chapter.

Department of Mathematical and Physical Sciences

The development of young scientists is particularly important for the development of mathematical and physical sciences. The Department has always been paying attention to fostering and supporting young scientists, and the success rate of the Young Scientists Fund has always been higher than that of General Program projects. In 2020, the Department will maintain a higher success rate for the Young Scientists Fund so as to give more young people the opportunity to do independent research, and to foster outstanding talents for basic research.

The Department received 6,774 applications in 2019, accepted 6,747, and funded 1,800. The success rate was 26.75%, and the direct cost funding was 250,000 yuan per project on average.

**Funding for Projects of the Young Scientists Fund in
Department of Mathematical and Physical Sciences in 2018 and 2019**

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Mathematics	Mathematics I	301	7,074	29.86	286	6,928.7	26.65
	Mathematics II	297	7,067	27.94	320	7,714.3	26.53
Mechanics	Basic problems and methods in mechanics	6	160	28.57	10	259	37.04
	Dynamics and control	59	1,487	28.92	63	1,609	26.92
	Solid mechanics	127	3,214	28.80	146	3,726	27.81
	Fluid mechanics	82	2,083	28.77	82	2,062	25.31
	Bio-mechanics	24	622	29.27	29	749	27.10
	Explosive and impact dynamics	51	1,318	28.81	41	1,029	22.78
Astronomy	Astrophysics	45	1,181	29.41	44	1,115	28.57
	Astrometry and celestial mechanics	51	1,335	28.49	46	1,180	24.73
Physics I	Condensed matter physics	203	5,173	28.79	209	5,295	26.56
	Atomic and molecular physics	48	1,271	29.45	49	1,239	26.78
	Optics	129	3,314	28.79	139	3,537	26.48
	Acoustics	30	765	29.13	28	723	27.18
Physics II	Fundamental physics and particle physics	74	1,844	30.20	83	2,052	27.67
	Nuclear physics, nuclear technology and its application	82	2,123	29.82	79	2,029	25.99
	Particle physics and nuclear physics experimental facilities	76	1,946	26.95	79	2,030	25.99
	Plasma physics	63	1,653	28.64	67	1,723	26.59
Total or average		1,749	42,160	29.65	1,800	45,000	26.57
Direct cost per project		24.11			25.00		

Department of Chemical Sciences

The Department upholds the principle of people first and fosters innovative talents, brings into full play the maintaining and fostering role of the Young Scientists Fund, and steadily enhances the funding following the idea of properly controlling the funding intensity and further expanding the funding scope. The Young Scientists Fund stresses on the research projects with innovative ideas, discourages the research that simply continue the advisors' topics, and gives less weight to research accumulation and the constitution of the relevant research teams, so as to facilitate the growth of young scientists.

In 2019, new discipline codes were employed to conduct funding and management in the Department. 8,015 proposals for the Young Scientists Fund were received by the Department (929 proposals and 13.11% more than that of 2018). 1,566 proposals were funded with a success rate of 19.54% and an average funding of 250,700 yuan per project. In 2019, the success rate decreased by 2.26% compared with that of 2018 based on the guarantee of the funding intensity by the Department.

Funding for Projects of the Young Scientists Fund in Department of Chemical Sciences in 2018 and 2019

Unit: 10,000 yuan

Disciplines	2018			2019		
	Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Synthetic chemistry	261	6,676.2	22.04	266	6,667	19.54
Catalysis and surface/ interface chemistry	173	4,396	21.82	189	4,744	19.50
Chemical theory and mechanism	81	2,058	21.77	89	2,239.5	19.91
Chemical measurement	147	3,732.5	22.07	146	3,661.5	19.52
Materials chemistry and energy chemistry	319	8,170.3	21.38	317	7,943	19.62
Environmental chemistry	194	4,930	21.65	188	4,710	19.67
Chemical biology	121	3,072	22.16	114	2,866	19.49
Chemical engineering and industrial chemistry	249	6,225	21.90	257	6,429	19.28
Total or average	1,545	39,260	21.80	1,566	39,260	19.54
Direct cost per project	25.41			25.07		

Department of Life Sciences

In 2019, the Department received a total of 13,519 applications for the Young Scientists Fund. 13,421 applications were accepted and 2,428 projects were funded with a success rate of 17.96%. The average direct cost of funding was 239,900 yuan per project. The Department will continue to follow the principle of “stabilizing research teams, fostering young talents, stimulating innovative thinking and supporting independent research” for the Young Scientists Fund, and provide steady support to researchers in the early stage of their academic career. **For application details and special notifications, please refer to the section of General Program of the Department in this Guide.**

Funding for Projects of the Young Scientists Fund in Department of Life Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I of Biology	Microbiology	162	4,034	21.40	160	3,832	20.92
	Botany	144	3,575	22.36	146	3,513	19.44
	Zoology	74	1,823	24.26	75	1,788	20.78
II of Biology	Genetics and bioinformatics	114	2,835	24.73	114	2,730	21.39
	Cell biology	74	1,864	22.84	77	1,837	18.08
	Developmental biology and reproductive biology	51	1,251	23.83	53	1,275	19.92
Biomedicine	Immunology	58	1,442	24.68	59	1,406	25.21
	Neurosciences and Psychology	120	2,984	19.87	123	2,947	17.06
	Physiology & integrative biology	45	1,135	22.61	47	1,118	18.22
Interdisciplinary Research	Biophysics/Biochemistry	106	2,628	21.90	84	2,017	21.21
	Biomaterials/ Imaging/tissue engineering	70	1,728	18.04	72	1,720	14.26
	Molecular Biology/Biotechnology	--	--	--	63	1,516	21.65
Environment and Ecology	Ecology	159	3,950	25.56	161	3,863	22.80
	Forestry and grassland science	171	4,243	17.48	163	3,907	16.00
Agriculture and Food Science	Agriculture and crop sciences	199	4,942	18.69	204	4,907	14.97
	Food science	222	5,418	18.05	224	5,374	15.34
Agricultural Environment and Horticulture	Plant protection	135	3,347	21.06	137	3,297	18.22
	Horticulture and plant nutrition	144	3,570	17.71	160	3,830	15.94
Agriculture Animal	Animal husbandry	99	2,437	18.82	100	2,411	16.21
	Veterinary medicine	117	2,892	22.85	118	2,837	20.42
	Aquaculture	86	2,142	17.95	88	2,115	17.96
Total or average		2,350	58,240	20.47	2,428	58,240	17.96
Direct cost per project		24.78			23.99		

Department of Earth Sciences

In 2019, the Department received 7,481 applications for the Young Scientists Fund from 989 institutions, among which, 4,857 were from universities (64.92%), and 2,282 from research institutes (30.50%). Totally, 1,727 projects were awarded with a funding of 432.2 million yuan (direct cost, and hereinafter), with an average funding of 250,300 yuan per project and a success rate of 23.09%. Among the projects funded in 2019, 1,123 were applied through universities (65.03%), and 565 through research institutes (32.72%). One of the most important goals of the NSFC is to support outstanding young scientists continuously and steadily. The main objective of Young Scientists Fund is “cultivation”, and to provide more opportunities for early-career young scholars, especially for recently-graduated scientists to start their research as soon as possible.

Funding for Projects of the Young Scientists Fund in Department of Earth Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Geography	400	9,789	27.21	415	10,388	23.08
II	Geology	253	6,207	27.15	326	8,140	23.14
	Geochemistry	52	1,272	27.23	71	1,762	23.28
III	Geophysics and space physics	171	4,196	27.14	171	4,281	23.08
	Environmental geoscience	525	12,859	27.19	411	10,289	23.08
IV	Marine science	229	5,634	27.07	201	5,061	22.95
V	Atmospheric science	133	3,263	27.14	132	3,299	23.12
Total or average		1,763	43,220	27.16	1,727	43,220	23.09
Direct cost per project		24.52			25.03		

Department of Engineering and Materials Sciences

In order to encourage and foster innovative young researchers and to create a good academic environment, the Department will continue to implement favorable funding policy for the Young Scientists Fund. In 2019, the Department received 16,460 applications (118 rejected) with an increase of 15.24%. 3,121 projects were funded with a total direct cost of 780.11 million yuan. The average funding was 250,000 yuan per project with a success rate of 18.96% (21.54% in 2018).

Please refer to the General Program and other related parts of this Guide for general instruction of the Department and detailed requirements on application.

Funding for Projects of the Young Scientists Fund in Department of Engineering and Materials Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Materials Sciences I	Metallic materials	238	5,945	20.31	254	6,319	18.27
	Organic polymer materials	246	6,151	20.99	258	6,444	18.17
Materials Sciences II	Inorganic non-metallic materials	361	9,045	23.01	360	8,999	19.09
Engineering Sciences I	Metallurgy and mining science	356	8,854	20.86	360	9,009	19.05
Engineering Sciences II	Mechanics and mechanical manufacturing	557	13,914	21.46	558	13,955	19.12
Engineering Sciences III	Engineering thermophysics and energy utilization	251	6,285	21.56	265	6,628	18.43
Engineering Sciences IV	Architecture, environmental and civil engineering	564	14,027	22.01	568	14,202	19.03
Engineering Sciences V	Electrical science and engineering	206	5,129	21.75	206	5,148	19.53
	Hydro-science and water research, Hydraulic engineering and ocean engineering	298	7,402	21.39	292	7,307	19.76
Total or average		3,077	76,752	21.54	3,121	78,011	18.96
Direct cost per project		24.94			25.00		

Department of Information Sciences

In 2019, the Department received 8,837 applications for the Young Scientists Fund, which increased by 6.73% compared with that in the previous year. 2,134 projects were funded with an average success rate of 24.15%. The total direct cost funding was 521.54 million yuan and the average direct cost funding was 244,400 yuan per project.

Funding for Projects of the Young Scientists Fund in Department of Information Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Electronics and technology	183	4,555	26.83	199	4,906	25.91
	Information and communication system	179	4,405.5	26.88	180	4,433	25.82
	Information acquisition and processing	166	4,109.5	26.99	160	3,937	25.81
II	Theoretical computer science, computer software and hardware	118	2,915	29.80	114	2,937	28.36
	Computer application	179	4,452	29.68	181	4,665	28.24
	Network and information security	162	3,975	29.67	159	4,062	28.50
III	Control theory and control engineering	397	9,813	24.72	389	9,415	23.50
	Systems science and system engineering	223	5,494	24.64	225	5,449	23.44
	AI and intelligent system	17	340	20.00	26	414	16.46
IV	Semiconductor science and information devices	188	4,620	22.60	208	4,955	21.24
	Information optics and photoelectric devices	118	2,917	22.82	113	2,692	21.16
	Laser technology and technical optics	171	4,226	22.41	180	4,289	21.17
Total or average		2,111	52,054	25.50	2,134	52,154	24.15
Direct cost per project		24.66			24.44		

Department of Management Sciences

In 2019, the Department received 5,817 applications for the Young Scientists Fund, 27.15% more than the application number of 4,575 in 2018. 865 projects were funded at a success rate of 14.87%. The average funding for direct cost was 187,600 yuan per project.

In 2020, the Department will select outstanding applications for the Young Scientists Fund according to the funding rule of “**controlling the number of funded projects and raising the average funding per project**”.

Please note that the requirements given in the General Program of the Department in this *Guide* are also applied to the Young Scientists Fund. Hence, please read carefully before submitting proposals.

Funding for Projects of the Young Scientists Fund in Department of Management Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Management Science and Engineering	233	4,308.17	19.50	230	4,316	17.57
II	Business administration	208	3,845.92	19.21	210	3,940	15.60
III	Economic sciences	206	3,807.99	18.04	210	3,940	13.57
	Macro-Management and Policy	208	3,845.92	18.01	215	4,034	13.31
Total or average		855	15,808	18.69	865	16,230	14.87
Direct cost per project		18.49			18.76		

Department of Health Sciences

In order to improve China's medical scientific research, the Department mainly supports basic research aiming at scientific problems in diseases prevention, control, treatment, and focusing on the structural, functional, developmental, genetic and immune abnormalities of human body, as well as the occurrence, development, outcome, diagnosis, treatment and prevention of disease.

Eligible young scientists are encouraged to submit proposals to the Department for funding. Applicants are expected to undertake and complete research project independently, and to identify creative scientific questions and research schemes. The PDF copies of no more than five relevant representative papers should be attached to the proposal. For more detailed information, please refer to sections in the Young Scientists Fund and General Program in this *Guide*. For the scope of funding of each Division, please refer to the sections in the General Program in this *Guide*.

Funding for Projects of the Young Scientists Fund in Department of Health Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Respiratory system, circulatory system, blood system	447	9,396	16.20	459	9,396	13.88
II	Digestive system, urinary system, endocrine system/metabolism and nutrition support, ophthalmology, otorhinolaryngology head and neck science, oral and craniomaxillo-facial science	594	12,469	14.56	608	12,469	12.41
III	Neurological and psychiatric diseases, gerontology	358	7,525	15.55	367	7,525	12.98
IV	Reproductive system/perinatology/neonatology, medical immunology	250	5,260	14.76	257	5,260	12.84
V	Medical imaging and biomedical engineering, special medicine, forensic sciences	232	4,867	15.01	237	4,867	11.87
VI	Orthopedics and sports medicine, emergency and intensive care medicine/trauma/burns/plastic surgery, rehabilitation medicine, medical pathogenic microorganisms, laboratory medicine	372	7,805	14.62	381	7,805	11.83
VII	Oncology (leukemia not included)	857	18,000	15.24	878	18,000	12.76
VIII	Skin and appendages, preventive medicine, epidemiology, occupational medicine, radiomedicine	228	4,789	19.98	234	4,789	17.85
IX	Materia medica and pharmacology	310	6,505	20.57	316	6,505	18.28
X	Chinese medicine, Chinese materia medica, integrated Chinese and western medicine	574	12,064	12.49	588	12,064	11.09
Total or average		4,222	88,680	15.19	4,325	88,680	12.92
Direct cost per project		21.00			20.50		

Fund for Less Developed Regions

The Fund for Less Developed Regions supports scientists in specified regions of China to conduct innovative research within the funding scope of NSFC, so as to foster and support researchers in the regions, to stabilize and gather outstanding talents to facilitate the construction of the regional innovation system as well as the social and economic development of the regions.

An applicant must meet the following qualifications:

(1) Have the experience of undertaking basic research projects or doing basic research;

(2) Have senior academic position (title) or doctoral degree, or are recommended by two professionals with senior academic positions (titles) in the same research field.

Full-time researchers meeting the above qualifications and working in Inner Mongolia Autonomous Region, Ningxia Hui Autonomous Region, Qinghai Province, Xinjiang Uyghur Autonomous Region, Xinjiang Production and Construction Corps, Tibet Autonomous Region, Guangxi Zhuang Autonomous Region, Hainan Province, Guizhou Province, Jiangxi Province, Yunnan Province, Gansu Province, Yanbian Korean Prefecture of Jilin Province, Enshi Tujia and Miao Prefecture in Hubei Province, Xiangxi Tujia and Miao Prefecture in Hunan Province, Liangshan Yi Prefecture in Sichuan Province, Ganzi Tibetan Prefecture in Sichuan Province, Aba Tibetan and Qiang Prefecture in Sichuan Province, Yan'an City and Yulin City in Shaanxi Province, may apply for the Fund. Researchers seconded by the Organization Department of the Central Committee of the CPC to Xinjiang Uyghur Autonomous Region and Tibet Autonomous Region for 3 or more years are also eligible to apply for this fund during their tenure, on the condition that they provide certificate documents issued by the organization departments or personnel department of their host institutions to prove their identity of aid scientists when applying for this fund. If the host institution that an aid scientist is working in Xinjiang or Tibet is not a registered host institution at NSFC, they are allowed to apply for the Fund for Less Developed Regions through the eligible host institutions in the aided autonomous regions.

Researchers from the affiliated institutions to the central government or

the PLA in the above regions and provinces, and researchers from other provinces and regions cannot apply, but may join the application as main participants. Graduate students cannot apply, but on-job students may apply through their employer institutions at the consent of their supervisors. Researchers without an institution or whose host institutions have not been registered at NSFC cannot apply for the Fund for Less Developed Regions.

In order to provide balanced support for qualified applicants for the Fund for Less Developed Regions and encourage them to apply for projects of General Program and other competitive programs of NSFC, so as to improve basic research in less developed regions, researchers who have been granted 3 or more projects under the Fund for Less Developed Regions are not allowed to apply for this fund again since the year 2016, but the Fund for Less Developed Regions grants approved in 2015 and earlier will not be counted in.

Applicants should prepare proposals in accordance with the outline of application. The number of collaborative institutions for Fund for Less Developed Regions projects should not exceed 2, and the duration is 4 years (except for PIs as in-site post-doctoral researchers, whose duration of the project should be determined based on the written commitment from their host institutions, and start time should be January 1, 2021 and finish time should be December 31, 20XX, and they cannot change the host institution after the project is awarded).

In 2020, for the Fund for Less Developed Regions, paperless applications are carried out. In process of the submission, the host institution shall only confirm the online application and the attachments, without having to submit a paper form application. Once approved, the signature and seal page of the application form should be submitted at the time of submitting the project plan. The signature and seal information should be consistent with that of the electronic application.

In 2019, the Fund for Less Developed Regions supported 2,960 projects with a total funding for direct cost of 1.10486 billion yuan. The average funding was 373,300 yuan per project, and the success rate was 14.88%, which is 1.53% lower than that in 2018 (please refer to the table below for the funding statistics).

In 2020, the average funding for direct costs is expected to be consistent with that of 2019. Please refer to the funding intensity of direct cost of relevant departments and make budget request in a realistic manner.

Please refer to sections of the General Program of various departments for the funding scope of the Fund for Less Developed Regions, and the respective

sections in each department of the Fund for Less Developed Regions for funding situations in recent years and relevant requirements.

Funding for Projects of the Fund for Less Developed Regions in 2019

Unit: 10,000 yuan

Departments	No. of applications	Awards				Success rate (%)
		No. of awards	Funding for direct cost	Average funding for direct cost	Share of NSFC total funding for direct cost (%)	
Mathematical and Physical Sciences	863	175	6,990	39.94	6.33	20.28
Chemical Sciences	1,360	235	9,400	40.00	8.51	17.28
Life Sciences	4,242	741	29,260	39.49	26.48	17.47
Earth Sciences	1,208	178	7,140	40.11	6.46	14.74
Engineering and Materials Sciences	2,639	344	13,750	39.97	12.45	13.04
Information Sciences	1,556	227	8,716	38.40	7.89	14.59
Management Sciences	974	143	4,030	28.18	3.65	14.68
Health Sciences	7,054	917	31,200	34.02	28.24	13.00
Total or average	19,896	2,960	110,486	37.33	100.00	14.88

Department of Mathematical and Physical Sciences

In 2019, the Department received 863 applications, accepted 858, and funded 175, with a success rate of 20.28%, and direct cost funding of 399,400 yuan on average. The Fund for Less Developed Regions in mathematical and physical sciences is aiming at creating a good research environment for these regions, fostering and stabilizing an appropriate number of researchers, training talents in basic research for local scientific and technological development, and increasing the capability of solving urgent scientific problems in the development of national economy and society. In the evaluation of proposals for the Fund, special attention is paid to researches that have relative good research background with characteristics and advantage, so as to give full play of the role of the Fund for Less Developed Regions in talent fostering, and strengthen the support to researchers in Western China.

Funding for Projects of the Fund for Less Developed Regions in Department of Mathematical and Physical Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Mathematics	Mathematics I	36	1,332	22.22	35	1,357	20.47
	Mathematics II	42	1,619	17.87	47	1,833	20.26
Mechanics	Basic problems and methods in mechanics	1	36	25.00	--	--	--
	Dynamics and control	4	170	22.22	6	259	23.08
	Solid mechanics	11	467	18.97	14	589	22.58
	Fluid mechanics	5	194	19.23	5	204	19.23
	Bio-mechanics	2	85	25.00	1	40	25.00
	Explosive and impact dynamics	1	40	33.33	--	--	--
Astronomy	Astrophysics	6	257	24.00	3	132	15.79
	Astrometry and celestial mechanics	1	40	12.50	2	91	28.57
Physics I	Condensed matter physics	26	1,132	19.40	22	873	19.30
	Atomic and molecular physics	5	210	25.00	6	237	21.43
	Optics	13	531	19.70	11	418	20.37
	Acoustics	3	115	25.00	3	123	21.43
Physics II	Fundamental physics and particle physics	8	312	18.18	9	375	16.98
	Nuclear physics, nuclear technology and its application	6	244	21.43	6	258	31.58
	Particle physics and nuclear physics experimental facilities	3	118	42.86	1	25	20.00
	Plasma physics	2	88	16.67	4	176	20.00
Total or average		175	6,990	20.11	175	6,990	20.28
Direct cost per project		39.94			39.94		

Department of Chemical Sciences

On the basis of stabilizing the funding scale of the Fund for Less Developed Regions, the Department will make efforts to further promote the research quality and efficiency of the Fund, stabilize a batch of research talents for fundamental research, and continuously bridge the gap with the developed regions. Applicants are encouraged to carry out research by taking advantage of the local resources, in order to promote the economic development of the regions in a coordinated way.

Funding for Projects of the Fund for Less Developed Regions in Department of Chemical Sciences in 2018 and 2019

Unit: 10,000 yuan

Disciplines	2018			2019		
	Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Synthetic chemistry	45	1,800	17.51	48	1,920	17.14
Catalysis and surface/ interface chemistry	23	920	17.04	22	878	16.30
Chemical theory and mechanism	10	400	18.18	10	400	17.54
Chemical measurement	26	1,040	17.57	23	920	17.42
Materials chemistry and energy chemistry	40	1,600	17.54	40	1,600	17.54
Environmental chemistry	33	1,320	17.55	33	1,320	17.19
Chemical biology	20	800	16.53	21	840	17.50
Chemical engineering and industrial chemistry	38	1,520	17.43	38	1,522	17.59
Total or average	235	9,400	17.41	235	9,400	17.28
Direct cost per project	40.00			40.00		

In 2019, new discipline codes were employed to conduct funding and management in the Department. 1,360 proposals for the Fund for Less Developed Regions were received by the Department (10 proposals and 0.74% more than that of 2018). 235 proposals were funded with a success rate of 17.28% and an average funding of 400,000 yuan per project. In 2019, the success rate decreased by 0.13% compared with that of 2018 based on the guarantee of the funding intensity by the Department. In 2020, the average funding per project will be at the same level as that of 2019.

Department of Life Sciences

In 2019, the Department received 4,242 applications for the Fund for Less Developed Regions (accepted 4,117 as eligible applications), and funded 741 projects. The success rate was 17.47% with the average direct cost of 394,900 yuan per project. The average funding for 2020 will be similar to that of 2019. In the future, the Department will continue to follow the principle of “fostering regional talents, supporting sustained exploration, gathering outstanding talents and promoting regional development” for this Fund, provide steady support to local talents and support researches related to local resources and natural conditions. **For details about funding scope, etc., please refer to the sections in the General Program of the Department in this Guide.**

Funding for Projects of the Fund for Less Developed Regions in Department of Life Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I of Biology	Microbiology	40	1,590	18.78	36	1,435	17.31
	Botany	62	2,448	18.73	60	2,366	17.49
	Zoology	23	912	19.17	25	993	17.36
II of Biology	Genetics and bioinformatics	18	694	20.00	21	814	18.75
	Cell biology	11	437	19.64	11	430	14.86
	Developmental biology and reproductive biology	7	265	20.59	7	274	20.59
Biomedicine	Immunology	6	226	18.75	6	235	17.65
	Neurosciences and Psychology	20	796	19.42	20	793	17.39
	Physiology & integrative biology	8	335	18.60	9	359	17.31
Interdisciplinary Research	Biophysics/Biochemistry	13	530	18.31	10	379	18.18
	Biomaterials/Imaging/tissue engineering	6	218	21.43	6	252	16.22
	Molecular biology/Biotechnology	--	--	--	6	231	18.18
Environment and Ecology	Ecology	74	2,932	19.07	69	2,725	17.47
	Forestry and grassland science	83	3,296	18.86	76	3,000	17.47
Agriculture and Food Science	Agriculture and crop sciences	90	3,571	18.91	91	3,580	17.53
	Food science	55	2,183	19.03	62	2,456	17.42
Agricultural Environment and Horticulture	Plant protection	51	2,004	19.71	54	2,124	17.53
	Horticulture and plant nutrition	71	2,815	19.35	71	2,814	17.40
Agriculture Animal	Animal husbandry	48	1,888	19.60	45	1,793	17.31
	Veterinary medicine	40	1,590	19.32	41	1,621	17.45
	Aquaculture	13	530	18.06	15	586	17.65
Total or average		765	29,260	19.10	741	29,260	17.47
Direct cost per project		39.59			39.49		

Department of Earth Sciences

In 2019, the Department received 12,008 applications for the Fund for Less Developed Regions from 161 institutions, among which, 1,057 were from universities (87.50%), and 124 from research institutes (10.26%). Totally, 178 projects were awarded with a direct cost of 71.4 million yuan. The average funding was 401,100 yuan per project, and the success rate was 14.74%. Among the projects funded in 2019, 155 were applied through universities (87.08%), and 20 through research institutes (11.24%). In 2020, the direct cost funding per project is expected to be similar to the amount approved in 2019.

Funding for Projects of the Fund for Less Developed Regions in Department of Earth Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Geography	62	2,463	16.89	65	2,619	14.67
II	Geology	13	503	17.33	19	774	14.50
	Geochemistry	5	208	16.13	8	311	13.56
III	Geophysics and space physics	7	288	16.28	8	307	15.38
	Environmental geoscience	74	2,953	16.82	59	2,376	14.68
IV	Marine science	8	322	16.67	9	369	16.07
V	Atmospheric science	10	403	16.67	10	384	15.38
Total or average		179	7,140	16.82	178	7,140	14.74
Direct cost per project		39.89			40.11		

Department of Engineering and Materials Sciences

According to NSFC policy on the Fund for Less Developed Regions, the Department will provide steady support to foster researchers in these regions, and encourage applicants to do basic researches by taking advantage of local resources and for regional economic development. In 2019, the Department received 2,639 applications (83 rejected) with an increase of 13.12%. 344 projects were funded with a total direct cost of 137.50 million yuan. The average funding was 399,700 yuan per project with a success rate of 13.04% (14.74% in 2018). In 2020, the average funding per project for Fund for Less Developed Regions will be the same as that in 2019.

Please refer to the General Program and other related parts of this *Guide* for general instruction of the Department and detailed requirements on application.

Funding for Projects of the Fund for Less Developed Regions in Department of Engineering and Materials Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Materials Sciences I	Metallic materials	34	1,340	15.38	35	1,399	12.50
	Organic polymer materials	22	874	14.97	21	836	13.73
Materials Sciences II	Inorganic non-metallic materials	36	1,478	15.45	36	1,427	13.64
Engineering Sciences I	Metallurgy and mining science	46	1,828	15.49	46	1,852	12.78
Engineering Sciences II	Mechanics and mechanical manufacturing	59	2,344	14.64	59	2,365	12.88
Engineering Sciences III	Engineering thermophysics and energy utilization	17	674	14.53	19	725	12.75
Engineering Sciences IV	Architecture, environmental and civil engineering	76	3,020	13.74	76	3,057	12.79
Engineering Sciences V	Electrical science and engineering	22	897	14.19	20	803	14.71
	Hydro-science and water research, Hydraulic engineering and ocean engineering	32	1,295	15.46	32	1,286	13.06
Total or average		344	13,750	14.74	344	13,750	13.04
Direct cost per project		39.97			39.97		

Department of Information Sciences

In 2019, the Department received 1,556 applications for the Fund and funded 227 projects with a total direct cost funding of 87.16 million yuan. The success rate was 14.59% and the average direct cost funding was 384,000 yuan per project. In 2020, the Department will continue to give preferential support to the Fund for Less Developed Regions, and the average direct cost funding will be about the same. All eligible researchers are welcome to apply.

Funding for Projects of the Fund for Less Developed Regions in Department of Information Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Electronic science and technology	16	592	16.49	15	588.5	14.15
	Information and communication system	17	627	16.04	14	534.5	14.89
	Information acquisition and processing	14	520	16.47	16	607	14.81
II	Theoretical computer science and computer software and hardware	18	679	15.93	14	542	14.89
	Computer application	30	1,154	15.62	27	1,045	14.60
	Network and information security	20	757	15.87	21	813	14.29
III	Control theory and control engineering	39	1,471	37.70	39	1,467	14.94
	Systems science and system engineering	40	1,519	37.98	41	1,574	14.64
	AI and intelligent systems	4	152	38.00	10	336	14.29
IV	Semiconductor science and information devices	12	466	15.38	14	564	14.43
	Information optics and photoelectric devices	7	272	15.91	7	282	13.73
	Laser technology and technical optics	8	310	16.67	9	363	14.75
Total or average		225	8,519	15.38	227	8,716	14.59
Direct cost per project		37.86			38.40		

Department of Management Sciences

In 2019, the Department received 974 applications for the Fund for Less Developed Regions, 3.84% more than the number of 938 in 2018. There were 143 projects finally funded at a success rate of 14.68%. The average funding for direct cost was 281,800 yuan per project.

In 2020, the average funding for direct cost will be about 300,000 yuan per project. The funding duration is 4 years.

Please note that the requirements given in the general description section of the General Program of the Department in this *Guide* are also applied to the Fund for Less Developed Regions. Hence, please read carefully before submitting proposals.

Funded for Projects of the Fund for Less Developed Regions in Department of Management Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Management science and engineering	34	955.3	16.27	31	873	16.32
II	Business administration	37	1,039.6	15.16	37	1,043	15.29
III	Economic Sciences	36	1,011.5	15.38	37	1,043	13.75
	Macro management and policy	38	1,067.6	15.14	38	1,071	13.92
Total or average		145	4,074	15.46	143	4,030	14.68
Direct cost per project		28.10			28.18		

Department of Health Sciences

In order to improve China's medical scientific research level, the Department mainly supports the basic research aimed at scientific issues in diseases prevention, control, treatment, and focused on the structural, functional, developmental, genetic and immune abnormalities of human body, as well as the occurrence, development, outcome, diagnosis, treatment and prevention of disease.

Eligible researchers are encouraged to apply for the Fund for Less Developed Regions. The Fund for Less Developed Regions aims to train the scientific research teams of the specific regions, promote the development of science and technology in relevant regions, and serve the local economic and social development. Applicants are encouraged to propose innovative research ideas and conduct basic research on local diseases by using modern medical science research methods. Joint research by applicants with institutions and labs in developed regions is also encouraged in order to fully utilize the various advanced research facilities in developed regions.

Applicants are reminded to note that the PDF copies of no more than five relevant representative papers should be attached to their electronic proposals.

For more detailed information, please refer to the sections in the Fund for Less Developed Regions and General Program in this *Guide*.

In 2019, 7,054 proposals were received by the Department, and 917 of them were funded with an average funding of 340,200 yuan (direct cost). The funding intensity of this program in 2020 will remain the same as that in 2019 and the applicants are expected to fill out the budget form with detailed justification.

For the scope of funding of each Division, please refer to the sections in the General Program in this *Guide*.

Funding for Projects of the Fund for Less Developed Regions in Department of Health Sciences in 2018 and 2019

Unit: 10,000 yuan

Divisions		2018			2019		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Respiratory system, circulatory system, blood system	96	3,347	17.14	99	3,347	14.84
II	Digestive system, urinary system, endocrine system/metabolism and nutrition support, ophthalmology, otorhinolaryngology head and neck science, oral and craniomaxillo-facial science	107	3,708	15.60	109	3,708	12.98
III	Neurological and psychiatric diseases, gerontology	58	2,026	12.18	60	2,026	10.40
IV	Reproductive system/perinatology/neonatology, medical immunology	39	1,362	15.23	40	1,362	12.99

V	Medical imaging and biomedical engineering, special medicine, forensic sciences	32	1,109	14.55	33	1,109	11.62
VI	Orthopedics and sports medicine, emergency and intensive care medicine/trauma/burns/plastic surgery, rehabilitation medicine, medical pathogenic microorganisms, laboratory medicine	79	2,755	14.18	81	2,755	12.44
VII	Oncology (leukemia not included)	136	4,712	11.93	138	4,712	9.96
VIII	Skin and appendages, preventive medicine, endemiology, occupational medicine, radiomedicine	61	2,150	19.93	62	2,150	18.24
IX	Materia medica and pharmacology	58	2,029	15.85	60	2,029	16.44
X	Chinese medicine, Chinese materia medica, integrated Chinese and western medicine	229	8,002	15.86	235	8,002	14.36
Total or average		895	31,200	14.89	917	31,200	13.00
Direct cost per project		34.86			34.02		

Excellent Young Scientists Fund

The Excellent Young Scientists Fund supports young scholars with good achievements in basic research to conduct innovative research in areas on their own choice, so as to promote fast growth of creative young talents and foster a number of outstanding talents on the international science frontiers.

The applicant for Excellent Young Scientist Fund should be based in the host institute and meet the following qualifications:

(1) Abide by the laws of the People's Republic of China and the management regulations of NSFC. Have good scientific integrity, and consciously practice the spirit of scientists in the new era;

(2) Under the age of 38 (for male, born on or after January 1, 1982) or 40 (for female, born on or after January 1, 1978) by January 1 of the year of application;

(3) Senior professional position (title) or PhD degree;

(4) Experience of conducting basic research projects or other basic research;

(5) No employment with foreign institutions;

(6) Able to work in host institution for no less than 9 months per year.

The following people may not apply:

(1) Grantees of the National Science Fund for Distinguished Young Scholars or the Excellent Young Scientists Fund;

(2) Applicants for the National Science Fund for Distinguished Young Scholars in the same year;

(3) Post-doctors and graduate students;

(4) Applicants for or grantees of any the following 5 talent programs: The Recruitment Program of Global Experts Innovative Talents Long-Term Project and Foreign Expert Project, the National Ten Thousand Talents Plan Leading Talents of Science and Technology Innovation, Leading Talents in Philosophy and Social Sciences, and the Changjiang Distinguished Professor.

(5) Applicants for or grantees of any of the following 3 talent programs: The Recruitment Program of Global Experts Young Talents, the National Ten Thousand Talents Plan Young top talent project, the Changjiang Scholars Program Young Scholars.

Special reminder to the applicants:

In 2020, for Excellent Young Scientists Fund [with the exception of Excellent Young Scientists Fund (Hong Kong and Macao)], pilot paperless application is carried out. In the process of submission, the supporting institution shall only confirm the online application and the attachments, without having to submit a paper form application. After the project has been approved, the signature and seal page (A4) of the application form should be submitted at the time of submitting the project plan. The signature and seal information should be consistent with that of the electronic application.

In 2019, NSFC received 5,623 applications for the Excellent Young Scientists Fund and granted 600 awards with a total funding of 747.4 million yuan for direct cost.

In 2020, the Fund plans to grant 600 projects, and the average funding is 1.2 million yuan per project for 3 years.

Funding for Projects of Excellent Young Scientists Fund in 2019

Departments	No. of applications	No. of awards	Success rate (%)
Mathematical and Physical Sciences	627	71	10.57
Chemical Sciences	805	86	10.68
Life Sciences	815	86	10.55
Earth Sciences	576	59	10.24
Engineering and Materials Sciences	1,080	110	10.19
Information Sciences	876	90	10.27
Management Sciences	192	22	11.46
Health Sciences	607	76	12.52
Total or average	5,623	600	10.67

Excellent Young Scientists Fund (Hong Kong and Macao)

In order to support the scientific and technological innovation and development of the Hong Kong and Macao Special Administrative Regions (hereinafter referred to as the Hong Kong and Macao Special Administrative Regions), encourage patriotic scientific researchers who love Hong Kong and Macao to participate in the central science and technology funding plan, and contribute to the construction of a strong country in science and technology, NSFC launches the Excellent Young Scientists Fund (Hong Kong and Macao) to the scientific researchers of the host institutions of the Hong Kong and Macao Special Administrative Regions in 2020.

1. The applicant for Excellent Young Scientist Fund (Hong Kong and Macao) should be based in the host institute and meet the following qualifications:

(1) Abide by the basic law of the Hong Kong Special Administrative Region of the People's Republic of China, the basic law of the Macao Special Administrative Region of the People's Republic of China and the management regulations of NSFC, have good scientific integrity and consciously practice the spirit of scientists in the new era;

(2) Officially employed in the support institutions of Hong Kong and Macao;

(3) The annual working time in the host institution of Hong Kong and Macao during the guarantee period is more than 9 months;

(4) Under the age of 38 (for male, born on or after January 1, 1982) or 40 (for female, born on or after January 1, 1978) by January 1 of the year of application;

(5) Senior professional position (title) or PhD degree;

(6) Experience of conducting basic research projects or other basic research.

2. The following people may not apply:

(1) Grantees of the National Science Fund for Distinguished Young Scholars or the Excellent Young Scientists Fund;

(2) Post-doctors and graduate students.

3. Host institutions in Hong Kong and Macao

The University of Hong Kong, the Chinese University of Hong Kong, the Hong Kong University of Science and Technology, the Hong Kong Polytechnic University, City University of Hong Kong, Hong Kong Baptist University, University of Macao, Macao University of Science and Technology have registered as NSFC host institutes. NSFC only accepts submission from the abovementioned institutes.

4. How to apply

(1) On-line application

(i) Applicants log onto <https://isisn.nsf.gov.cn/>.

(ii) Applicants open the account from the host institute's contact person and log in onto the online submission page.

(iii) Click on "Add new application", select Excellent Young Scientists Fund (Hong Kong and Macao) in the funding category and compose the application either in simplified Chinese or English. The application should choose the correct application code based on the applied research direction or research area.

(iv) After completing the application, the applicants should sign on the commitment form online and submit the electronic version as well as the attachments to the host institute, who in turn submits to NSFC.

(v) **Paper form is needed for Excellent Young Scientist Fund (Hong Kong and Macao).** Applicants should download and print out the finalized PDF version, which should be consistent with the electronic version. The applicant should sign on the signature and seal page of the paper form proposal. The host institute should stamp the seal on it and submit to NSFC.

(2) Attachment for the online application

(i) Attachment directory.

Fill in the name of all the uploaded electronic attachment materials in the attachment directory.

(ii) Attachments

The uploaded attachment should include the identity certificate of the applicant, representative achievements obtained by the applicant and other required materials.

A. Electronic scanning of the ID card, passport or other identification materials;

B. No more than 5 electronic copies of representative works (if the length of the works is too large, only the cover, abstract, contents, copyright page, etc.,

can be provided);

C. In case of a science and technology award, the electronic scanning document of the award certificate should be provided;

D. In case of patent or other recognized outstanding creative achievements, electronic scanning documents of supporting materials should be provided;

E. In case of conference report or invited report at the international academic conference, you should provide the electronic version of the invitation letter or notice;

F. In case of scientific research ethics and safety issues, the applicant should provide the electronic scanning documents of the corresponding ethics committee certificate, the biological safety guarantee commitment of the host institute and other attachments.

(3) Special notice to the host institutes

The host institutes shall conduct the submission of proposals in accordance with the relevant *Management Measures for Host Institutes of the National Natural Science Foundation* and the *Opinions of the National Natural Science Foundation on Further Strengthening the Management of Host Institutes*, and check the authenticity, integrity and compliance of the application submitted by the applicant, before submitting to NSFC within the specified time. The specific requirements are as follows:

(i) The electronic application form and attachments of the host institute shall be submitted before the deadline and the paper form application should be signed and sealed by the host institute before being submitted uniformly (one copy).

(ii) When submitting the electronic application, the host institute shall confirm the materials one by one through the system and submit it to NSFC after signing the commitment form online.

(iii) When the host institute submits the paper application, it should provide the host institute's letter of commitment signed by the legal representative and sealed by the institute, and attach the list of application items. If the materials are incomplete, NSFC will not accept them.

(iv) The paper form application should be delivered directly or mailed to the Application Receiving Office of NSFC. In case of mailing, please mail before the deadline (i.e., March 20, 2020, according to the date of mailing postmark) by express mail, and indicate "application material" in the lower left corner of the envelope.

In 2019, NSFC received 294 applications for the National Science Fund for Distinguished Young Scholars (Hong Kong and Macao) and granted 25

awards with a total funding of 32.5 million yuan for direct cost.

In 2020, the National Science Fund for Distinguished Young Scholars (Hong Kong and Macao) plans to fund 25 projects for 3 years with 1.2 million yuan as direct cost per project and 300,000 yuan as indirect cost per project.

Funding for Projects of Excellent Young Scientists Fund (Hong Kong and Macao) in 2019

Department	No. of applications	No. of awards	Success rate (%)
Mathematical and Physical Sciences	34	3	8.82
Chemical Sciences	24	2	8.33
Life Sciences	40	4	10.00
Earth Sciences	16	1	6.25
Engineering and Materials Sciences	38	4	10.53
Information Sciences	42	3	7.14
Management Sciences	27	2	7.41
Health Sciences	73	6	8.22
Total	294	25	8.50

National Science Fund for Distinguished Young Scholars

The National Science Fund for Distinguished Young Scholars supports young scholars who have made outstanding achievements in basic research to select their own research directions and conduct creative research, so as to speed up the growth of young scientific talents, attract overseas talents and foster a group of prominent academic pacemakers in the forefront of international science and technology.

The applicant for National Science Fund for Distinguished Young Scholars should be based in the support institution and meet the following qualifications:

(1) Abide by the laws of the People's Republic of China and the management regulations of NSFC. Have good scientific integrity, and consciously practice the spirit of scientists in the new era.

(2) Under the age of 45 by January 1 of the year of application (born on or after January 1, 1975);

(4) Senior professional position (title) or PhD degree;

(5) Experience of presiding over basic research projects or conducting other basic research;

(6) No employment by foreign institutions;

(7) Able to work in host institution for no less than 9 months per year.

The following people may not apply:

(1) Post-doctors or graduate students;

(2) Grantees of ongoing project of the Excellent Young Scientists Fund (application is allowable on the year of completion of the funding of the Excellent Young Scientists Fund);

(3) Applicants for the Excellent Young Scientists Fund in the same year;

(4) People studying for a post-doctoral degree or graduate degree.

(5) Applicants for any of the following 5 talent programs: The Recruitment Program of Global Experts Innovative Talents Long-Term Project and Foreign Expert Project, the National Ten Thousand Talents Plan Leading Talents of Science and Technology Innovation, Leading

Talents in Philosophy and Social Sciences, and the Changjiang Distinguished Professor, or grantees of any of the abovementioned on-going talent programs.

Special reminder to the applicants:

(1) For application in 2020, recommendation comments from the host institutions and comments from Academic Committee or Expert Panel are not required.

(2) In 2020, the creation of ceilings and enabling retention of unused funds will be piloted in National Science Fund for Distinguished Young Scholars. Division between direct and indirect funding will be removed. The funding for each project is 4 million yuan (for the Department of Mathematical and Physical Sciences and Department of Management Sciences, the intensity is 2.8 million yuan).

(3) In 2019, NSFC received 3,159 applications for the National Science Fund for Distinguished Young Scholars and granted 296 awards with a total funding of 11,612 million yuan for direct cost.

In 2020, the National Science Fund for Distinguished Young Scholars plans to fund 300 projects for 5 years.

Funding for Projects of the National Science Fund for Distinguished Young Scholars in 2019

Departments	No. of applications	No. of awards	Success rate (%)
Mathematical and Physical Sciences	388	35	9.02
Chemical Sciences	439	45	10.25
Life Sciences	369	38	10.30
Earth Sciences	327	32	9.79
Engineering and Materials Sciences	611	56	9.17
Information Sciences	523	43	8.22
Management Sciences	111	10	9.01
Health Sciences	391	37	9.46
Total	3,159	296	9.37

Science Fund for Creative Research Groups

The Science Fund for Creative Research Groups supports prominent middle-aged and young scientists to work as academic leaders and PIs on creative research focusing on key research issues, and fosters research groups with international impacts.

Applicants and participants should meet the following requirements:

(1) Experience of conducting basic research projects or other basic research;

(2) Guarantee to work in host institutions for no less than 6 months per year within the funding period;

(3) Have a research team based on long-term collaboration, including 1 academic leader and 5 or more backbone researchers;

(4) The academic leader or the PI should have senior professional position (title), high academic qualifications and international influence, and be less than 55 years old by January 1 of the year of application (born on or after January 1, 1965);

(5) Backbone researchers or group members should hold senior professional position (title) or have PhD degrees;

(6) Applicants and participants should be in the same host institution.

PIs who have been awarded the Science Fund for Creative Research Groups before may not apply again. PI and participants with senior academic title of an ongoing project supported by the Science Fund for Creative Research Groups may not apply or participate in the application. Participants who quit from a project supported by the Science Fund for Creative Research Groups are not permitted to apply again in 2 years after the quit.

Applicants with senior academic titles may only apply for one project of the Science Fund for Creative Research Groups each year. **The total number of Science Fund for Creative Research Groups and Basic Science Center Program shall not exceed 1.**

In 2019, a total of 240 applications for the Science Fund for Creative Research Groups and 45 awards were made with a total funding of 445 million

yuan for direct costs.

In 2020, the Science Fund for Creative Research Groups will support 46 awards, with duration of 5 years and a funding amount of 10 million yuan for direct cost and 2 million yuan for indirect cost per award (6.7 million yuan for direct cost and 1.7 million yuan for indirect cost for awards by the Department of Mathematical and Physical Sciences and the Department of Management Sciences).

Awards Granted by the Science Fund for Creative Research Groups in 2019

Unit: 10,000 yuan

Departments	No. of applications	Awards		Success rate (%)
		No. of awards	Direct cost	
Mathematical and Physical Sciences	34	6	5,720	17.65
Chemical Sciences	27	6	6,200	22.22
Life Sciences	36	6	6,100	16.67
Earth Sciences	31	6	6,200	19.35
Engineering and Materials Sciences	31	6	6,150	19.35
Information Sciences	30	6	6,150	20.00
Management Sciences	12	3	2,010	25.00
Health Sciences	39	6	6,050	15.38
Total	240	45	44,580	18.75

Basic Science Center Program

The Basic Science Center Program aims to gather and integrate domestic advantageous scientific research resources, target at international science frontiers, advance deployment, give full play to the advantages and characteristics of the science funding system, rely on high-level academic leaders, attract and assemble outstanding S&T talents, and promote in-depth cross-disciplinary integration, support scientific personnel to conduct research and exploration in a relatively long-term and stable way, so as to produce a number of original achievements at international leading level, seize the dominant position in international scientific development and establish a number of academic highlands with important international influence.

Applicants and key participants for the Basic Science Center Program should meet the following qualifications:

(1) Have the experience of undertaking basic research project or doing other basic research;

(2) The consortium should be an excellent research team with multi-disciplinary crossings at the scientific frontiers, including 1 academic leader and at most 4 key applicants.

(3) As the applicant, the academic leader should be an internationally well-known scientist in the field, with senior academic position (title), outstanding academic ability and a proven track record of coordinating and managing large-scale projects, strong coordination and cohesion, and able to assemble excellent researchers from various scientific backgrounds, under the age of 60 by January 1 of the year of application (born on or after January 1, 1960);

(4) Key applicants should be mainly young or middle-aged, with senior academic position (title) and outstanding research achievements in related scientific fields and potential for continuous growth.

Note to applicants:

The total number of host institute and cooperative research institute cannot exceed 3.

At the stage of application, the Basic Science Center Program is not counted in the total number of application and on-going projects, but counted before receiving NSFC's formal funding decision and after approval. After

receiving the Basic Science Center Program, the applicant and the key participants cannot apply for or participate in other types of program except for the National Science Fund for Distinguished Young Scholars and the Excellent Young Scientist Fund.

The total number of applications for National Major Instrument Equipment R&D Program and Basic Science Center Program for one applicant within the same year cannot exceed 1.

The total number of Creative Research Group and Basic Science Center Program that one researcher applies for either as the applicant or the main participants (including key participants and key research personnel) cannot exceed 1.

The applicant and the participant with senior academic positions (titles) of the on-going Basic Science Center Program cannot apply for the same program either as the applicant or participant, unless it is in the last year of the funding.

In the course of application, select “Science Center Program” in the funding category, “Basic Science Center Program” in the subclass introduction and the correct application code according to the actual research content.

The funding period of Basic Science Center Program is 5 years. The direct cost shall not exceed 80 million yuan (for Mathematics and Management sciences, the direct cost shall not exceed 60 million yuan).

International (Regional) Cooperation and Exchange Programs

In order to improve the quality of China's scientific research and its international competitiveness, the International (Regional) Cooperation and Exchange Programs aim at funding Chinese scientists to conduct substantial cooperation with their international collaborators in science frontier and take full advantage of international scientific and technological resources on the basis of "equal cooperation, mutual benefits, and equal sharing of results".

The funding system of the International (Regional) Cooperation and Exchange Programs is currently comprised of Key International (Regional) Joint Research Program, International (Regional) Joint Research and Exchange Programs funded under the Agreements/MoUs between NSFC and its foreign partners, and Research Fund for International Young Scientists.

Key International (Regional) Joint Research Program

The Key International (Regional) Joint Research Program (hereafter referred to as Key Joint Research Program), gives priority to research in the following areas: the priority funding areas of NSFC, areas that China urgently needs to develop, international mega projects and programs with Chinese participation, and utilizing large-scale scientific facilities abroad.

Researchers applying for this program shall, in accordance with the priority funding areas announced by relevant scientific departments in the *Guide*, choose innovative joint research subjects centering on major scientific issues, and clarify the necessity and complementarities of the cooperation. Chinese applicants in the mainland and their partners shall have long-term steady collaboration (e.g., coauthored publications and continued personnel exchanges and interactions) and the partners shall have matching resources for this research. In the process of cooperation, attention shall be given to the sharing of outcomes and the protection of intellectual property rights.

In 2019, altogether 103 out of the total 559 applications under the Key Joint Research Program were funded with a total funding of 250 million yuan for direct costs.

In 2020, the Key Joint Research Program plans to fund 100 projects with the same average funding for direct costs per project as in 2019, and the duration of each project is 5 years.

An applicant must meet the following eligibilities:

(1) With the position (title) of professor or associate professor; and as the PIs of on-going or completed NSFC research project with the duration of no less than 3 years.

(2) Holding Innovative Talent Long-term Project or Young Talent Project of National Overseas High-level Talent Introduction Plan (Thousand Talent Plan for short),

Partners should meet the following eligibilities:

(1) Engage in scientific research abroad and be in charge of research laboratories or hold key research projects independently;

(2) With the position (title) of professor or associate professor in the host countries/regions.

Appendix Documents

Apart from the Chinese application form, the applicant must also submit the following documents as required:

(1) English Application Form: The English Application Form can be downloaded in NSFC's Internet-based Science Information System (ISIS) and should be submitted online at the time of submitting the application.

(2) Letter of Agreement: A copy of the Letter of Agreement signed between/among the collaborating PIs must be provided. Unilaterally signed letters are not valid. The Letter of Agreement mainly covers:

(i) Research contents and objectives;

(ii) List of collaborating PIs and participants;

(iii) Duration, mechanism and plan of joint research;

- (iv) Ownership, use and transfer of IP rights;
- (v) Relevant budgetary arrangements.

Please refer to the sample Letter of Agreement which can be downloaded at http://www.nsf.gov.cn/Portals/0/fj/fj20161230_02.doc.

(3) Documents verifying the partners' holding of or participation in research projects related to the application, or a list of publications related to the submitted application by the foreign partners in the past 3 years.

- (4) Letter of confirmation by the partner.

If the partner cannot sign the English Application Form, a letter of confirmation by him/her should be provided. The letter of confirmation must be written in official forms including the title, logo and contact information of the foreign collaborator's employer. The letter of confirmation should contain contact information about the partner. In addition, it should contain detailed information such as the title of the research, the content and period of cooperation, the way to share IPR, etc. as well as the confirmation that the partner has read and agrees with the English Application Form.

Funding Priorities for the Key Joint Research Program in 2020

1. Department of Mathematical and Physical Sciences

- (1) New methods and new technologies of experimental mechanics
- (2) Nonlinear mechanical issues of complex systems
- (3) Sky surveys and space observations
- (4) New astronomical technological methods associated with the large telescopes
- (5) Quantum computation and simulation in extensible solid physics system
- (6) Light field control and its interaction with matter
- (7) Precision measurement of physical constants
- (8) Research on high performance particle detector
- (9) Hadron structure and new cutting-edge research of hadron states
- (10) Generation and confinement process of plasma and advanced measurement diagnosis technology plasma
- (11) Physical issues in new energy
- (12) Joint research based on large-scale scientific facilities at home and abroad

2. Department of Chemical Sciences

- (1) Catalysis and chemical precision synthesis
- (2) Green chemistry and the reaction and process of sustainable chemistry
- (3) Process and mechanism of surface and interface chemistry
- (4) Theoretical and computational chemistry of complex systems
- (5) Precise chemical measurement and imaging
- (6) Molecular assembly, structure and function
- (7) Molecular basis for advanced functional materials
- (8) Natural products chemistry and drug discovery
- (9) Chemical biology
- (10) Environmental pollution chemistry and control
- (11) Scientific issues on the medium scale in chemical process
- (12) Artificial intelligence chemistry

Applicants should focus on topics featuring basic, interdisciplinary, frontier and complementary research.

Analysis, function and mechanisms of genetic and epigenetic regulation to important traits

3. Department of Life Sciences

(1) Discovery, transmission, pathogenesis and prevention of novel pathogenic organisms

(2) Genetic law analysis of important biological traits analysis of genetic law function and its regulating rules

(3) Species competition, coexistence, and coevolution

(4) Cell editing and synthetic biology

(5) Structure, dynamic change and regulation of cell nuclear and chromatin;

(6) Multi-groups study on development and disease evolution;

(7) Dynamic modification and epigenetic regulation of immune molecules; Chromatin structure and function and epigenetic regulation

(8) The neural mechanisms of sensation and behavior;

(9) Brain mechanisms for cognition and decision-making;

(10) Mechanism and intervention for organ, tissue and cell senescence;

(11) Homeostasis regulation and functional mechanism of metabolism;

(12) Biomacromolecule structure, modification and interaction and their empirical evidence;

(13) Construction, remodeling and expansion of artificial life;

(14) Regulation mechanisms of complex biological networks;

(15) Biodiversity and ecosystem function and its response to global climate change;

(16) Degradation mechanisms and restoration of forest or grassland;

(17) Molecular basis for genetic improvement in agricultural biology;

(18) Food safety, quality and nutrition;

(19) Mechanisms of organism resistance and insect resistance;

(20) Epidemic characteristics, trends, risk assessment and early warning of animal infectious diseases;

(21) Excavation and utilization of Marine biological resources

China's international cooperation and exchanges in the field of biology should be guided by national demands and national interests, and be closely combined with China's medium and long-term scientific and technological development plans and major scientific and technological special program. Due attention will be paid to joint research between strong partnering research teams and joint research between Chinese researchers and foreign partners with superior research capacities or facilities. Chinese applicants are encouraged to take the lead in joint research activities.

4. Department of Earth Sciences

(1) Surface critical processes and their multivariate effects

(2) Environmental pollution and its impacts

(3) Eco-environment effect of globalization and human activities

(4) System and mechanism of metallogenic accumulation

(5) Processes in and between continental plates

(6) Coupling relation between deep and surface earth processes

(7) Mechanism, monitoring, early warning and risk prevention and control of geological disasters

(8) Solar-terrestrial energy transfer between and its impact on human activities

- (9) Water cycle and ecohydrological process
- (10) Key processes and extreme weather events in weather and climate system
- (11) Monsoon, drought and global change
- (12) Origin and major evolutionary events of key biological taxa and the environmental backgrounds
- (13) Life process under extreme conditions
- (14) Dynamic process and mechanism of marine multi-scale interactions
- (15) Marine ecological system security and deep-sea biological resources
- (16) Advanced technology platforms to promote the development of earth and planetary sciences
- (17) Resources, environment and ecology along the Belt and Road regions

5. Department of Engineering and Materials Sciences

- (1) Energy materials
- (2) Nano material and devices
- (3) Biomedical materials
- (4) High performance structural materials
- (5) Sustainable materials
- (6) Resource circulation and clean metallurgy
- (7) Advanced manufacturing, green manufacturing and smart manufacturing
- (8) Sustainable energy, efficient and clean utilization of energy
- (9) High efficiency power electronic system
- (10) Efficient high quality motor system
- (11) Water resources and water environment
- (12) Urban water environment and water quality safety
- (13) Civil engineering disaster prevention and whole life reliability
- (14) Deep-sea engineering

6. Department of Information Sciences

- (1) The basic theory and key technology in new generation mobile communications
- (2) Terahertz communications and devices
- (3) Information acquisition and processing
- (4) Information detection and processing in medical sciences
- (5) Basic theory and method of system software
- (6) Network and information security
- (7) Social media analysis, processing and application in big data
- (8) Novel system theory
- (9) Robot theory and method
- (10) System theory and method driven by artificial intelligence
- (11) Brain-like computing software
- (12) Data-driven educational evaluation
- (13) Semiconductor electronic device integration
- (14) Micro-nano electromechanical devices
- (15) Spectrum technology
- (16) Quantum photon integration and devices

7. Department of Management Sciences

- (1) Behavioral law in the management systems
- (2) Analysis, experiment and modeling of complex management systems

- (3) Complex engineering and complex operation management
- (4) Analysis and optimization of traffic system in mobile Internet environment
- (5) Data-driven financial innovation and risk laws
- (6) Laws of entrepreneurial activity and its ecosystem
- (7) Laws of the transformation and innovation of Chinese enterprises
- (8) Enterprise innovation behavior and national innovation system management
- (9) Management science issues in service economy
- (10) Laws governing China's green and low-carbon socio-economic development
- (11) Research on China's economic restructuring and mechanism reconstruction
- (12) Laws of the basic management of national security
- (13) Basic laws of state and social governance
- (14) Rules and mechanisms of new urbanization management
- (15) Mobile Internet medical and health management
- (16) Coordination mechanism for international macroeconomic policy and international economic governance structure
- (17) Ethics and integrity in scientific research

8. Department of Health Sciences

- (1) New mechanisms of the common pathology of development, inflammation, metabolism, probiotics, microenvironment, etc.
- (2) Pathogenesis and precise diagnosis and treatment of major chronic diseases
- (3) Epidemiology of chronic diseases and injuries and related prevention and intervention strategies
- (4) Rapid identification, pathogenesis, prevention, early warning new treatment of emerging and emergency infectious diseases
- (5) Infectious diseases and antibiotic resistance
- (6) Frontier research on first aid, trauma, rehabilitation and regenerative medicine
- (7) Women and children's health
- (8) Research on the frontier of reproduction, development, aging related diseases
- (9) Nutrition, environmental, genetic and health
- (10) Stem cells and diseases
- (11) Organ fibrosis and prevention mechanism
- (12) Tissue and organ damage, dysfunction and intervention
- (13) Protection of organs and replacement therapy
- (14) Pathogenesis and intervention of neuropsychiatric disorders
- (15) Mechanisms of immune-related diseases and new immunotherapy strategies
- (16) Interdisciplinary scientific research on diseases
- (17) Medical imaging and biomedical engineering
- (18) Innovative medical technologies and personalized medicine
- (19) Biomarkers and personalized medicine
- (20) Discovery of new drug targets and pharmacological validation
- (21) Modern scientific connotation of traditional Chinese medicine theories
- (22) Material basis and mechanism of traditional Chinese medicine
- (23) Basic research on special and forensic medicine

In principle, PIs in programs with large funding amounts such as Key International (Regional) Joint Research Program, Major Program, Key Projects of Major Research Plan Program granted in 2019 will not be considered for funding

under the Key International (Regional) Joint Research Program in 2020.

International (Regional) Cooperation and Exchange Programs under Agreements/MoUs

Jointly organized and funded by NSFC and foreign science funding agencies (or research institutions and international organizations), the International (Regional) Cooperation and Exchange Programs under Agreements/MoUs support bilateral and multilateral joint research and academic exchanges between Chinese scientists and their foreign partners. In recent years, greater efforts by NSFC have been focused on policy research on international collaboration, and both the cooperation network and funding areas have been expanded with the U.S., Canada, and Australia. More extensive exchanges have been conducted between NSFC and partners in South America. The partnership between NSFC and European partners has been promoted comprehensively by further enhanced diverse collaborative activities with respective European partner countries and the EU as a whole. The collaboration mechanisms with Japan and South Korea have been further deepened, with expanded funding scale for the Asian 3 Foresight Program. The scientific cooperation with Israel and Singapore has also been promoted to more expanded research areas. Greater efforts have been put in furthering the bilateral cooperation with partners of key potentials and impacts in such developing countries as India, South Africa, Brazil, Thailand, Egypt, etc. Multi-lateral international cooperation between Chinese applicants and their international partners has been encouraged to take advantage of the coordinative role played by international scientific organizations in promoting cross-border scientific research programs, and participate in and conduct cross-border regional research programs. Besides, NSFC plays an active role in promoting the cooperation between Chinese scientists and their partners along the Belt and Road route. Adhering to the “one country, two systems” policy of the central government, NSFC has always been attaching significance to the collaboration between researchers in mainland China with partners in Hong Kong, Macao and Taiwan regions. NSFC has by far concluded 97 cooperation agreements/MoUs with science funding agencies and research institutions in 51 countries/regions. By negotiation, NSFC reaches agreements with its foreign partners on cooperation and exchange pattern, funding area, volume of awards, funding amount and review mechanism. Based on mutual agreement, NSFC launches joint call for proposals with its foreign partners on their websites and then organize scientists to submit and review applications.

The International (Regional) Cooperation and Exchange Programs under Agreements/MoUs include Joint Research Program and Personnel Exchange Program.

The Joint Research Program under Agreements/MoUs includes bilateral or multilateral joint research projects funded by NSFC and its international partners under the framework of cooperation agreements/MoUs signed between them to support Chinese researchers and their collaborators abroad to carry out research in basic sciences.

The Personnel Exchange Program under Agreements/MoUs aims to encourage NSFC grantees to participate in extensive international cooperation and exchange activities, and to enhance the innovativeness, talent training, disciplinary development and research

quality of the on-going NSFC projects. The Personnel Exchange Program under Agreements/MoUs include personnel exchange program and academic conference program featuring the mobility of scientists. Meanwhile, it encourages scientists to maintain sound bi/multilateral relations with overseas partners through wide cooperation and exchange, laying a solid foundation for future in-depth and substantial collaboration. Academic Conference Program under Agreements/MoUs is aimed at supporting scientists to hold bilateral or multi-lateral international conferences in China or outside the mainland with a view to enabling Chinese scientists to keep pace with the latest research frontiers and hotspots in the international academic arena, to enhancing the partnership between Chinese scientists and their foreign peers, and to promoting the visibility of the results achieved by NSFC funded projects and raising the profile of China's academic community.

Applicants could refer to the following introductions and the calls for proposals irregularly launched on NSFC website for application eligibility, priority funding areas, funding duration, and application requirements. In addition, the National Overseas High-level Talents Program ("Thousand Talents Program"), Innovative Talents Long-Term Project holders or Young Talent Project holders are not restricted by the application limit listed in the International (Regional) Cooperation and Exchange Programs under Agreements/MoUs, when applying for the collaborative research projects.

Applicants could also refer to the column for International Cooperation on NSFC's website for relevant information about these programs in 2020. An introduction of the funding opportunities under this category in 2020 is listed as follows.

Asia and Africa

Japan

Japan Society for the Promotion of Science (JSPS)

The call for proposals of exchange project and bilateral workshop is issued jointly by both NSFC and JSPS on their respective websites in June to July every year. The submission deadline is Friday of the first complete week in September.

(1) Exchange Project

NSFC and JSPS jointly support 10 exchange projects each year, the duration of which is 3 years. The exchange volume shall not exceed 60 person-days per year for each side.

(2) Bilateral Workshop

NSFC and JSPS support 4 bilateral workshops per year organized jointly by Chinese and Japanese scientists, of which two are held in China and two in Japan. Participants of a bilateral workshop from each side must come from at least three institutions.

In 2020, NSFC and JSPS will also release a call for joint research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

South Korea

National Research Foundation (NRF)

NSFC and NRF will jointly support joint research projects, exchange projects and

bilateral workshops in 2020.

Two calls for proposals will be released in 2020 by both foundations on their respective websites, one for joint research project, and the other for exchange project & bilateral workshop. The joint funding decision for exchange project and bilateral workshop will be made at the Sino-Korean Joint Committee on Basic Science after deliberation and discussion of participating experts.

(1) Joint Research Project

Two three-year joint research projects are planned to be funded by NSFC and NRF in 2020 with NSFC investing 2 million yuan (direct cost) for each project.

(2) Exchange Project

Around 20 two-year exchange projects are planned to be funded by NSFC and NRF in 2020.

(3) Bilateral Workshop

Around 10 bilateral workshops are planned to be funded by NSFC and NRF in 2020. Participants of bilateral workshops from each side must come from at least three institutions.

Israel

Israel Science Foundation (ISF)

NSFC and ISF together fund joint research projects and bilateral workshops.

(1) Joint Research Project

The priority collaborative areas in 2020 are life sciences and medical sciences. Around 35 three-year projects are planned for joint funding with NSFC investing 2 million yuan (direct cost) for each project.

(2) Bilateral Workshop

Each year, no more than 2 bilateral workshops are planned to be funded by NSFC and ISF. The workshop themes are decided by both sides through negotiation.

Three Asian Countries (China, Japan and South Korea)

A3 Foresight Program

The A3 Foresight Program is a funding program for joint research which was set up and sponsored by NSFC, Japan Society for the Promotion of Science (JSPS) and National Research Foundation of Korea (NRF) together. China, Japan and South Korea support the cooperation of scientists from the three countries to conduct world-class cutting-edge research in selected strategic areas, so as to foster excellent young researchers and make contributions to the solution of common regional issues.

The priority area of A3 Foresight Program for each year is in accord with the theme of the Northeastern Asian Symposium jointly organized by NSFC, JSPS and NRF in the previous year. The priority collaborative area in 2020 is internet of things with intelligence.

The call for proposals is simultaneously announced on the websites in November by the three parties and 2 five-year projects will be jointly funded annually, with NSFC investing 4 million yuan (direct cost) in each approved project.

Thailand

National Research Council of Thailand (NRCT)

NSFC and NRCT jointly support joint research projects, exchange projects and

bilateral workshops. In 2020, NSFC and NRCT will also release a call for joint research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of “Notice and Announcements” on its website in due time.

(1) Joint Research Project

In 2020, the joint call for proposals with specific collaborative topics will be launched by NSFC and NRCT on their websites respectively, and around 5 projects with duration of three years will be funded, with an investment of 2 million yuan (direct cost) by NSFC for each project.

(2) Exchange Project

Chinese and Thai scientists are required to submit proposals to NSFC and NRCT respectively. The two agencies would make a funding decision after consultation.

(3) Bilateral Workshop

NSFC and NRCT support bilateral workshops every year. The themes and number of workshops to be funded will be decided by both sides through negotiation.

Singapore

National Research Foundation of Singapore (NRF)

NSFC and NRF together fund joint research projects and bilateral workshops.

In 2020, NSFC and NRF will also release a call for joint research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of “Notice and Announcements” on its website in due time.

Pakistan

Pakistan Science Foundation (PSF)

NSFC and PSF together fund joint research projects and bilateral workshops.

(1) Joint Research Project

In 2020, the joint call for proposals with specific collaborative topics will be launched by NSFC and PSF on their websites respectively, and around 10 projects with duration of three years will be funded, with an investment of 2 million yuan (direct cost) by NSFC for each project.

(2) Bilateral Workshop

NSFC and PSF support bilateral workshops every year. The themes and number of workshops to be funded will be decided by both sides through negotiation.

Egypt

Academy of Scientific Research and Technology (ASRT)

In 2020, NSFC and ASRT will also release a call for joint research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of “Notice and Announcements” on its website in due time.

Other Cooperation Channels

NSFC has signed bilateral collaborative agreements for funding personnel exchange projects and bilateral workshops with the Mongolian Foundation for Science and Technology (MFST), Department of Science and Technology of India (DST), Council of

Scientific & Industrial Research of India (CSIR), Iran National Science Foundation (INSF), etc. The specific projects as proposed by scientists will be jointly decided on a case by case basis through mutual agreement.

International Scientific Organizations

Center of European Nuclear Research (CERN)

According to the cooperation agreement with CERN, NSFC supports Chinese scientists' participation in international collaborative research on LHC experiment at CERN together with the Chinese Ministry of Science and Technology and the Chinese Academy of Sciences.

In 2020, NSFC and CERN will also release a call for joint research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

International Center for Theoretical Physics (ICTP)

About 50 Chinese young scholars are funded by NSFC every year in the areas of mathematics, physics and earth sciences to participate in various research activities at ICTP, such as summer seminars and short-term joint research.

An open call for candidates of short-term specific activities at ICTP is announced on NSFC's website in November every year. A name list of candidates is recommended by NSFC to ICTP after being selected by relevant experts. The recommended candidates should apply to ICTP according to requirements of each ICTP activity.

International Institute of Applied Systems Analysis (IIASA)

NSFC encourages Chinese scientists to conduct multilateral cooperation with various IIASA Programs in the areas of energy, environment, land use, water, population, etc., and to jointly apply for research funding from various governmental organizations, private and national science foundations, World Bank and EU Framework Program.

NSFC provides full support for 5 to 7 Chinese young scholars to participate in the annual 3-month Young Scientists Summer Program (YSSP) from June to August at IIASA in Vienna every year. For detailed information and application forms, please refer to the IIASA website (www.iiasa.ac.at). Besides, NSFC also supports workshops, exchange and joint research projects jointly applied by Chinese and IIASA scientists.

For more information regarding application in 2020, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

Consultative Group on International Agricultural Research (CGIAR)

NSFC has reached agreements with 11 CGIAR affiliated institutes/centers (i.e., Bioversity International, CIAT, CIFOR, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, ILRI, and IRRI) to fund joint research projects conducted by scientists from both sides.

The call for proposals is released by NSFC on its website in February every year,

and the deadline for application in 2020 is April. Around 12 projects are planned for funding in 2020 with an average funding amount of 2 million yuan (direct cost) per project with duration of 5 years.

United Nations Environment Program (UNEP)

According to the cooperation agreement between NSFC and UNEP, both sides support scientists to conduct scientific collaborative research in the fields of eco-system, climate change, resource efficiency and environment governance. Special importance is placed on cooperation with developing countries in Africa and Asian-Pacific regions.

The call for proposals is released by NSFC on its website in February every year, and the deadline for application in 2020 is April. Around 4 projects are planned for funding in 2020, with a funding amount of 3 million yuan (direct cost) per project for 5 years.

Multilateral Collaboration under Belmont Forum (BF/IGFA)

According to the agreement between NSFC and Belmont Forum, since 2014 NSFC has supported Chinese scientists to participate in the multilateral cooperation under the framework of Belmont Forum. For more information regarding application in 2020, please refer to the call for proposals to be launched by NSFC in the column of “Notice and Announcements” on its website in due time.

International Centre for Integrated Mountain Development (ICIMOD)

According to the agreement between NSFC and ICIMOD, starting from 2016, both sides have supported Chinese scientists, ICIMOD scientists and scientists from ICIMOD member countries to carry out cooperation and advance research in China and the surrounding countries in the region of Hindu Kush-Himalayas. For more information regarding application in 2020, please refer to the call for proposals to be launched by NSFC in the column of “Notice and Announcements” on its website in due time.

BRICS STI Framework Program

According to the agreement to fund joint research projects under the framework of BRICS STI Framework Program among research funding agencies such as NSFC, Chinese Ministry of Science and Technology (MOST), Brazil National Council for Scientific and Technological Development (CNPq), Foundation for Assistance to Small Innovative Enterprises of Russia (FASIE), Russia Ministry of Education and Science (MON), Russian Foundation for Basic Research (RFBR), Department of Science and Technology of India (DST), Department of Science and Technology of South Africa (DST), and National Research Foundation of South Africa (NRF), the aforementioned parties have jointly supported scientists from the countries to carry out cooperation starting from 2016. For more information regarding the fourth round of application, please refer to the call for proposals to be launched by NSFC in the column of “Notice and Announcements” on its website in due time.

America and Australasia

USA

The National Science Foundation (NSF)

According to the cooperation agreement between NSFC and NSF, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and NSF accept joint research applications in the areas of sustainable urban systems, dimensions of biodiversity, and the evolution and ecology of infectious diseases in the year of 2020.

NSFC and NSF will together publish the guide to programs. Chinese and USA researchers submit to NSFC and NSF respectively. NSFC and NSF jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and NSF will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

The National Institutes of Health (NIH)

According to the cooperation agreement between NSFC and NIH, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and NIH will together publish the guide to programs. Chinese and USA researchers submit to NSFC and NIH respectively. NSFC and NIH jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and NIH will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Bill & Melinda Gates Foundation (BMGF)

According to the cooperation agreement between NSFC and BMGF, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and BMGF will accept joint research applications in the areas of global health and agriculture in the year of 2020.

NSFC and BMGF will together publish the guide to programs. Chinese and USA researchers submit to NSFC and BMGF respectively. NSFC and BMGF jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and BMGF will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Canada

Canadian Institutes of Health Research (CIHR)

According to the cooperation agreement between NSFC and CIHR, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and CIHR will together publish the guide to programs. Chinese and Canadian researchers submit to NSFC and CIHR respectively. NSFC and CIHR jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and CIHR will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Fonds de Recherche du Québec (FRQ)

According to the cooperation agreement between NSFC and FRQ, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSF and FRQ will accept joint research applications in the areas of Green Chemistry and big data management in the year of 2020. NSFC and FRQ will together publish the guide to programs. Chinese and Quebec researchers submit to NSFC and FRQ respectively. NSFC and FRQ jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(2) Exchange Program

NSFC and the FRQ provide support for exchange visits between Chinese and Quebec researchers with duration of 1 to 3 months. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(3) Bilateral Workshop

NSFC and FRQ will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

New Zealand

Health Research Council (HRC)

According to the cooperation agreement between NSFC and HRC, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and HRC will accept joint research applications in the area of biomedicine in the year of 2020.

NSFC and HRC will together publish the guide to programs. Chinese and New Zealand researchers submit to NSFC and HRC respectively. NSFC and HRC jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and HRC will fund bilateral workshops in areas and numbers mutually

identified and agreed by both parties.

Chile

National Commission for Scientific and Technological Research of Chile (CONICYT)

According to the cooperation agreement between NSFC and CONICYT, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and CONICYT will together publish the guide to programs. Chinese and Chilean researchers submit to NSFC and CONICYT respectively. NSFC and CONICYT jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and CONICYT will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Argentina

National Scientific and Technical Research Council of Argentina (CONICET)

According to the cooperation agreement between NSFC and CONICET, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and CONICET will together publish the guide to programs. Chinese and Argentine researchers submit to NSFC and CONICET respectively. NSFC and CONICET jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2020, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and CONICET will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Other Cooperation Channels

NSFC has signed bilateral collaborative agreements for funding joint research projects, personnel exchange projects and bilateral workshops with the Gordon and Betty Moore Foundation (GBMF), the São Paulo Research Foundation (FAPESP), the Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES), Consejo Nacional de Ciencia y Tecnología of Mexico (CONACTY), and the Ministerio de Ciencia, Tecnología y Medio Ambiente-República de Cuba (CITMA), etc. The specific projects are jointly decided on a case by case basis through mutual agreement.

Europe

European Union

European Research Council (ERC)

Talent Program

NSFC and ERC jointly fund the Chinese researchers to visit European countries for a single long-term or multiple short-term research stay (3 to 12 months in total). The Chinese researchers should join the ERC-funded project teams to carry out collaborative research based on the common interest. The international traveling cost will be covered by NSFC. The local and research costs in Europe will be covered by the ERC-granted projects. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Directorate-General for Research and Innovation of the European Commission (DG-RTD)

Joint Research Program

According to the mutual agreement on collaboration, NSFC and DG-TRD jointly fund the multi-lateral research projects in the field of “Microbiology Technology” between Chinese and European researchers. NSFC and DG-TRD will jointly launch call for proposals. The Chinese and European researchers should submit the proposals to NSFC and DG-RTD, respectively. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

UK

Royal Society (RS)

(1) Exchange Program

NSFC and RS jointly fund the exchange visits between the Chinese and UK researchers. The funding period is 2 years. The maximum funding amount for each project is 100,000 yuan for Chinese researchers from NSFC and 12,000 pounds for UK researchers from RS. The cost for the international traveling, accommodation, meals and intercity transportation will be covered by the granted projects. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

(2) Talent Program

NSFC, RS and Academy of Medical Sciences (AMS) jointly fund the talent program (Newton Advanced Fellowship) to establish the collaboration and support the joint research between the distinguished young researchers from China and their British collaborators. The maximum funding amount for each project is 500,000 yuan from NSFC. The salary, research cost, training fee as well as international traveling and exchange costs will be covered by RS and AMS. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

British Council (BC)

Workshop Program

NSFC and BC jointly fund the bi-lateral workshops between young researchers in China and UK. The maximum funding amount for each project is 150,000 yuan from NSFC and 24,000 pounds from BC. To the bi-lateral workshops held in China, the local cost for

the attendees and the expense for the workshop will be covered by NSFC. While the cost for the international traveling of British attendees will be covered by BC. To the bi-lateral workshops held in UK, the local cost for the attendees and the expense for the workshop will be covered by BC. While the cost for the international traveling of Chinese attendees will be covered by NSFC. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

UK Research and Innovation (UKRI)

Joint Research Program

NSFC and the funding agencies from UKRI (EPSRC, BBSRC, NERC, MRC, ESRC and STFC) jointly fund the researches between the Chinese and UK researchers based on the previous collaborations and the research fields of common interests. NSFC and the funding agencies mentioned above will jointly launch the call for proposals. The Chinese and UK researchers should submit the proposals to the respective funding agencies. The submitted proposals will be evaluated according to the agreed approach and procedures. The final decision for funding will be mutually made. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Germany

German Research Foundation (DFG)

Joint Research Program

According to the mutual agreement on collaboration, NSFC and DFG jointly fund the research projects in areas of common interest between Chinese and German researchers. NSFC and DFG will jointly launch call for proposals. The Chinese and German researchers should submit the proposals to NSFC and DFG, respectively. The submitted proposals will be evaluated according to the agreed approach and procedures. The final decision for funding will be mutually made. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

France

Agence Nationale De La Recherche (ANR)

Joint Research Program

NSFC and ANR jointly fund the research projects in areas of common interest between Chinese and French researchers. NSFC and ANR will jointly launch call for proposals. The Chinese and French researchers should submit the proposals to NSFC and ANR, respectively. The submitted proposals will be evaluated according to the agreed approach and procedures. The final decision for funding will be mutually made. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

French National Center for Scientific Research (CNRS)

Exchange Program

NSFC and CNRS jointly fund the exchange visits between the Chinese and French researchers. The funding period is 2 years. The maximum funding amount for each project is 150,000 yuan from NSFC, supporting the traveling cost for the Chinese researchers to France and local expense for the French researchers in China. While the traveling cost for the French researchers to China and local expense for the Chinese researchers in France will be covered by CNRS. The details for the application in 2020 can be found in the call for

proposals to be launched on NSFC official website.

Russia

Russian Foundation for Basic Research (RFBR)

Exchange Program

NSFC and RFBR jointly fund the exchange visits and bi-lateral workshops between the Chinese and Russian researchers. The funding period is 2 years. The maximum funding amount for each project is 150,000 yuan from NSFC, supporting the traveling cost and local expense for the Chinese researchers in Russia. While the traveling cost and local expense for the Russian researchers in China will be covered by RFBR. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Finland

Academy of Finland (AF)

(1) Exchange Program

NSFC and AF jointly fund the exchange visits between the Chinese and Finnish researchers. The funding period is from January 2020 to December 2020. The traveling cost for the Chinese researchers to Finland and local expense for the Finnish researchers in China will be covered by NSFC. While the traveling cost for the Finnish researchers to China and local expense for the Chinese researchers in Finland will be covered by AF. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

(2) Workshop Program

NSFC and AF jointly fund the bi-lateral workshops between Chinese and Finnish researchers. The funding period is from January 2020 to December 2020. To the bi-lateral workshops held in China, the local cost for the attendees and the expense for the workshops will be covered by NSFC. While the cost for the international traveling of Finnish attendees will be covered by AF. To the bi-lateral workshops held in Finland, the local cost for the attendees and the expense for the workshops will be covered by AF. While the cost for the international traveling of Chinese attendees will be covered by NSFC. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Netherlands

Netherlands Organization for Scientific Research (NWO)

(1) Joint Research Program

NSFC and NWO jointly fund the research projects in areas of common interest between Chinese and Dutch researchers. NSFC and NWO will jointly launch call for proposals. The Chinese and Dutch researchers should submit the proposals to NSFC and NWO, respectively. The submitted proposals will be evaluated according to the agreed approach and procedures. The final decision for funding will be mutually made. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

(2) Exchange Program

NSFC and NWO jointly fund the exchange visits between the Chinese and Dutch

researchers. The funding period is from January 2020 to December 2020. To the visiting of the Dutch researchers to China, the Chinese and Dutch PIs should submit the proposals to NSFC and NWO 3 months in advance, respectively. To the visiting of the Chinese researchers to Netherlands, the Chinese and Dutch PIs should submit the proposal to NSFC and NWO 6 months in advance, respectively. The submitted proposals will be evaluated by NSFC and NWO respectively and joint funding decisions will be made. No call for proposal will be launched on NSFC official website and applications can be submitted anytime throughout the year.

(3) Workshop Program

NSFC and NWO jointly fund the bi-lateral workshops between Chinese and Dutch researchers. The funding period is from January 2020 to December 2020. The Chinese and Dutch PIs should submit the proposals to NSFC and NWO 3 months in advance, respectively. The submitted proposals will be evaluated by NSFC and NWO respectively and joint funding decisions will be made. No call for proposal will be launched on NSFC official website and applications can be submitted anytime throughout the year.

Italy

Italian National Research Council (CNR)

Exchange Program

NSFC and CNR jointly fund the exchange visits between the Chinese and Italian researchers. The funding period is 2 years. The maximum funding amount for each project is 100,000 yuan from NSFC, supporting the traveling cost and local expense for the Chinese researchers in Italy. While the traveling cost and local expense for the Italian researchers in China will be covered by CNR. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Sweden

Swedish Research Council (VR)

Joint Research Program

NSFC and VR jointly fund the research projects in areas of common interest between Chinese and Swedish researchers. NSFC and VR will jointly launch call for proposals. The Chinese and Swedish researchers should submit the proposals to NSFC and VR, respectively. The submitted proposals will be evaluated according to the agreed approach and procedures. The final decision for funding will be mutually made. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Swedish Foundation for International Cooperation in Research and Higher Education (STINT)

Exchange Program

NSFC and STINT jointly fund the exchange visits and bi-lateral workshops between the Chinese and Swedish researchers. The funding period is 3 years. The maximum funding amount for each project is 400,000 yuan from NSFC, supporting the traveling cost and local expense in Sweden for the Chinese researchers as well as the expense for the workshop. The maximum funding amount for each project is 600,000 Swedish Kroner from STINT, supporting the traveling cost and local expense in China for the Swedish researchers as well as the expense for the workshops. The details for the application in 2020 can be found in the

call for proposals to be launched on NSFC official website.

Norway

The Research Council of Norway (RCN)

Joint Research Program

NSFC and RCN jointly fund the research projects in areas of common interest between Chinese and Norwegian researchers. NSFC and RCN will jointly launch call for proposals. The Chinese and Norwegian researchers should submit the proposals to NSFC and RCN, respectively. The submitted proposals will be evaluated according to the agreed approach and procedures. The final decision for funding will be mutually made. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Belgium

The Research Foundation-Flanders (FWO)

Exchange Program

NSFC and FWO jointly fund the exchange visits between Chinese researchers and Flemish researchers from Belgium. The funding period is 2 years. The maximum funding amount for each project is 100,000 yuan from NSFC, supporting the traveling cost for the Chinese researchers to Belgium and local expense for the Flemish researchers in China. The traveling cost for the Flemish researchers to China and local expense for the Chinese researchers in Belgium will be covered by FWO. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

The Fund for Scientific Research (FNRS)

Exchange Program

NSFC and FNRS jointly fund the exchange visits between researchers from China and Brussels-Wallonia Federation (BWF) of Belgium. The funding period is 2 years. The maximum funding amount for each project is 100,000 yuan from NSFC, supporting the traveling cost for the Chinese researchers to Belgium and local expense for the Belgian researchers in China. The traveling cost for the Belgian researchers to China and local expense for the Chinese researchers in Belgium will be covered by FNRS. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Czech Republic

Academy of Science of the Czech Republic (CAS)

Exchange Program

NSFC and CAS jointly fund the exchange visits between Chinese and Czechic researchers. The funding period is 2 years. The maximum funding amount for each project is 100,000 yuan from NSFC, supporting the traveling cost and local expense in Czech Republic for the Chinese researchers. The traveling cost and local expense in China for the Czechic researchers will be covered by CAS. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Bulgaria

Bulgaria National Science Foundation (BNSF)

Exchange Program

NSFC and BNSF jointly fund the exchange visits between Chinese and Bulgarian researchers. The funding period is 2 years. The international traveling cost, local expense and expense for the bi-lateral workshops will be covered by NSFC and BNSF jointly. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Poland

The National Science Centre (NCN)

Joint Research Program

NSFC and NCN jointly fund the research projects in areas of common interest between Chinese and Polish researchers. NSFC and NCN will jointly launch call for proposals. The Chinese and Polish researchers should submit the proposals to NSFC and NCN, respectively. The submitted proposals will be evaluated according to the agreed approach and procedures. The final decision for funding will be mutually made. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Turkey

The Scientific and Technological Research Council of Turkey (TUBITAK)

Joint Research Program

NSFC and TUBITAK jointly fund the research projects in areas of common interest between Chinese and Turkish researchers. NSFC and TUBITAK will jointly launch call for proposals. The Chinese and Turkish researchers should submit the proposals to NSFC and TUBITAK, respectively. The submitted proposals will be evaluated according to the agreed approach and procedures. The final decision for funding will be mutually made. The details for the application in 2020 can be found in the call for proposals to be launched on NSFC official website.

Hong Kong and Macao SARs and Taiwan Region of China

NSFC has established cooperation with the Research Grant Council of Hong Kong (RGC), Beijing-Hong Kong Academic Exchange Centre, Macao Foundation, Macao Foundation for the Development of Science and Technology, and K.T. Li Foundation for the Development of Science and Technology in Taiwan, jointly funding cooperation and exchange between researchers from mainland China and Hong Kong and Macao SARs, and between researchers from two sides of the Taiwan Straits in areas of common interest. Types of activities that can be funded are joint research projects and exchange projects (including academic workshops and exchange visits).

Hong Kong

NSFC and the Research Grant Council of Hong Kong (RGC) will continue to fund joint research in areas of natural sciences in 2020. Priority funding areas include information sciences, biological sciences, new materials, marine and environmental sciences, medical sciences, and management sciences. Meanwhile, to encourage academic exchanges between young researchers from Hong Kong SARs and inland China, academic forums are organized and funded in areas of common interest. For detailed requirements, please refer to the call for proposals launched on NSFC's website.

Macao

In 2020, NSFC and Macau Foundation for Science and Technology Development (FDCT) will, under the framework of the newly signed cooperative agreement, together fund joint basic research projects between scientists from inland China and Macao. The priority areas include: information science, TCM research, marine science, environmental science, biological science, new materials, as well as management science. Meanwhile, NSFC and FDCT will organize and fund academic workshops in areas of mutual interest for academic communities from inland China and Macao region. For detailed requirements, please refer to the call for proposals launched on NSFC's website.

Taiwan

NSFC has been dedicated to encouraging and promoting scientific cooperation and exchange between scientists on both sides of the Taiwan Straits. In 2020, NSFC will continue to support cross-Strait academic workshops held by scientists from mainland China and Taiwan region. NSFC will also fund substantial joint research projects according to the consensus reached with K.T. Li Foundation for the Development of Science and Technology. For detailed requirements, please refer to the call for proposals launched on NSFC's website.

In view of the fact that some universities in Hong Kong and Macao have established research branches in different forms in mainland China, NSFC will not accept applications by one scientist as both inland and outside PIs at the same time.

Sino-German Center for Research Promotion

The Sino-German Center for Research Promotion is a research funding agency, jointly set up by NSFC and German Research Foundation (DFG), and put into operation in October 2000. It aims at promoting scientific cooperation and exchange between Chinese and German researchers and providing all-around services with its diverse funding instruments for researchers at various stages of their career development, and thus is able to push forward in-depth cooperation and development in fundamental science between China and Germany.

1. Subjects Covered

The Sino-German Center for Research Promotion mainly supports the cooperation

activities between Chinese and German Scientists in fundamental research in all fields of natural sciences.

2. Eligibility of Applicants

An applicant from China must be a PI or participant in an NSFC grant project (either ongoing or already completed); or an excellent young researcher who is less than 35 years old and holding a doctorate degree. Applicants from Germany must be eligible to apply for funding from DFG. Eligible Chinese and German scientists might submit a proposal jointly to the Sino-German Center for Research Promotion.

3. Application Limit

The applicant for projects funded by the Sino-German Center for Research Promotion will not be subject to NSFC's regulation on the limit of the number of projects that an individual researcher could undertake or apply for.

4. Programs

(1) Preparatory Visit

Chinese and German scientists might apply to the Sino-German Center for funds to pay a short visit to their partners' institutions in order to make preparations and plans for proposing a Bilateral Workshop, Summer School, Young Scientist Forum, Mobility Program or NSFC-DFG Joint Research Project. Through the short visit, the two sides could work out a plan for a joint project efficiently, complete the preparation and submit their joint proposal as soon as possible.

(2) Bilateral Workshop

The most fundamental program supported by the Sino-German Center is Bilateral Academic Workshops which aim at setting up new partnerships, deepening existing partnerships, and stimulating new joint research projects between Chinese and German scientists. The workshops must have specific scientific themes, and be coordinated and co-hosted by senior scientists from both sides. To ensure the authoritativeness and representativeness, participants of the workshops must be representative scientists in related fields in both countries, and should come from different institutions and regions. The workshop could be held either in China or Germany. The Sino-German Center could provide funding for up to 40 participants for each workshop, i.e., not more than 15 participants from the traveling party and at most 25 participants from the hosting party. The number of participants from the same institution should not exceed a third of all the participants from that party. In addition, scientists from a third party can be invited to the workshop and the total number of such scientists should be no more than three, that is, 20% of the number of participants from the traveling party. Formal representatives from Germany must have doctorates. The Center provides funding for domestic and international travel expenses, local subsistence of all formal participants, venue fees and other necessary costs of the workshop according to its current funding standard.

(3) Mobility Program

The mobility program aims at supporting in-depth cooperation and exchanges between Chinese and German scientists in a specific field over a period of 3 years. It mainly supports scientists' short-term visits and small-scale workshops. The Sino-German Center covers domestic and international travel expenses, accommodation costs, meal cost and

venue fees according to its current funding standard. A maximum of 1.5 million yuan (or equivalent sum of euros) per project would be provided to both Chinese and German teams.

(4) Summer School

Summer school aims to introduce advanced scientific methods, techniques and their applications to young scientists and provide them with training and discussion on specific issues in a certain area. The Sino-German Center attaches great importance to the screening/selection of the young scientists to attend the Summer School and requires that the participants of the seminars must be selected according to an open and competitive selection procedure.

The Sino-German Center may fund 4 to 6 senior experienced scientists from both countries as lecturers. The applicants on both sides must be among the funded lecturers. Participants are mainly university undergraduates, graduates or young researchers from both countries. The number of participants is decided according to specific conditions, such as equipment and infrastructure of the laboratory, but it shall not exceed 40 persons in total. The number of participants shall not exceed 15 from traveling party, and 25 from the hosting party. The Summer School can be held either in Germany or in China and usually lasts at most 14 days, including one day for arrival and one for departure. The Center provides funding for all formal participants and lecturers for domestic and international travel expenses, local accommodation & meal costs and venue fees according to its current funding standard.

(5) Young Scientists Forum

The forum aims at providing a venue for Chinese and German young scientists active in their own fields to meet and discuss with each other, providing them with an opportunity to introduce their own work to the outstanding scientists and learn new research methods. The forum could be held either in China or Germany. The Sino-German Center in principle provides 5 to 7 days' funding including one-day academic visit and arrival & departure. The total number of participants shall not exceed 42 persons. The traveling party shall not be more than 16 persons (15 young scientists and one senior scientist). The receiving party shall not exceed 26 persons (25 young scientists and one senior scientist). In addition, scientists from a third party can be invited to the workshop and the total number of such scientists should be no more than three, that is, 20% of the number of participants from the traveling party. Apart from the basic eligibility required, the participants shall be less than 40 years old (as of the starting date of forum). The German participants must have doctorates. The Chinese assistant professors (lecturers) are also eligible to attend. The organization of the forum shall be coordinated by a young scientist from each side. The Center provides funding for international travel expenses, inter-city travel expenses, local subsistence costs and venue fees according to its current funding standard.

(6) Young Scientist Team Leader Visit to China

The Sino-German center aims to encourage excellent young German scientists to seek, establish and strengthen connection and cooperation with Chinese scientists as early as possible in their scientific research careers, so as to promote more contacts between young Chinese and German scientists. The program is aimed at "Emmy Noether" prize winners from DFG, team leaders and young professors who have received similar project funding. The Center provides funding for these young scientists to find a cooperation partner, develop cooperation plans or carry out their cooperative research in China.

(7) Lindau Program

Lindau Nobel Laureate Meeting is held in late June each year in Lindau, Germany. Excellent young scientists from around the world are also invited to attend the event. The Sino-German Center, together with Lindau Nobel Laureates Foundation, invites and funds 30 to 45 (including 15 in the field of economics) excellent Chinese PhD students to participate in the Nobel Laureate meeting in Lindau, Germany, followed by a week-long academic visit to the well-known German research institutions in relevant disciplines organized by the Center.

Candidates are selected throughout China and must be recommended by their home institutions. The final approval list is decided by correspondence review and interviews by a panel of Chinese and German experts. The Center provides funding for formally selected students for international travel expenses, inter-city travel expenses and accommodation costs according to its current funding standard. The Center will handle the visa affairs for the selected students and pay for the related fees.

(8) Post-Lindau Program

Grantees of Lindau Program who has got the PhD degree and a fixed position in a Chinese research institution may apply for the funding from the Sino-German Center for an academic stay of less than 12 months in Germany if they could get invitations from German research institutions or universities, and approval from their host institutions. The Center provides funding for international travel expenses, inter-city travel expenses, accommodation costs and insurance expenses according to its current funding standard.

Mobility program will be accepted according to a solicited call, while other types of programs will be accepted in a continuous mode at any time. The detailed requirements, application forms and processes of each type of program in 2020 can be found in the website of the Center: <http://www.sinogermanscience.org.cn>.

Research Fund for International Young Scientists

The Fund supports foreign young scientists to conduct basic research on self-selected topics in NSFC's funding scope in mainland China so as to promote long-term sustainable academic collaboration and exchanges between Chinese and foreign young scientists.

Grantees of on-going project are eligible for renewal fund in case of research need.

An applicant with foreign citizenship must meet the following eligibilities:

- (1) Less than 40 years old by January 1, 2020 (born on or after January 1, 1980);
- (2) Have a doctoral degree;
- (3) With the experience of conducting basic research or postdoctoral research;
- (4) Guarantee of full-time work at the host institutions during the project implementation;
- (5) Abide by Chinese laws and NSFC's relevant rules and regulations while doing research in China.

The host institution must meet the following conditions:

- (1) Appoint a contact person responsible for providing consultation to applicants and assisting project management such as the use of budget.

(2) Sign an agreement with the applicant. The agreement must include the following items:

- (i) The title of the research project and the expected outcomes;
- (ii) Living expenses and necessary working conditions that the host institution offers;
- (iii) The attribution of the intellectual property;
- (iv) Obligation to have applicant work in full time at the host institution during the project implementation.

The PI of the granted project can apply for renewal if needed and provided that the on-going project has made good progress.

In 2019, 161 foreign young scientists were granted with 45 million yuan for direct cost. Among them, 9 foreign young scientists were granted project renewal. It is expected that 150 foreign young scientists (including 20 project renewals) will be granted with 45 million yuan for direct cost in 2020.

Project duration:

Programs funded in 2020 start from January 1, 2021. The funding direct cost is 200,000 yuan per project for one year or 400,000 yuan per project for two years.

Application procedure

Applicants must fill out and submit online proposal forms via the Internet-based Science Information System with the following supplementary documents:

- (1) Copy of agreement signed by applicant and host institution;
- (2) Copies of the front pages of no more than five representative papers.

Please pay attention to the column of Research Fund for International Young Scientists on NSFC's homepage for more detailed information on application and requests.

Please visit <http://bic.nsf.gov.cn/show.aspx?CI=31>.

Programs of Joint Funds

The joint funds set up by NSFC and other relevant government departments, provincial governments and industrial sectors aim at supporting basic research in agreed scientific areas.

The joint funds are designed to give full play to the guiding role of the National Natural Science Fund, guide and integrate social resources in basic research, promote cooperation of relevant departments, industries and regions with universities and research institutions, foster scientific and technological talents and enhance China's indigenous innovation capabilities in relevant research areas, industries and regions.

The joint funds are part of the Natural Science Funds. The application, evaluation and management of the joint funds will comply with management methods such as the *Regulations*, NSFC's Rule on Funding Management and NSFC's Rule on Joint Fund Management.

In 2020, the joint funds in the *Guide* include NSAF Joint Fund, Astronomical Joint Fund, Joint Fund for Scientific Research of Large Scientific Facilities, Joint Fund for Advanced Aerospace Manufacturing Technology Research, Civil Aviation Joint Research Fund, NSFC-GenerTec Joint Fund for Basic Research, Joint Fund for Seismological Science, Joint Fund for Iron and Steel Research, Joint Fund for the Innovation-Driven Development of China Automobile Industry, Yalong River Joint Fund, Joint Fund for Smart Grid, Joint Fund for Nuclear Technology Innovation, NSFC-Guangdong Joint Fund, NSFC-Yunnan Joint Fund, NSFC-Xinjiang Joint Fund, NSFC-Henan Joint Fund, Joint Fund to Promote Cross-Strait Scientific and Technological Cooperation, NSFC-Shandong Joint Fund, NSFC-Liaoning Joint Fund, NSFC-Zhejiang Joint Fund for the Integration of Industrialization and Informatization, NSFC-Shanxi Joint Fund for Coal-Based Low-Carbon Technology, NSFC-Guangdong Center for Big Data Research and NSFC-Shenzhen Robotics Research Center Project, etc. **Guidance for other Joint Funds will be published on NSFC website.**

Applicants for the Joint Funds should:

- (1) Have the experience of conducting basic research;
- (2) Hold senior professional position (title) or PhD degree;
- (3) Meet other requirements in the *Guide*.

For any research achievements funded by the Joint Fund, NSFC's

contribution and support to the project should be acknowledged in a prominent place and in an appropriate form according to the *Guide* with the title of the joint fund and the project number.

Proposals for the joint funds should be prepared according to relevant program type (such as General Program or Key Program) outlines. Please select “Joint Fund” for funding category, Fostering Project or Key Project or “Foster Local Talents” or “Center Project” or “Integrated Project” for subcategories, and select the name of the joint fund in the notes section.

The number of collaborative institutions for Key Project or Fostering Project shall not exceed two.

The funding duration for Fostering Project is three years and the funding period shall be “from January 1, 2021 to December 31, 2023”. The funding duration for Key Project is four years and the funding period shall be “from January 1, 2021 to December 31, 2024”.

Joint Fund for Regional Innovation and Development (the First Round)

The Fund is jointly established by NSFC and provincial governments. It aims to make full use of the guiding role of the National Natural Science Fund, attracting and gathering talented scientists across China to conduct basic research on key scientific issues behind the significant demands in regional economic and social development. It also aims to encourage cross-sectoral, trans-industrial and cross-regional collaborative innovation and promote the indigenous innovation capability of related provinces.

In 2020, the Fund is going to support a number of Key Projects. Average funding budget (direct costs) for each project will be 2.6 million for 4 years

I. Biology and Agriculture

i. Research on the special agronomic resources in Sichuan and on scientific problems related to the upgrading and transformation of traditional agriculture, promotion of high-quality green agricultural industry and development of ecological agriculture.

Priority research areas:

1. Regulatory mechanism of the adaptation and cultivation of rice under low-light conditions in Sichuan (C13001)

The proposed research is expected to provide theoretical basis for the cultivation of high-quality and high-yield rice in Sichuan and focus on the impact of low-light conditions on rice quality and yield, adaptation mechanism for rice varieties to low-light conditions, cultivation regulatory mechanism for high-quality and high-yield rice under low-light conditions.

2. Basic research on the occurrence, prevention and control of oilseed rape clubroot (C14007)

The proposed research is expected to address the disease diversity of oilseed rape clubroot in compound cultivation in Sichuan and provide theoretical basis for the establishment of a green prevention and control system against the oilseed rape clubroot in Sichuan basin.

3. Intestinal homeostasis maintenance mechanism of Giant Panda (C04001)

The proposed research is expected to focus on mechanisms of intestinal microbiota succession and microbial imbalance and regulatory measures for captive-bred giant panda and giant panda released into the wild to adapt to the changes of living environment.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Sichuan province.

ii. Research on the genetic basis of important traits of key grain crops, cash crops, livestock and aquatic products in Hunan; or key eco-environmental issues and key technological questions related to the sustainable development of agriculture and ecosystem.

Priority research areas:

1. Mechanism of rice fertility and heterosis and new application pathways

(C13001)

The proposed research is expected to address problems in breeding of hybrid rice such as the restriction in choosing the combinations, environmental impact on fertility and insufficient use of hybrid advantages, explore the molecular mechanism of the male/female sterility and hybrid vigor, discover new genes concerning fertility, embryogenesis and advantage utilization, and develop new materials, technologies and pathways to utilize hybrid vigor.

2. Genetic basis of the eating quality of hybrid rice (C13001)

The proposed research is expected to look into sterile line, restorer line, regular rice with different eating qualities and their combinations, search for the major genes in the genetic regulation of starch quality and protein content, conduct systematic research on the rice eating quality deterioration mechanism in storage period and the genetic basis of good eating quality, discover genes of parent lines and environmental impact related to good eating quality.

3. Physiological and ecological mechanism of super high yield and efficient nutrients utilization of super hybrid rice (C13002)

The proposed research is expected to address the high biomass, high fertilizer demand, weak lodging resistance and yield gap of super hybrid rice, and focus on key scientific questions such as the physiological mechanism of achieving super high yield, adaptability of hybrid rice to diverse regional ecological conditions, efficient utilization of nutrients and sustainable super-high yield of hybrid rice.

4. Genes of good traits of special crops in Hunan and basic research on breeding (C1304)

The proposed research is expected to respond to the urgent demand for sustainable development of agriculture and promotion of agricultural industry in Hunan, build up the germplasm bank of special grain crop in Hunan, discovery new genes related to good crop traits such as high yield, high quality, stress resistance, pest resistance, efficient nutrient utilization, low accumulation of heavy metals, stability during storage and seed quality, and unveil relevant genetic functions and regulatory mechanism.

5. Mechanism of crop resistance to biotic and abiotic stresses (C13004)

The proposed research is expected to unveil the stress resistance mechanism of cash crop in Hunan at the molecular level, including research on the genes, resistance mechanism and regulatory mechanism related to the resistance of new diseases, major pests, drought/flood, high/low temperature, and low nutrient stress.

6. Molecular genetic mechanism of good traits of special livestock, poultry and aquatic products in Hunan and key breeding technology (C1703 or C1902)

The proposed research is expected to systematically look into the genetic characteristics of high quality, high yield, disease resistance and high feed-to-meat efficiency of special livestock and poultry products in Hunan, especially the molecular level structure, expression and function, to development key breeding technologies; systematically look into the genetic characteristics and the molecular regulatory mechanism of the yield, quality, stress resistance of special aquatic products in Hunan and provide theoretical basis for developing breeding technologies of special fishes in Hunan.

7. Molecular basis of key nutrient metabolism and regulation of special livestock, poultry and aquatic products in Hunan (C1705, C1706 or C1904)

The proposed research is expected to explore the nutrient metabolic basis of the high

quality, coarse feedstuff endurance, high productivity, strong stress resistance of special livestock, poultry and aquatic products in Hunan; explore the collaborative metabolic mechanism of main nutrients and high efficient utilization methods, especially the metabolic mechanism of local non-grain feedstuff; and explore the nutrient regulation mechanism to improve the quality, intestine health and productivity of special livestock, poultry and aquatic products in Hunan.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Hunan province.

iii. Research on the quality and stress resistance of grain crops in Anhui, crop straw utilization in the black meadow soil at Huaibei, origination and adaptive evolution of tea plants, and artificial breeding of Chinese alligator.

Priority research areas:

1. Genetic basis of stress resistance and high quality of wheat in the plain of the Yangtze-Huai Rivers (C13002)

The proposed research is expected to focus on wheat in the plain of the Yangtze-Huai Rivers, explore the genetic basis of its stress resistance and high quality, search for functional genes, analyze the molecular mechanism, explore the expression, regulation and interactive network of important functional genes and provide scientific support to the high-efficient utilization of key genetic resources and molecular design breeding.

2. Mechanism of regulating phosphorus inversion in black meadow soil by crop straw recycling and its effectiveness (C15102)

The proposed research is expected to address factors that may influence the phosphorus inversion and its effectiveness when returning crop straw to the black meadow soil, especially factors and mechanism of phosphorus release, clarify the conversion process, explore the mechanism underlying the regulation and effectiveness of phosphorus inversion in black meadow soil by crop straw recycling, and provide theoretical support for high-efficient utilization and fertility improvement of black meadow soil in northern Huai River region.

3. Origination and adaptive evolution of tea plants (C15002)

The proposed research is expected to focus on representative tea plants in Anhui, analyze the genetic diversity and population structure of tea plants, find the centers of genetic diversity and potential expansion pathways, identify the domestication region based on genomic evidence, unveil the adaptive evolution mechanism of tea plants and provide theoretical basis for the conservation and sustainable utilization of the germplasm resources of tea plants.

4. Reproductive physiology and reproduction regulation mechanism of Chinese alligator (C15002)

The proposed research is expected to address the unstable reproductivity of Chinese alligator in artificial breeding, study the early gonad differentiation and genesis and development of gametophytes of Chinese alligator, and explore the genetic mechanism underlying the reproductive physiological regulation of Chinese alligator.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Anhui province.

iv. Research on key scientific questions of mechanism of important agronomic traits and utilization of germplasm resources of important agronomic products in Jilin such as soybean, corn, rice, beef cattle, edible and medicinal fungi.

Priority research areas:

1. Genetic basis of the high quality and high yield of soybean and application in germplasm innovation (C13004)

The proposed research is expected to address the low yield per unit area, low comparative benefits and shrinking growth area of soybean in northeastern China, explore the interaction mechanism of factors influencing soybean collective yield, molecular mechanism of hybrid vigor, innovation and utilization of high-yield germplasm resources, and physiological and ecological mechanism of high-yielding cultivation. The aim is to unveil the regulation mechanism of high yield properties of soybean and mechanism of high yield advantage, and provide theoretical support to the improvement of per unit yield of soybean.

2. Application of cover plants in corn cultivation in Jilin (C13003)

Excessive use of fertilizer, pesticide and herbicide in corn cultivation may decrease soil quality, produce serious non-point source pollution, harm the crop quality and cause a series of environmental, ecological and food safety problems. The proposed research is expected to look into the selection of cover plants in corn cultivation, the interactive mechanism of corn and cover plants, the collaborative functioning mechanism between cover plants and decomposed materials, soil and corn root in the microenvironment of soil, and provide theoretical support for Jilin to development green, environmental-friendly eco-agriculture.

3. Biotechnology for prevention and control of major diseases and pests for rice in cold regions in northern China (C14001)

There are limited biotechnology to prevent and control major diseases and pests threatening the rice production of Jilin and the capability to develop and produce bio-control products is also insufficient. The proposed research is expected to collect and identify bio-control bacteria resources, build up a bio-control resource reservoir for rice in Jilin, explore the interaction mechanism between rice, pathogenic bacteria and bio-control bacteria, unveil the bio-control mechanism, select high-efficiency bio-control bacteria, develop industrial production process, study on the new theories and technologies for the prevention and control of major diseases and pests for rice in cold regions and provide scientific support to the promotion of high quality green rice in Jilin.

4. Reproductive disorder mechanism of local beef cattle in Jilin (C1704)

The proposed research is expected to address the increase of reproductive failure, low reproductive efficiency of beef cattle and the unclear mechanism of diseases such as endometritis and follicular atresia, research on the micro-ecology of the cow's reproductive tract and its influence on the cow's endometritis, causes and regulation of ovarian dysfunction, regulation mechanism and technology of follicular development and estrus of beef cattle, and provide theoretical support for breaking through the technological bottleneck of the beef cattle industry in Jilin.

5. Molecular mechanism of domestication and degeneration of edible and medicinal fungi (C01 or C15)

The proposed research is expected to address the genetic basis limit, unclear genetic background and serious degeneration of fungi species of edible and medicinal fungi in Jilin, research on the evolution and formation of key commercial fungi and congeneric fungi species, molecular mechanism of artificial domestication and breeding, molecular regulation mechanism of fungi degeneration, and provide theoretical support to the

development of health industry and the recycling of crop straw and livestock/poultry manure.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Jilin province.

II. Environment and Ecology

i. Research on the prevention and control of natural disasters and ecological protection based on study of the distinctive natural geographical environment and ecological resources of Sichuan and neighboring regions.

Priority research areas:

1. Dynamics and early warning of landslide and debris flow in small watershed (D01, D05 or D07)

Landslide and debris flow in small watershed regions are featured with large scale, high frequency and heavy damage. The proposed research is expected to focus on tectonic kinetics of the formation of landslide and debris flow, the driving mechanism of extreme drying and wetting cycles and freezing and thawing cycles, and explore early forecasting methods for landslide and debris flow in small watershed regions.

2. Mechanism and prevention of natural hazards induced by piedmont river scouring and undercutting of Longmen Mountain (E09)

The proposed research is expected to explore the driving force, disaster mechanism, prevention and control of piedmont river scouring and undercutting after earthquake, and provide scientific support to piedmont river security and the construction and maintenance of riverbank building.

3. Evolution characteristics, formation mechanism and trend prediction of extreme precipitation in complex terrain of east Tibet plateau (D05)

The proposed research is expected to focus on the spatial and temporal evolution characteristics of extreme precipitation in complex terrain of east Tibet plateau, multi-scale influence of complex terrain, mesoscale processes and large scale circulation, forecast future extreme precipitation in the context of climate change, and provide scientific evidences for natural hazards prevention and control and ecological protection of east Tibet plateau.

4. Karst evolution mechanism under the background of rapid uplift of the Tibet Plateau and prevention and control of karst water bursting disaster in tunnels of the Sichuan-Tibet railroad (D02 or D07)

The proposed research is expected to explore the karst evolution mechanism under the background of rapid uplift of the Tibet Plateau and alpine climate, make major breakthroughs in the prevention and control of water outburst in tunneling and contribute to the progress of the construction of Sichuan-Tibet railroad.

5. Key technology of deep shale gas fracturing and control of potential geological hazards (E04)

The proposed research is expected to address the exploitation difficulty of deep shale gas in Sichuan basin and the frequent small scale earthquake in Sichuan, explore effective quantification of shale gas fracturing area, gas-solid flow mechanism based on deep earth multiphysics field, the spatial and temporal evolution mechanism of the impact on geological fault, and contribute to the green utilization of deep earth resources and hazard prevention and emergency management in Sichuan.

6. Theory and technologies of forest wildfire early warning based on remote sensing in complex forest environment (D01)

The proposed research is expected to develop theories and technologies such as the quantitative inversion method of combustible materials based on remote sensing in complex environment, inducing factors of wildfire, wildfire predicting and warning model based on collaboration of multi-source spatial and temporal data, build up a system of forest wildfire early warning based on remote sensing technology, and provide theories and methods of the early prevention and control of wildfire in western Sichuan area and China.

7. Impact of climate change on the ecosystem and functioning of alpine meadows (C03)

The proposed research is expected to look into the structure and functions of the aboveground/underground ecosystem of the alpine meadows, the relative contribution of each module to the functioning of alpine meadow ecosystem, the impact mechanism of climate change on biodiversity and ecosystem multifunctioning and contribute to the ecosystem multifunctioning theory of the alpine meadow in northwestern Sichuan.

8. Nitrogen and phosphorus pollution transmission and ecological resilience in the urban-rural boundary area of Sichuan basin (E10)

The proposed research is expected to look into the characteristics and spatial/temporal dynamics of nitrogen and phosphorus pollution in the urban-rural boundary area of Sichuan basin, analyze the process and mechanism of nitrogen and phosphorus pollution transformation in the ecosystem in the course of urbanization, and develop a multi-scale regulation strategy and precision management strategy of the purification service of ecosystem.

9. Nitrogen conversion process in purple soil and its ecological effect and regulation mechanism (D01 or D07)

The proposed research is expected to solve key scientific problems faced by the green development of agriculture in Sichuan, analyze the nitrogen conversion capacity of different purple soils, key process of nitrogen retention in soil, biotic and abiotic mechanism of nitrogen retention, nitrogen loss process and flux of different types of purple soils such as ammonia volatilization, nitrogen oxides emission nitrogen runoff and leaching, and denitrification, interaction characteristics of nitrogen loss process, main factors and regulation mechanism.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Sichuan province.

ii. Research on ecological process and regulation for typical agricultural area, to meet the demand for the sustainable management of agricultural ecosystem, regional ecosecurity, and the stability of agricultural ecosystem in Hunan.

Priority research areas:

1. Landscape change and ecosystem service regulation mechanism of Tongting Lake basin (D01 or D07)

The proposed research is expected to address eco-environmental problems of the Tongting Lake basin caused by land development and land cover change, analyze the spatiotemporal change of landscape driven by natural and human factors, explore ecological response process in changing environment, and unveil the formation and regulation of ecosystem service in the Tongting Lake basin.

2. Soil and water erosion and regulatory effect of vegetation in hilly areas in

Hunan (D01 or D07)

The proposed research is expected to address the high risk of water and soil erosion and low efficiency in ecological management, analyze the water and soil erosion process of different underlying surfaces and reasons for the difference in erosion process, and explore the regulatory effect of vegetation recovery on water and soil conservation and nutrient retention.

3. Pollutant migration and control mechanism in typical ecological regions (D01, D07, E04 or E10)

The proposed research is expected to address the pollution caused by heavy metals, refractory organics and radioactive pollutants in typical ecological regions in Hunan, conduct research on the interaction of pollutants, pollution migration and transformation, pollution control and environment remediation, radioactive tailings surface solidification mechanism, remediation method optimization and so on, unveil the effect and mechanism of passivation of heavy metals by functional microorganism, and develop new theories for the remediation of pollution caused by heavy metals, refractory organics and radioactive pollutants in typical ecological regions in Hunan.

4. Mechanism and regulation of chemical and biological transformation of agricultural and forestry wastes (D01 or D07)

The proposed research is expected to address the large quantity and low utilization efficiency of agricultural and forestry wastes in Hunan, research on the influence of production process and processing method of agricultural products on waste production, high efficiency transformation mechanism of organic components of agricultural and forestry wastes, green waste disassembly and restructuring mechanism, carbon and nitrogen loss features, greenhouse gas emission reduction characteristics, transformation and control of toxic substances such as antibiotics and pesticide residues.

5. Biotic environmental stress and ecological response in global climate change (D01, D05 and D07)

The proposed research is expected to address problems caused by global climate change such as extreme climate events, occurrence of major pests, and major bio-invasion, conduct research on pest species evolution of different ecological regions, pest catastrophes and diagnose of environmental stresses, disaster occurrence and collaborative response of key processes of ecosystem.

6. Pollutant migration process and control mechanism under the synergistic effect of people, land and water (D01, D07, E09 or E10)

The proposed research is expected to address the key problems of non-point source pollution in Hunan, make in-depth analysis of the source of main pollutants (COD and nitrogen/phosphorus pollutants) and its relations with people's lives and productive activities, the relations between hydrological process and the migration of pollutants, response of sensitive water to pollution, and the pollutant loading, migration process and environmental impact of pollutants under the synergistic effect of people, land and water.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Hunan province.

iii. Research on atmospheric extinction, separation of high-viscosity oil and water, acid water treatment in mining area, to improve the air quality and control water pollution in mining area of Anhui.

Priority research areas:

1. Pentosecond laser processing technology for heat-assisted porous film and its application in separation of high-viscosity oil and water (E03, E04, E05 or E13)

The proposed research is expected to address the difficulty of separating high-viscosity oil and water, focus on crude oil, conduct research on controlled etching of silver nanowire porous media heater by pentosecond laser processing, and thermohydrodynamic mechanism of acceleration of crude oil permeability by coupling of joule heat and unsymmetrical micropore, and provide theoretical and technological support to the treatment of high-viscosity oil in city waste water.

2. Natural evolution of acid water in mining area and in situ bioremediation mechanism (E04 or E10)

The proposed research is expected to explore the water quality natural evolution process and key factors for large scale acid mine drainage in key metal mines in Yangtze-Huai Rivers, unveil the microbial community structure and function evolution, migration and transformation mechanism of carbon, nitrogen, sulphur, iron and heavy metal elements in the in situ bioremediation process, and provide scientific evidence to the treatment of acid mine drainage.

3. Characteristics of long-term change of atmospheric extinction and its influencing factors in Yangtze-Huai Rivers (D05)

The proposed research is expected to focus on the characterization of atmospheric extinction factors and the interaction mechanism between air pollution and atmospheric extinction, analyze the high-spatiotemporal-resolution changing features of atmospheric extinction in Yangtze-Huai Rivers, the impact of environmental and atmospheric elements such as physical properties of particles and relative humidity on local atmospheric extinction coefficient, and identify key influential factors of atmospheric extinction and potential pollutions sources in Yangtze-Huai Rivers.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Anhui province.

iv. Research on groundwater pollution in cold area, control of pollution caused by livestock and poultry waste, urban sewage treatment, soil organism change and its ecological effect in Changbai Mountain, productivity improvement of grassland in western Jilin.

Priority research areas:

1. Characteristics of vertical pattern changes of soil organism in Changbai Mountain and its ecological effect (D01)

Due to the climate change, the pattern of vertical vegetation spectrum in Changbai Mountain is undergoing obvious succession, which increases the uncertainty of underground fauna pattern and decreases the ecological function of soil. The proposed research is expected to look into the pattern changes of vertical soil fauna spectrum and its impact mechanism on soil carbon and nitrogen cycling, explore the response mechanism of food web of soil fauna, the relations between soil fauna and ecosystem functions, develop new adaptive regulation theories and technologies, and provide theoretical support to the environmental protection of the Changbai Mountain and the building up of ecological civilization.

2. Migration, transformation and control mechanism of harmful substances in livestock and poultry wastes in cold area farmland system (D07)

The proposed research is expected to address the serious threats to food safety and

people's health caused by heavy metals and antibiotics into the farmland from wastes of livestock and poultry breeding industry, explore the migration and transformation of key pollutant elements and their safety thresholds in the application of livestock and poultry wastes into the farmland, build up a technological system for the detoxification treatment and recycling of livestock and poultry wastes, and provide theoretical and technological support to the livestock and poultry waste control and protection of regional eco-security in Jilin.

3. Cold area groundwater pollution monitoring and pollution source tracing technology (D01, D02, and D07)

In view of the serious groundwater pollution caused by industrial and agricultural production activities, the proposed research is expected to overcome the subtleness and hysteresis of groundwater pollution, trace the pollution source, investigate the spatiotemporal distribution and evolution of groundwater pollution, optimize the monitoring scheme, develop basic theories and key technologies for tracing groundwater pollution source appropriate for cold area, and provide theoretical basis for the treatment and risk assessment of groundwater pollution.

4. Theories for new biodegradation technology for urban sewage treatment in cold area (D01, D02, and D07)

The proposed research is expected to solve technical problems caused by low temperature and big changes in pollutant loading in urban sewage treatment in winter such as low growth rate and low activity of microorganisms, and large amount of residual sludge, develop new biodegradation technology suitable for variable loading of urban sewage in cold temperature, and provide theoretical basis for stable operation of low-temperature urban sewage treatment in winter.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Jilin province.

III. Energy

i. Research on exploitation of special resources in Sichuan, nuclear science and engineering, nuclear security, to contribute to the Sichuan's energy and nuclear technology strategy and improvement of innovation capability of Sichuan.

Priority research areas:

1. Basic theories and key technologies of high-efficiency, intelligent, and green exploitation of shale gas (E04)

Exploitation of shale gas in Sichuan basin is facing difficulties such as large water consumption and poor fracturing result because of deeply buried gas reservoir, great difference in horizontal principal stress and strong rock strengthen and plasticity. The proposed research is expected to focus on basic theories and key technologies of high-efficiency, intelligent, and green exploitation of deep shale gas with low water consumption and good fracturing effect, and provide theoretical support to sustainable utilization of deep shale gas in Sichuan.

2. Low-cost energy storage materials (B08, E01, E02 or E04)

The proposed research is expected to address the demands and technological bottlenecks in high-efficiency recycling of advantageous minerals and waste in Sichuan such as vanadium, titanium, phosphorus, iron and lithium, focus on basic theories and key scientific problems in scale-up production process, explore low-cost and high-performance

energy storage materials and meet the urgent need of the development of clean energy in Sichuan.

3. Large scale exploitation of marine natural gas hydrates (NGHs) through solid fluidization and high efficiency transportation and optimization of key parameters (E04 or E06)

The proposed research is expected to focus on theories and key technologies for the high efficiency exploitation and industrial development of non-diagenetic marine natural gas hydrates, especially wellbore flowing control and regulation method in solid fluidization gas well with the purpose of large scale exploitation; explore methods of identification of medium properties while drilling, develop technologies and software of downhole risk prewarning; develop large physical simulation experimental systems and simulation methods for the whole process of exploitation of NGHs deep under water in South China Sea and technologies for controlling and supporting large scale mining.

4. Physics of plasma neutralization of high-energy ion beams (A05002)

The proposed research is expected to investigate the physics of neutralization of high-energy ion beams, especially the plasma neutralization of negative ion beams, and explore the mechanism of laser neutralization and electron neutralization, to support the development of nuclear energy in Sichuan.

5. Key problems of power conversion in the organic Rankine cycle (ORC) driven by nuclear power (E06)

The proposed research is expected to investigate the pyrolysis properties and stability boundary of ORC working fluid under high temperature and irradiation conditions, the thermal physical properties of working fluid and heat transfer enhancement mechanism, the 3D unsteady aerodynamics of complex structure of power devices, and dynamic characteristics and control methods for ORC system, to meet the need for nuclear power and clean geothermal energy in Sichuan.

6. In situ characterization of electron kinetics in fast charging of high energy density lithium-ion batteries (A04006)

The proposed research is expected to focus on the safety of high energy density lithium-ion battery for high end equipment and electric vehicles, explore the in situ characterization of electron kinetics in repeated high-rate charging and discharging, and provide scientific support for the development of high end equipment and power battery in Sichuan.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Sichuan province.

ii. Research on key problems related to battery diaphragm, recycling of agricultural and forestry wastes, fusion power and combustion engine using clean alternative fuel, to contribute to the development of renewable energy industry in Anhui.

Priority research areas:

1. Energy storage battery and new battery diaphragm materials (B05, E01, E02, E03 or E04)

The proposed research is expected to address the grid interconnection problem of distributed photovoltaic power and wind farms in Anhui's renewable energy development plan, conduct applied basic research on energy storage battery and diaphragm, especially the energy storage process of batteries, the impact and regulatory effect of electrolyte

structure on key performance of batteries, and the structure-activity relationship of the chemical structure-molecular orbital-electrochemical properties of electrolyte molecules; develop new diaphragm materials for energy storage batteries, explore the mechanism underlying the impact of diaphragm microstructure on key battery parameters such as energy storage efficiency and cycling life, develop diaphragm with high selectivity and low impedance, and achieve large scale production.

2. Co-production of liquid fuel and chemicals by catalytic conversion of agricultural and forestry wastes (B05 or E06)

The proposed research is expected to focus on utilization of the large amount of agricultural and forestry waste in Anhui and conduct research on key reactions, catalysts and technologies in the catalytic transformation of biomass, unveil the mechanism underlying the typical catalytic transformation of specific chemicals and provide theoretical and technological support to the utilization of agricultural and forestry wastes in Anhui.

3. Key technologies of internal combustion engine using clean alternative fuel (E06)

The proposed research is expected to respond to the need of developing high efficiency and zero emission engine for Anhui's automobile industry, explore the mixture formation mechanism and combustion strategy of internal combustion engine using clean alternative fuel under multiple injection conditions, clarify the impact of multiple injection on internal combustion engine performance, the mechanism of knocking, and the production and transformation of pollutants, so as to provide theoretical and technological support to the development of high efficiency and zero emission internal combustion engines.

4. Mechanism of improving the efficiency and power of nanostructured radioisotope battery based on β -radio-voltaic effect (A0504)

The proposed research is expected to investigate the collision and ionization process of β particles in wide-bandgap semiconductors, explore the mechanism of excitation, separation and transmission of electron hole pairs, investigate the new effects of high density 3D coupling loading of tritium and other radioisotope, and provide theoretical support and evidences for radioisotope microbattery based on β -radio-voltaic effect with high efficiency, high power density, and low costs.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Anhui province.

IV. New materials and advanced manufacturing

i. Basic research on functional materials, to meet the need of developing functional material industry in Sichuan.

Priority research areas:

1. Broadband and high response infrared detection technology for quantum functional materials (E02, E13 or F05)

The proposed research is expected to significantly improve the sensitivity and response speed of room temperature infrared detectors by conducting research on new quantum functional materials, new detection mechanism and application verification of broadband high-response infrared detectors.

2. Advanced vanadium titanium phase-change materials for dynamic Terahertz devices (E02, E13 and F05)

The proposed research is expected to focus on the vanadium and titanium resources of Sichuan, develop advanced vanadium-titanium membrane materials with automatic reversible and non-automatic reversible phase change, break through the key scientific problems of the materials' application into the high efficiency and ultra-fast regulation of Terahertz devices, and support the development of dynamic Terahertz devices.

3. Key materials and devices for wide spectrum adjustable photoelectric detection (E02 or E13)

The proposed research is expected to address the technical bottlenecks of infrared detectors such as low integration level, high dark current and low temperature environment, look into the basic scientific problems of photoelectric detection based on two-dimensional atomic crystals, especially the theory of adjustable photoelectric detection, photoelectric conversion mechanism, and key material selection, so as to promote the upgrading and development of electronic information industry in Sichuan.

4. Infrared laser glass with ultra-high damage threshold (E02, E13 or F05)

The proposed research is expected to respond to the need for high power infrared optical materials of the national defense industry, look into the basic questions of damage of oxyfluoride glass materials under 1 to 3 μm wavelength infrared laser irradiation, realize accurate performance regulation of infrared optical materials, and develop 2 to 3 type of new materials with ultra-high damage threshold under infrared laser irradiation at 1 to 3 μm wavelength.

5. Fatigue assessment and characterization method of gas turbine rotor under complex conditions (E05 or E06)

The proposed research is expected to respond to the need of developing high end manufacturing industry of gas turbine, conduct research on the ultra-long life and reliability of key gas turbine materials and components under complex conditions, especially basic questions of fatigue damage and failure mechanism, material degradation mechanism, and impact of complex environment, and solve key technical issues such as fatigue damage assessment, life prediction, reliability assessment of gas turbine under complex working conditions.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Sichuan.

ii. Basic research on new alloys, advanced energy materials, composite materials, chemical and catalytic materials, and advanced electronic information materials, to meet the need of developing the aerospace, national defense, transportation, energy and advanced manufacturing industries in Hunan.

Priority research areas:

1. Nonferrous metal processing and efficient green purification of rare and precious metals (E01, E04 or E13)

The proposed research is expected to look into the component design, microstructure evolution and residual stress control, performance regulation and service performance of nonferrous metals and their composites; forming and deformation processing of complex nonferrous metal components, mechanisms of successive electro-hydraulic extrusion and expansion of light alloy and magnetic pulse welding of different materials; the mechanism of superfast ice-phobic biomimetic surface induced by laser; new theories and methods of efficient green purification of rare and precious metals; and basic theories and new methods of deep processing of rare and precious metals.

2. New piezoceramic materials and devices (E02 or E13)

The proposed research is expected to respond to the urgent need for lightweight, flexible and large-scale piezoelectric components of the new generation of communication, navigation and control technology, break through the bottleneck of lead-free piezoelectric ceramic component performance, improve the design of functional ceramic components and the microstructure of piezoelectric composite materials, explore the multi-field response mechanism and new production technology, and develop new technology for manufacturing of lightweight, flexible and large-scale piezoelectric composite material devices.

3. Special alloy and superhard materials (E01, E02, E04 or E13)

The proposed research is expected to focus on the design theories, new production methods, and new application of special alloy and superhard materials; clarify the impact of production process parameters on the microstructure and properties of special alloy and superhard materials, improve their service performance in complex and extreme working conditions; and improve the material design and production technology of new long-life wear-resistant coating.

4. Efficient comprehensive recycling of secondary nonferrous metal resources (E04)

The proposed research is expected to address the difficulty in achieving low-cost and high quality recycling of waste nonferrous metals, develop new theories and methods for high quality recycling of secondary nonferrous metal resources and high efficiency utilization of residual energy, and solve key scientific problems such as regulation of the impurity properties, element separation and extraction, transformation and efficient utilization of energetic substances

5. Design, preparation and performance assessment of advanced materials for power batteries and energy storage batteries (E01, E02, E03, E06 or E13)

Design, calculation, preparation and electrochemical performance assessment of high capacity and high rate lithium, sodium and potassium power battery materials; design, interface control, preparation and electrochemical reaction mechanism of key materials for high energy density metal fuel cell and long life solid-state lithium metal battery; in situ testing system of power and energy storage battery materials, and real-time crystalline phase change and component migration in charging and discharging process; battery failure mechanism in extreme conditions; heat generation and dissipation mechanism and systematic design of electrode materials.

6. Composite materials and green intelligent manufacturing technology (E01, E02, E03, E05 or E13)

The proposed research is expected to focus on basic scientific issues and applicable technologies concerning new composite materials and green intelligent manufacturing technology. Main research topics include: new matrix materials for high temperature resistant resin and ceramic precursor; high modulus and high heat conductivity carbon fiber; high efficiency green intelligent preparation technology; function and structure integrated composite materials; stress and phase regulation mechanism of direct bonding copper of large scale and high heat conductivity ceramics; recycling of composite materials; green manufacturing technology of high strength weather resistant bamboo fiber composite materials; high efficiency manufacturing technology of functional biomass composite materials; theories and applied basic research on preparation of high yield and low impurity nano-carbon lubrication materials.

7. Short process preparation of high efficiency new energy catalytic materials and its theoretical basis (B05)

The proposed research is expected to focus on development of complex polymetallic materials and high value utilization of polymetallic ores; develop short process preparation methods for photocatalytic/electrolytic hydrogen production, oxygen reduction in fuel cell, energy storage by super capacitor, and heavy oil cracking; explore the mechanism of in situ controllable chemical transformation of rare and precious polymetallic ores and the mechanism of doping-updoping of rare and precious metal ions and other energy metal ions in layered minerals; investigate the catalytic mechanism and interface science of energy catalytic materials.

Applicants are encouraged to conduct researches on the above topics in collaboration with universities and research institutes in Hunan province.

iii. Research on new theories, methods and technologies of high performance basic materials and new functional materials based on the development needs, research strengths and large scientific facilities of new materials in Anhui.

Priority research areas:

1. Structure, function regulation and application of new polyvinyl alcohols (PVA) optical basement membrane (E03 or E13)

The proposed research is expected to focus on basic scientific and engineering problems in the production and application of PVA optical basement membrane, develop technologies for the synthesis and production of raw materials of high drawing ratio PVA optical basement membrane by using advanced technologies such as synchrotron radiation online testing; solve the scientific and engineering problems in the solution casting of PVA optical basement membrane; clarify the relations between raw material formula, processing parameters, membrane structure and performance, and membrane stability and uniformity; develop and make industrial trial production of the raw material production and casting of high performance PVA optical basement membrane, so as to promote the development of industrial base of new strategic industries of Anhui province.

2. Liquid metal induced corrosion mechanism and composition regulation of ODS reduced activation steel (E01 or E13)

The proposed research is expected to study the corrosion mechanism of ODS reduced activation steel for advanced reactor in extreme environment of high temperature, liquid and oxygen-controlled lead; explore the microscopic mechanism of the interaction between oxide dispersion strengthened (ODS) phase, trace alloy elements and liquid lead alloy; establish thermodynamic and dynamic models of the formation and growth of corrosion interface products; find new directions for the regulation of liquid metal induced corrosion of ODS low activation steel; and provide theoretical support and evidences for the development of new ODS low activation steel.

3. Catalysts and magnetic materials based on organic rare earth metal complex (B01, B05, E01, E02, E04 or E13)

The proposed research is expected to respond to the demand of the development and utilization of rare earth resources; study the synthesis, magnetic properties and catalytic functions of rare earth metal organic complex; investigate the interactions and mechanism of electronic effect, stereoscopic effect, bonding mode and performance of catalyst ligands of rare earth metal based catalysts; and provide theoretical support and design basis for the selection and development of high efficiency rare earth metal complex-based catalysts and

magnetic materials.

4. Mechanism of the control of microstructure and properties of ceramic core by lithography-based additive manufacturing (E02, E05 or E13)

The proposed research is expected to investigate the influence and mechanism of slurry component, forming process and sintering on microstructure and properties of ceramic core produced by lithography-based additive manufacturing; explore the relations between slurry component, processing technology, microstructure and properties; develop new technology for lithography-based additive manufacturing of ceramic cores with complex structure; and provide theoretical and technical support to the production of complex-cavity turbine blade.

5. Nonlinear ultrasonic testing theory and methods for micro defects of pressure equipment (E05 or E06)

The proposed research is expected to address the need to detect the micro defects of pressure equipment and other key energy equipment, focus on the nonlinear ultrasonic response mechanism of micro defects; develop composite phased array ultrasonic inspection equipment; explore nonlinear high-end imaging and assessment methods, and solve the key problems concerning the effective testing of micro defects and quantitative monitoring of early micro-damage of energy equipment.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Anhui province.

iv. Basic research on new materials and new technologies needed by Jilin's advantageous industries such as automobiles, railway vehicles, energy, aviation, aerospace and medical industries.

Priority research areas:

1. Thermoelectric coupling mechanism and efficient management of all-climate power battery system for electric vehicle in cold area (E06 or E07)

The proposed research is expected to focus on the battery degradation mechanism and problems restricting the climate-immune operation of electric cars such as the poor collaborative management of power battery system, explore the multi-dimensional evolution mechanism of power battery degradation in fast self-heating and the coupling of battery degradation and self-heating speed; and improve the accuracy, safety and integration level of the collaborative power management of the power battery system.

2. Basic research on integrated design of automobile and key components (E05 or E07)

The proposed research is expected to improve the innovation and iterability of the current design theory of automobile and key components; explore big data-based integrated design methods and principles, design of automobile components and the mechanism of manufacturing complexity control.

3. Basic research on hydrogen production by catalytic conversion of renewable energy (B05, E02 or E06)

The proposed research is expected to make full use of the wind power in Jilin, address the difficulty of wind power grid integration, explore the wind power generation coupled with catalytic electrolytic hydrogen production, change the wind power into chemical energy stored in hydrogen; develop high activity, low cost and high stability new catalytic materials by design of atomic-level dispersed catalytic sites and accurate control of catalyst structure; explore the need for successive catalytic sites by using the advanced

in-situ and non in-situ methods, clarify the impact of collaborative catalytic mechanism and microstructure of interface catalytic sites on catalytic hydrogen production, and unveil the mechanism of catalytic hydrogen production.

4. Fault diagnosis method and intelligent optimization and control technology of railway vehicle brake system based on plug-and-play framework (F03)

The proposed research is expected to focus on the safety and efficient operation of railway vehicles, and provide more reliable and effective solutions for the plug and play design framework independent of any specific control structure, micro-fault diagnosis and intelligent optimization and control of braking system, data-driven online learning and optimization of key design parameters.

5. Basic research on reliability-based design and acceleration testing of grating sensing components for CNC machine tools (E05)

The proposed research is expected to address the low reliability and high failure rate of domestic components of CNC machine tools, study the basic theoretical framework and design methods of innovative reliability design of high speed and high accuracy grating sensing components for CNC machine tools; explore the multi-physical fields dynamic coupling mechanism and acceleration testing methods for the environment simulation of grating sensing components under complex working conditions of CNC machine tools, and investigate main failure modes and failure mechanisms affecting the reliability of grating sensing components of CNC machine tools.

6. Basic research on the casting of mirror blank for large-aperture multi-focus reflector by multi field coupling centrifugal casting (E04 or E05)

The proposed research is expected to solve the difficulties in casting large-aperture multi-focus reflectors due to complex shape and long processing time, study the basic problems concerning the casting of mirror blank for large-aperture multi-focus reflector by multi field coupling centrifugal casting, improve the understanding of the mirror shape evolution mechanism in multi field coupling centrifugal casting, explore the accurate control of glass melt flow in casting process, improve the theories of accurate casting of the optical surface of multi-focus reflectors, and provide theoretical support for the multi field coupling centrifugal casting technology for complex curved reflectors.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Jilin province.

V. Modern transportation and Aerospace

Basic research on aero-engine, avionics network, air traffic control, aerodynamics, aerospace materials and structure and difficulties caused by special landscape and geography in the development of modern transportation, to serve the development need of aerospace industry and modern transportation in Sichuan.

Priority research areas:

1. Online monitoring method for strain field of non-contact optical aero-engine turbine rotor blade (E05, E06 or F05)

The proposed research is expected to respond to the development need of aero-engine, explore basic theories and methods for online monitoring of strain field of non-contact optical turbine blade under conditions of narrow space, high temperature, high pressure, and strong interference.

2. Key technologies of heterogeneous information transmission and fusion of

new optical avionics network (F05)

The proposed research is expected to break through the technological bottlenecks in improving information transmission and processing capacity of avionics network in complex environment, focus on new optical network architecture and information processing mechanism, comprehensively improve the transmission capacity and fusion accuracy of heterogeneous information in avionics network, to meet the need of sustainable development of aerospace industry and provide technical support for the leading position of Sichuan and Southwest China in aircraft design and manufacturing.

3. Theories and methods of machine learning-based collaborative monitoring for air traffic control (ATC) safety in complex environment (F01 or F06)

The proposed research is expected to respond to the need of collaborative control of multi-airport air traffic safety in complex airspace of southwest China, focus on the theories and methods of machine learning-based collaborative monitoring for air traffic safety, improve the intelligent level of safety management of ATC command, and increase the competitiveness and industrialization of intelligent ATC technology.

4. Regulation principles and flow mechanism of the variable geometry inlet duct of air-breathing hypersonic vehicle (A0204)

The proposed research is expected to respond to the development need of aerospace industry, focus on the variable geometry inlet duct of air-breathing hypersonic vehicle, and investigate the shock wave arrangement and regulation of variable geometry inlet, the flow structures and flow mechanism in the regulation process.

5. Theories and methods of the preparation and processing of high strength and self-healing polymer and composite materials for aviation (E03 or E13)

The proposed research is expected to respond to the need of developing aerospace technology, focus on the basic questions concerning the preparation and processing of high strength and self-healing polymer and composite materials, especially the structure and properties of new self-healing materials and the self-healing mechanism, new methods and theories of additive manufacturing of self-healing materials, and provide technical support for the manufacturing of complex structural aviation components.

6. Rapid repair technology and high polymer materials for the foundation settlement of ballastless track in complex environment (E03, or E08)

The proposed research is expected to solve the difficulty in track settlement repair in high altitude, low air pressure, large slope and undulating and uneven topography, focus on the polymer materials for track settlement repair in Sichuan-Tibet railway, investigate the perfusion rheological characteristics and environmental stability of polymer materials for the rapid settlement repair and the safe operation of Sichuan-Tibet railway, and develop the basic theories of lifting the underground foundation of ballastless track by polymer grouting.

7. Operation management of the engineering material transportation corridors of the Sichuan-Tibet railway project (G0102)

The proposed research is expected to meet the demand for high-efficiency, high-safety, stable and sustainable material transportation corridors in the dangerous mountainous areas along the Sichuan-Tibet railway, investigate the matching and coupling mechanism of specialized transportation capacity and privately owned transportation capacity, dynamic supply and demand prediction theory, spatiotemporal distribution of construction shortcuts and existing roads, motorcade operation reliability, and automatic

motorcade formation driving stability, and develop a whole system for the operation management of material transportation corridors for major engineering projects in mountainous regions.

8. Mechanism underlying the impact of strong earthquake and fault zone on tunnel construction of Sichuan-Tibet railway and tunnel safety control (E08)

The proposed research is expected to focus on the safety control of tunnel construction of Sichuan-Tibet railway project, investigate the characteristics of fault movement and site seismic effect of Hengduan Mountain tunnel site, clarify the mechanism underlying the impact of the coupling of fault creep and strong earthquake on tunnel, develop the assessment criteria of the tunnel surrounding rock and the evaluation system for the tunnel lining structure service performance, and provide design methods and key parameters for the structure of tunnels passing through active fault zone under strong earthquake.

9. The correlation effect between traffic complex and city and transportation efficiency optimization methods (E12 or G01)

The proposed research is expected to focus on the role of traffic complex as the driving force of the transportation and spatial planning of cities and urban agglomeration in Sichuan, investigate the traffic demand and demand evolution trend of traffic complex based on the modern traffic operation characteristics and intensive urban layout, analyze the correlation effect between urban development and urban agglomeration-oriented traffic complex, and explore the functioning mechanism and efficiency optimization of traffic complex in different development stages of cities and urban agglomeration in Sichuan.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Sichuan province.

VI. Electronic information

i. Basic research on electronic information, network security and artificial intelligence.

Priority research areas:

1. Basic problems of the data security of edge node fusion for the internet of things (F02 or F06)

Current data security protection methods and mechanisms are not suitable for the protection of data fused from distributed multi-source heterogeneous edge nodes. The proposed research is expected to focus on the theories and models of edge data fusion system security assessment, lightweight security sensitive computing task scheduling, and collaborative data security protection mechanism, so as to achieve safe and efficient utilization of sensitive data.

2. Theory and methods of 3D face modeling for dynamic face recognition (F06)

The proposed research is expected to break through the technical bottleneck in dynamic face recognition in complex scenes, explore theory and methods of 3D face modeling and dynamic face recognition method based on 3D facial features, improve the real-time performance, robustness and accuracy of dynamic face recognition, to meet the demand for high security identity authentication in complex environment and provide technical support to the social stability and safety of Sichuan and southwest China.

3. Key technology of broadband tunable mid-infrared high power femtosecond fiber laser at the wavelength of 2 to 10 μm (F05)

The proposed research is expected to meet the development need of laser medical treatment and upgrading of laser precision processing technology, focus on technical bottlenecks such as the light field manipulation of mid-infrared femtosecond fiber laser and high power amplifier, develop the methods of designing and producing new optical fiber and highly non-linear functional crystals, and realize the generation of multi-mode solitons, wavelength extension, broadband tuning and high power amplification of mid-infrared femtosecond pulse.

4. Key technology of portable ultra-wideband Terahertz wave generator (F01)

The proposed research is expected to focus on key scientific questions in electronic information, wireless communication, and biomedical testing, explore generation method of high signal-to-noise ratio ultra-wideband terahertz pulse driven by 1,550 nm fiber laser source, and investigate the integration of ultra-wideband terahertz wave source and new micro-nanostructure and their collaborative function mechanism.

5. Compression of highly dynamic and ultra-high frame rate video and identification of key target (F02)

The proposed research is expected to focus on theory and technology of highly dynamic and ultra-high frame rate video compression and key target identification, break through the traditional methods, realize high efficiency compression and accurate identification and apply it in national defense, social security and transportation.

6. Basic theory and key technology of phased nano-antenna array based on silicon-based electro-optic phase shifter (F01)

The proposed research is expected to focus on technical bottlenecks such as the silicon/organic hybrid electro-optic phase shifter, mechanism, design and production of large-scale phased nano-antenna array, especially the mechanism and design of phased beam scanning.

7. Key technology and method of high-precision and high-resolution online wavefront testing (F05)

The proposed research is expected to meet the extensive need of optical precision testing in national defense and civil application, focus on theory of wavefront distortion measurement, optical structure design, wavefront reconstruction and data analysis, and break through the technical bottleneck of high-precision and high-resolution simultaneous identification of different targets in complex environment.

8. Theory and method of multifunctional planar optical devices based on catenary optics (F05)

The proposed research is expected to focus on the scientific problem of light-microstructure interaction in planar optics and its application in high resolution imaging, investigate the topological optimization and intelligent optimization of catenary structure, break through the problems of low efficiency, small visual field and narrow bandwidth faced by traditional planar optical systems, and promote the application of catenary optics in multifunctional photoelectric detection and large visual field laser imaging.

9. Nano alignment method for super-resolution optical imaging lithography (F05)

The proposed research is expected to focus on the need of producing new nano chip for research and industry of microelectronics, optoelectronics and bio-sensing, study nano alignment theory and methods, investigate key problems in evanescent wave alignment

signal control and collaborative design of alignment and imaging, and provide theoretical and technical support for the development of high-end lithography equipment with independent intellectual property.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Sichuan province.

ii. Basic research on chip and basic software with independent intellectual property, industrial control and automation, satellite navigation technology, to meet the development need of internet-based intelligent manufacturing of advanced equipment in Hunan.

Priority research areas:

1. Key chip technology with independent intellectual property and high security (F04)

The proposed research is expected to address the demand for information security in data transmission and processing in industrial automation, image processing, internet of things, and big data analysis, study the design theory and methods of chips with physical unclonable functions, solve the technical problems such as the vulnerability to machine learning attack, lack of shared key generation function, and difficulty in testing security and reliability, develop methods and technologies of protection against machine learning attack, physical unclonable function for shared key, fast security assessment and intelligent information security system construction, design chips with independent intellectual property based on new micro-nano devices, and provide technical support for the new generation of high security information processing and control system.

2. Key technology of safe and efficient large-scale graph data management (F02)

The proposed research is expected to meet the demand for efficient and safe management of large-scale graph data in knowledge mapping, social network and intelligent transportation and develop theories and methods of safe management of large scale graph data with independent intellectual property based on the high-performance computing capacity in Hunan. The key areas include: high-efficiency data storage and second-level query-and-response technology for billion-edge graph data, 1-PFLOPS-level graph computing framework based on the CPU-GPU heterogeneous parallel architecture, semantic based high-efficiency sharing of ciphered graph data, privacy protection method for high-availability graph data, interactive retrieval method and low delay visualization method, complex sound reconstruction and extraction method based on graph database.

3. Data sensing and security system of the cyber-physical network (F02)

The proposed research is expected to meet the rapidly increasing demand of real-time dynamic acquisition and secure transmission of cyber-physical network data, solve the problems of wide coverage and large spatial span of the cyber-physical network data, investigate the dynamic data acquisition architecture, universally applicable data acquisition method for heterogeneous sensing resources data, data fusion analysis and modeling method for integrated multi-source heterogeneous sensing resources data, adaptive scheduling and secure transmission of sensing resources data, so as to support the efficient and secure acquisition, transmission, fusion and decision making for high concurrent and dynamic tasks.

4. Basic theory and key technology of dynamic decision making of the industrial artificial intelligence system (F06)

The proposed research is expected to support the efficient, green and intelligent development of manufacturing industry, explore new method of multi-source information fusion and perception in advanced manufacturing, intelligent cognition of working conditions in open environment, knowledge expression and evolution based on data mining and mechanism fusion, key technology of dynamic multi-objective decision making based on human-machine integration, and build up an dynamic decision making method system for industrial artificial intelligent system featured with integration of manufacturing process perception, cognition and decision.

5. Accurate control and intelligent operation of the green and high-efficiency preparation of renewable energy materials (E01, E02, E03 or E13)

The proposed research is expected to study the heat and mass transfer characteristics and collaborative mechanism of energy and mass flow in the preparation of renewable energy materials, accurate control of key parameters of the preparation process and product consistency regulation mechanism, put forward optimization methods for multi-process collaboration and whole process intelligent operation strategy, develop new technological system for intelligent manufacturing, and provide theoretical and technical support to the high quality preparation of renewable energy materials.

6. Theory and method of designing the system architecture for a new generation of satellite navigation system (F03)

The proposed research is expected to solve the problems of the coordination of high, medium and low orbits and the inter-satellite or satellite-earth connections of a new generation of satellite navigation system, explore optimization method and design strategy for satellite constellation design, ground control station layout, inter-satellite and satellite-earth network topology routing based on intelligent computing technology, and provide theoretical basis for high-performance, high stability and low cost architecture scheme for a new generation of satellite navigation system.

7. Theory and application of high accuracy spatiotemporal information networking in special environment (F01 or F03)

The proposed research is expected to meet the demand for high accuracy spatiotemporal information of remote and complex regions, study methods, systems and key technologies of spatiotemporal information measurement infrastructure with high availability, especially the wide-area time and frequency transfer technology based on optical switching network for high accuracy time and frequency transfer with a coverage of more than 1,000km, real-time millimeter level positioning in complex and extreme environment based on GNSS and pseudo satellite networking architecture, and provide technical basis for spatiotemporal information networking in complex environment.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Hunan province.

iii. Basic research on key scientific questions of quantum information and communication, artificial intelligence, robotics.

Priority research areas:

1. High-permittivity capacitor materials for advanced dynamic random access memory (DRAM) (F04)

The proposed research is expected to improve the manufacturing technology of advanced dynamic random access memory, study the energy band design, material preparation, integration technology and reliability of new multi-layer stacked

high-permittivity composite capacitor materials, and meet the demand for large capacity, high density and low current leak DRAM capacitor.

2. Sub-wavelength light field manipulation and photon integration (F05)

The proposed research is expected to study on-chip light field manipulation, photon integration and nano-light source base on the mode, transmission and coupling characteristics of the surface electromagnetic field of sub-wavelength multi-layer membrane, and develop the high accuracy optical measurement and high resolution optical imaging technology.

3. Rydberg atom-based self-organized quantum simulation (F05)

The proposed research is expected to focus on Rydberg atom and study the measurement and dynamic evolution of multi-body self-organized critical behavior, and realize self-organized quantum simulation based on Rydberg atom multi-body system.

4. Theory and key technology of high energy efficiency heterogeneous cloud platform (F06)

The proposed research is expected to meet the need for high energy efficiency computing system of the AI industry, focus on theories and key technologies of intelligent cloud platform and software based on intelligent processor, build up application environment test and verification platforms, develop key technologies of intelligent heterogeneous cloud platform with high flexibility and scalability, explore efficient and unified scheduling mechanism, and provide design method and implementation technologies of high energy efficiency heterogeneous cloud platform.

5. Theory and key technology of cognition diagnosis for learners based on multimodal data (F07)

The proposed research is expected to contribute to the development of intelligent education in Anhui and in China, integrate cognitive theory and model on education, machine learning method and big data processing technologies, investigate the theoretical framework of cognition diagnosis for learners based on multimodal data, develop interpretable cognitive analysis models, develop cognitive structure-based intelligent educational method and self-adaptive learning system, establish interpretable cognitive analysis models with high fitting and easy to operate and promote its large scale application, so as to advance the development of intelligent educational system in Anhui and China.

6. Key technology of high efficiency analysis and understanding of sign language videos (F02 or F06)

The proposed research is expected to aim at the semantic expression and understanding of video content, focus on the human-computer interaction for cross-modal automatic interpretation of sign language videos, study the large scale video sign language recognition and synthesis based on hand gesture, lip shape and facial expression, realize high efficiency analysis and understanding of sign language videos and provide important technical support for the communication of deaf-mutes.

7. Key technology of autonomous cooperative perception and networked early warning for unmanned vehicles (F06)

The proposed research is expected to address the limit of autonomous collaborative perception of unmanned vehicles in extreme and severe weather, study the image enhancement and restoration, tracking, testing, collaborative perception and fine-grained target identification for low quality and multi-modal image with special pose pedestrians, establish networked collaborative perception and pre-warning mechanism for unmanned

vehicles and improve the acquisition, perception, analysis and interaction of environmental data in static and driving conditions.

8. Theory and key technology of high-speed and high precision robots based on natural human-computer interaction and collaboration (F03)

The proposed research is expected to meet the demand of 3C, e-commerce logistics and medical industries, make breakthroughs in the basic theory and key technology of high-speed and high precision robots with more than 6 degrees of freedom based on natural human-computer interaction and collaboration, solve the problems of adaptive visual servo, multi-dimensional human-computer security protection, compliance control, and high-level integration of electromechanical components, and produce commercial prototypes with international competitiveness.

9. Key technology of functional enhancement robots for patients with femoral head diseases (F03)

The proposed research is expected to meet the growing need of functional enhancement of patients with femoral head diseases, study the key theories and technologies of new robot mechanism, human-computer interactive multi-dimensional force sensing, hip joint motion intention perception, and coexisting-cooperative-cognitive control, clarify the human-computer interactive adaptive self-learning mechanism for functional enhancement in different stages of femoral head diseases, establish robot verification platform, and provide theoretical basis and key technologies for the application of functional enhancement robots for patients with femoral head diseases.

10. Theory of micro-macro integrated multi-physical field electromagnetic modeling (F01)

The proposed research is expected to focus on the problem of micro-macro integrated electromagnetic modeling, develop the multi-physical and multi-scale coupling modeling theory of nano/sub nano structure and quantum system, accurate, stable, efficient and self-consistent structure preserving symplectic solution for atom-level electrodynamics and quantum mechanics, make breakthroughs of semi-classical quantum electromagnetic problems of the dipole approximation, rotating wave approximation, reactionless approximation and the multi-spatiotemporal difficulties in multi-physical field simulation, discover the principles of interaction between classical electromagnetic system and quantum system, unveil its spatiotemporal dynamics mechanism, so as to meet the need of developing quantum information and communication in Anhui.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Anhui province.

iv. Basic research on industrial needs of intelligent automobile, photoelectric materials and devices, small satellite in Jilin.

Priority research areas:

1. Basic research on high-performance new electroluminescent materials and devices based on rare earth or transition metal complexes (E03, E13 or F05)

The proposed research is expected to focus on luminescent materials and devices, investigate the working mechanism of new rare earth sensitized white light-emitting diodes, clarify the impact of energy level distribution and triplet state energy of rare earth complexes on the performance of light-emitting diodes, high efficiency broadband near-infrared upconversion luminescent materials and spectral regulation mechanism.

2. Key technology of homomorphic integrated optoelectronic chips based on the

third generation of compound semiconductor (F04)

The proposed research is expected to focus on key technologies of the third generation of compound semiconductor, and study scientific problems such as the physical mechanism and regulation of coexistence of light emission and detection of the quantum well diodes, consistency of high-speed modulation and detection response of quantum well diodes, and low-loss high-efficiency coupling of chip light source, optical waveguide and detector.

3. Methods and key technologies of precise laser monitoring of haze in cold regions of northern China (F05)

The proposed research is expected to address the monitoring of environmental pollution caused by heating and straw burning in winter in northeast China, investigate the mid-infrared laser multi-wavelength Gemini-units frequency conversion mechanism of real-time identification of multi-components of low-temperature trace gas, simultaneous compression of time domain and frequency of multi-wavelength mid-infrared laser for high resolution detection of harmful gas components in low temperature evolving process, high-speed precision tuning technology for trace component detection by multi-wavelength mid-infrared laser, and improve the accuracy and quality of high-resolution detection of air components and concentration in alpine environment.

4. Key technologies of secure networking and fast and intelligent collaborative data transmission of low orbit small satellites (F01)

The proposed research is expected to focus on the real-time and stable transmission of in-orbit satellite data, explore the congestion mechanism and flow control optimization technology for massive data of low orbit satellite cluster, intelligent routing technology of highly dynamic and high-diversity network collaborative transmission, secure collaborative data transmission, wireless open communication, large-scale collaborative data distribution technology, multi-link simultaneous intervention and control technology, so as to solve the problems of high-speed data transmission and network congestion.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Jilin province.

VII. Population and health

i. Basic research on characteristic traditional Chinese medicinal resources of Sichuan and bio-therapy.

Priority research areas:

1. Breeding theory and technologies of characteristic Traditional Chinese medicinal resources of Sichuan (H28)

The proposed research is expected to focus on characteristic Traditional Chinese medicinal resources of Sichuan, solve key scientific questions of germplasm resource collection and preservation, variety breeding and improvement, and conduct basic research on breeding to improve the quality of Traditional Chinese medicine.

2. Characteristics and mechanism of traditional Chinese medicine intervention of the great vessel injury caused by metabolic memory in diabetes (H27)

The proposed research is expected to investigate the cause and accumulation of metabolic memory and its impact on the occurrence and development of diabetic macroangiopathy from the traditional Chinese medicine perspective, clarify the characteristics and functioning mechanism of traditional Chinese medicine intervention, and

provide early prevention strategy for diabetic macrovascular diseases.

3. New medicinal parts of high-quality traditional medicinal resources of Sichuan (H2801)

The proposed research is expected to focus on high-quality traditional medicinal resources of Sichuan, study the functional component identification, quality assessment and comprehensive utilization of new medicinal parts, and solve key scientific problems concerning the discovery of potential pharmaceutical effects of different medicinal parts, formation and distribution of chemical components, chemical components and therapeutic effect and drug safety.

4. Discovery and testing technology of biomarkers for early diagnosis of high incidence esophageal cancer in Sichuan (H20)

The proposed research is expected to focus on esophageal cancer, design and develop new methods and technologies of new magnetic multi-functional composite materials, explore precise early testing of tumor markers (such as CTCs, ctDNA, exosomes and so on), and establish early diagnosis technological platform for esophageal cancer.

5. Interaction between respiratory tract micro-ecology and lung cancer and its molecular mechanism (H16)

The proposed research is expected to focus on the micro-ecology characteristics, molecular immunophenotyping and of lower respiratory tract of lung cancer patients and the immune microenvironment changes of lung cancer tissue, study the model of interaction between respiratory tract micro-ecology and lung cancer, explore the interactions among respiratory tract micro-ecology disorder, host immune response and lung cancer evolution and related molecular mechanism.

6. Oral tissue regeneration strategy based on epigenetic mechanism (H14)

The proposed research is expected to focus on key scientific problems of oral tissue regeneration such as dental pulp regeneration, especially the correlation between key genes and epigenetic modification factors (non-coding RNA, histone methylation and DNA methylation) and its evolution in directional differentiation of stem cells, so as to provide new epigenetic modification strategy for oral tissue regeneration and function restoration.

7. Kidney-targeted delivery system of natural products (H30)

The proposed research is expected to focus on high-incidence kidney diseases in China such as the glomerulonephritis, improve the kidney-targeted drug delivery theory and technology for natural monomeric compound of Sichuan, develop new kidney-targeted delivery system of monomeric compound from natural products and explore the pharmacological effect and mechanism of monomeric compound from natural products.

8. Space configuration and biological characteristics of nuclear drugs for the integrated diagnosis and treatment of malignant tumors by special nuclides (H1806)

The proposed research is expected to make use of the nuclear resources in Sichuan, especially high specific-activity carrier-free ^{177}Lu , study the key scientific problems in pre-clinical transformation research of diagnosis and treatment of malignant tumors by domestic nuclear drugs, especially the space configuration and biological characteristics of nuclear drugs such as $^{177}\text{Lu}/^{68}\text{Ga}$ in their combination with over-expression molecules in tumor cells, investigate the key factors influencing therapeutic effect, and advance the study of domestic nuclear drugs with integrated diagnosis and treatment functions.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Sichuan province.

ii. Basic research on substance basis of traditional Chinese medicine, efficacy component accumulation principles, mechanism of the early prevention and treatment effect of traditional Chinese medicine; basic research on genetic susceptibility, pathogenesis and precise prevention and treatment of genetic diseases of nervous system, cervical cancer, breast cancer and oral cancer; basic research of pharmacogenomics and individualized therapy based on individual differences of drug response

Priority research areas:

1. Basic research on the formation mechanism and quality assessment of high-quality medicinal materials in Hunan (H28)

The proposed research is expected to focus on the genetic, environmental and substance basis of high quality medicinal materials and the efficacy component accumulation mechanism, study the basic problems of the relations among production, quality and therapeutic effect and the causes of high medicine quality, establish medicinal material quality assessment system consistent with traditional Chinese medicine theory, and provide scientific evidences for the development policy of traditional Chinese medicine industry.

2. Early diagnosis of prostate cancer and prevention and treatment of prostate cancer by traditional Chinese medicine (H16, H28 or H29)

The proposed research is expected to focused on middle-aged and old male patients with prostate cancer, carry out epidemiological investigation and early diagnosis of prostate cancer in Hunan, explore the pathogenesis of prostate cancer, study the key mechanism in prevention and early treatment of prostate cancer by traditional Chinese medicine, and provide theoretical basis and scientific evidences for the life quality improvement of castration-resistant prostate cancer.

3. Applied basic research on early diagnosis and precise prevention and treatment of cervical cancer and breast cancer (H16)

The proposed research is expected to focus on epigenetic characteristics of cervical cancer and breast cancer in their evolution process, analyze the impact of key molecular events on this process, clarify its function and mechanism, and provide theoretical basis and scientific evidences for the early diagnosis and precise prevention and treatment of cervical cancer and breast cancer.

4. Risk warning and pathogenesis of nervous system genetic diseases (H09)

The proposed research is expected to search for the risk factors and pathogenic genes of nervous system genetic diseases, e.g., polyglutamine disease, by molecular classification and bioinformatics, unveil the key pathogenic mechanism, build up real-time monitoring and risk warning platform for nervous system genetic diseases and provide theoretical basis for the early prevention and precise treatment of nervous system genetic diseases in Hunan.

5. Pharmacogenetics and individualized treatment of platinum drugs (H16 or H13)

The proposed research is expected to focus on new molecular mechanism of the individual differences in response to traditional and the new generation of platinum drugs, establish corresponding animal models based on the new mechanisms, explore new strategies to overcome resistance to chemotherapy of platinum drugs, search for new genomic molecular markers for the prediction of platinum drug efficacy and individual differences in response to side effects of platinum drugs, establish the individualized

medical prediction model based on genomic analysis of individual differences in response to platinum drugs, and explore new approaches of individualized treatment by platinum drugs.

6. Pathogenesis, prevention and treatment of high-incidence oral submucous fibrosis and oral cancer in Hunan (H14 or H16)

The proposed research is expected to focus on the evolving process of high-incidence oral submucous fibrosis and oral cancer in Hunan, study the pathogenesis of oral submucous fibrosis and oral cancer, especially the proteomics, immune microenvironment and the regulation of epithelial mesenchymal transformation, explore the roles and mechanisms of new nucleotide based drugs and drug carriers, bioactive glass carriers and oral stem cells in the treatment of oral verrucous cancer.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Hunan province.

iii. Basic research on azoospermia, mitochondrial genetic diseases, low-temperature plasmas at atmospheric pressure for the treatment of tumor, new anti-inflammatory and immune compounds, to meet the development need of biotherapy and traditional Chinese treatment of Anhui.

Priority research areas:

1. Molecular basis and mechanism of spermatogenesis disorders (C1202)

The proposed research is expected to study the histopathological, cytopathological and molecular pathological characteristics of patients with azoospermia based on their family data, especially the potential pathogenic variation caused by abnormal meiosis, explore the impact of pathogenic variation on the meiotic phase of spermatogenesis and explain its molecular mechanism, and provide molecular targets for diagnosis of patients with azoospermia.

2. Discovery and functional study of new innate immune receptor in aseptic inflammation (H10)

The proposed research is expected to focus on the mechanism of aseptic inflammation, discover new receptors by which the innate immune cells identify endogenous “danger signals”, explore its role and mechanism in stimulating innate immune response and aseptic inflammation, and provide immune intervention strategies for inflammatory diseases.

3. Mechanism of tumor treatment by low-temperature plasmas at atmospheric pressure (H16)

The proposed research is expected to focus on the rapidly developing new technology of tumor treatment by low-temperature atmospheric-pressure plasmas, study the tumor cell damage and death mechanism, explore the relations between characteristic parameters, representative liquid-phase intermediates and key biological effectiveness, and develop the in situ small size plasma generation technology and methods of real-time parameter diagnosis and optimization.

4. Key technology of blocking mitochondrial genetic disorders (H0426)

Mitochondrial genetic disorders are harmful and difficult to cure and prevent. The proposed research is expected to focus on the pre-implantation genetic diagnosis of mitochondrial genetic disorders and the safety and effectiveness of mitochondrial replacement therapy, explore the influence of genetic distance on the mitochondrial DNA haplotypes of offspring after mitochondrial replacement, test the feasibility of clinical

application of mitochondrial replacement ensured by matched mitochondrial genes, develop key technologies of blocking mitochondrial genetic disorders and provide technical support and treatment strategy for the establishment of a step-by-step prevention system for mitochondrial genetic diseases.

5. Discovery of new anti-inflammatory and immunomodulatory compounds from natural medicinal resources in Anhui and their function mechanism (H31)

The proposed research is expected to focus on natural medicinal resources in Anhui, such as radix paeoniae alba of Bozhou, paeonia ostii root bark, and chaenomeles speciosa nakai, search for new anti-inflammatory and immunomodulatory natural active components, identify the leading compounds and produce new compounds with high therapeutic effect through chemical modification and structure transformation, clarify their anti-inflammatory and immunomodulatory effects and mechanism, and provide substance basis and structure-activity relation for the development of new anti-inflammatory and immunomodulatory drugs.

6. Mechanism of improving patients' quality of life by the Pei Ben Gu Yuan method of traditional Xin'an medicine (H27)

The proposed research is expected to focus on high-incidence immune, inflammatory and metabolic diseases in Anhui such as rheumatoid arthritis, chronic obstructive pulmonary disease, diabetes, hepatolenticular degeneration, and gynecological inflammatory diseases, study the molecular mechanism of improving patients' quality of life by the Pei Ben Gu Yuan method of traditional Xin'an medicine, explore data mining models for the relations between the Pei Ben Gu Yuan method, the prescriptions and the patients feeling improvement, and provide new strategies to improve patients' feeling based on the Pei Ben Gu Yuan method.

7. Accurate intelligent comprehensive assessment of cerebral hemodynamics and clinical decision-making assistant system for ischemic cerebrovascular diseases (H09)

The proposed research is expected to focus on cerebrovascular morphology, hemodynamics and automatic quantitative calculation of blood perfusion after cerebral stenosis based on clinical symptoms and vascular image data, develop one-stop intelligent assessment technology based on cerebrovascular morphology and cerebrovascular function, and apply the new technology to the risk prediction and early diagnosis of ischemic cerebrovascular diseases and the decision and prognosis prediction of intravascular interventional therapy.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Anhui province.

iv. Basic research on the key effective materials of Ginseng, velvet antler and other high-quality traditional Chinese medicinal resources in Jilin and their biological mechanisms; basic research on high-incidence respiratory diseases and immune modulation after organ transplantation.

Priority research areas:

1. Exploitation of excellent germplasm resources and molecular breeding of Ginseng (H2801)

The proposed research is expected to search for Ginseng genes related to high-quality, high-yield, pest and disease resistance and stress resistance, clarify its genetic function and regulatory mechanism; build up the Ginseng germplasm bank and explore the

theoretical basis of the molecular breeding based on high efficiency utilization of Ginseng resources; analyze the active components and genomic sequence characteristics of high-quality ginseng varieties, and formulate the corresponding quality standards and molecular assessment methods, so as to provide theoretical and technical support to the development of Ginseng industry in Jilin.

2. Unique biological characteristics, complex efficacy and mechanism of Sika deer velvet antler (H2803)

The proposed research is expected to study the mechanism of rapid growth, reverse ossification and complete regeneration of Sika deer velvet antler, clarify the unique biological characteristics of velvet antler and its relationship with velvet antler's clinical efficacy, and provide theoretical and technical support to the development of Sika deer industry in Jilin.

3. Mechanism of the regulation of stem cell proliferation and differentiation by small molecular compounds from natural drugs of the Changbai Mountain (H30)

The proposed research is expected to study the microstructure of stem cell scaffolds made by polysaccharide complex combined with small molecular compounds from natural drugs of the Changbai Mountain and the micro-nano scale self-assembly technology; study the influences of the composition, structure and micro morphology of composite stem cell scaffolds on the proliferation, differentiation, adhesion, growth, migration and function of stem cells.

4. Epidemiological characteristics and pathogenesis of respiratory airway allergic diseases in Jilin (H01)

The proposed research is expected to study the immunological mechanism, treatment and prevention of respiratory airway allergic diseases caused by regional allergens, and provide theoretical basis for the tertiary prevention and precise treatment of airway allergic diseases in Jilin and Northeast China.

5. Immune modulation and tolerance mechanism of organ transplantation (H1006)

The proposed research is expected to study the immune modulation mechanism in patients with organ transplantation based on clinical samples in Jilin, investigate the molecular mechanism of immune tolerance in organ transplantation by cellular and animal models, so as to improve the theory and technology of organ transplantation in Jilin.

6. Comparative study on the substance basis, efficacy and mechanism of wild Ginseng and cultivated Ginseng (H28)

The proposed research is expected to focus on the differences in efficacy of wild Ginseng and cultivated Ginseng, compare the differences in the type, content and structure of the active components of wild Ginseng and cultivated Ginseng, such as polysaccharides and saponins, and the differences in the efficacy mechanisms, such as the target, signal regulation pathway, etc.

Applicants are encouraged to research into the above topics in collaboration with universities and research institutes in Jilin province.

Joint Fund for Corporate Innovation and Development

The Fund is jointly funded by the NSFC and the industries. It aims to, by taking into consideration of the urgent needs in the industrial development, give play to the guiding role of the National Science Fund, attract and gather the nation's scientific research forces and focus on the basic research of core scientific issues in key technology areas. It intends to integrate the knowledge innovation system and technology innovation system, so as to advance the independent innovation capabilities of Chinese enterprises.

In 2020, the Fund calls for proposals of the Integration Project and Key Project with a funding duration of 4 years.

I. Energy Area

i. Integration Project

China Petroleum and Chemical Corporation (SINOPEC)

In 2020 the Integration Project will call for proposal in the following research directions with an average direct funding budget of 12.6 million per project.

1. Deep geological processes and resource effects in the basin

The application should, by starting from the study on the mode, scale and scope of the deep geological effects on the sedimentary basins, focus on the influence mechanism of the deep geological effects on the formation and distribution of multiple types of resources in the sedimentary basins, and clarify the effects of the materials and energy carried by deep fluids on resource accumulation and resource potential. Main research areas include:

(1) Background and environment description of geological dynamics in deep basin

The application should categorize the types of deep geological activities, clarify the dynamic mechanism of the coupling between deep geological processes and basin tectonic evolution; identify the material and energy exchange pathways between deep geological processes and sedimentary basins; establish deep geological and geochemical tracer methods; elaborate how deep geological processes in the basin affect temperature and pressure fields, and establish a method for restoring paleotemperature and pressure fields in deep basins.

(2) Physicochemical mechanism and tracer method of deep geological fluids and sedimentary surrounding rocks

The application will simulate the mechanism of composite catalytic hydrocarbon generation by ancient high-evolution C-rich H-depleted hydrocarbon sources with the participation of deep hydrogen-rich materials and energy, and explore the potential for reactivation of deep high-evolution hydrocarbon sources; clarify the mechanism of activation and migration of Ca, Mg, Si and other components during the migration of deep CO₂, H₂S and other fluids from deep to shallow along deep faults, and reveal the development mechanism of hydrothermal dolomite and siliceous rocks; through experiments, simulate the dissolution-precipitation mechanism of different hydrothermal fluids on the major diagenetic minerals in the reservoir and caprock, and explore the

synergistic diagenetic evolution relationship between reservoir dissolution and caprock filling and closure during the long-term physicochemical interaction between deep fluid and reservoir caprock; explore the identification method of complex fluid interactions in deep and shallow regions, and establish the next dating technology of fluid interactions.

(3) Deep geological and resource effects of ancient cratons

The application should, through the anatomy of a typical example of the ancient craton in the central and western regions, reveal the thermal effects of materials and energy carried by deep fluids on the surrounding rocks of sedimentary basins, and disclose the mechanism of oil-gas phase transformation and aggregation; clarify the He enrichment mechanism of the ancient craton, explore the main controlling factors of independent accumulation of non-hydrocarbon resources such as He; identify the mechanism of deep geofluids/thermal energy on the accumulation and transformation of ancient craton oil and gas, and establish a trace of deep geofluids to accumulate hydrocarbon geological-geochemical identification indicators affected.

(4) Deep geological and resource effects under the neotectonic movement system

The application should explore the feasibility of independent accumulation of deep source CO₂, He, inorganic CH₄, etc., through the anatomy of the active area of deep and large faults in eastern China, and clarify the main controlling factors for its effective accumulation; clarify the process of displacement, migration and accumulation of deep geological fluids to deep-seated hydrocarbons in sedimentary basins, and establish geological and geochemical identification indicators that trace the effects of deep geological fluids on hydrocarbon accumulation; reveal the thermal effects of energy carried by deep fluids on the surrounding rocks in the sedimentary basin under the Neotectonic Movement System, and clarify the formation mechanism and evaluation of the exploitation potential of dry and hot rock resources in the sedimentary basin area.

The application for this project should include the above four research areas, and carry out in-depth and systematic research closely related to the project theme "deep basin geological processes and resource effects". The research results should include principles, methods, technologies, equipment, papers, patents, etc.

2. Theories and methods of efficient multi-component development of difficult-to recover heavy oil

The application should focus on basic and innovative research of the key scientific issues of the theory of multi-component complex and efficient development of difficult-to recover heavy oil and core development technology, by taking into consideration of the difficult-to recover heavy oil featuring deepness and ultra-heaviness, thin reservoirs, strong sensitivity and strong edge-and-bottom water caused by multi-factors. Main research contents include:

(1) Occurrence of heavy oil and non-isothermal percolation mechanics

The application should study the rheological characteristics of heavy oil under reservoir conditions, explain the non-isothermal flow laws and phase behavior of fluids such as steam, heavy oil, and water in porous media; carry out micro and macro physical simulations, describe the occurrence states and Model, and reveal the mechanical action mechanisms such as displacement, interfacial and viscous forces that control and initiate heavy oil flow; study clay mineral hydration and thermal/rock reactions, conduct thermal pore infiltration thermal sensitivity studies, describe the law of thermal effects, and reveal the coupled mechanism of flow-heat-solid interaction in heavy oil reservoirs.

(2) Multi-element multi-phase thermal recombination mechanism and development mechanism of heavy oil

The application should develop a physical model that takes into account the effects of steam, chemistry, and gas, establish a physical simulation experiment method for heavy oil multi-phase and multi-phase thermal complex flooding, and study the interaction mechanism of steam/water/chemical agents/gas/rock/heavy oil; explore the synergistic mechanisms of heat, high-efficiency chemical agents, inert gases and other multi-fluids in flow control, extended spread, composite viscosity reduction, heat and mass transfer, reveal the main control factors of thermal and multi-fluid composite flooding, and establish the theory of multiple complex and efficient development of difficult to recover heavy oil.

(3) Efficient development method for difficult-to recover heavy oil

The application should construct multivariate composite flooding systems suitable for different types of difficult-to-recover heavy oil reservoirs, develop numerical simulation methods based on thermal and multivariate multiphase interactions, conduct microscopic flow simulation and numerical simulation research, study factors affecting flooding effects and efficient control methods, explore new development methods for different types of difficult-to-recovery heavy oil heat and multi-composite, establish injection and production optimization design methods, screen typical heavy oil reservoirs for field test application research, and form supporting technologies for efficient development of difficult-to-recovery heavy oil.

The application for this project should include the above three research areas at the same time, and carry out in-depth and systematic research closely related to the project theme "difficult-to-recover heavy oil". The research results should include principles, methods, technologies, patents, and application in the experimental area.

3. Basic scientific and engineering issues of high-efficiency distributed hydrogen production integration technology

The application should aim at the key scientific issues involved in distributed hydrogen production technology, carry out basic research on the application of natural gas catalytic conversion technology and new catalytic materials, form process characteristics in water electrolysis hydrogen production, natural gas catalytic partial oxidation hydrogen production, natural gas chemical chain hydrogen production, hydrogen separation and purification, etc., and achieve breakthroughs in device integration, intelligence, modular skid design and one-click start-stop process control. It should provide safe, stable, efficient, clean and environmentally-friendly distributed hydrogen production technology for the construction of hydrogen energy society in cities and remote areas in China, and enhance China's core competitiveness in the field of automotive clean energy. Main research contents include:

(1) Efficient hydrogen production by electrolytic water

The application should investigate the reaction mechanism of catalyst surface at the molecular level, explain the reaction mechanism of hydrogen evolution and oxygen evolution in electrolyzed water; develop efficient hydrogen evolution and oxygen evolution catalysts; develop new three-dimensional integrated electrode technology (slot pressure at current density $1\text{A}/\text{cm}^2$ does not exceed 1.7V), conduct pilot test verification; solve the safety and stability problems caused by the detachment of the catalytic layer.

(2) Hydrogen production by catalytic reforming of natural gas

The application should investigate the migration and sintering of active components

on the surface of the carrier in the catalytic reforming of natural gas hydrogen; develop natural gas catalytic reforming catalysts and carrier materials with high activity, anti-sintering, and coking resistance; develop a new process for the catalytic reforming of natural gas to produce hydrogen, improve the intrinsic safety of the reaction system, and conduct pilot test verification of the process. The methane conversion rate is greater than 90%.

(3) Hydrogen production from natural gas chemical chain reforming

The application should study the structure-activity relationship of the oxygen carrier-catalytic coupling effect of hydrogen production from natural gas chemical chain reformation, and, through formulation optimization and texture design of active components, doping, and modification of oxygen carrier crystal forms, achieve synergy of hydrogenolysis, oxygen storage, and redox capacity of oxygen carrier catalysts. It should solve the problem of oxygen carrier preparation engineering through mode enlargement, create an oxygen carrier catalyst for natural gas chemical chain reforming, develop a new process for chemical chain reforming hydrogen production, design and construct a pilot plant, and obtain fuel cell-grade hydrogen products.

(4) Integration of natural gas distributed hydrogen production system

The application should, aiming for the goal of producing high-purity hydrogen that meets the standards for hydrogen used in hydrogen fuel cells, develop a set of natural gas distributed hydrogen production technology that includes natural gas purification, natural gas conversion, synthesis gas conversion, and hydrogen separation and purification. The concentration of carbon monoxide, a key impurity in hydrogen, should meet the requirements of on-board applications.

The application for this project should include the above four research areas at the same time, and carry out in-depth and systematic research on the theme of the project "distributed hydrogen production". The research results should include principles, methods, technologies, equipment, papers, patents, etc.

4. Basic theory and technology for comprehensive utilization of low-concentration methane

The application should carry out research on basic theories and key technologies such as adsorption, separation, activation, and catalytic conversion of low-concentration methane, and achieve new breakthroughs in low-concentration methane recovery and comprehensive utilization, lay a theoretical foundation for the next generation of deep treatment of volatile organic compounds (VOCs) in petroleum and petrochemical companies, and carry out corresponding pilot industrial tests and demonstration applications. Main research contents include:

(1) Efficient adsorption separation of low-concentration methane

The application should investigate low-concentration methane separation technology based on controllable pore structure and micro-surface chemical properties of the adsorbent, explore the effects of the surface chemistry and pore structure of new materials on the selective adsorption performance of low-concentration methane and its control mechanisms, obtain the basic theory and technology for the separation and enrichment of low-concentration methane by pressure swing adsorption (PSA) with a new adsorbent, and build a demonstration device.

(2) Efficient and controllable catalytic oxidation of low-concentration methane

The application should investigate the initiation, transfer and annihilation

mechanism of methane catalytic oxidation process, explore new materials for C-H bond activation, study the restricted region construction of catalytic material active sites and its regulation methods, establish the kinetics of catalytic oxidation reaction of methane, lay a theoretical foundation for the catalytic combustion and efficient use of low-concentration methane, and build a demonstration device.

(3) Study on oxidation-reduction coupling of low-concentration methane

The use of low-concentration methane as a reducing agent to carry out a redox coupling reaction with SO_x and NO_x is a possible way to control air pollution. The application should, using the redox catalytic purification technology of $\text{CH}_4\text{-NO}_x$ as the research system, reveal the catalytic active sites and catalytic reaction mechanism of selective catalytic reduction of NO_x by methane.

The application for this project should include the above three research areas at the same time, and carry out in-depth and systematic research closely related to the project theme "Comprehensive utilization of low-concentration methane". The research results should include principles, methods, technologies, patents, etc.

China National Offshore Oil Corporation (CNOOC)

In 2020 the Integration Project will call for proposal in the following research directions with a direct funding of 11 million per project.

5. Gas hydrate accumulation mechanism and efficient mining engineering science of the South China Sea

The application should conduct basic and innovative research on key scientific issues concerning the gas hydrate accumulation mechanism, safe and efficient development mechanism, and core engineering technologies in the South China Sea. Main research contents include:

(1) Accumulation mechanism of gas hydrates in the South China Sea and fine characterization of reservoirs

The application should make full use of the actual data of south seawater hydrate exploration and drilling, establish rock geophysical models of different types of hydrate reservoirs, study the characteristics of hydrate accumulation, analyze the heterogeneous characteristics and control factors of hydrate deposits, reveal the hydrate enrichment and distribution rules and the coexistence mechanism of natural gas hydrates and upper and lower overlying layers, carry out fine geological modeling of hydrate reservoirs and inversion of pore-saturation and connectivity of reservoirs based on the core, and ultimately reach the spatial distribution of hydrates that can be accurately described, and provide a recommended target for the trial target area for research target areas.

(2) Efficient mining mechanism of natural gas hydrate in the South China Sea

The application should reveal the gas-liquid-solid multi-phase, multi-component flow mechanism in the reservoir during natural gas hydrate extraction, solve key technical issues of heat transfer, flow, and capacity evaluation in the reservoir during natural gas hydrate extraction, and propose a scale for mining simulation effects and similar laws and criteria. It should explore the related factors of heat transfer, flow, and capacity evaluation in the reservoir during the gas hydrate extraction process; gradually establish the mining adaptability evaluation theory for mineral characteristics of gas hydrates for multi-reservoir types (including diagenesis and non-diagenesis), full intervals (from the surface of the sea floor, shallow and deep layers).

(3) Coupling creep mechanism and risk evaluation mechanism of thermal flow field in the process of natural gas hydrate decomposition

The application should establish a creep model of hydrate and argillaceous silt reservoirs and technology for predicting formation safety risks, and study the evolution of methane gas in seawater. Focusing on the characteristics of complex reservoir phase change, low permeability, stress sensitivity, and interlayer in the process of gas hydrate development in the South China Sea, the application should investigate the strength characteristics of argillaceous silt hydrate reservoirs and overburden cores under the coupling of thermo-fluid-force multi-field, carry out multi-scale multi-field coupling calculation analysis of formation deformation, establish feature signal extraction and monitoring analysis methods, and develop formation loss research on stabilization mechanism and evaluation method of formation stability during mining.

(4) Mechanism and method for safe drainage and continuous transportation of gas-water-sand-hydrate multiphase fluid

The application should, aiming to solve the challenges in the development of marine natural gas hydrates, multi-phase gas extraction, water, and sand multiphase lift drainage and recovery, and mobile safety assurance, establish multi-phase flow coupling model and fluid transport model in reservoirs, wellbore to underwater tree, subsea pipeline and downstream process facilities, reveal the characteristics of the gas-water-sand-hydrate multi-phase lifting, secondary gas hydrate formation, ice blockage and other flow blockage operating conditions, and form continuous drainage and recovery processes such as natural gas hydrate drainage and gas production, and provide theoretical support for the safe development and operation of hydrates and oil and gas fields.

The application for this project should include the above four research areas at the same time, and carry out in-depth and systematic research closely related to the project theme "Gas hydrate of South China Sea". The research results should include principles, methods, technologies, patents, etc.

ii. Key Project

China National Offshore Oil Corporation (CNOOC)

In 2020 the Key Project will launch call for proposals in the following research directions with a direct funding budget of 2.6 million per project.

1. Key issues in fast and efficient processing of polymer-containing production fluids in offshore heavy oil

The application should, aiming at the problems of high stability of chemical flooding produced fluids in offshore heavy oil fields, short hydraulic retention time of gathering and transportation processing units, and high oil content of the discharged water, focus on supporting the exploration of oily wastewater with high-efficiency, low-resistance, low-shear pre-degreasing technology and its supporting new high-efficiency freshener by relying on the characteristics of the existing three-stage sewage treatment system and cationic water scavenger. It should study the new methods and synergistic theory of physical and technological coupling and synergistic new-type pharmaceutical pre-degreasing, reveal the interaction mechanism between discontinuous phases in water under the action field and the pharmaceuticals, and achieve the purpose of high-efficiency pre-degreasing of highly oily wastewater, reduce the load of the existing three-stage sewage

treatment system and avoid the formation of difficult-to-treat sludge oil flocs in the treatment system (due to the electrostatic interaction between traditional cationic agents and anionic polyacrylamide in the produced liquid), and develop effective method to obtain sludge oil floc/mud source reduction.

2. New theory and method for increasing production of deep water-bearing low-permeability tight gas reservoirs

The application should, aiming at the problems of large water production and gas flooding after the reconstruction of deep water-bearing low-permeability and tight gas reservoirs on the sea, carry out analysis of rock mechanics and in-situ stress characteristics of the reservoir based on the analysis of the scale and source of water production. Combined with the fracture extension law in the reservoir, it should preferentially optimize the "sweet hearts" of the reservoir reconstruction project, and use the water control mechanism of the water-containing gas reservoir to optimize the sand addition scale and fracture parameters.

3. Load response and safety analysis of floating platform based on CFD

The application should focus on the research on the theory of wave slamming random load prediction based on tests and computational fluid dynamics (CFD) calculations under typical sea conditions on typical floating platforms, establish a load prediction method for typical structures (pillars, decks) of floating facilities under random sea conditions, and develop typical fully coupled vortex-excited motion (VIM) tests and CFD numerical simulation studies of floating production systems (including platforms, risers, and mooring systems), and establish safety evaluation mechanisms through test or monitoring data analysis.

4. Rock physical characteristics and seismic response mechanism of high-temperature and overpressure reservoirs in Yingqiong Basin, South China Sea

The application should, aiming at the abnormal seismic response characteristics of high-temperature and overpressure (temperature: 175 to 230°C, pressure: 140 to 200 MPa) reservoirs in the Yingqiong Basin of the South China Sea, study the relationship between the rock skeleton and fluid and elastic parameters under high temperature and high pressure and high geothermal gradient conditions, as well as the effect on seismic wave response characteristics by combining with cross-band rock physics experiments. It should establish a quantitative relationship between different rock types and hydrocarbon characteristics and seismic response. The research should focus on the elasticity parameters of sandstone skeleton under different temperature and pressure conditions, the elasticity parameters of pore fluid under different temperature and pressure conditions, the establishment of the relationship between porosity, permeability and elastic parameters under different temperature and pressure conditions, and the comparative analysis of elastic parameter prediction and actual seismic response of high-temperature and high-pressure reservoirs under petrophysical constraints.

5. Research on the theory and method of composite rotary steering drilling tools

The application should, in order to expand the adaptability of the rotary guidance system to stratum conditions such as soft, hard, and interactive, research the theory and method of the composite (directional and push-type) rotary guidance system, and realize the theoretical basis of the new generation of rotary guidance technology. Specifically, it should include the theoretical, method and mechanism research work of composite rotary steering automatic control, comprehensive drilling conditions, inertial navigation and geomagnetic navigation fusion, mechanical and strapdown inertial stabilization platform.

6. Prediction of medium and deep reservoirs in Yingqiong Basin

The application should, based on the existing drilling data, clarify the petrophysical characteristics of reservoir logging, and use the seismic wave equation as the theoretical basis to explore the changes in petrophysical characteristics under different lithological combinations, pore structures, and fluids. The influence mechanism of high temperature and high pressure on seismic wave propagation, the formation mechanism of low-speed mudstone in ultra-high-temperature and high-pressure formations, and the theoretical basis for identification and description of low-speed mudstone should be established. It should reveal the effects of porosity, shale content and gas saturation on the characteristics of seismic response in high-resistance gas reservoirs, improve the interpretation rate of gas layers, and lay a theoretical foundation for the identification and evaluation of high-temperature, ultra-high pressure, and high-resistance gas reservoirs.

7. Coalbed methane and coal-methane gas production and transformation mechanism

The application should, in line with the basic theoretical bottlenecks such as the development of coalbed methane and coal-methane gas and the initiation and crack propagation of heterogeneous fractured coal rocks, research on the mechanism and main controlling factors of initiation and crack propagation of coal rocks, study on the mechanism and main controlling factors of cracking and crack propagation in the coal-bearing gas production group, research on complex interaction mechanism and characteristics of multi-stage cracks, study on critical stress and natural crack initiation mechanism, study on the mechanism of pulverized coal generation and solute transport under high-speed shearing, reveal the damage mechanism of coalbed methane and coal measure gas reservoirs, and solve the problem of effective production and transformation of coal bed gas and coal measure gas reservoirs.

8. Research on key issues of efficient CO₂ removal from offshore gas

The application should, in line with the problems of low separation efficiency and large equipment volume of existing natural gas CO₂ removal, based on biomimetic and biological inspiration ideas and the new paradigm of material genes and structural chemistry, develop high-performance membrane separation materials and key technologies for natural gas CO₂ removal. It should study the controllable preparation technology and structure-effect mechanism of natural gas CO₂ membrane material, and study the thermodynamics, kinetics and mass transfer mechanism in the process of CO₂ separation and removal. It should explore the scientific laws of reducing equipment volume, energy and material consumption, and develop related membrane separation materials and separation technologies that can effectively improve the CO₂ removal capacity per unit equipment volume. It should provide theoretical basis and technical support for the efficient removal of CO₂ from methane gas on offshore platforms.

9. New way to directly synthesize C₂⁺ products from carbon-rich natural gas

The application should, in line with the characteristics of CO₂-rich natural gas in the South China Sea, conduct basic catalytic research on the direct synthesis of C₂⁺ products such as ethanol and acetic acid from methane and CO₂. It should study the catalytic activation mechanism of C=O and C—H bonds in CO₂ and methane molecules, design highly active catalysts, and reveal the reaction mechanism and the relationship between C₂⁺ product selectivity and catalyst structure; develop new reactors and study kinetic control factors of redox process and lay a scientific foundation for the efficient use of carbon-rich

natural gas resources.

10. Basic research on application of electrochemical purification and compressed hydrogen technology

The application should, in line with the key steps of high cost and high energy consumption hydrogen compression and purification in the hydrogen energy industry chain, based on the electrochemical proton exchange, material chemistry, and thermodynamic theories, develop electrochemical compression hydrogen composite membrane materials and enhance characteristics methods, and establish electrochemical hydrogen compression purification system; study the coordination mechanism of kinetics and thermodynamics of gas molecules during membrane separation, and grasp the influencing factors and rules of electrochemical hydrogen compression efficiency; reveal the mechanism of membrane material transporting hydrogen, the structure-effect relationship between membrane structure and hydrogen transport, and establish a meso-scientific correlation mechanism between membrane structure formation and application process; lay a technical foundation for the development of high reliability, low cost, high pressure hydrogen system to meet rapid development demand for hydrogen compression and purification in the hydrogen industry.

11. Intelligent manufacturing solutions and key technologies for offshore engineering equipment

The application should, focusing on the relatively weak foundation of digitalization, informationization, and intelligentization of offshore engineering equipment manufacturing, research on an intelligent welding manufacturing model for the upper module of the offshore oil and gas production platform that can be promoted and applied by the industry, and design intelligent manufacturing process flow, and overall scheme. It should carry out research on welding path intelligent planning and automatic offline programming technology, high-precision welding seam tracking and welding trajectory intelligent correction technology, intelligent molten pool control principles and methods based on welding thermophysical model, welding quality online assessment technology based on industrial big data, and research on intelligent welding manufacturing process integration for typical structures of offshore engineering. It should form intelligent welding object matching, intelligent welding path planning, intelligent seam tracking, and intelligent welding quality evaluation technology. It should develop an intelligent management and control platform to comprehensively improve production efficiency and production quality. It should establish a research and development data integrity management platform to provide secure and efficient data guarantee and service support for the upper module intelligent manufacturing

II. AI Area

China Electronics Technology Group Corporation (CETC)

In 2020 the project will launch call for proposals in the following research directions with a direct funding of 2.6 million per project.

1. Intelligent sensing and real-time simulation of urban emergency management events

The application should, in line with the characteristics of rapid changes, multiple factors, and difficult determination of urban emergency management events (such as

waterlogging, fire, chemical leaks, etc.), and considering that the existing simulation models of urban emergency management events are solidified, the content is single, and information is lagging, carry out research on intelligent perception fusion method of urban multi-source heterogeneous IoT data; on urban emergency management event modeling and trend forecasting method; on urban emergency management event real-time dynamic simulation technology to realize large-scale urban 3D space scenes and emergency details cross-scale scheduling; on monitoring, evaluation, cause-based reasoning and early warning models for typical emergency management events.

2. Intelligent perception and abnormal behavior warning for public safety scenarios

The application should, in line with the problems of existing systems in the field of public safety, such as difficult scene intelligent perception, poor anti-malicious attack defense performance, slow early warning speed, and weak generalization performance, comprehensive utilization of multi-source data such as images, video, text, audio, sensors, investigate the construction of scene feature maps in typical public open environments and extremely harsh environments such as high radiation, high brightness, and occlusion, and adapt to a rich classification algorithm for scene changes within the class; study precise perception of intelligent scenes under malicious attacks, multi-feature deep learning theories and methods under complex behavioral patterns and multi-dimensional interference, multi-modal, multi-scale, multi-granular abnormal behavior recognition models, establish scene intelligent perception based on massive multi-source data and rapid behavior early warning system to support public safety risk perception and assessment, and carry out application demonstration.

3. Key technologies of fusion perception and collaborative processing of big data in cyberspace

The application should, in line with the problems of dynamic random behavior, sudden network event analysis caused by insufficient spatial information utilization, difficult identification of malicious network behavior, and inaccurate detection, study behavior-oriented collaborative modeling and unified representation methods for large-scale multi-modal features. It should realize the complexity measurement and extreme learning based on meta-paradigm representation in heterogeneous graphs, make breakthroughs in the data fusion and dynamic update problems of behavioral calculations with multi-modal features; study cross-scale based large-scale spatio-temporal sequence data over-coordinated learning and prediction methods, realize the graph feature sharing, construction of excess collaborative learning model and agile long-term prediction based on meta-learning under the complex topology assumption.

4. Research on parallel cognitive and reasoning methods for complex ATC operational scenarios

In order to address issues such as cross-region, involvement of the interests of all parties, frequent incidents, and the existence of uncertain factors in complex air traffic control (ATC) operating environments, and difficulties in making rapid and effective cognitive reasoning about the evolution and impact of dynamic events, the application should investigate the spatial and temporal semantic modeling and correlation methods for the dynamic evolution of events in the ATC field, build a parallel knowledge extraction and analysis framework for large-scale ATC semantic data, and study the multi-source heterogeneous knowledge representation and large-scale knowledge map for the ATC field

storage, construction methods; investigate the multi-stakeholder cross-domain collaborative cognition theory and uncertainty reasoning methods in dynamic environments under complex operating scenarios, and verify it in a cross-regional air traffic control system to realize the analysis of the space-time evolution mechanism of air traffic control events, the analysis of the space-time evolution mechanism of ATC events, intelligent construction of multi-event correlation analysis models, and real-time dynamic inference analysis and prediction under uncertainty; provide theoretical and technical support for intelligent inference decisions in the ATC field.

5. Intelligent monitoring and forecasting technology for extreme disaster meteorology

In line with the needs for fine and precise monitoring and forecasting of extreme disaster meteorology in the fields of aviation, railways, disaster relief, etc., the application should use the intelligent sensing technology and deep learning algorithms to solve the problem of detection, identification, and prediction of local low-air targets, and to reduce economic losses caused by severe weather; investigate the high-temporal resolution detection technology of low-altitude meteorological targets to solve the problem of fine-scale meteorological monitoring in low-altitude air; study the intelligent fusion of electromagnetic meteorological big data and information mining technology to solve the problem of assimilation of heterogeneous data from multiple sources; investigate the intelligent identification technology of complex structure meteorological targets and the multi-element accurate forecast and risk assessment technology of complex meteorological environment to solve the problem of accurate monitoring and forecasting of disaster meteorology; study the intelligent inversion technology of meteorological laws of extreme disasters, mine effective information of low-value density meteorological data, build an integrated system of intelligent monitoring and forecasting of meteorological disasters, and realize minute-level detection and forecasting capabilities of meteorological disasters.

6. Key technologies for knowledge map construction and personalized recommendation for learning resources

In line with the problems of low learning efficiency caused by the complexity, fragmentation and lack of targeted filtering mechanisms in the Internet era, the application should conduct research on personalized educational knowledge map models and construction techniques that integrate subject knowledge, learning resources, and learning strategies; study the concept linking, analysis and evaluation technology of learning resources based on knowledge maps; research on the assessment model of learner knowledge system and the intelligent planning of learning paths that integrate knowledge maps and learning goals to achieve accurate knowledge push and personalized learning resource and learning strategy recommendation centered on learners' personalized interests and needs.

7. Intelligent identification and collision warning technology for space targets

In line with the problems of difficult space target recognition in complex space environments, and the threat to space targets from space events such as collisions and falls, the application should investigate the method of spatial target characteristic analysis, identification and comprehensive decision-making based on radar, photoelectricity and other multi-source data, and develop a deep network model with multi-modal attribute perception and self-learning technology of spatial target features; conduct research on machine learning algorithms for situational awareness of complex space environments in

large scenarios, and achieve accurate acquisition of feature information such as the type of the space target platform, working status, in-orbit attitude, geometric size, surface material, etc., and develop target attribute identification and intention discrimination ability; in view of the automatic warning for space events, study the intelligent assessment of target collision warning, automatic analysis of target fall, and multi-constraint judgment method for space target threat warning, and realize fast and accurate analysis and warning of space events in complex space environments.

8. Theory and method of security state estimation for unmanned systems based on distributed information fusion

In line with the problems of incompleteness, asynchronousness, and falsehood of measurement information in unmanned systems under network attacks, the application should, from the perspective of information fusion, carry out research on methods such as optimal distributed fusion detection of attack signals, distributed online estimation and identification of attack signals, real-time information compensation of attack signals, and security state fusion estimation of unmanned systems; develop an integrated theoretical system of rapid warning of attack signals, online fusion identification, information compensation, and security state fusion estimation in unmanned systems, solve the problem of unreliable state estimation caused by incomplete, asynchronous, and false measurement information, and build a set of security state estimation methods for unmanned systems under network attack.

9. Theory and key technologies of anti-network key information infrastructure mapping

The application should focus on problems including that the information on network critical information infrastructure equipment, networks, resources, and vulnerabilities is easy to expose when facing adversarial network mapping, which brings serious hidden safety hazards, as well as weak current anti-mapping theory foundation, and that the Anti-mapping technology means lack of initiative, wisdom, synergy, and confrontation. It should investigate anti-network key information infrastructure surveying and mapping theory, improve anti-mapping related theoretical system, guide anti-mapping technology and method research, study anti-network key information infrastructure surveying and mapping information hiding methods, support complex network analysis and infrastructure information featuring de-characterization, de-correlation, and de-coupling in big data era; research on anti-deceptive technology for information deception of network critical information infrastructure mapping, support equipment feature simulation, traffic feature confusion, behavior feature camouflage, etc.; investigate information active deception technology for anti-network key information infrastructure mapping, support equipment characteristics simulation, traffic characteristics confusion, behavior characteristics camouflage, etc., it should study the coordinated resource scheduling method for the anti-network key information infrastructure mapping, and support the optimal scheduling of anti-mapping resources under the conditions of high anti-mapping efficiency and low network latency.

10. Intelligent detection and traceability of high hidden unknown threats in cyberspace

The application should focus on unknown complex cyber-attack threats with high complexity, strong adversity, and hidden features, as well as problems such as severe harms, difficult detection, and insufficient intelligent defense capabilities. It should investigate the

classification and identification technology of unknown network attack threats under zero (small) sample learning and weakly monitored scene information, and establish a technology platform to achieve active defense of network attacks and a chain of trusted evidence; carry out research on cross-regional and cross-network attack source tracing analysis methods and countermeasures for key technologies such as subject determination, source location, scenario reconstruction, intent inference, and early-warning response; establish a reliable non-intrusive attack detection method based on machine learning in view of key information infrastructures such as industrial systems.

11. Theories and key technologies of the artificial intelligence interconnected network architecture for knowledge interconnection

The application should, taking into account of the limitations of the network primitives in the existing Internet protocol system, carry out research the theories and key technologies of the new artificial intelligence internet network with embedded artificial intelligence capabilities, including the study of network primitives and new network protocol systems with artificial intelligence capabilities, knowledge interconnection; study the knowledge expression and coding theory and algorithm for artificial intelligence internet transmission, and network addressing and routing in artificial intelligence interne, and on this basis, support basic algorithms and key technologies such as high-performance artificial intelligence computing in large-scale networks.

12. Spectrum intelligent management and control technology in complex electromagnetic environment

The application should address the spectrum use safety problems caused by the variety of electromagnetic target types and variable frequency behavior in complex spectrum environments. It should study spectral feature extraction methods based on knowledge discovery, investigate frequency behavior intention inference mechanism and the relationship between normal/abnormal behavior, and establish a model of spectrum management and security system based on intelligent cognition; propose the inference mechanism and monitoring and analysis methods for frequency behavior intent, study the theory and methods of intelligent spectrum security decision making that can be interpreted and studied, and set up an intelligent spectrum monitoring and management application system.

13. Research on key technologies of broadband wireless communication driven by data and knowledge

The application should focus on the problems of low power efficiency, time-varying channels, nonlinearity of links, and limited computing and processing resources of broadband wireless communications in complex communication environments, and study model construction method of end-to-end broadband wireless communication system combining data-driven and knowledge-driven; investigate time-varying channel understanding methods based on conditional adversarial generation networks; study joint optimization algorithms of signal peak-to-average ratio and bit error rate; build a real channel wireless communication data set; realize data, knowledge and reasoning-driven end-to-end broadband wireless communication prototype system, and carry out OTA test to optimize system performance.

14. Theory and method of probing communication fusion and intelligent sharing in constrained environment

The application should focus on constraints such as limited platform space and

insufficient energy supply, as well as the problems of electromagnetic self-interference, resource monopoly, low coordination efficiency, and poor anti-interference ability caused by the co-location of detection and communication co-location work. It should carry out research on shared theory and method of radar communication driven by data and model and on the sharing and mutual interference mechanism of integrated radar communication waveforms; establish a multi-channel beamforming and interference intelligent coordination mechanism based on deep networks, and form a multi-point cooperative detection communication fusion architecture in a common waveform scenario. Faced with the problems of high feature dimension, low information feedback and difficult solution space search in integrated collaboration, the application should study small sample learning, transfer learning, or generative adversarial network methods, and build a multi-dimensional detection and communication fusion and intelligent sharing model.

15. The theory and method of short-wave broadband intelligent transmission

The application should focus on problems of narrow bandwidth, low transmission rate, and poor link stability of short-wave skywave communications, and study the short-wave broadband channel characteristics and the space-time transmission theory based on wide-area diversity, including the relationship between the reachable rate of information transmission and the space-time transmission mechanism, and propose shortwave broadband waveform design method; investigate the relationship between environmental factors such as ionospheric propagation mode, dispersion and fading, and optimization strategies of space-time transmission mechanisms based on deep learning, and develop a short-wave broadband transmission strategy based on environmental autonomous cognition to achieve short-wave stable high-speed communication.

16. Full-lifecycle intelligent monitoring and management technology for multi-core chips

In line with the requirements of high-reliability and high-security applications of multi-core chips in harsh working environments, the application should carry out research on the monitoring and management methods of the entire life cycle from chip shipment to application based on artificial intelligence technology; research on early intelligent warning methods and aging suppression technologies for system-on-chip based on software and hardware collaboration; research on low-overhead, high-reliability, intelligent on-chip management system, and intelligent full life-cycle on-chip monitoring system, and design an intelligent on-chip management system.

17. Research on key technologies of smart reconfigurable antenna

In view of problems such as the poor overall efficiency of the existing phased array antenna system in complex electromagnetic environments, poor adaptability to the scene, few switchable states, slow response speed, and insufficient adaptive capability, etc., the application should study a multidimensional fast reconstruction method of the antenna RF layer; investigate continuous dynamic control methods of frequency, polarization, and pattern; research on smart antenna sub-array partitioning and scheduling methods for different tasks and complex environments; design an artificial intelligence-based beamforming acceleration optimization algorithm, and develop a smart antenna that cooperates with software and hardware in real-time reconstruction to achieve the purpose of adaptive, accurate, efficient, and real-time response to complex electromagnetic environments in smart antenna systems

18. Intelligent sensor theory and method for molecular specific capture of

hazardous chemicals

In view of problems of existing monitoring systems in complex environments such as low sensitivity for identifying hazardous chemicals and other chemical targets, poor conversion to scenes and sensing devices, slow response speed, insufficient adaptive capacity, and large volume power consumption, the application should carry out research on the physical mechanism of the interaction between specific molecules and nanomaterials, and explore the principle of chemical molecular specific capture sensors; build a target database of molecular fingerprints, develop intelligent learning strategies for self-renewal learning, break through the difficulties of online learning and transfer learning in the field of chemical molecular characterization, and form theories and methods that can adaptively, accurately and efficiently respond to intelligent target recognition of chemical targets; develop a smart node that realizes high-sensitivity, high-specificity, high-integration chemical fingerprinting and real-time monitoring of specific molecules.

19. Research on heterogeneous accelerated architecture programming model and compilation optimization for artificial intelligence applications

In view of the complex programming of artificial intelligence heterogeneous processor architecture, the application should study how to give full play to the hardware performance of each processor when running AI algorithms, reduce the complexity of parallel programming by users, improve the artificial intelligence application program execution performance issues, and study the unified programming model of heterogeneous processor architecture suitable for artificial intelligence algorithms; conduct research and development of automatic compilation optimization technology based on heterogeneous processor architecture; study task mapping and scheduling based on artificial intelligence application task characteristics and computing resource characteristics; study tensor memory optimization techniques based on unified programming model.

20. Theory and method of generative adversarial machine learning for attack and defense of image recognition system

Aiming at the vulnerability of camouflage image video samples (also known as adversarial samples) to video surveillance and image recognition systems based on deep learning network models, investigate the generation mechanism of camouflage samples, the attack mechanism of deep recognition network models, and the interpretability principle, and establish the evaluation criteria for the aggression metrics of the camouflage samples and the vulnerability measurement criteria for the recognition models; investigate the intelligent screening method of camouflage samples and the positioning detection method of vulnerability model components to form a model self-repair and defense mechanism that effectively resists attacks; Investigate high-reliability anti-attack technologies that can defend against samples; implement intelligent image/video recognition systems to effectively detect, accurately locate, and reliably defend and control counterfeit attack samples.

21. Theories and methods for intelligent identification and fault tracing of power battery pack states in complex working environments

In view of the shortcomings of the existing system for the state estimation of battery packs composed of different types of single cells in complex working environments, such as long measurement time, difficult testing, and large estimation errors, the application should investigate the correlation between internal and external parameters during the charge and discharge reaction of the battery pack, and clarify the transmission and hierarchy between

the various factors of battery attenuation; Investigate intelligent fault location and fault tracing methods when high-volume cells are assembled into power battery packs, and establish a correlation model between cell and battery pack failure; research on the fault sample enhancement technology and theory based on generative adversarial network, strengthen the learning of the dynamic system model from the data, find the difference between the state of the battery pack and the observed value, and finally form a predictive model for the working state of the power battery pack and intelligent fault Traceability method.

22. The optimization method for unsupervised data feature generation driven by hybrid data and model

In view of the lack of "explanability" and "targeting" of feature generation in the process of unsupervised deep learning, the application should study new data feature generation methods. It should use algebraic representation theory, topology and optimization and other related mathematical theories, analyze the general characteristics of the data space, and study the method of data-model hybrid-driven feature generation to make the generated features more interpretable and targeted; study, based on methods such as matrix optimization, manifold learning, and self-encoding, the correlation between the characteristics of sample data and empirical features, and design task-independent feature generation methods; study the matching relationship between unsupervised data and clustering models, and propose an efficient unsupervised learning model selection algorithm, which is verified in a certain field of data.

23. Theory and method of deep recognition of tiny targets

In view of the problems of low accuracy and low efficiency of identifying small targets in complex environments, the application should study the adaptive fusion model and unified representation method of multi-source heterogeneous data; investigate high-precision micro target recognition methods based on deep fusion; study micro target recognition theory and methods that support incremental learning and can adaptively cope with complex environments

24. Multi-agent group confrontation deduction and game method research

In view of the game decision needs of multi-agents to compete against groups/groups, combined with game theory, cybernetics, information theory, graph theory, machine learning and other theories and methods, the application should study the information interaction and incremental generation mechanism in groups under complex confrontation environments; investigate group adversarial game decisions under incomplete information; study equilibrium strategy solutions based on game reinforcement learning; study the visual analysis method of game confrontation data and the comprehensive evaluation method of group confrontation game effectiveness, explore new mechanisms of confrontation learning and game reinforcement learning, and conduct principle verification for typical confrontation scenarios.

25. Key theories and technologies of target recognition and cluster intelligent control system based on brain-computer collaboration

In view of the problem that target detection and recognition in complex environments is too dependent on individual experience and attention, and the computer vision method has insufficient migration capabilities, the application should conduct research on basic theories and key technologies of brain-computer hybrid intelligent systems based on transfer learning; study the neural mechanism of attention detection based

on multimodal brain neural signal analysis and neurofeedback; study the neural feedback mode based on the key features of attention-related neural oscillations in different brain regions, and adjust different brain rhythm characteristics through training; study the eye movement trajectory and the multi-brain neural signals of simultaneous scanning to establish the implicit attention and explicit attention models in the visual nervous system, study the key technologies and methods of brain-brain feedback training; study the brain-brain intelligence fusion in the real-time feedback environment theory and method.

26. Artificial intelligence mining and computing technology for material fingerprints in uncertain environment

In view of the problems of uncertain performance such as energy density and capacity during the development of new materials in the battery and other fields, the application should carry out research on material fingerprints to achieve multi-level/dimension/scale fusion of material data, perception, correlation analysis and characterization; conduct research on deep learning of material fingerprints, rapid evaluation and intelligent mining of material properties under uncertain conditions; study and establish fingerprint artificial intelligence test and mining platform to realize rapid intelligent screening and performance optimization of multi-component new material systems.

27. Research on fine-grained visual analysis reasoning technology and interpretability

In view of the weak adaptability and generalizability of the fine-grained analysis of harmful visual information on the Internet and the lack of reasoning ability and unexplainability, the application should investigate new categories, self-learning, and fine-grained visual semantic analysis techniques in complex and open environments; study the fine-grained visual reasoning methods from partial to whole, from attribute to semantics to implicit knowledge discovery and knowledge graph embedding, and implement interpretable and generalizable fine-grained analytical reasoning; investigate the auto-learning paradigm of fine-grained features in small sample environments, data augmentation, and knowledge transfer methods; study new methods of fine-grained association analysis and comprehensive reasoning of data in cross-domain and cross-modal environments

28. Intelligent fusion of multi-source information in dense clutter environment

In view of the problems of multiple false track, poor stability, and high target maneuverability in the fusion of heterogeneous sensor information under dense clutter environment, the application should study the mechanism and method of intelligent fusion of massive information; research on clutter filtering and target detection methods under the background of dense clutter based on machine learning; research on false track identification methods based on machine learning; research on intelligent target tracking methods for complex moving targets. A multi-source information intelligent fusion algorithm model should be constructed to verify the effect of improving the target detection and perception ability in a dense clutter environment.

29. Research on future-oriented smart city (group) relevant cognitive theory and cooperative control method

The application should, taking into account of needs of efficient, convenient, safe and reliable construction of smart cities in the future, and addressing the issues of cross-domain and cross-organizational transaction association and collaborative control of

urban agglomerations, carry out research on the city Internet of Things data perception and multi-link data aggregation strategy, study the theory and method of high dynamic data fusion of multi-dimensional urban field, construct the multi-source data correlation cognitive model, and identify and predict the urban agglomeration system operation situation. It should investigate the collaborative control theory and the linkage mechanism of urban (cluster) related events, establish the detection, evaluation, and event collaborative control model of urban events, support the global transaction coordination of field data link feedback, and develop the situation deduction, cognitive decision-making and collaborative control technology system of the related events of the urban agglomeration.

30. Theoretical and empirical research on the impact of artificial intelligence on the innovation ecology of very large industrial enterprises

The application should study challenges, changes and evolution of governance structures, governance forms, and governance capabilities of innovation ecosystems under the influence of Artificial Intelligence technology; the intelligent evolution of ecological location in the process of enterprise transformation; characteristics and laws of innovative ecological organization model, capability generation model, and capability application model; theory and practice of using artificial intelligence technology for ecosystem governance.

31. Theory and method of small sample target recognition in uncertain environment

In view of the constraints of timeliness and limited resources, and problems of traditional target recognition such as low sample quality, limited sample size, and difficulty in model training, the application should develop target recognition theory and methods in uncertain environments from aspects of machine learning methods, high-quality sample generation, and unknown target recognition research, and achieve precise discovery and reliable identification of specific targets in uncertain environments. The research should focus on small sample machine learning methods and theories, high-quality sample generation models based on limited examples, and unknown target recognition based on semantic information under zero sample conditions.

32. Theory and method for intelligent recognition of multi-feature target images in complex environments

In view of the problem of intelligent recognition and detection of multi-feature target images under complex working conditions, the application should research on the theory and method of feature analysis and inference based on multi-source information fusion and driving; research on multi-feature deep learning theory and methods under complex environment and multi-dimensional error interference in line with parallel and efficient recognition of multi-feature target images, and study the method of improving recognition efficiency based on hybrid enhanced cognitive computing and decision-making technology.

33. Intelligent sensing and recognition of electromagnetic targets in complex environments

In view of the problems of existing systems in complex environments such as difficulty identifying electromagnetic targets, poor robustness to scene and sensing device changes, slow response speeds, and insufficient adaptive capabilities, the application should research on methods such as feature extraction and implicit knowledge discovery, build a target knowledge base, and develop continuous learning machine learning strategies. It should make breakthroughs of the difficulties of online learning and transfer learning

applied to the electromagnetic field, and form an intelligent sensing recognition model that can adaptively, accurately and efficiently cope with electromagnetic environments in complex environments

34. Intelligent main lobe anti-jamming technology for complex electromagnetic environment

In the complex and ever-changing electromagnetic environment, aiming at the problem of insufficient adaptive anti-interference ability, the application should research on the method of constructing intelligent anti-electromagnetic interference models for the self-evolution of electronic equipment and systems, break through the difficulties of strong adaptive correlation between electromagnetic interference cognition and anti-interference strategy, self-learning and dimension reduction of search space in anti-electromagnetic interference strategy; realize fast and accurate understanding of complex and changeable electromagnetic interference environment, and form corresponding intelligent main lobe anti-repression and deception strategies such as different interference strategies

35. Multi-source and cross-platform approach to intelligent perception and deep understanding of social public safety

In view of the problems of the current social public safety event intelligent perception mode and single platform, low accuracy, etc., and by use of a comprehensive audio and video network, ground surveillance cross-temporal video, drone aerial video and geographic information, the application should research on multi-source and cross-platform collaborative optimization data acquisition, fast and accurate all-weather target detection and tracking, event understanding, and establish multi-scale, multi-level, multi-granularity correlation models of multi-source heterogeneous data, break through the bottlenecks of weak analysis and shallow understanding of social public safety incidents, build a multi-domain and multi-dimensional intelligent perception and deep understanding information system for social public safety goals and events, support multi-source cross-platform abnormal targets and incident intelligent perception and emergency decision-making, and carry out application demonstrations.

36. Theory and method of social network false media content detection and identification

In view of the problem of frequent and harmful use of false media information in social networks, while with the difficulty to accurately and timely find and control the problem, the application should research on the mechanism and model of online social dissemination of false media content, study the mechanism and model of online social communication of fake media content, investigate the cross-modal feature expression of false media content and the mining and correlation of multiple forensic clues, and study the accurate detection and identification methods of false media content and the transmission blocking strategy.

37. Knowledge graph technology for complex reasoning

In view of the major bottlenecks in the complex application scenarios of knowledge maps at this stage, the application should research on the method of constructing knowledge maps for complex data, and high-coverage and high-accuracy automated knowledge extraction technologies for sparse domain data; investigate knowledge map construction methods that can effectively learn and represent common sense, and study cross-media knowledge map construction methods based on multi-modal content understanding technology; research on knowledge graph computation methods for deep-level cognitive

reasoning, and knowledge graph application methods for interpretable machine learning.

38. Information modeling and measurement of governmental big data intelligence

In view of the problem that information is “difficult to model, difficult to measure, and difficult to calculate” when transforming government affairs big data to artificial intelligence, the application should research the computational properties of information such as objectivity, reducibility, transmission, relevance, and combination, study the subjective cognition of information and its objective computing nature, define the quantitative expression and topological analysis of each metric in conceptual, logical and physical modeling, and establish a multi-level information metric system; research on the multi-source heterogeneous, complex polymorphism, and autonomous evolution of government affairs scenarios of big data, and mine the interaction law of "objective world-observation data-semantic knowledge-machine intelligence-human intelligence"

39. Holographic modeling and group computing based on super large-scale agent array

In view of the problems of adaptive combination of ultra-large-scale agent arrays, multi-dimensional and multi-view information acquisition, intelligent group computing and holographic imaging, etc., the application should study the calculation architecture of ultra-large-scale agent arrays, as well as Multi-dimensional and multi-dimensional data fusion, holographic modeling, and imaging methods after adaptive combination. It should research on behavior-level modeling, information correlation, and electromagnetic regulation of single-agent circuits, investigate the behavior-level modeling, information correlation, electromagnetic regulation and other methods of single agent circuit to realize real-time group intelligence collaborative computing after agent reconstruction, and shorten the delay of holographic imaging and improve imaging accuracy.

40. Research on basic theory and key technology of offense and defense analysis for deep learning models

The application should conduct research of offensive and defensive basic theories and key technologies for deep learning models from three levels: the generation methods of deep learning adversarial attacks, defense models, and empirical research on offense and defense. It should study the generation mechanism and method of adversarial attacks, a unified model framework for various adversarial attacks, a unified defense framework for adversarial attacks, and cooperative defense strategies, and use these basic theories and key technologies for empirical research on adversarial offense and defense for scenarios such as visual recognition, signal processing, and network analysis, and evaluate their effectiveness.

41. Cyberspace systematic modeling theory and method

In view of the complex, heterogeneous, dynamic, multi-dimensional cyberspace, the application should study the systematic modeling method of key elements, dynamic features and cross-domain associations in cyberspace; the unified space-time coordinate benchmarks and globally unique element identification mechanisms in cyberspace; the logical characteristics and abstract expression methods of physical devices, security mechanisms, business applications, user behaviors, and organizations in cyberspace; the dynamic model and simulation mechanism of complex network evolution; and the automatic discovery and labeling of network elements based on big data Painting method.

42. Enhance machine learning and decision-making reasoning for experts in interpretable smart justice

In view of the problems of lack of judicial logic and inadequate interpretability in the automatic application of legal reasoning and conviction and sentencing in deep learning, the application should study the representation and construction methods of legal facts and adjudication grounds, enhance the transparent reasoning and fair refereeing framework of machine learning, study the bias detection system of artificial intelligence applied in justice, and conduct verification and evaluation on large-scale intelligent judicial information systems.

III. Aerospace Area

China Aerospace Science and Technology Corporation (CASC)

In 2020 the project will call for proposals in the following research areas with an average direct funding of 2.6 million yuan per project.

i. Near space vehicle technology

1. Complex interference effects of jets at the tail of a plane symmetrical reuse carrier

In view of the problem of complex and symmetrical use of jet tail jet interference which affects the design of the carrier, the application should apply the theoretical analysis, numerical simulation and wind tunnel test comprehensively to study the unsteady high-precision calculation method of the jet interference effect on the tail of a surface symmetrical reuse carrier, the mechanism of the jet interference effect, and the heaven and earth conversion criterion of the jet interference effect; provide high-precision prediction of the interference characteristics of the tail jets of the symmetrically reused carrier on the support surface, the wind tunnel tests of the tail planes of the symmetrically reused carrier on the wind tunnel test and the overall design of the carrier.

2. Study on the mechanism of near-space aircraft surface ablation morphology on near-wall flow and accurate prediction of aerodynamic characteristics

In view of the problem that it is difficult to accurately analyze the influence of ablation morphology on aerodynamic characteristics in aerodynamic design, the application should study the surface ablation morphology of typical heat-resistant materials, establish a mathematical model suitable for theoretical analysis, investigate the mechanism and law of the influence of surface topography on the flow of the boundary layer, establish the theory of flow stability of the boundary layer considering the surface topography and the method of transition prediction, and study the mechanism of the effect of surface topography on the structure of the near-wall flow field. It should establish a refined simulation method for near-wall flow of surface topography, study wind tunnel test technology for surface topography flow display, and obtain internal characteristics and disturbance information of the boundary layer, provide data support for the study of stability theory and refined simulation methods, and promote the further improvement of aerospace predictive capabilities of near space vehicles.

3. Connection failure mechanism and evaluation method for the composite space panel of near space aircraft

In view of the connection failure dynamic strength problem of the complex connection thin-walled structure of the C/SiC composite material in the near space aircraft under the multi-field coupling environment, the application should obtain a nonlinear

dynamic response law of the high temperature composite material connection wall plate, reveal the connection failure mechanism of composite wall panels in a multi-field coupling environment, and establish a force/thermal/vibration/noise environment equivalent criterion. It should develop a theory and method for dynamic strength assessment and verification in a multi-field coupling environment, which provides theoretical support for the design and performance evaluation of thermal protection structures of adjacent space vehicles.

4. Research on multi-scale and multi-effect flow mechanism and global optimization methods of near space interceptor

In view of the difficulties faced by high Mach and high-acceleration vehicles, such as the wide range of maneuverability, narrow aerodynamic design space, and strong multi-effect coupling, the application should carry out research on multi-wave/multi-vortex interference complex flow characteristics, nonlinear unsteady physical modeling, and dynamic stability analysis, and reveal multi-effect multi-scale coupled flow mechanisms such as multi-control surfaces, attitude/orbit-controlled jets, and local thinning; develop global matching physical models such as flow transition, local thin gas slip flow and dynamic stability criteria, and establish a multi-constrained multi-objective multi-effect global aerodynamic layout optimization method.

5. Study on electromagnetic and optical characteristics of near space vehicles and associated ablation diffusers

Based on the thermochemical non-equilibrium theory, the application should study the mechanism of collisions and dissociation between gas molecules in the thin atmosphere and its proximity to space vehicles, explore the mechanism of action of ablative diffuser plasma and photoelectric radiation and electromagnetic waves, and master the aerosol of aircraft volume optical radiation, electromagnetic characteristics modeling, etc. It should establish a flow field model containing ablative diffuser plasma to reveal the influence of ablative plasma on the electromagnetic and optical characteristics of the aircraft, laying a theoretical foundation for the effective detection and identification of nearby space vehicles

6. Research on sensing method of weak fluctuation pressure of EFPI with high temperature and broadband optical fiber for near space vehicles

In view of the high-frequency weak pulsating pressure measurement of the outer surface of the near space vehicle, based on EFPI interference and ultrasonic acoustics, the application should study the ultra-high temperature high-frequency pulsating pressure sensing mechanism, establish a weak pulsating pressure-sensitive model in the ultra-high temperature environment, and reveal the response mechanism under the combined effect of temperature field and sound field of the full sapphire EFPI structure in the high temperature environment. It should carry out research on the physical and chemical mechanisms of sapphire hydrophilic bonding, the high-order guided mode dispersion mechanism of sapphire fiber, the evolution mechanism of interference signals under high temperature, and make breakthroughs in sapphire wafer-level bonding technology, multi-mode fiber high-order mode dispersion suppression technology, high-frequency pulsation pressure high-precision pickup technology, master the high-frequency pulsating pressure sensing method and complete the ground test verification, and provide support for the upgrade of the boundary layer flow state test technology and the optimization of the aerospace structure of the near space aircraft.

7. Theory of heaven-earth correlation and the intelligent prediction technology of transition in the complex transition phenomenon of the near-space aircraft

boundary layer

In view of the problems of insufficient understanding of the complex transition mechanism of the boundary layer of the near space aircraft, the low accuracy of the prediction of the complex transition phenomenon, and the lack of the theory of heaven and earth correlation, the application should study the complex transition mechanism of the boundary layer of several typical aircraft, establish the correlation method between wind tunnel and wind tunnel, flight and flight, wind tunnel and flight test results, develop the theory of complex transition between heaven and earth on the boundary layer, and realize the boundary transition criterion. It should, based on this, use the artificial intelligence technology to build a correlation model between the transition mechanism and the flow characteristics, and create the transition intelligent prediction technology.

ii. Underwater launching technology

8. Structural evolution and fluid dynamics control mechanism of porous exhaust flow field in the boundary layer of large underwater launching rocket

In view of the problems such as multi-phase flow mixing of porous exhaust gas in the turbulent boundary layer of large underwater launching rockets, the fusion process of porous bubble flow is difficult to predict, difficult to measure, and the mechanism is unclear, etc., the application should investigate the fine prediction and measurement methods of the unsteady flow field structure of porous bubble flow, reveal the turbulent blending mechanism of multi-scale bubble fusion near the wall, and grasp the fusion criterion, stabilization mechanism and adjustment mechanism of porous bubble flow.

9. Evolution mechanism and law of nonlinear and non-steady dynamics of underwater rocket tail cavities

In view of the complex development and evolution law of underwater rocket tail cavitation and its strong interference to the surrounding flow field, the application should study the evolution of the multiphase flow field of the tail bubble, the coupling effect of the tail bubble and the attached cavities, the interaction of the tail bubble and the free liquid surface, and reveal the propagation mechanism of the tail bubble pressure oscillation, the interaction mechanism of the shoulder/tail bubble fusion interaction, the tail bubble collapse and tail surge formation mechanism, and provide theoretical and methodological support for the analysis of the force and motion characteristics of underwater rockets.

10. Multi-media influence mechanism and dynamic model of underwater floating launching process

In view of characteristics of the underwater floating launching of a voyage body such as strong coupling, multi-medium, multi-interference, and complex applied load, and the problems of difficult launch and unclear action mechanism, the application should focus on the process of floating launching and launching under water, establish a transient mathematical model, grasp the mechanism of action, and form an effective calculation method to guide the design of underwater launching systems; propose, by studying the influencing factors of water-air intermediary and the sensitivity of the factors, the coping methods and strategies to effectively guarantee the launch stability to support the scheme demonstration and design of the underwater floating launching system.

iii. Deep space exploration technology

11. Failure mechanism and control method of complex body sampling

equipment in space extreme environment

In response to the need for efficient and reliable sampling of complex targets in extreme space environments, the application should research on the thermal and mechanical coupling failure mechanism of sampling under multiple factors such as large temperature differences, high vacuum, and low gravity, make breakthroughs in space extreme environment materials control technology, master the key influencing factors of the complex object environment on the sampling effect, establishing an efficient and reliable adaptive sampling control method under the severe conditions of extraterrestrial objects, and carry out intelligent sampling simulation and experimental verification of complex targets in space extreme environments.

12. Research on in-situ 3D dense printer mechanism of lunar soil in lunar environment

In line with the demand for in-situ resource utilization of lunar soil, and the problems of handling, transporting and densification of lunar soil particles, based on the theory of particle dynamics, interface physics, and phase transition, the application should study the characteristics of lunar soil particles in the lunar environment, reveal the rheological mechanism of particulate matter in heterogeneous lunar soil, and establish a mechanical model of particle transport; explore the thermodynamic phase transition mechanism of multi-component lunar soil particles, reveal the mechanism of the melting and solidification process, and establish a thermo-dynamic-coupling analysis thermodynamic model; explore the interface characteristics of lunar molten droplets, reveal the melting lunar soil spreading dynamics and microscale infiltration and fusion mechanisms, elucidate the defect formation mechanism in the lunar surface, and establish a 3D dense printing method adapted to the lunar special environment and lunar soil material characteristics, thus laying a theoretical foundation for the implementation of major missions for lunar exploration.

13. Research on wide range metrology grade absolute magnetic field measurement technology

In view of the problems that the range of domestic absolute magnetic field measurement devices cannot cover 10 to 100,000 nT, the sensitivity index cannot reflect the background noise of the magnetic field reproduction system, and the frequency response bandwidth of the sinusoidal alternating magnetic field is generally lower than 5 Hz, the application should carry out research on wide-range absolute magnetic field measurement technology, research on weak magnetic field standard generation devices, research on weak magnetic measurement methods, etc.; develop a set of standard magnetic field generation and absolute magnetic field measurement devices suitable for weak magnetic metering; scientifically describe the problem of accurate measurement of stable magnetic field and changing magnetic field by absolute magnetic field measurement device; scientifically analyze the interrelationships of indicators such as range, sensitivity, resolution, and bandwidth.

14. Full autonomous relative navigation method and experimental techniques for deep space small celestial object detection using optical sequence images only

Based on the theory of optical detectability, identifiability and observability of faint small objects, and starting from the fast identification and high-precision extraction of faint small celestial bodies, efficient characterization and robust matching of small celestial bodies with unknown physical properties, the application should complete estimation of small celestial bodies under precise conditions and accurate error compensation, explore the

mechanism of optical detectability and identifiability of faint small objects at medium and long distances, develop an efficient representation model of small objects under unknown conditions of target physical properties, reveal the inherent relationship between the representation and matching of small celestial bodies, and establish a space-time synchronization and multi-source heterogeneous observation model of small celestial bodies under large dynamic conditions, and reveal the key factors affecting the estimation and error correction of small celestial bodies under observation conditions. It should study the equivalent simulation of the relative motion of small celestial bodies under complex space optical background conditions and the experimental verification method of relative navigation of the whole process, and lay the theoretical foundation for the deep space small celestial body detection mission under the condition of severely limited resources on the satellite.

15. Design criteria and key technologies for the superelastic load domain of deep space exploration vehicle structures

In line with the urgent need for lightweight aircraft in future deep space exploration missions, the application should make breakthroughs in the traditional strength design guidelines, research on the use of "redundant" materials to characterize the bearing capacity between structural elasticity and ultimate load and the use of "redundant" materials to characterize the bearing capacity between structural elasticity and ultimate load; couple uncertain factors such as materials and manufacturing, establish a reliable design-evaluation-optimization integrated design system suitable for large and complex structures, provide a theoretical basis and key technologies for the lightweight design of complex bearing structures for deep space exploration aircraft support.

16. Study on conversion efficiency and attenuation rate of space isotope power system based on thermal photovoltaic technology

Based on black body radiation, frequency selective interface, physical vapor deposition and other physical theories, starting from the selective radiation infrared spectrum emission and regulation mechanism, frequency selective high transmission mechanism, and long-wavelength high reflectance regulation, the application should explore the precise matching mechanism of infrared spectra of thermal photovoltaic isotope power systems, and the mechanism of long-term performance evolution of wide-band radiative heat transfer systems; reveal the key control factors that affect the thermal-optical-electric conversion process of the system, establish a high-efficiency thermo-photovoltaic technology machine-thermal-optical-electric coupling model suitable for high-temperature radiation systems, achieve high-efficiency precise matching and regulation of infrared spectra, and complete experimental verification; reveal the evolution laws that affect system performance over a long period of time, accurately identify the key elements and parameters that affect performance evolution, establish a system performance evolution model, propose a system performance attenuation suppression method, implement control and optimization of related key elements and parameters, and lay the research foundation for the performance improvement and engineering application of thermal photovoltaic isotope power systems.

17. Study on a novel nuclear power/nuclear thermal dual-mode cosmic space propulsion method based on alkali metal hydride

In line with the demand for high-thrust, high-specification propulsion of high-power, deep-space nuclear-powered spacecraft such as manned deep space exploration, space cargo

tugboats, and large-scale transfer vehicles, and in view of the long-orbit storage of liquid hydrogen in existing nuclear thermal propulsion systems and the low thrust of nuclear power propulsion systems and the low storage density of gaseous working fluid, the application should study a new nuclear power/nuclear thermal dual-mode co-propulsion method based on alkali metal hydride, an efficient and controllable thermal decomposition and separation mechanism of alkali metal hydride, and a single-component two-phase multi-phase material flow control method in a microgravity environment.

18. Study on fine modeling and control methods of marble orbiter's thin atmospheric assisted derailment dynamics

In line with the maneuvering requirements of the orbiter de-orbit for the Mars sampling return detection mission, the application should study high-precision aerodynamic characteristics prediction method of the orbiter complex shape across the river basin, and the aerodynamic stability during the orbiter de-orbiting process; establish an accurate dynamic model of lean atmosphere assisted orbital reduction, study trajectory optimization and control algorithms, and propose a ground equivalent test verification method to provide theoretical support for the design of marble circumferential atmospheric auxiliary reduced orbit and flight tests.

iv. New Intelligent Spacecraft Technology

19. Research on continuous deformation mechanism and application of adaptive airspace/speed domain aircraft

In view of the adaptive deformation requirements for aircraft in the Mach 10 speed range and airspace up to 300 km, the application should study the continuous deformation of flexible materials in the extreme thermal environment and the controllable deformation mechanism; research on the topological structure characterization method of large-scale deformation mechanism and its dynamic characteristics modeling method, research on the flexible device sensing and system intelligent realization method under extreme force thermal environment, and finally solve the problem of adaptive cross-domain aircraft deformation structure design.

20. Cross-basin flow mechanism and precise regulation method with minimal thrust in space width adjustment ratio

In view of the problem of high-precision regulation and multi-physics noise control of continuous wide river basins with extremely small space thrust ratio, the application should investigate the mechanism of cross-basin flow with minimal thrust in the space wide regulation ratio and the coupling mechanism of continuous cross-basin regulation noise, and build a model for accurately regulating the basic fluid and noise coupling; study the precise driving law and operating characteristics of wide-ratio piezoelectric, and obtain the basic drive model and control method for precise regulation; research on the coupling mechanism of complex microfluid morphological characteristics, micro-scale heat transfer, and accurate measurement of a wide range of extremely small flows to establish a wide basic model for accurate flow measurement; develop the high-precision, high-stability, and fast-response control mechanisms for the wide-thrust ratio thrust, combined with the complex coupling process of multiple physical effects such as micro-scale flow effects, micro-scale heat transfer effects, laying the foundation for the application of ultra-fine, ultra-stable, and ultra-static spacecraft wide-thrust ratio minimum thrust propulsion technology

21. Theoretical method of spatial fine operation feature modeling and stability

control based on learning

In view of the problems that learning-based spatial operation control cannot be measured in practical engineering applications and its robustness is difficult to guarantee, the application should research on feature modeling methods for complex space environments and multi-tasking fine operations, learning-based stability control and robustness analysis methods for nonlinear uncertain systems, study the learning-based spatial fine operation control algorithm and conduct ground simulation verification to lay a theoretical foundation for engineering applications.

22. Basic research on fine detection and identification of maritime targets

Based on the target detection and identification theory of multi-source heterogeneous sensors, and starting from weak signal detection, signal feature extraction and identification, multi-source information fusion, and adjustment of sensor operating modes, the application should explore the cooperative control mechanism of signal detection sensors in complex natural environments at sea; reveal the mechanism of target signal weakening under complex backgrounds such as strong sea clutter, island reefs, or island shores, as well as the dynamic correlation between the working mode of multi-source heterogeneous sensors and target detection and recognition capability, establish an accurate evolution model of the sensor's working mode for target detection and recognition performance, and study the refined detection and identification methods of target signals and experimental verification in complex natural environments, and lay a theoretical foundation for improving the intelligent detection and scene awareness of complex marine targets.

23. Research on the theory and method of space-based target morphology and behavior recognition oriented to space high dynamic games

In view of the problems of insufficient positioning, identification, and tracking accuracy caused by the high-dimensional heterogeneity of the original measurement information during the spacecraft game maneuvering and fine operation, etc., the application should study the theoretical methods such as space-based target feature location and recognition and behavioral state inference prediction under various information modalities and discontinuities, reveal the association prediction mechanism of target morphology and behavior characteristics under the condition of multiple heterogeneous information, develop and improve the theoretical framework and method system of autonomous intelligent identification of space-based targets, and provide theoretical support for space vehicles to carry out game maneuvers and fine operations.

24. Collaborative sensing, planning and control methods for large-scale intelligent constellations

In response to the needs of autonomous transformation such as emergency avoidance, regional enhancement, and failure recovery for large-scale constellations of low-orbit Internet and other long-term autonomous security operations, the application should study and solve problems such as the mechanism of large-scale dynamic constellation coupling and evolution, fast network orbit determination based on local information, multi-constrained collaborative decision-making and decentralized planning in dynamic transition process, and centerless emergency coordination and self-organizing control, and construct a large-scale constellation's intelligent sensing, planning, and control theory and method system.

25. Influencing mechanism and suppression method of high-power narrow-line-width fiber laser space irradiation performance

Based on the laser theory and optical waveguide theory and starting from the amplification of narrow-line-width fiber lasers, the effect of space irradiation on fiber devices, and changes in the thermodynamic state of space-induced lasers, the application should explore the effect mechanism of space irradiation on the output characteristics of high power narrow linewidth fiber lasers and effective protection methods. It should reveal the influence of space irradiation conditions on the thermodynamic states of various fiber devices and lasers, and establish a radiation degradation model of high-power narrow linewidth fiber lasers, reveal the change law of high power narrow linewidth fiber laser with radiation dose power attenuation, center wavelength drift, beam quality degradation, spectral line widening, etc., uncover the effects of radiation-induced changes in the thermodynamic state of optical fibers on non-linear effects, and lay a theoretical foundation for the radiation protection technology of high-power narrow linewidth fiber lasers.

v. Rocket Engine Technology

26. Micro-homogeneous control of Al-Li alloy powder and study on energy release mechanism of solid propellant

In view of the problems of low and medium burning rate, low combustion efficiency of aluminum powder in solid propellant with high aluminum content, low specific impulse efficiency of the engine, and severe erosion of residue, the application should investigate the microscopic homogeneous control of aluminum-lithium alloy powder and the energy release mechanism of solid propellant, and break through the problem of easy phase separation between high melting point, high density metal aluminum and low melting point, low density metal lithium during the preparation of aluminum lithium alloy powder, and achieve microscopic homogeneous control and controllable preparation of aluminum-lithium alloy powder; reveal the mechanism of "micro-explosion" in the combustion process of aluminum-lithium alloy powder solid propellants, study the energy release mechanism, and establish the structure-activity relationship between the combustion characteristics and microstructure of aluminum-lithium alloy powder.

27. Study on regulation mechanism of combustion characteristics of solid propellants by aluminum-based composites

Based on the theory of fluid mechanics, condensed states, and reaction kinetics, starting from the control of the fuel's interface structure, the surface microenvironment, the structure and characteristics of the condensed phase combustion products, and the condensed phase motion mode, the application should explore the regulating mechanism of combustion characteristics of solid propellants by aluminum-based composites, reveal the mechanism of agglomeration inhibition during the combustion of aluminum-based composites, establish a micro-kinetic model of aluminum-based composites combustion, explain the synergistic mechanism of components-combustion characteristics-safety performance of aluminum-based composite solid propellants, uncover the inherent relationship between aluminum-based composites and propellant combustion characteristics, and establish the combustion theory of aluminum-based composite solid propellants.

28. Study on ablation mechanism of solid-liquid rocket engine nozzles under multiple long-term and transient conditions

In view of the problem of non-linear ablation of the solid-liquid rocket engine's long-term working nozzle, the application should reveal the combustion flow mechanism of the solid-liquid rocket engine during transient and start-stop processes, and establish a

high-precision combustion model; uncover the micro-change mechanism of the nozzle material, establish an accurate nozzle transient ablation model, reveal its micro-ablation and long-term macro-ablation mechanisms, and break through the nozzle micro-ablation technology under long-term transient multiple cycle conditions.

29. Study on gelation mechanism and flow combustion characteristics of UDMH/N₂O₄ gel propellant

Based on the theory of supramolecular chemistry and colloid rheology, starting from the structure-activity relationship of the gelling agent and the mechanism of hydrodynamic regulation, the application should explore the principle of gelation, rheology and flow behavior regulation mechanism of gelling agent-propellant synergism with different structures, complete the research and verification of gel propellant combustion behavior, and grasp the quantitative relationship between the macroscopic properties and microstructure of gelling agent-gel propellant. It should accurately identify the key factors affecting propellant performance, establish basic principles of gelling agent design, and reveal the inherent relationship between gel propellant composition and rheology and combustion performance.

30. Study on self-excited oscillation of gas-liquid coaxial centrifugal nozzle and its effect on combustion stability

In view of the problem of self-excited oscillation of the nozzle in the process of the depth change of the hydrogen-oxygen rocket engine, the application should research on the self-excited oscillation mechanism of the high-density gas-liquid coaxial centrifugal nozzle, and clarify the physical process of the origin, development and maintenance of self-excited oscillation. It should reveal the key structure dimensions and working parameters of centrifugal nozzles and gas membranes on the mechanism of self-excited oscillations, establish the boundaries of self-excited oscillations and dimensionless discrimination criteria, uncover the effect and mechanism of self-excited oscillating spray on combustion stability, and lay the foundation for the reliable design of the injector of the hydrogen-oxygen rocket engine.

31. Study on energy conversion and transfer mechanism of laser deflagration driven flyer

Based on the laser-material interaction mechanism and the energy release theory of energetic materials, the application should focus on the microstructure design of the charge-driven charge, the laser absorption and diffusion of the drug, the parameter matching of the drug and the flying sheet, and energy transfer law of medicament-driven flying discs at critical scale, explore the microstructure design and preparation technology of high burning rate driven charge, and reveal the key influencing factors of burning rate and the mechanism of rapid burning rate increase. It should establish a multi-physics model, explain the energy absorption and diffusion mechanism of driving charge under laser irradiation at the molecular scale, determine the size matching rule of driving charge and flying sheet, reveal the energy transfer mechanism of deflagration-driven flying fins at the critical scale, obtain the performance of laser deflagration-driven flying fin impact detonators, and provide an effective and safe technical approach for the ignition of rocket engines.

32. Research on cross-scale simulation method for combustion of high energy and low residual gas generator

In view of the problems of lack of theoretical guidance for the combustion performance control methods of high-energy and low-residue gas generators for solid power

systems, and difficulties in matching various combustion indicators, the application should construct a typical micro-geometric structure based on a random particle filling algorithm, develop a simulation of the solid-phase micro-evolution of the gas generating agent and macro-phase flow and combustion models to reveal the mechanism and rules of high-energy clean energetic components, and lay the theoretical foundation for the accurate prediction of the combustion characteristics of the gas generating agent and the design and optimization of the high-energy and low-residue gas generating agent formula.

vi. New materials and advanced manufacturing technologies for extreme environments

33. Research on property characteristics and failure mechanism of thermal protection material ultra-high temperature mechanics under extreme conditions

In line with the research and development demands for new low-ablation carbon/carbon, ultra-high temperature ceramic matrix composite materials, high thermal conductivity carbon/carbon, and other thermal protection materials, the application should investigate the interaction mechanism of graphitic lamellar structure characteristics of carbon materials with multiple physical fields such as electric field, temperature field, and stress field under ultra-high temperature conditions, study the evolution of material microstructure and its response to mechanics in the complex coupled environment of high temperature heat, force, and oxygen (gas), and make breakthroughs in the scientific characterization of mechanical properties at ultra-high temperatures, research on cross-scale analysis of materials and high-temperature constitutive models to reveal the evolution of mechanical properties and failure mechanisms of materials.

34. Basic research on high-precision manufacturing of SiC free-form surface based on multifocal ultrafast laser

Based on the interaction mechanism between femtosecond laser and matter and the theory of free-form surface detection, the application should explore the precise control mechanism of nanometer-scale material removal depth from the nonlinear absorption and energy coupling of femtosecond laser. It should establish a multi-technology optimal matching application link combined perspective difference effect, structured light illumination, interference detection, etc., and accurately integrate multi-method detection signals, establish a multi-focal laser energy field distribution function that matches the removal function, reveal the rules of controlled laser light field ablation to remove SiC optical materials, and lay a theoretical foundation for the realization of high-precision manufacturing of SiC free-form surfaces with multi-focus ultrafast lasers in advanced manufacturing technology.

35. Precision machining mechanism of high-performance large-scale thin-wall feed array

Based on the theory of high-performance precision manufacturing, it should explore the controllable removal mechanism of a new type of integrated strongly constrained feed array material, and reveal the evolution of the dynamic behavior of a large-scale active and weak array processing technology system, establish a process inversion model of component passive intermodulation performance for defect sensitivity. It should focus on developing large-area thin-walled arrays with low-temperature cooling and clean cutting mechanisms, large-area thin-walled arrays with less stress-free phase change retention principle, multi-source information-driven thin-walled arrays processing behavior

characterization and adaptive control methods, and precision machining optimization of feed array with geometric and physical mixed constraints and other research work, and develop new principles and methods for forming precision machining of large and complex thin-walled structures.

36. Construction of aerospace thermal gel and study on small molecules migration

Based on polymer chain entanglement theory, intermolecular interaction theory, and interface infiltration theory, the application should focus on the formation and regulation of the physical entanglement lease of small silicone oil molecules and gel networks and the reversible strong interaction with the thermally conductive filler interface, explore the influence of the topological structure of the gel network, the surface modification state of small molecules of silicone oil and the filler on the migration characteristics and thixotropic coating characteristics, and propose a method for inhibiting the migration of silicone oil small molecules is proposed combining the diffusion kinetics of silicone oil small molecules at the contact interface. It should investigate the damage behavior of thermally conductive silicone gels under irradiation and high and low temperature two-factor exposure conditions, and guide the design of low migration, radiation resistant, high and low temperature resistant silicone gel components. It should explore the preparation method of aerospace thermally conductive gels with performance as the guide, and reveal the regulation mechanism of powder characteristics and the laws of dispersion kinetics, interface structure and composite configuration, and the evolution of enhanced heat transfer performance during the preparation process, and provide a basis for the development of new principles and technologies for the design and controllable composite preparation of high-performance aerospace thermal interface materials.

37. Data manifold-driven ultra-long base antenna manufacturing precision theory

In response to the needs of ultra-long-base antenna manufacturing in orbit, the application should carry out research on material-manufacturing-structure-performance multi-manifold space modeling, the mechanism of in-orbit manufacturing process parameters and product geometric accuracy, the material-manufacturing-structure-performance mapping relationship under extreme conditions of data manifolds, precise control of product performance based on manufacturing data manifold cut space, and ground test verification of assembly accuracy of products built in orbit. It should complete the manifold characterization of material-manufacturing-structure multi-link multi-factor multi-dimensional data, reveal the mapping mechanism of on-orbit manufacturing process parameters and product geometric accuracy under extreme environments, grasp the effect of on-orbit manufacturing process parameters on the physical properties of product performance, and establish a method and theory for ultra-long base antenna on-orbit manufacturing.

38. Fundamental study on controllable precision grinding of micro-tooth internal thread with large aspect ratio

The application should focus on the common problems, such as low precision, low-axis grinding interference, poor machining stability, and difficult process detection, faced by the hard turning of internal thread of high-performance roller screw thread transmission mechanism featuring high-precision (accumulated pitch error $\leq 8 \mu\text{m}$, surface roughness $R_a \leq 0.1 \mu\text{m}$), high hardness ($\geq \text{HRC}60$), large aspect ratio (8 to 12), and

microtooth (0.2 to 0.8 mm). The application should study the high-precision large-length-to-diameter ratio internal thread grinding force spatial distribution regulation mechanism under extremely weak stiffness conditions, reveal the force-controllable precision grinding machining mechanism under weak stiffness conditions, clarify the mapping relationship between the tool surface topological microstructure matrix and the spatial distribution of grinding force; research on the macro-microscale wear evolution rule of high-precision special-shaped large abrasive super-hard grinding tools and the correlation mechanism between acoustic signals, and obtain the failure and regeneration mechanism of shape-position accuracy of special-shaped large abrasive super-hard grinding tools; reveal the internal relationship between the grinding sound signal and machining stability, and lay the foundation for the precision manufacturing of high precision, high stiffness, large aspect ratio servo transmission mechanism.

39. Material-mechanical-electrochemical-photochemical coupling damage mechanism and basic protection in the South China Sea atmospheric environment

In view of the problems of severe corrosion and short service life of the protective coating on the surface of transmission parts in the harsh marine environment of the South China Sea, the corrosion failure process of metals and coating materials in the atmosphere of the South China Sea, the application should reveal the coupling mechanism of environmental factors such as irradiation, damp heat, salt spray, etc., on corrosion failure. It should establish the mathematical structure-activity relationship of material microstructure-environment characteristics-corrosion life, and create a stainless steel/wear-resistant-corrosion-lubricating organic protective coating system for corrosion life epitaxial theoretical prediction.

40. Study on ablation characteristics and wave transmission mechanism of new type high temperature resistant ceramic wave transmitting materials

In view of the problems of temperature resistance, thermal shock, and insufficient thermal insulation performance of radome materials for high-speed aircraft in close space, the application should carry out research on the ablation characteristics and wave transmission mechanism of new high temperature resistant ceramic wave transmitting materials, obtain the relationship between atomic, molecular, and phase-scale structures and high-temperature ablation, thermal shock damage, and wave-transmitting behavior of materials, and make breakthroughs in the development and design problems of new materials that have both electrothermal and thermal. It should explore the principle of low-temperature semi-solid densification and high-temperature pressureless sintering process, and carry out multi-physics simulation of radome and research on radome electrical performance under high-temperature environment to realize reverse design of new ceramic material radome properties.

41. Microstructure damage mechanism and performance evolution model of ultrahigh temperature materials under the action of repeatable high enthalpy gas flow

The application should use the spacecraft thermal protection system to quantitatively predict the structural evolution and performance decay under the extreme environment of high enthalpy and high velocity airflow, study the multi-scale coupling mechanism of catalysis, oxidation and heat transfer of high enthalpy aerodynamic heating environment and ultrahigh temperature ceramic composite materials, construct the micro-mechanical evolution model of ultra-high temperature ceramic composites under extreme environment of high temperature oxidation, develop coupled calculation models and methods for

thermochemical oxidation damage evolution and multi-mechanical heat transfer; support the theoretical design and characterization evaluation of multi-course heating wind tunnel ground experiments, realize quantitative prediction of material thermochemical performance evolution, and complete wind tunnel experiment verification.

NSAF Joint Fund

Jointly set up by NSFC and the China Academy of Engineering Physics (CAEP), the Fund is aimed to encourage and mobilize scientists and teams from universities and research institutes nationwide to focus on core fundamental issues of national security, carry out forward-looking research on multidisciplinary cross-integration, promote openness and exchanges, cultivate high-level personnel in national defense science and technology, and upgrade the innovative ability of science and technology in national defense.

In 2020, this joint fund plans to fund two types of projects, namely Fostering Project and Key Project. The Fostering Project aims to expand the open sharing of the National Science Facility built by the China Academy of Engineering Physics and promote exchanges and cooperation. The Key Project focuses on key bottlenecks in the field of national strategic security, interdisciplinary innovations that may be applied in the future, and prospective and disruptive basic science research. The Fostering Project has an average direct funding of 500,000 yuan per project for 3 years; the Key Project has an average direct funding of 3 million yuan per project for 4 years.

I. Fostering Project

The fund aims to enable scientific researchers to carry out scientific research based on China's Mianyang Research Reactor and its neutron scientific platform, "Xingguang III" laser device, high average power terahertz free electron laser device, and micro-nano technology platform. Before applying for this joint fund, the applicant should communicate with the institution where the relevant device is located, fully understand the performance, status, and user time allocation of the dependent device, and is encouraged to conduct the collaborative research with researchers in the institution where the device is located. The main funding areas include:

1. Research on Scientific and Technological Issues Related to Mianyang Research Reactor and Its Neutron Science Platform;
2. Research on scientific and technological issues related to the "Xingguang" device;
3. Research on scientific and technological issues related to high average power terahertz free electron laser devices;
4. Research on Science and Technology Issues Related to Micro/Nano Technology Platform.

II. Key Project

The Fund mainly supports research on cutting-edge interdisciplinary and disruptive concepts such as functional materials with high environmental adaptability, sensing technology for complex scenes, micro/nano surface reconstruction technology for material performance improvement, and quantum sensing science. The applicants and research teams

should have a good research foundation in relevant research fields. The research content listed in this Guide is not required to be fully covered, but the research focus should be highlighted to be able to accurately identify and solve one or several key scientific problems.

1. Functional materials with high environmental adaptability

The Fund aims to integrate theories and methods of materials science, nuclear science, chemistry and other disciplines, and to address the major basic scientific issues of material applications in environments such as long-term force heat, low-dose irradiation, complex atmospheres, and high overloads. It should study the response behavior and mechanism of materials in complex environments, develop material theory, new design methods and advanced preparation techniques adapted to complex environments, create new functional materials such as nuclear materials, energetic materials, special polymer materials, new battery materials, atmosphere control materials, and structural support materials with high environmental adaptability, thus promoting the innovative development of materials science and technology oriented to the specific needs of the country. Main funding areas include:

(1) Study on the control of the thermal and thermal properties of polymer bonded explosives and its mechanism;

(2) Multi-scale structural design and performance customization of polymer materials;

(3) Strengthening and toughening design of lithium-based hydride and damage behavior in complex environment.

2. Intellisense technology for complex scenes

The Fund aims to explore how to integrate sensing, detection, artificial intelligence and micro-nano manufacturing technologies to obtain intelligent sensing principles and methods for multi-physical quantity sensing and accurate detection under complex conditions, thereby building a new generation of intelligent sensing systems and enhance comprehensive intelligent perception and autonomous decision-making capabilities in complex electromagnetic environments. The research in this direction will promote the innovative development of intelligent sensing technology through demand traction. The main funding areas include:

(1) Research on on-line monitoring technology for state changes of multi-layer complex structures;

(2) Research on composite sensitive intelligent micro-sensor technology;

(3) Research on multi-task AI brain model and architecture for complex environments.

3. Micro-nano surface reconstruction technology with improved material properties

The Fund aims to integrate materials science, surface/interface science and micro/nano technology to process and manipulate the material surface at the micro-nano scale, to achieve the purpose of material surface morphology reconstruction, organization structure regulation, environmental adaptability improvement, specific function design, etc., and to improve the comprehensive performance of nuclear materials, energetic materials, polymer materials and other functional materials in specific use environments. The main research contents involve micro-nano scale effects and applications of materials, micro-nano scale organization structure regulation mechanism and characterization, surface

micro-nano structure and functional design, etc. The main funding areas include:

- (1) Surface reconstruction and activity regulation of hydrogen storage materials;
- (2) Surface reconstruction and surface interface regulation of energy storage materials;
- (3) Functional design and preparation of active metal surfaces.

4. Quantum sensing science and technology for information security

The Fund focuses on the basis of quantum sensing technology, systematically carry out a full-chain research from structural analysis to dynamic response, and the scale effect of stability and reliability. The main funding areas include:

- (1) Physical basis for high-precision sensing of inertial signals in miniaturized units;
- (2) Research on information perception and security sharing for overall reliability;
- (3) High-precision spectroscopy of space-time quantum perception.

Joint Fund for Astronomy

Jointly funded by NSFC and the Chinese Academy of Sciences (CAS), the Joint Fund of Astronomy aims to give play to the guiding and coordinating role of the National Natural Science Fund, attract and mobilize the strengths of institutions of higher education and scientific research institutes across the country, make full use of the astronomical research observation equipment and data of the CAS, carry out astronomical research and research on some new technological methods. It also intends to promote the development of China's astronomical research, cultivate basic research talents, and enhance China's innovation ability in the area of astronomy.

The joint fund is an integral part of the science fund. The application, evaluation and management of the Joint Fund of Astronomy comply with Regulations on the Management of the Joint Fund of the NSFC and the Agreement of NSFC-CAS on the Joint Fund of Astronomy.

The Joint Fund of Astronomy includes Fostering Project and Key Project. Key Project will not specify project titles, but applicants may decide their project titles, research contents, research schemes and research expenses according to the important scientific issues in the following first five directions. The sixth one is not within the funding scope of Key Program Project. In 2020, the Joint Fund of Astronomy plans to fund about 8 to 10 Key Projects with an average direct funding of 2.5 million yuan per project for four years. The funding period will be from January 1, 2021 to December 31, 2024. In 2020, for the Fostering Project, the average direct cost funding will be 500,000 yuan per project for 3 years, and the duration of funding will be from January 1, 2021 to December 31, 2023.

Six Funding Directions for 2020

1. Observational and theoretical research in cosmology, galaxies, stars, the sun and solar system, and basic astronomy carried out by researchers in institutions of higher education and research institutes other than the CAS Observatory system using the astronomical observation equipment of all band owned by the CAS (researchers of the CAS Observatory system can only apply as Main Participant rather than Principle Investigator for the Fund); astronomical research carried out by national researchers using the 500-meter

Spherical Radio Telescope (FAST), the High Altitude Cosmic Ray Observatory (LHAASO) and the data generated accordingly.

2. Research on astronomical detection technology based on the proposed space project, including new space astronomical detection technology, new method research and preliminary research on key technologies of astronomical satellite.

3. High-energy, ultraviolet, optical, infrared and radio technology methods related to astronomical detection, including X-ray and gamma-ray imaging technology and high-resolution detector technology (position-resolved and energy-resolved), weak photoelectronic signal detection, storage and transmission technology, and high-energy, optical, infrared and radio technology, automatic control technology, precision mechanical technology and terminal equipment related to astronomical telescopes.

4. Applied basic research to solve the problems of data, calculation and information extraction faced by major astronomical projects, including massive astronomical data storage and sharing, data mining, high-performance computing and virtual observatory technology, etc.

5. Key scientific issues arising from the application of basic astronomy (Astrometry and Astronomy) methods to meet national strategic needs.

6. The pre-research on the scientific problems and technical solutions of the proposed large-scale astronomical observation equipment specifically includes: demonstrating the technical solutions of the proposed observation equipment and clarifying the technical indicators of the equipment in accordance with the cutting-edge scientific issues to be developed; demonstrating its scientific goals based on the capabilities of the proposed observation equipment.

Among them, the Key Project from the 2nd to 4th areas give priority support to the following research contents, please specify the target research content at the beginning of the application text by selecting among the following research contents (For example, the key technical issue to be solved in this application is multi-fiber positioning detection technology.):

(1) Multi-fiber positioning detection technology

Research content: Research on the new method, stability and error analysis of the real-time detection system of the complete focal plane (4,000 optical fibers) of the LAMOST, the study of the application of machine learning in optical fiber positioning detection; the application of machine learning in optical fiber positioning detection; the source analysis and correction methods of optical fiber positioning error; the relative/absolute position calibration and position reference system of large focal plane and multi-fiber positioning unit; optical fiber positioning strategy and efficiency under closed-loop control, and optical fiber positioning detection and closed-loop control software system, thus improving the detection accuracy of the optical fiber position to be within 0.1, and the optical positioning accuracy of LAMOST to be within 0.4 by use of the closed-loop control.

(2) Key technologies of large-diameter sub-millimeter wave telescope

Research content: Research on real-time measurement technology of surface profile and pointing of aperture sub-millimeter wave antennas, to achieve real-time surface shape measurement accuracy better than 10 μm rms and sub-arc-second real-time point measurement accuracy; research on closed-loop automatic control technology for large-diameter sub-millimeter wave antennas; research on the manufacturing process of

high-precision sub-millimeter wave antenna panels, achieving a surface accuracy better than 10 microns on a 2-meter panel.

(3) Key technologies for high-resolution imaging of large-aperture solar telescopes

Research content: Multi-channel high-resolution imaging optical system design of large-aperture solar telescope; key technology of large-aperture filter; on-line calibration technology, the filter center calibration accuracy is better than 1 picometer, the channel field calibration accuracy is better than 0.005 arc seconds; the high-resolution data processing technology of the large-aperture solar telescope, through the high-resolution data before and after the AO correction wave, realizing diffraction limit imaging with a time resolution of 1 second and a spatial resolution of 0.02 seconds (@ 705.8 nm).

(4) Key technologies for active optics and scientific instruments of extremely large telescopes

Research content: High-stability measurement mechanism technology research of the high-precision edge sensor, low noise, low drift conditioning circuit technology research and precision temperature drift compensation technology research of high-precision edge sensor, of which the main technical indicators are: 400 micron range, 1 nanometer resolution, temperature drift 5 nanometers/°C, time drift 10 nanometers/week, working temperature range from -25°C to 30°C; research on multi-splicing mirror active support technology, research on calibration technology, control technology, automatic diagnosis and reliability technology of splicing mirror, of which the optical technical indicators are: 2 mm of distance, 10 nm of resolution, no less than 3 mirrors in common stitching, lasting longer than 2 hours; research on the optical infrared technology and method research for large-scale telescope scientific instruments, sub-millisecond arc-second high-resolution imaging of exoplanet exploration and galaxy cosmological detection, or sub-meter-level sight velocity high-precision spectroscopy, high-contrast imaging and other instrument technologies, and research on the interface unit technology, core device technology and observation methods of scientific instruments.

(5) Key technologies of high-precision interplanetary laser ranging, time transfer and comparison

Research content: Interplanetary laser ranging study (with an accuracy better than 10 mm), precision clock difference measurement of space atomic clock (with a resolution better than 1 picosecond) analysis; research on high-precision and stability timing technology, laser remote time comparison method and synchronization method (with a synchronization accuracy better than 50 picoseconds), and research on spaceborne time comparison measuring instrument and sub-millimeter precision laser reflector; research on reference point correction model, precise measurement orbit of deep space vehicle; research on laser signal acquisition, tracking and aiming technology of deep space vehicle.

(6) Measurement and data analysis of astronomical site parameters

Research content: Measurement of key parameters of the site and statistical analysis of available astronomical time; climatic characteristics and astronomical meteorological conditions of the site area; exploring the reasons for leading astronomical and meteorological conditions of the site; properties and rules of site atmospheric turbulence and the height of the near-Earth turbulent layer; analysis of site optical/infrared extinction, electromagnetic pollution and its near-and-long-term trends, and discussion of specific site protection strategies; comparison analysis and comprehensive evaluation criteria to achieve the ordering of key astronomical and meteorological parameters and the comprehensive

ordering of astronomical and meteorological conditions at existing stations and sites.

Joint Fund for Large Scientific Facilities Research

Jointly funded by NSFC and the CAS, the Joint Fund aims to use the advantages of NSFC's review, funding and management system, and attract and organize the strength of universities and colleges and scientific research institutes. To make full use of the large research facilities built by CAS as a comprehensive research platform with the purpose of conducting research on frontier research, multidisciplinary and comprehensive cross-disciplinary research. It intends to cultivate scientific research talents for large scientific devices, open up new research directions, and exert the effectiveness of large scientific devices to promote openness and exchange. It strives to enhance China's independent innovation ability, the original innovation ability and international academic status in the frontier science and multidisciplinary research field, so that China's basic scientific research can better serve the national strategic needs.

The joint fund is an integral part of the science fund. The application, review and management of the joint fund are carried out in accordance with the *Regulations on the Management of the Joint Fund of the National Natural Science Foundation of China* and the Agreement of NSFC-CAS on the Joint Fund of Major Research Facility. The large scientific devices include: Beijing electron-positron collider and Beijing synchrotron radiation device, Lanzhou heavy ion accelerator and cooling storage ring device, Shanghai light source device (including protein facility with five lines and six stations), Hefei synchrotron radiation device, Hefei stable strong magnetic field device, and Chinese spallation neutron source device.

The types of projects funded by the joint fund include Cultivation Projects and Key Projects. In 2020, Key Projects provide a direct funding of 3 to 3.5 million yuan per project with a funding period of 4 years; the Cultivation Projects provide a direct funding of 500,000 to 600,000 yuan per year with a funding period of 3 years.

I. Three Research Aspects

1. Scientific research work based on platform devices, focusing on research in the fields of physical science, chemical science, information science, life science, materials science, energy science, environmental science, and other cross-cutting frontier issues;

2. Based on the research work of special devices, focusing on the high-energy physics research of Beijing spectrometer III (BESIII) on the Beijing electron-positron collider and the nuclear physics research of the Lanzhou heavy ion accelerator cooling storage ring device;

3. Research on experimental techniques, methods, methods and development of small specialized instruments to enhance the research capabilities of large scientific devices.

II. Main Funding Areas in 2020

1. Cultivation Project

Synchrotron radiation, neutron scattering, and steady-state strong magnetic fields

research in the fields of physics, chemistry, information, life, medicine, environment, materials, energy, geosciences, agriculture, metrology, microelectronics, and micromechanics, and cross-cutting issues; Research on t-charm physics experiment and related software and data analysis methods on BESIII; nuclear physics experiment research and heavy ion application basic research on Lanzhou heavy ion accelerator and cooling storage ring; ion beam research in life, medicine, materials and semiconductor defects engineering; new techniques and methodological studies of beam lines; research on key technologies of advanced X-ray detectors; research on key technologies, methods and equipment for particle accelerators and particle detectors; magnetic resonance technology on steady-state strong magnetic field and research on new methods for material preparation.

2. Key Project

The Key Projects research field exceeds the actual number of funded projects. Applicants can independently determine the project title, research content and research plan according to the following research areas. Applicants are encouraged to conduct collaborative research with researchers in the laboratories where each device is located. The research areas are as follows:

1. Research on scientific problems based on synchrotron radiation devices

- (1) Structure and performance of complex materials;
- (2) Structure, performance and dynamic process of energy materials;
- (3) New catalysts and catalytic mechanisms;
- (4) Structure, function and dynamic process of biological macromolecules;
- (5) Fine structure of cells and biological tissues;
- (6) Environmental biological effects and environmental pollution control technologies;
- (7) Material structure and properties under extreme conditions.

2. Research on scientific problems based on steady-state strong magnetic field devices

- (1) Physical properties of quantum materials under strong magnetic field (≥ 20 T);
- (2) Chemical synthesis, material preparation and properties under strong magnetic field (≥ 20 T);
- (3) Research on the related mechanisms of life activities based on strong field magnetic resonance spectroscopy and imaging.

3. Research on scientific problems based on Chinese spallation neutron source devices

- (1) Structure and performance of new energy materials, quantum materials and other functional materials;
- (2) Structure and properties of structural materials;
- (3) Structure and properties of soft substances and biological macromolecules;
- (4) New catalysts and catalytic processes;
- (5) Study on the radiation effects of living organisms, materials and components.

4. Frontier physics and extension research based on BEPCII and HIRFL

- (1) New hadron state search and hadron spectroscopy;
- (2) The production and decay of Charmonium and Charmed hadron;
- (3) Heavy ion physics and strange nuclear reactions;
- (4) Peculiar nuclear structure and fine spectroscopy;

(5) Heavy ion irradiation effect.

5. New principles, new methods and key technologies of the device

(1) New principles, new methods, new technologies and key components of the accelerator;

(2) New theories and key technologies of advanced light sources;

(3) New experimental methods and new techniques on heavy ion devices;

(4) New methods and new techniques for strong magnetic field experiments;

(5) New principles, new methods and key technologies for high power target stations and experiments of the spallation neutron source;

(6) New experimental methods and techniques for synchrotron radiation;

(7) New detectors and related technologies such as electronics and optical components;

(8) Experimental data analysis, processing method and software.

Joint Fund for Aerospace Advanced Manufacturing Technology Research

Joint Fund for Aerospace Advanced Manufacturing Technology Research was jointly set up by NSFC and China Aerospace Science and Technology Corporation (CASC). The fund aims at playing a guiding and coordinating role of National Natural Science Fund, promoting the cooperation of industry-university-research, attracting and gathering social resources to participate in fundamental research for the development of aerospace advanced manufacturing technology and enhancing China's indigenous innovation capabilities in aerospace manufacturing industries. In 2020, the Joint Fund for Aerospace Advanced Manufacturing plans to fund two types of projects, namely Integrated Project and Key Project.

This joint fund calls for proposals all over the country, which ensures fair competition and encourages interdisciplinary research and industry-university-research cooperation. Universities and research institutions with sufficient research conditions and abundant research strengths are preferentially selected and supported to conduct researches on the topics within the *Guide*. Applicants should have deep understanding of the key fundamental research problems and the actual needs of aerospace field in China, grasp the essentials of the Joint Fund for Aerospace Advanced Manufacturing Technology Research, concentrate on scientific problems, and focus research directions that closely related to the actual problems and needs of aerospace industries. Applicants are advised to apply projects in collaboration with the manufacturing institutions or the scientific research departments of CASC.

Joint Fund for Aerospace Advanced Manufacturing Technology Research is part of the fund of NSFC. The process of application, evaluation and management of this fund will comply with management methods such as the Regulations of NSFC, NSFC's Rule on Joint Fund Management, and NSFC's Rule on Funding Management. Proposals of this joint fund will be accepted and evaluated by the Department of Engineering and Materials Sciences of NSFC.

I. Themes for Integrated Program Projects in 2020

1. Control of uniform microstructures and mechanical properties in the manufacturing of large-scale magnesium-rare earth alloy castings

Based on the demands of high strength and high mechanical reliability of the primary load carrying components in carrier rockets, proposals are expected to investigate the following issues: the synergistic effect of purification and grain refinement in large-sized melts is unclear; the evolution of materials and energy transmission in large-scale castings is elusive and the lack of control technologies for high strength and toughness. It aims at providing theories, methodologies and manufacturing technologies for controlling uniform and stable microstructures and mechanical properties in large-scale magnesium-rare earth alloy castings with high strength and toughness.

2. Investigation of the basic problems of multi-equipment cooperation and long-term service in the construction of robotic lunar base

Based on the construction of robotic lunar base, proposals are expected to investigate the fundamental problems of multi-equipment cooperation and long-term service at lunar surface, to solve the huge challenges of the safety operations, group manipulations, cooperative operations and long-term services of multiple agent equipment at lunar surface. It aims at providing theoretical basis for the construction of Chinese robotic lunar base.

3. Long service mechanisms and manufacturing basis of ultrasonic motor for aerospace

Proposals are expected to focus on the following issues: when ultrasonic motor works at vacuum, heat-alternating or irradiation aerospace environment, the wear resistance of friction materials is low; the time/temperature stability of piezoelectric ceramics is weak; the key factors influencing mechanical properties under long-term service is unclear and the matching mechanism with space equipment is elusive. It aims at providing theoretical basis for the designing and manufacturing of aerospace ultrasonic motor with long life, good performance and high reliability by conducting research from three aspects: materials, technology and integration.

II. Themes for Key Projects in 2020

1. Manufacturing basis of lightweight and high strength large aerospace components

Main research areas include:

(1) Study of the theoretical basis and control technology of additive manufacturing for SiC components;

(2) Study of the mechanism and technologies of near-net rolling for aluminum alloy conical cylinder with inner rib;

(3) Fundamental study of the additive manufacturing and synthesizing of single particle micro-nano composite spherical powder of high strength stainless steel;

(4) Study of stiffness optimization, interface forming and controlling of large-span composite support structure;

(5) Manufacturing technology basis of graphene/copper composite conductor for aerospace high-speed data cable.

2. Precision mechanical machining and installation basis of aerospace mechanical and electrical products

Main research areas include:

- (1) Basis of key technology of high modulus CFRP precision ablation and cutting by femtosecond laser;
- (2) Heterogeneous micro damage mechanism and optimization control of precision assembly of aerospace servo systems;
- (3) Intelligent assembly technology basis of hybrid-robot-based large scale space products.

3. Reliability and control technology basis of aerospace electromechanical products

Main research areas include:

- (1) Fundamental study of micro region thermal control technology of metal microstructures embedded multicavity ceramics;
- (2) Study of the contact behavior, abrasion mechanism and control technology of inertial-platform-used conductive devices.

4. Structure design and manufacturing basis of technologies of thermal protection materials in spacecraft

Main research areas include:

- (1) Study of design, manufacturing and mechanical properties of highly porous and high entropy ceramics with low thermal conductivity used in spacecraft;
- (2) Combustion behavior and flame retardant technology of lightweight thermal protection materials under extreme thermal environments.

5. Basic manufacturing technologies of aero-engines

Main research areas include:

- (1) Automatic winding and performance control of heat insulating layer in the combustion chamber of solid rocket motor;
- (2) Evolution mechanisms and suppression methodology of pores in composite solid propellant;
- (3) Study of the control of rheological characteristics and casting properties in composite solid propellant.

III. Notices of Application

(1) Applicants should have experiences of undertaking fundamental research projects or doing fundamental research; hold senior professional position (title). Post-doctors in station, graduate students, researchers without affiliation to a research institution or whose home institutions have not been registered at NSFC cannot apply as the Principle Investigator.

(2) The proposed project should be within the research areas and meet the requirement outlined in this *Guide*. Applicants should select “Joint Fund” for funding category, Integrated Project or Key Project for subcategories, and select “Joint Fund for Aerospace Advanced Manufacturing Technology Research” in the notes section. Applicants must select the application code for the Department of Engineering and materials sciences (starting with “E”) for “Application Code I” and choose the proper application code based on research areas for “Application Code II”. The number of collaborative institutions for Integrated Project shall not exceed three, and the number of collaborative institutions for Key Project shall not exceed two.

(3) Programs of these joint funds and other programs of NSFC shall comply with the

same restriction on the total number of projects. Restriction on applications, limit on the number of undertaken programs and the program types that share the same restriction can be found in the *Guide*.

(4) Applicants are advised to prepare for the research proposals in accordance with the outlines for the Integrated Project or Key Project of this Joint Fund. The research area for the applicants of Integrated Project or Key Project should be stated at the beginning of the “Research Background and Significance” in the proposal. If the applicant has undertaken other National Science and Technology Projects related to this application, distinction and relationship between the proposed project and other related undertaken projects should be discussed in the “Research Basis and Working Conditions” in the proposal.

(5) For any project in collaboration with the attached institutions of CASC, the proposal should be recorded by the Department of Technology and Quality of CASC. Applicants may request background information from the Department of Technology and Quality of CASC.

(6) For any research achievements funded by the Joint Fund, including paper publications, books, patents and awards, etc., NSFC’s support to the project should be acknowledged as “Supported by Joint Fund of Advanced Aerospace Manufacturing Technology Research (project No. XXX)”. For any research achievements related to the manufacturing of CASC, the publication must be reviewed and agreed by CASC.

Joint Fund for Civil Aviation Research

The Joint Fund of Civil Aviation Research is jointly set up by NSFC and the Civil Aviation Administration of China (CAAC). The Fund aims to attract researchers across China to participate in basic research for the sustainable development of aviation science and technology, so as to foster high level scientific talents, enhance the ability of indigenous innovation in the aviation industry, promote the integration of knowledge and technological innovation, and contribute to the building of China into a nation with strong aviation industry.

As a component of the National Natural Science Fund, the Joint Fund is open to all scientists across China. Researchers in non-aviation sectors are encouraged to carry out collaborative researches with those in aviation sectors.

Funding plan and priority areas in 2020

In 2020, the Joint Fund of Civil Aviation Research is going to support a number of Key Projects in the following 21 priority areas. Average funding (direct costs) for each project will be 2.1 million for 4 years. Qualified researchers are welcomed to apply for this fund according to the research scope and requirements listed in the *Guide*.

1. E-tag based whole process luggage tracking technology

The proposed research is expected to address the demand for meticulous management of air passenger luggage and solve problems such as electromagnetic confinement of reader/writer in complex environment, accurate electronic identification of large numbers of luggage, whole process data sharing and exchange, combination of e-tag

and card-tag, modeling of luggage check-in/collection/sorting/boarding/deboarding, reading of densely laid luggage tags with short distance, block chain-based whole process luggage data sharing and exchange.

2. Key technology for the improvement of flight operations control efficiency based on real time computation and online data

The proposed research is expected to address the need to improve the efficiency of flight operations control and solve key problems such as the low precision of meteorological forecast data in flight operations control, inaccurate quantification of irregular flight operations, and insufficient active intervention in flight turnaround management. Topics include integrated forecast for massive meteorological data of multiple time windows and multiple airports, key points of time analysis and turnaround time estimation based on online data, real-time quantitative prediction of abnormal flights based on the whole flight chain data, verification of flight operation prediction parameters and numerical simulation of flight flow, and establish real-time computing-based active intervention system for flight control and timely service.

3. Key technology of airport hub collaborative decision making (A-CDM) system based on integration of all airport components

The proposed research is expected to solve the problems in achieving safe, efficient and high-quality operation of the runway and apron, terminal building and public areas of civil airports based on A-CDM management, study the spatiotemporal network model of multi-modal and multi business object collaborative operation, performance measurement and assessment system of airport operation, method of making the optimal strategy for multi-modal and multi business object operation, spatiotemporal network evolution and strategy optimization based on transition probability, and the enhanced A-CDM prototype system of whole airport operation.

4. Key parameters of airport pavement based on laser point cloud data and vehicle borne image

The proposed research is expected to meet the demand for high quality airport pavement and aircraft take-off and landing safety, solve the difficulty in extracting key pavement parameters, study the pavement key parameter algorithm based on fusion of laser point cloud data and vehicle borne imaging data, build up large-scale databases of airport pavement key parameters, develop the airport pavement safety detection system, provide specific suggestions for timely repair and protection of the airport pavement in different timeslots, effectively reduce pavement testing and repair costs and lower the accident rate of civil aviation.

5. Key technology of precise sensing and intelligent analysis of airport surface movement

The proposed research is expected to meet the need of intelligent management of airport surface movement, solve the problems of precise dynamic sensing and monitoring of surface movement and intelligent analysis and accurate identification of surface moving features, develop key technologies of fine-grained classification of similar targets, object segmentation and contour-based three dimensional spatial relation calculation, behavior analysis and abnormal behavior detection.

6. Early warning markers of sleep disorders and depression in airline pilots and intervention measures.

The proposed research is expected to focus on the health of pilots operating long

haul flights crossing multiple time zones or night-flying flights, study the nervous-mental diseases such as sleep disorders and depression, collect and test the biological samples of pilots, study the influences of long-haul and night-flying flights on biological indicators of nervous/endocrine systems, the pathogenesis of sleep disorders and depression in airline pilots, early warning based on nervous/endocrine biological markers, and intervention measures.

7. Basic theory of thermal runaway of lithium battery for civil aircraft and key technology of airworthiness certification of lithium battery

The proposed research is expected to meet the demand for lithium battery safety for more electric and all electric aircraft, solve the problems of thermal runaway prevention and airworthiness certification of aircraft-borne lithium battery in flight, study the multi-field coupling properties of thermal runaway of aircraft-borne lithium battery in wide range of temperature and pressure environment, thermal runaway propagation mechanism of Lithium battery packs in changing and pressure environment, pre-warning of Lithium battery thermal runaway based on multi-parameter monitoring, Lithium battery thermal safety management technology and airworthiness certification of aircraft-borne lithium battery.

8. Theory and method of big data-driven intelligent safety evaluation of flight training

The proposed research is expected to meet the need of intelligent safety evaluation technology for flight training, solve limits of the current safety evaluation such as time delay and shortage in comprehensiveness of evaluation index, study the knowledge discovery from multi-source hybrid flight training big data, quantitative evaluation model of multi-level flight training, big data-driven intelligent evaluation method of flight training, intelligent evaluation system of flight training big data.

9. Mechanism and prediction technology of aircraft turbulence in the frontal zone

The proposed research is expected to meet the safety need of aircraft and passengers in turbulence, solve the problems of frontal zone characteristics extraction, turbulence mechanism and turbulence forecast, and study the temporal and spatial distribution, large-scale circulation background and weather characteristics of frontal zones, the turbulence mechanism of different types of frontal zones and prediction of aircraft turbulence in frontal zones.

10. Automatic laser aircraft paint stripping technology and its application

The proposed research is expected to control the environmental pollution caused by painting and paint stripping of the aircraft, solve the problems of quality control, efficiency improvement and environmental protection of new laser paint stripping technology, and study the mechanism and parameters of high-power laser paint stripping, the closed-loop control method and cost optimization of paint stripping, the development of automatic and intelligent laser paint stripping equipment, the development of prototype and its verification and evaluation.

11. Key technology of the application of high-resolution remote sensing in airport life cycle management

The proposed research is expected to meet the demand for airport life cycle management based on high-resolution satellite earth observation data, solve the problems of low accuracy of airport location data, lack of intelligent airport clearance management, and poor coverage of settlement monitoring, and study the data fusion and feature combination

analysis of multi-source heterogeneous monitoring data of typical ground features based on high-resolution remote sensing, accurate identification of ultra-high buildings/potentially dangerous buildings in the clearance area, high-precision monitoring of deformation and settlement of airport runway/terminals, refined management of typical macro-scale ground features in the airport and prediction of the spatial environment security evolution.

12. Key technology and test platform of aircraft towing and taxiing

The proposed research is expected to analyze the mechanical behavior of aircraft towing and taxiing, establish simulation models of towing and taxiing system, reveal the system dynamics of towing and taxiing, put forward the control strategy of towing and taxiing system, develop the physical test platform of aircraft towing and taxiing, explore the safety response criterion of the towing and taxiing system, and provide theoretical and technical support for safe, controllable and environmental friendly aircraft towing and taxiing.

13. Technology of civil aviation safety analysis

The proposed research is expected to meet the urgent need of civil aviation safety analysis and setting-up of the safety assessment system, establish technical specifications and standards for data collection and management of civil aircraft operation safety status, study the data fusion technology for multi-source heterogeneous aviation safety data, establish aircraft continuous safety assessment models, put forward methods for aircraft continuous safety assessment and prediction, develop continuous safety analysis systems for domestic civil aircrafts, and provide theoretical and technical support for the continuous safety operation of domestic civil aircrafts.

14. Basic theory and key technology of information security of network-based air traffic control system

The proposed research is expected to address the potential network attacks to air traffic control system security, study basic theories of the security protection mechanism, security information measurement and assessment index system of air traffic control system, break through the key technologies of air traffic control system security protection, such as the potential safety hazard and vulnerability detection, security situation awareness, security guarantee, and etc., build up an integrated and network-based defense system for the air traffic control system, develop the prototype system for the protection of information security of air traffic control system, and test its effectiveness.

15. Revenue management system based on dynamic pricing

The proposed research is expected to solve the revenue problem of airline under the current pricing model, set up blockchain-based big data platform for airline revenue management, establish dynamic price models based on passenger profile and statistical analysis of traffic, predict the dynamic trend of flight class price change, explore flight product recommendation technology based on deep learning, establish flight sales market simulation system, and provide technical and system support to individualized price management.

16. Key technology of avionics system fault prediction and health management

The proposed research is expected to solve the problems of inaccurate fault prediction and poor maintenance strategy of avionics system, study the technology and method of avionics system fault prediction and health management driven by a combination of data and model, make breakthroughs in key technologies, such as the modeling of typical fault and failure of key components of avionics system, the fault feature extraction of

avionics system based on deep learning, fault and service time prediction of avionics system driven by a combination of data and model, avionics system maintenance decision optimization, and establish fault prediction and maintenance decision verification platform and standards, and test their effectiveness.

17. Technology of intelligent operation of hub airport terminals based on passenger flow information

The proposed research is expected to meet the need of high efficiency operation of large hub airport terminals, study technologies of the intelligent sensing, real-time analysis, real-time expression, dynamic evolution and real-time simulation of passenger flow information, put forward optimization model and strategy for hub airport terminal operation, develop prototype system of hub airport terminal operation, and carry out application verification.

18. Mechanism and control of secondary combustion in aircraft fire

The proposed research is expected to focus on fire caused by secondary combustion in aircraft, study the mechanism, critical ignition condition, evolution and control of secondary combustion in low pressure and low oxygen environment, real the spatiotemporal evolution and heat transfer mechanism of the combustible materials in secondary combustion based on mathematical models of the motion and heat transfer process of the combustible materials, clarify the critical conditions of typical combustibles in aircraft fire, develop technologies to block and prevent secondary combustion in aircraft, and carry out application verification.

19. Technology and method of safety risk assessment of human-computer intelligent interaction in civil aircraft cockpit

The proposed research is expected to meet the need of airworthiness certification of the human-computer intelligent interaction system of the civil aircraft cockpit, study the formation and propagation mechanism of safety risk, the coding mechanism of complex interaction information, the transaction processing model, the security risk assessment method for multi-channel human-computer interaction, and develop a technological and method system to support airworthiness certification of safety risk assessment of human-computer intelligent interaction in civil aircraft cockpit.

20. Technology and method of optimal allocation of flight time resources in airport group

The proposed research is expected to focus on the problem of flight time resource management and efficient utilization of flight time resource in world-class airport groups, study the key technologies of predictive and guiding analysis of flight time resource management of airport groups from the perspective of optimal resource allocation, breakthrough the key technologies such as the determination of robust published capacity, the mechanism of airport operation interaction within the airport group and the robust optimal allocation of heterogeneous network node resources, propose models and algorithm for the optimal allocation of flight time resources in the airport group, realizes the optimal resource allocation of air transport system, and carry out application verification.

21. Key technology of air ground integrated air traffic control system for 4D trajectory operation

The proposed research is expected to meet the urgent need of 4D trajectory operation of civil aviation, develop key technologies such as enhanced collaboration of aircraft-borne and ground air traffic control systems, construction and evolution of airspace security

situation based on air ground coordination, knowledge-driven intelligent decision-making and control based on large-scale four-dimensional trajectory, solve the problems of the automatic and efficient synchronization between airborne flight management system and ground control system, cross regional sensing and pre-warning of meteorological and other airspace security risks, the robust regulation of 4D trajectory in complex operational environment, develop the verification system of the core principles of air ground integrated air traffic control system for 4D trajectory operation, and carry out application verification.

Joint Fund for Seismological Science

The Joint Fund for Seismological Science was jointly funded by NSFC and China Earthquake Administration. It aims to attract and bring together outstanding talents in related research fields across the country, and conduct basic, prospective and innovative research around several frontier scientific problems and critical technological issues in the field of seismological science research. In view of the urgent needs of the national defense earthquake disaster reduction work and the development trend and research frontiers of the international seismological science, the joint fund in 2020 will focus on topics including “seismic structure and seismogenic environment”, “new technology, new theory and new method for earthquake monitoring and prediction” and “application basis of earthquake resilience technology”. The Fund accepts Key Project in the following three areas. The average direct funding is 2.8 million yuan per project, and the funding period is 4 years. The research period should be from January 2021 to December 2024.

I. Seismic structure and seismogenic environment

In view of the basic theoretical and technical issues such as active fault habits and deep and shallow structural relationships, regional seismic tectonic models and seismic mechanisms, three-dimensional imaging and deep structures, this joint fund provides funding in the following four key research directions.

1. Study on the change of slip rate of active faults at different time scales and the characteristics of strong earthquake recurrence

Scientific objective: To explore the dynamic mechanism of active fault earthquake initiation, occurrence and change of fault slip rate by selecting typical large-scale active boundary faults (zones) in China, using technologies as geodetic surveying and space-to-ground observation, and methods as ancient seismic analysis and fault geomorphology, combined with high-precision quaternary dating technology, accurately limiting active fault slip rates on time scales of ten, millenniums, and ten thousand years, and analyzing the change of slip rate and its relationship with the recurrence of strong earthquakes.

Main contents include:

- (1) Slip rates of active faults at different time scales;
- (2) Change of slip rate of active faults and strong earthquake recurrence characteristics on different time scales;
- (3) Dynamic mechanism of earthquake initiation, occurrence and change of fault slip rate;

(4) Dynamic structures of active structures and key tectonic units in the sea area.

2. Study on the understanding and judgment method of fault activity in bedrock area

Scientific objective: To address the problem that the fault rupture mechanism and the traditional fault activity determination method cannot play its role in the bedrock area, explore the fault activity of the bedrock area and its judgment method, analyze the seismic hazard, and improve the research system of active faults.

Main contents include:

(1) The relationship between structural geomorphology and fault activity in the bedrock area and paleo-earthquake;

(2) Relationship between fault structure and composition change and fault sliding habit;

(3) Fault-measurement activities in the bedrock area and dating methods for paleo-earthquake events;

(4) Fault rupture behavior and seismic hazard analysis.

3. Current deformational features of the main active faults and the mechanism of strong earthquakes initiation

Scientific objective: To map the relationship between the current motion state, the deep and shallow structural deformation and the large earthquake inoculation process in the key structural parts of the main seismic faults of the Chinese Seismological Science Experimental Site, proposals should apply continuous GPS observation, InSAR measurement, seismic observation, geological survey and numerical simulation and a variety of methods to study the three-dimensional stress-strain state of faults, reveal the fine characteristics of active fault sliding behavior, and explore the mechanism of strong earthquakes and occurrence.

Main contents include:

(1) Current motion state and deformation characteristics of active faults;

(2) Comprehensive observation of cross-fault encryption and movement state of deep and shallow faults;

(3) The activity mode and strain accumulation of the active fault zone;

(4) The relationship between deep and shallow structure and its control on earthquake rupture.

Note: The projects supported under this topic shall fulfill the scientific data and results transfer agreement of China Seismic Experimental Site.

4. Study on the active neotectonic zones and seismogenic environment

Scientific objective: The occurrence of some strong earthquakes and their seismogenic structures are beyond the understanding the seismotectonic framework. This topic encourages researchers to explore the distribution and dynamics of active neotectonic zones, to study the tectonic correlation and the occurrence of strong earthquakes at different levels of the lithosphere seismogenic environment, and to reinforce the fundamental role of seismic tectonic pattern in China Seismic Experimental Site.

Main contents include:

(1) Distribution and dynamics of active neotectonic zones;

(2) Intersection and evolutionary sequence of active neotectonic zones in different directions;

(3) Tectonic associations at different levels of the lithosphere and seismogenic

environment;

(4) The latest division model of active blocks and the determination of seismic danger zone.

Note: The projects supported under this topic shall fulfill the scientific data and results transfer agreement of China Seismic Experimental Site.

5. Research on certainty-probability method for seismic risk analysis based on numerical simulation

Scientific objective: Aiming at the time dependence of the occurrence of strong earthquakes and the complexity of the field affected, researchers are encouraged to select a typical active seismic structure, take the complexity and uncertainty of the source rupture process of strong earthquakes into full consideration, construct a 3D crustal structure model and a superficial fine structure model, and to conduct method research on the certainty-probability seismic risk using numerical simulation, based on the results of seismic zoning research.

Main contents include:

(1) Certainty and uncertainty of seismic occurrence rate of typical seismogenic structure;

(2) Strong earthquake focal model based on the complexity and uncertainty of focal rupture process;

(3) New methods of time-dependent probability seismic risk analysis;

(4) Method of certainty-probability seismic risk evaluation and its application.

6. Research on response characteristics of the ground motion of lake sediment and seismic recurrence model

Scientific objective: Aiming at the unique sedimentary characteristics and sedimentary sequences caused by ground motions in lake sediments in the Sichuan-Yunnan region, researchers are encouraged to restore lake ground motion response processes, integrate effective chronological testing methods, obtain ancient earthquake records, develop recurring sequences and models of major earthquakes, and to provide theoretical basis for the study on the regularity of earthquake recurrence.

Main contents include:

(1) Sedimentary process and sedimentary characteristics of lacustrine sedimentary event layer;

(2) Mechanism and process of lacustrine sediment ground motion;

(3) Criteria and chronology of lacustrine sediment ground motion;

(4) Research on seismic recurrence model.

Note: The projects supported under this topic shall fulfill the scientific data and results transfer agreement of China Seismic Experimental Site.

II. New technologies, new theories, new methods of earthquake monitoring and forecasting

The key to improve earthquake forecasting consists in strengthening the observation of earthquake initiation, thoroughly understanding the mechanism of earthquake occurrence, improving and developing the theory and methods of earthquake forecasting. Based on the current research status and development trends in this field at home and abroad, and combined with the needs of China's seismological work, the priorities for scientific development in the next few years are: to improve mid- and long-term forecasting of major

earthquakes by using the latest observations to carry out research on the interaction of active block boundary zones and understanding of the occurrence mechanism of regional group strong earthquakes; to lay a solid foundation for earthquake monitoring and forecasting by carrying out anatomy studies of typical strong earthquakes and establishing a dynamic model of strong earthquakes; to explore the theories and methods of seismic physical forecasting by carrying out experimental research and numerical simulation of seismic physical processes; to develop new technologies and methods for earthquake forecasting by strengthening the applied research on observation data, i.e., space observations such as electromagnetic satellites, global navigation satellite systems (GNSS), and InSAR, earthquake and ELF electromagnetic active source detection network, and dense arrays; to improve seismic monitoring capabilities and data quality by carrying out R&D of new sensors such as optical fibers and lasers, and developing borehole observation technologies that integrate seismic measurement, deformation, fluid, and geomagnetism. The focus is to conduct monitoring, forecasting, testing, and theoretical research making the best of China Seismic Experimental Site.

In 2020, China Seismic Experimental Site is set as the major research area. Funding priorities will mainly focus on the anatomy studies of strong earthquakes and the model of seismogenesis, the relationship between physical field evolution and strong earthquakes, shale mining and seismic activities, earthquake forecasting and monitoring technologies, etc.

1. Study on the occurrence process and precursor mechanism of typical strong earthquakes

Scientific goal: According to the characteristics of abnormal distribution and physical mechanism of pre-earthquake earthquakes, select typical earthquake cases, establish seismic seismogenic models based on geological, geophysical, geodetic, geochemical and other observations, and analyze typical pre-earthquake anomalies or the physical mechanism of precursor anomalies, and reveal the mechanistic characteristics of typical anomalies before strong earthquakes.

Main contents include:

- (1) Strong earthquake seismogenic model based on multidisciplinary observations;
- (2) The relationship between the multi-physical (field) space-time evolution process and strong earthquakes;
- (3) Seismic observation techniques and prediction methods related to the process of strong earthquakes;
- (4) Research on seismic electromagnetic anomalies and mechanisms.

Note: The projects supported under this topic shall fulfill the scientific data and results transfer agreement of China Seismic Experimental Site.

2. Study on dynamic microgravity observation and genesis model of deep structure changes

Scientific objective: Based on high-precision time-varying gravity observation data from mainland China, sites with better observation conditions are selected to construct an integrated observation system of gravity, level, GNSS, and water level. Researchers are encouraged to build the monitoring ability for physical changes in deep structure, explore the correlation between deep media changes and seismic activity, and study the state, properties and changes of deep structure in the crust and related deep geodynamic processes by separating the signals of gravity changes caused by different deep field sources.

Main contents include:

- (1) Distribution of microgravity observation network and analysis of observation capabilities;
- (2) R&D and processing system for assimilation models of different gravity data on land;
- (3) Numerical simulation and model interpretation of time-varying gravity data;
- (4) Microgravity changes and their causes.

Note: The projects supported under this topic shall fulfill the scientific data and results transfer agreement of China Seismic Experimental Site.

3. Research on seismic prediction methods based on numerical simulation and artificial intelligence

Scientific goal: In view of the application of artificial intelligence and numerical simulation technology in earthquake prediction, using multi-scale and multi-type geophysical and geochemical observation data, combined with rock dynamics experiments, construct the digital model and boundary conditions of the source of strong earthquake area, and propose the medium and long-term prediction techniques and methods for regional strong earthquakes based on artificial intelligence and numerical simulation technology and the temporal and spatial evolution characteristics of regional strong earthquakes.

Main contents include:

- (1) Constitutive parameters of fault friction and deep viscoelastic parameters constrained by field observations and laboratory experiments;
- (2) Characteristics of temporal and spatial evolution of fault stress during strong earthquake initiation;
- (3) The process of seismic nucleation, dynamic rupture and post-seismic stress relaxation;
- (4) Medium and long-term forecasting techniques based on physical and statistical models;
- (5) Precursor information recognition methods and techniques that integrate multi-source data.

Note: The projects supported under this topic shall fulfill the scientific data and results transfer agreement of China Seismic Experimental Site.

4. Study on the relationship between energy development and seismic activities

Scientific objective: Aiming at issues such as the relationship between energy development and seismic activities and their disaster risks, researchers are encouraged to explore the integrated technologies and risk prevention measures for the research on the mechanism of earthquakes induced by energy development, so as to improve the capabilities in ensuring earthquake safety related to energy development.

Main contents include:

- (1) Seismic monitoring and temporal and spatial evolution features of seismic activities in energy development zones;
- (2) Changes of structure and stress state caused by energy development and focal mechanism;
- (3) Risk assessment on earthquakes induced in energy development zones;
- (4) Technology for safe production and operation of energy development and seismic risk prevention.

Note: The projects supported under this topic shall fulfill the scientific data and

results transfer agreement of China Seismic Experimental Site.

5. Research on distributed optical fiber sensing technology

Scientific objective: Aiming at the problems of observation technology equipment and data analysis and processing faced by the distributed optical fiber sensing observation network, researchers are encouraged to develop highly sensitive, highly accurate, and low-cost distributed optical fiber seismic monitoring equipment and related methods of processing, imaging and inverting seismic signals that have originality and independent intellectual property rights, and to conduct demonstration studies using existing optical communication cables in the China Seismic Experimental Site.

Main contents include:

(1) R&D of high-sensitivity and high-precision distributed optical fiber monitoring equipment;

(2) R&D of seismic signal processing, imaging and inversion methods for optical fiber sensor recording;

(3) Carry out field demonstration observations using the existing communication optical cables in the Sichuan-Yunnan area.

Note: The projects supported under this topic shall fulfill the scientific data and results transfer agreement of China Seismic Experimental Site.

III. The seismic toughness technology application basis

The important foundation for building resilient urban and rural areas is to study the function mechanism of earthquakes and secondary disasters on engineering systems, conduct in-depth research on the damage mechanism of engineering systems under the coupling of multiple disasters, and to assess and improve the post-disaster recoverability of engineering systems. Based on the current status and development trends of domestic and international research in this area and the actual needs of our country, the priorities for the next few years include: constructing urban and rural seismic toughness assessment theories and methods, establishing the principles of urban and rural seismic toughness capabilities; studying the occurrence of earthquakes and secondary disasters and its function mechanism on engineering systems to provide evidence for understanding the entire process of disaster evolution of engineering systems; proposing the destruction mechanism and coupling failure theory of urban-rural engineering systems under the coupling of multiple disasters, and establish the theoretical basis for dynamic disasters of urban-rural engineering systems under strong earthquakes; developing integrated monitoring and earthquake identification methods by applying new disaster mitigation techniques in an innovative manner, so as to provide efficient and practical technical support for resilient urban and rural construction.

In 2020, priorities under this topic will be simulation of marine ground motions and engineering stability, risk assessment of earthquake disasters, and site effects of China Seismic Experimental Site.

1. Disaster-causing mechanism and risk prevention and control methods for the liquefaction of broadly graded coral soil reclaimed engineering sites

Scientific objective: In view of the threat of liquefaction of dredged coral soil to China's major offshore projects and foreign aid projects, researchers are encouraged to develop a parametric model of typical coral soil reclaimed engineering site, analyze the soil characteristics and liquefaction triggering conditions of dredged coral soil, reveal the liquefaction mechanism of dredged coral soil, and establish a broadly graded coral soil

liquefaction predicting method based on in situ parameters, so as to complete the seismic damage analysis and demonstration studies on the prevention and control of the liquefaction of typical coral soil reclaimed sites.

Main contents include:

- (1) Soil characteristics and earthquake liquefaction mechanism of coral soil reclaimed sites;
- (2) Parameterized model and index database of typical coral soil reclaimed engineering sites;
- (3) Large particle size test of coral soil liquefaction and steady-state replication of hypergravity physical simulation;
- (4) Method of predicting the liquefaction of broadly graded coral soil based on in situ parameters;
- (5) Seismic damage analysis and demonstration study on the liquefaction of typical deep-flooded coral soil reclaimed sites and critical deep underground facilities.

2. High-frequency strong ground motion and toughness fortification standards in Sichuan and Yunnan

Scientific objective: To develop the high-frequency strong ground motion numerical simulation technology based on the deep and shallow attenuation medium model and earthquake rupture process for the analysis of the earthquake disaster and toughness in the Sichuan-Yunnan region where the mountains and basins are interspersed, the terrain is undulating, the basin is thick and the basement is undulating. So technical support will be provided to the standard setting of the fortification provides technical support.

Main contents include:

- (1) Model of the elastic and attenuating medium containing the relief of the topography;
- (2) Model of strong earthquake source rupture process;
- (3) High-frequency strong ground motion simulation based on the rupture process and the attenuation medium;
- (4) The main controlling factors of low frequency and high frequency components of ground motion;
- (5) Research on urban and rural resilience standards.

3. Study on soil layer space model and site seismic effect in Xichang area

Scientific objective: In view of the international difficult problem of seismic effects of deep and soft overburdens, a 3D framework for seismic response and seismic damage analysis of soil layers was established in Xichang area of the China Seismic Experimental Site. Researchers are encouraged to study the features of soil layer parameter test deviations, reveal the actual amplification effect of the ground motion of deep and weak overburdens and develop corresponding numerical simulation technology, explore the long-period ground motion probability prediction model for deep soil layers, and conduct simulation and demonstration research of soil layer amplification effect, so as to provide theoretical and technical support for the construction of China Seismic Experimental Site.

Main contents include:

- (1) Non-linear data structure of the soil layer of the experimental site and 3D meter-scale fine model;
- (2) Uncertainty probability distribution model of soil layer parameters in the experimental site;

- (3) Numerical calculation methods for deep and liquefiable soil layers;
- (4) Simulation and demonstration of soil layer amplification effect in the experimental site.

Note: The projects supported under this topic shall fulfill the scientific data and results transfer agreement of China Seismic Experimental Site.

4. Study on simulation and function mechanism of ground motion in complex sea area

Scientific objective: In view of the lack of marine engineering seismological theory and records of marine ground motions, researchers are encouraged to develop the simulation of strong ground motions in complex sea areas from the earthquake rupture process to the response of engineering structures and the methods of analyzing its interaction with marine engineering structures, study the propagation law of marine ground motions, explore the influence of topographic and geological conditions on ground motions, reveal the features and damage mechanism of the response of marine engineering structures, and provide technical support for earthquake and geological disaster warning in marine areas and seismic toughness assessment of marine engineering.

Main contents include:

- (1) Anelasticity time domain fluctuation simulation of fluid-solid coupling in seawater-sediment layer;
- (2) Decoupling simulation technology of local saturated site response in sea area;
- (3) The influence of the topography and geology of the sea floor on the ground motion of the sea area;
- (4) Research on the features of ground motions in key sea areas;
- (5) Method of analyzing seawater-seabed-structure interaction under the impact of earthquake.

5. Research on disaster-causing mechanism and toughness improvement technology of offshore engineering under the combined action of earthquake and tsunami

Scientific objective: To study the mechanical effects of earthquakes and their tsunami on offshore engineering, study the failure mechanism of engineering systems under combined action, and propose technical means to mitigate compound disasters.

Main contents include:

- (1) A risk model for the combined action of earthquakes and tsunamis;
- (2) Test and analysis methods for the whole process of destruction of offshore engineering systems under the combined action of earthquake and tsunami;
- (3) A qualitative design method that considers the effects of multi-level earthquakes and tsunami;
- (4) Offshore engineering seismic toughness improvement technology based on intelligent control principle.

Joint Fund for Water Science of the Yangtze River

The Joint Fund of Water Science of the Yangtze River is jointly set up by NSFC, Ministry of Water Resources of the People's Republic of China and the China Three Gorges

Corporation. The Fund is aimed to give full play of the guiding role of the National Natural Science Fund, attract and mobilize researchers of universities and research institutes across China to research on the theoretical basis and applicable technologies to solve the key water science problems related to the green development of the Yangtze River economic belt, open up new research directions and contribute to the improvement of original innovation capacity in water science in China.

In 2020, the Joint Fund of Water Science of the Yangtze River is going to support a number of Key Projects in the following priority areas. Average funding (direct costs) for each project will be 2.6 million for 4 years.

Priority areas in 2020

1. Water circulation of the irrigation area in the Yangtze River basin and water saving and emission reduction effect (D01, D07, or E09)

The proposed research is expected to solve the problem of low water efficiency in agricultural irrigation in the Yangtze River Basin, focus on the rice irrigation area, study the multi-scale water cycle and non-point source pollution migration in irrigation area, assess the adaptability of water saving and emission reduction potentials of the irrigation area, explore the water saving and emission reduction models for efficient utilization of water resources in irrigation area and optimal water regulation mechanism based on integration of multiple water sources in ditch, pond and reservoir, so as to provide basic theories and technologies for the improvement of irrigation water efficiency, water resource protection and food security of the Yangtze River Basin.

2. Change mechanism and comprehensive simulation of water cycle process in Hanjiang River Basin (D01, D05, D07 or E09)

The hydrological cycle process of the Hanjiang River Basin is undergoing dramatic changes, and the rate of water resources exploitation is growing. Both have brought great challenges to the protection of water ecological environment and water safety of the South-to-North water diversion project. The proposed research is expected to study the influence mechanism of factors such as continuous drought, underlying surface change and water conservancy projects on the water cycle process of the river basin, establish a comprehensive simulation system of the water cycle process under the influence of climate and human activities, estimate the water cycle changes and water shortage risk under different scenarios in the future, put forward adaptive strategies, so as to provide scientific support for the sustainable utilization of water resources in the Hanjiang River Basin and the water supply safety of the South-to-North water diversion project.

3. Evolution of water resources in the Yangtze River Basin and method of medium and long-term prediction and evaluation planning of water resources (D01 or E09)

The proposed research is expected to investigate the evolution pattern of hydrological situation in the Yangtze River Basin, study the evolution pattern of water supply in the Yangtze River Basin, medium and long-term prediction, scientific evaluation, planning and utilization methods, establish the dynamic prediction model of the medium and long-term water resources supply, put forward the water resources redistribution and utilization plan for the Three Gorges project, and provide scientific and technical support for the refined management of regional water resources.

4. Pattern and regulation mechanism of seasonal ecological and hydrological

changes of large river-connected lakes (D01 or E09)

The proposed research is expected to focus on the significant decrease of large river-connected lakes in the Yangtze River basin and serious degradation of their ecological functions, study the pattern and mechanism of seasonal ecological and hydrological changes of transition area between water and land of the large river-connected lakes and corresponding regulation mechanism, investigate the pattern of ecological and hydrological evolution of large river-connected lakes in river-lake interaction, reveal the evolution mechanism of the ecological and hydrological process of transition area between water and land, set up transition area ecological and hydrological coupling model, explore the appropriate seasonal ecological and hydrological changes for large river-connected lakes and regulation threshold, and provide theoretical basis for the protection of river and lake ecosystem in the Yangtze River Basin.

5. The temporal and spatial changes of sediment flux in the middle and lower reaches of the Yangtze River under the influence of joint operation of reservoirs and its impact on habitat attributes (D01 or E09)

The proposed research is expected to focus on the influences of upstream reservoir operation on the hydrological properties of the Yangtze River, study the connections between the reservoir operation and the temporal and spatial changes of sediment and nutrient salts transport flux, the impact mechanism of reservoir operation on sediment micro habitats of the middle and lower reaches of the Yangtze River and environmental impact effect, the restoration and management of micro habitats in the middle and lower reaches of the Yangtze River under the influence of the joint operation of the reservoirs.

6. Multi-dimensional characteristics and regulation of eco-environmental effects of water conservancy and hydropower projects in the upper and middle reaches of the Yangtze River (E09)

The proposed research is expected to study the spatial and temporal changes of river habitats of the upper and middle reaches of the Yangtze River under the influences of water conservancy and hydropower projects and the multi-dimensional regulation of the eco-environmental effects of water conservancy and hydropower projects based on the distribution pattern of water conservancy and hydropower projects in the upper and middle reaches of the Yangtze River, and the multi-source and long-term monitoring data of basin hydrology, water environment and water ecology.

7. Key process and regulation theory of Oncomelania habitat evolution in the middle and lower reaches of the Yangtze River (C03 or E09)

The proposed research is expected to focus on typical habitats of Oncomelania in the middle and lower reaches of the Yangtze River, study the evolution process and pattern of Oncomelania habitats under new silt-discharge conditions, the key ecological factors influencing the distribution of Oncomelania habitats, the ecological hydrological mechanism underlying the changes of Oncomelania population density, and put forward the ecological prevention and control technology to inhibit Oncomelania reproduction.

8. Mechanism of landform evolution of wetlands in the Yangtze River Estuary and ecological restoration methods (C03 or D01)

The proposed research is expected to meet the need of protection and green utilization of the tidal flat wetland in the Yangtze River Estuary under the condition of the sharp decrease of sediment entering the sea, study the mechanism and simulation method of water-sand-landform-vegetation interaction in the tidal flat wetland in the Yangtze River

Estuary, the evolution pattern, driving mechanism and development trend of the tidal flat wetland under the influence of multiple factors, the development trend of tidal flat vegetation, and the methods of wetland ecological conservation and restoration.

9. Evolution pattern of water ecological environment of typical river-connected lakes in the Yangtze River Basin and the optimal reservoir regulation method (C03 or D01)

The proposed research is expected to focus on the ecological problems of river-connected lakes in the middle and lower reaches of the Yangtze River, study the driving mechanism and simulation method of the ecological environment evolution of river-connected lakes under the changing relations between the Yangtze River and the lakes, the spatial and temporal pattern and trend of the evolution, and the optimal regulation strategy of the reservoirs that benefits the ecological environment of river-connected lakes.

10. Regulation mechanism of nitrogen transformation in shallow lakes in the middle and lower reaches of the Yangtze River (C03, D01 or D07)

The proposed research is expected to meet the demand of prevention and control of nitrogen and phosphorus nutrient pollution in shallow lakes in the middle and lower reaches of the Yangtze River, study the forms and transformation characteristics of nitrogen in lake environment, nitrogen exchange flux at important interfaces and influencing factors, and the biological effect and regulation mechanism of nitrogen utilization in lake ecosystem.

11. Key technologies of river and lake sediment control in cities along the middle and lower reaches of the Yangtze River (D07, E09 or E10)

The proposed research is expected to focus on the distribution characteristics of river and lake sediment, study the mechanism of rapid bacterial transformation of organic matter in river and lake sediment under different pollution conditions, break through the control technology of ultra-high temperature fermentation stability, explore the forms of environmental pollutants such as microplastics, POPs and heavy metals in the sediment and their transformation in treatment process, and put forward the in situ restoration strategy of river and lake sediment based on physical, chemical biological methods.

12. Mechanism of the ecological response to changes of connectivity between river and lakes and analysis and evaluation of landscape evolution for river-connected lakes in the middle and lower reaches of the Yangtze River (D01 or D07)

The proposed research is expected to focus on the medium-sized river-connected lakes in the middle and lower reaches of the Yangtze River, especially the impediment of the free flow of materials, species and information due to the damage of physical and hydrological connectivity between river-connected lakes, study the mechanism of the ecological response to changes of connectivity between river and lakes and analysis and evaluation of landscape evolution for river-connected lakes in the middle and lower reaches of the Yangtze River, and provide scientific and technological support for the restoration of river-lake connectivity.

13. Ecological regulation of eutrophication and algal bloom in the tributaries and bays of reservoir based on water level fluctuation (C03, D01, D07 or E09)

The proposed research is expected to control the algal blooms in the tributaries and bays of the Three Gorges Reservoir, study the influences of different operation periods and operation processes of the Three Gorges Reservoir on the algal blooms and the underlying mechanism, investigate the mechanism of the influence of the water level change of the reservoir on the community structure of the Algae Phytoplankton in the tributaries, set up

the interactive decision support system for the water quality and water quantity operation of the reservoir, dynamically present the evolution of various targets during the water quantity and water quality operation of the reservoir, and put forward ecological operation strategies to control algal blooms.

14. Eco-compensation mechanism of the Yangtze River Basin (C03 or D01)

The proposed research is expected to study the interactions among the economic and social development, the protection of ecological environment, the ecological resources and eco-compensation mechanism of the Yangtze River economic belt in the implementation of the "coordination environment conservation of the Yangtze River" strategy. Research topics include the classification, distribution and ownership of ecological resources in the Yangtze River Basin, the stock of ecological resources, the influencing factors of dynamic changes of ecological resources, the theory and method of value assessment of eco-resources, the design of ecological resource balance sheet, the theory and method of ecological service quality assessment, diversified eco-compensation mechanism, eco-compensation models based on regional function planning and the demand of poverty alleviation, market-oriented eco-compensation mechanism, the design of the "eco-bank" mechanism for the central government and the local reserves, the mechanism of smooth operation of eco-compensation, formulation of national policies, financial and organizational guarantee, assessment of eco-compensation monitoring and allocation of eco-compensation fund.

15. Vertical ecological value of reservoir and adaptive operation technology (C01, D01 or D07)

The proposed research is expected to focus on the ecological value of vertical stratification in the high-dam reservoirs of the Yangtze River, study the pattern and formation mechanism of the vertical distribution of biogenic materials and microorganisms of the cascade reservoirs, the mechanism of the ecological impact of water stratification and strategies to reduce negative ecological impact.

16. Mechanism and regulation of the influences of water temperature changes on fish of the Three Gorges Reservoir (C19)

The proposed research is expected to study the characteristics of water temperature changes in the Three Gorges Reservoir and the cumulative effect of water temperature in the cascade reservoirs, the characteristics of dynamic changes of water temperature near the dam and its influence mechanism, the swimming behavior of fish community under the changing water flow and water temperature conditions, the mechanism of the influences of fish biological ecological characteristics on the perception ability and responses to stress of fish, the mechanism of the influences of changing environment on the perception ability and responses to stress of fish, the control index of fish passage suitable for multiple fish species, and the regulation mechanism of up-stream and down-stream fish passage suitable for specific fish communities in changing environment.

17. Key technologies for the assessment of ecological impact and restoration effect of small hydropower stations in the Yangtze River Economic Belt based on hydrological ecological responses (C03 or D01)

The proposed research is expected to focus on the eco-environmental problems caused by small hydropower stations in the Yangtze River economic belt, study key scientific issues such as the hydrological ecological responses of rivers to small hydropower stations, the mechanism of ecological degradation of small watersheds, the theory and methods of ecological restoration of rivers with small hydropower stations.

18. Performance change pattern of dam concrete in long-term service and theory and method of durability improvement of dam concrete of water conservancy and hydropower projects in the Yangtze River Basin (E08 or E09)

Topics include the effect of long-term natural weathering on the performance degradation and structure damage of cement-based materials and its micro-mechanism, the relations between micro-structure and macro performance changes, the long-term pattern of performance changes and durability evolution mechanism of dam concrete, the long-term performance evaluation system of dam concrete, the prediction model of service life of dam concrete, and theory and methods of the improvement of dam concrete durability.

19. Theory of dilatancy related to the state of landslide dam and the evolution of dam collapse (E08 or E09)

The proposed research is expected to focus on key scientific problems of the safety assessment and disaster mechanism of landslide dam in the upper reaches of the Yangtze River, and provide evidences for the emergency decision making and disaster prevention and mitigation. Topics include: theory and constitutive model of dilatancy related to the state of landslide dam, the erosion mechanism of landslide dam under the action of sediment-laden water, the simulation method of the dam collapse process based on fluid-solid coupling, and the evaluation method of the stability of the landslide dam.

20. Technology and method of biological reinforcement and anti-seepage for the soft-hard joint of concrete and soil of water conservancy and hydropower projects in the middle and lower reaches of the Yangtze River (E08 or E09)

The proposed research is expected to solve the seepage problem and damages caused by repeated separation of the concrete and soil of water conservancy and hydropower projects in the middle and lower reaches of the Yangtze River, and provide measures and methods for improving the uniformity and strength of consolidation in engineering application. Topics include: technology and method of microbial anti-seepage reinforcement; the coupling pattern of microbial migration and diffusion, adsorption, mineralization and deposition near the interface in the fractures of the concrete and soil joint and in complex porous-media seepage flow field; the consolidation process; the mechanism of responses to the consolidation process and changes of the seepage field; and the durability of consolidation body.

21. Mechanism and prediction of drought in the Yangtze River Basin (D01 or D05)

The proposed research is expected to study the impact mechanism of the air-sea and air-land interactions on the formation of drought in the Yangtze River Basin under the climate change and human activities, explore methods and models of dynamic forecast of drought at different temporal and spatial scales, and provide evidences for drought risk management.

22. Evolution mechanism and green control of reservoir landslide under the condition of sudden rainstorm (D02, D05, D07 or E09)

Topics include: field observation of sudden rainstorm in the mountainous area of reservoirs of the Yangtze River Basin; key technology of rainstorm model and hydrological model coupling; prediction method of river rainfall probability; mechanism of rainstorm evolution and mechanism of mountain torrents and landslides in different geological structures caused by rainstorm; identification of landslide evolution processes in the Three Gorges Reservoir area under the condition of sudden rainstorm; the coupling technology of

the meteorological, hydrological, geological and ecological models in the landslide area; the new technology integrating the prevention and control of landslide and green ecological protection in the reservoir resettlement area.

23. Influences of changes in water system structure on flood and water environment in the Yangtze River Delta (D01, D05, D07 or E09)

The proposed research is expected to focus on the river system of the Yangtze River Delta and provide scientific support for the flood control and water environment protection. Topics include: characteristics and driving factors of the evolution of water system structure and connectivity under the background of intense human activities and high-speed urbanization; quantitative analysis of the evolution characteristics of hydrological process of river and lake water system and quantitative estimation of flood and other environmental risks; the assessment of the flood control and environmental functions and effects of river and lake water system after restoration; index systems and assessment methods of water system structure and river-lake connectivity.

24. Early warning mechanism and control of river bank collapse in the middle and lower reaches of the Yangtze River (D02, D07, or E09)

The proposed research is expected to focus on the river bank collapse in the middle and lower reaches of the Yangtze River and provide scientific evidences for its control and prevention. Topics include: the causes, mechanism, analysis methods, monitoring, early warning and control technology of river bank collapse under the background of water conservancy projects and human activities changes.

25. Mechanism of asynchronous propagation of flood peak and sediment peak and the model of water and sediment yield and transportation in the upper reaches of the Yangtze River (E09)

The proposed research is expected to focus on the Three Gorges Reservoir and other cascade reservoirs in the upper reaches of the Yangtze River and provide scientific support for the reduction and distribution improvement of sediment deposition of the cascade reservoirs and the better exertion of the comprehensive benefits of water conservancy projects. Topics include: the asynchronous time-space variation characteristics, propagation mechanism and propagation effects of the flood peak and sediment peak in the upper reaches of the Yangtze River based on the sediment production and transportation characteristics of typical rainstorm floods; the multi spatial-scale sediment production and transportation models; and strategies of refined operation for sediment peak regulation in reservoirs of the upper reaches of the Yangtze River.

26. Evolution mechanism and dynamic regulation of sediment scouring and silting of the cascade hydropower stations in the lower reaches of Jinsha River (E09)

Topics include: mechanism of bed load transport with a wide range size distribution, river bed reconstruction process and long-term evolution of sediment scouring and silting of the downstream of cascade hydropower stations in the lower reaches of Jinsha River; the flood peak and sediment peak evolution of the reservoirs and sediment discharge technology based on the dynamic flow and sediment process of the mainstream of Jinsha River; the sediment deposition mechanism of the mouth bar area and technologies of dynamic regulation of flood peak and sediment peak based on the dynamic flow and sediment process of the tributaries of Jinsha River; the response process and scouring protection measures of the downstream rivers of reservoirs; and technologies of dynamic regulation and control of the sediment of cascade hydropower stations in the lower reaches

of Jinsha River which help the long-term maintenance of the reservoir capacity, the balance of sediment deposition and the relative stability of the downstream riverbed.

27. Stability of new pattern of the Yangtze River Estuary and management of deepwater channels (D01, D07 or E09)

The proposed research is expected to focus on the protection of tidal flat resources in estuary and the maintenance of estuary pattern and ecological system stability under the background of sharp decrease of river sediment. Research is urgently needed to study the evolution characteristics and mechanism of the channel-shoal systems, evaluation of the optimal river regime pattern and the protection of the shallow and deep water resources of the Yangtze River Estuary, so as to provide scientific evidences and technical support for the flood control planning, the maintenance of the shallow and deep water resources, and the protection of the water sources and the ecological environment of the Yangtze River Estuary.

28. Basic theory and technical system of revetment and riverbed treatment by biocompatible solid waste-based ecological cementation (E04 or E09)

The proposed research is expected to address potential pollution of tailing reservoir in the upper reaches of the Jialing River, and study the theory and methods of using tailings as the substitute material for the river bank revetment and channel regulation project of the Yangtze River. Topics include: the multi-component cementation theory and ecological solidification mechanism of solid tailings, activators and cementitious materials tailings; the escape mechanism and control threshold of harmful substances in the solid waste-based cementation revetment system; the mechanical properties and durability evolution pattern of the new solid waste-based ecological cementation; the biocompatibility and improvement mechanism of the solid waste-based ecological cementation; the standard system of the new solid waste ecological cementitious materials for revetment and riverbed treatment; and water ecological risk assessment method of tailing reservoirs.

29. Multi-scale study on consolidation technology and characteristics of dredged soil in the lower reaches of the Yangtze River (E08 or E09)

The proposed research is expected to focus on typical dredged soil in the lower reaches of the Yangtze River, study the curing agent formula, macro and micro properties of consolidated dredged soil, and application of the curing agent, explore the consolidation mechanism of the curing agent, establish the macro-property prediction model, the triaxial constitutive model, the molecular dynamics model and the micromechanical model for the solidified soil, develop the curing agent suitable for the dredged soil in the lower reaches of the Yangtze River and the optimal mixture ratio, so as to provide technical support for the utilization of dredged soil resources in the lower reaches of the Yangtze River.

30. Soil erosion and ecological utilization of reservoir riparian zones in the upper reaches of the Yangtze River (C03, d01, D07 or E09)

The proposed research is expected to analyze the dynamic characteristics and spatial-temporal distribution pattern of the soil erosion of reservoir riparian zones in the upper reaches of the Yangtze River, clarify the soil-vegetation evolution characteristics in the reservoir riparian zones under the extreme alternation of the land and water periods, systematically study the process and mechanism of soil erosion in the reservoir riparian zones under the complex coupling of erosion stresses, put forward the evaluation method of the quality and ecological value of biological resources in the reservoir riparian zones based on the purpose of utilization, and provide the ecological management and restoration

strategy based on stratification of the reservoir riparian zones.

31. Simulation of the soil erosion process of the Yangtze River Economic Belt based on erosion dynamic process (D01, D07 or E09)

Topics include: the relationship between the sediment yield of slope erosion and the sediment transport in the small watershed with small watershed as the statistical unit of sediment transport and the land slope as the sediment production site; the sources and transport characteristics of sediment in Yangtze River tributaries with the main tributaries in the Yangtze River Economic Belt as the statistical unit; the accumulation process and temporal-spatial distribution of soil erosion energy produced by the Yangtze River Economic Zone; and the prediction model of sediment yield and transport in the Yangtze River Economic Belt based on the dynamic process.

Joint Fund for Smart Grid

The joint fund for Smart Grid is jointly founded by NSFC and State Grid Corporation of China. The aim for this joint fund is to give full play of the NSFC's guiding role in the researches; enhance the combination among the industry, academia and research; attract and mobilize the excellent science and technology resource in society to carry out the fundamental and cutting-edge researches to fulfil the national energy requirement; promote the self-innovation capability and core competitiveness in Chinese power industry.

In 2020, this joint fund plans to fund two types of projects, namely Integration Project and Key Project. The funding period should be uniformly filled as "January 1, 2021 to December 31, 2024". The integration project has an average direct funding of 12 million yuan per project for 4 years; and the key project has an average direct funding of 2.6 million yuan per project for 4 years.

I. Integration Project

Applicant may submit proposals in any of the following two funding areas and decide the title and research plan for the project independently.

1. The fundamental theory for the stability under a huge disturbance and revolution of chain reaction malfunction in the power system with a large ratio of electronic devices

Research area: Plan and operation for the large grid.

Research purpose and significance: There is a large disturbance when the power system breaks down, a large number of electronic devices need to switch the control pattern to overcome this disturbance. The dynamic behavior possesses the pronounced characteristics of conditional switching, which is different from the traditional rotation devices, such as the synchronous generator, dominated by the electromechanical processes. The switch-control property in the electronic devices significantly influences the dynamic behavior of the electrical power system. The main system can be mathematically described by the uniform electromechanical process equation throughout the whole malfunction process. It can be further transferred into mixed equation containing segment control process equation and electromechanical process equation based on the preinstalled conditions and dynamic switching of system variables. There is a change in the stability mechanism

under a large systematic disturbance, which induces the even more complicated evolution for the malfunction chain reaction process. The present mechanical approach is not only unable to describe and analyze the stability problem under the disturbance as well as the malfunction chain reaction process containing a large number of switch-control behaviors, but also unable to sufficiently support the safe and stable operation of the electrical power system with a large ratio of electronic devices. This project focuses on investigating the stability mechanism under the large disturbance and discipline for the evolution of the malfunction chain reaction in the electrical power system with a large ratio of electronic devices, proposing the analytical and control methods, which provide the theoretical and technical supports for the stable operation of the electrical power system.

Scientific Objects: To establish the switch-control model for the electronic devices in the electrical power system and cluster; reveal the stability mechanism under the large disturbance in the electrical power system containing a large ratio of electronic devices; propose the criteria for the stability; reveal the reaction mechanism for the dynamic behavior in the electrical power system and cluster to the evolution of the malfunction as well as the risk evaluation; propose the method for the stability control under the large disturbance and prevention for the malfunction chain reaction process.

Main research contents:

- (1) Switch-control model for the electrical power system and cluster;
- (2) Stability mechanism and criteria under the large disturbance in the electrical power system containing a large ratio of electronic devices;
- (3) Evolution mechanism and risk evaluation in the electrical power system containing a large ratio of electronic devices;
- (4) Method for the stability control under the large disturbance and prevention for the malfunction chain reaction process in the electrical power system containing a large ratio of electronic devices.

2. The intelligent cognition about the load in broad sense and the investigation about the control with a high efficiency

Research area: Intelligent distribution and utilization of electrical power.

Research purpose and significance: Load is the basic component for the smart grid and ubiquitous electric internet of things. On the one hand, grid needs to supply the load with reliable power. On the other hand, the properties of load significantly influence the grid operation. Recently, there are new challenges emerging in the grid operation: first of all, the ratio of power produced by the new energy source is increased from the power supply side, inducing the reduced controllability of power supply; secondly the city grid is hollowed from the receiving side, causing the severe security situation to the grid; thirdly the component from the load side experiences a huge change, inducing the significant increase of the complexity in the load. Simultaneously, there are also new chances for the grid: first of all, the properties of the load experience a huge change. The formerly uncontrollable load turns to be partially controllable. The areas supplied by the substation in the power distribution network are defined as “load in broad sense”, including uncontrollable load, dispersed power supply, controllable load and dispersed energy storage, controllability of the latter two; Secondly, the novel technology are emerging, such as ubiquitous electric internet of things, big data related to load, artificial intelligence, 5G communication and so on. This project focuses on the researches based on the technologies related to the big data, artificial intelligence and 5G, try to understand the characteristics of “load in broad sense”,

realize the rebalance between the source and load by efficiently adjusting the controllable load, promote the security operation level in the hollowed city grid.

Scientific Objects: To propose the method to analyze the component for the load in broad sense, especially the flexible load, reveal the observability and controllability of the load in broad sense, establish the frame and theory for the security control of the load in broad sense.

Main research contents:

- (1) Research about the observability of the load in broad sense based on big data;
- (2) Research about the controllability of the load in broad sense based on social system;
- (3) Research about the efficient adjustment of the load in broad sense based on multi market entities;
- (4) Research about the security control of the load in broad sense based on the multi-network fusion.

II. Key Projects

Applicant may submit proposal in any of the following 17 funding areas and decide the title and research plan for the project independently.

- (1) Theory and method for the enhanced intelligent control about the schedule in the grid;
- (2) Theory and method for the synergic optimization in composite power system;
- (3) Characteristic analysis and behavior optimization about the multi-type users in ubiquitous electric internet of things;
- (4) 5G communication in ubiquitous electric internet of things and theory for the kinetic optimization in network resource;
- (5) Application of random game and optimization for the dispersed energy in ubiquitous electric internet of things;
- (6) Theory and method for the edge-cloud synergic intelligence in the optimization of energy internet;
- (7) Theory and method for the multi-parameter sensing and intelligent perception in electronic devices;
- (8) Fine recognition and efficiency analysis for the non-invasion power utilization;
- (9) Fundamental theory and key technique for the competitive market for selling electricity;
- (10) Synergic control and stable operation of the AC/DC grid containing a large ratio of dispersed new energy source;
- (11) Theory and method for the short-circuit current after the high resource-network-load electronization;
- (12) Evolution mechanism for the malfunction in the AC/DC hybrid grid and new protection mechanism;
- (13) Composite insulation and performance adjustment for the high voltage DC devices;
- (14) Fundamental theory and key technique for the control of new DC power flow controller;
- (15) Characteristics of the surface structure and mechanism for the ablation resistance in the contact material used for the high voltage vacuum circuit breaker;

(16) Rheology behavior and extrusion theory for the cross-linked polyethylene used as the insulating materials in high voltage AC cables;

(17) Mechanism for the high reserves storage of hydrogen in solid state at room temperature.

Joint Fund for Nuclear Technology Innovation

The Joint Fund of Nuclear Technology Innovation is jointly set up by NSFC and the China National Nuclear Corporation. The Fund is aimed to give full play of the guiding role of the National Natural Science Fund, attract and mobilize researchers across China, strengthen basic research on leading technologies that meet the national strategic need of nuclear technology, promote the sustainable development and the improvement of independent innovation capacity of the nuclear industry.

In 2020, the Joint Fund of Nuclear Technology Innovation is going to support a number of Key Projects in the following 37 priority areas. Average funding (direct costs) for each project will be 2.8 million for 4 years. The funding period is from January 1, 2021 to December 31, 2024.

1. Properties of laser-induced ultra-short pulse neutron source (A05)

Epithermal electron acceleration mechanism, the theoretical simulation of neutron source properties, the ultra-short pulse neutron generation mechanism and diagnosis technology.

2. Microcosmic theory and experiment of important neutron induced light nucleus reaction (A05)

Computing method of few-body nuclear reaction based on the three-body Faddeev equation; light nucleus reaction theory based on micro Gamow shell model; macroscopic integral experiments of key light nucleus data.

3. Physical mechanism of reducing the pressure drop of liquid cladding based on the MHD effects on turbulent flow (A05)

Influences of the turbulent state of the magnetic fluid on the pressure drop and velocity distribution in the pipeline under the condition of strong magnetic field, and the physical mechanism and method of reducing the pressure drop by using MHD effects on turbulent flow.

4. Theory and experiment of unstable nuclear reaction mechanism (A05)

Mechanism of transfer reactions and fragmentation and spallation reactions in the unstable nuclear reaction; the energy level properties of the excited states of the unstable nuclear reaction products; the detector array technology with large solid angle coverage.

5. Multi objective intelligent optimization method and noise analysis for reactor physics calculation (A05)

Large-scale multi-objective combinatorial optimization method for reactor core; intelligent optimization method for reactor overall shielding under complex constraints; reactor neutron noise dynamics mechanism.

6. Heat transfer and nuclear thermal mechanical coupling characteristics of high temperature heat pipe of solid reactor core (A05 or E06)

Multi physical-field coupling analysis method of solid reactor core under dynamic

geometry condition; heat transfer properties of high temperature heat pipe; thermal mechanical coupling characteristics of solid reactor core.

7. Transient flow and heat transfer characteristics of the reflood phase in rectangular narrow channel of reactor core (A05 or E06)

The flow characteristics and evolution pattern of precursory cooling area and quench front in the reflood phase in the rectangular narrow channel; the influence of the micro behavior of the solid-liquid-gas phases near the wall on the rewetting and quenching characteristics of the rectangular narrow channel; the key physical model and numerical analysis of the heat transfer process of the reflood phase in the rectangular narrow channel.

8. Dynamic damage mechanism of the supporting structure of nuclear power system and quasi-zero stiffness vibration and noise reduction technology (E05)

Mechanism of dynamic brittleness and crack propagation of supporting materials of nuclear power system; the mechanism of implosion of alloy supporting structure of nuclear power system; the vibration isolation technology of quasi-zero stiffness six-degree freedom structure.

9. Damage mechanism and fault tolerance mechanism of temperature sensor in reactor compound field (A05, E02, E05 or E13)

Damage mechanism of temperature sensors under the strong neutron and strong gamma compound field of the new high temperature reactor; the construction method of the wide range temperature field of the high temperature reactor core; the fault tolerance mechanism of the temperature-field data based on neural networks.

10. Influence of impurities and defects in wide-bandgap semiconductor materials on detector performance (A05, E02 or E13)

Influence of defects in boron nitride materials on the detector performance; the influence of doping ions and defects on the luminescence of (Ga/In) doped zinc oxide semiconductor; the irradiation response and surface emission characteristics of charged particles of (Ga/In) doped zinc oxide semiconductors.

11. Stability of beam with X-band accelerator structure (A05)

Beam dynamics of the high-flux short-pulsed X-band accelerator structure; transverse wakefield suppression method of the X-band accelerator structure; high gradient accelerating field stability.

12. Cosmic ray muons detection and imaging method (A05)

The interaction mechanism between cosmic ray muon and matter; the study on the trajectory of the muons as they penetrate materials; the time fitting and image reconstruction methods.

13. The complex heat transfer mechanism of high temperature gas cooled reactor (HTGR) core (A05 or A06)

The high temperature radiation heat transfer pattern, mechanism and coupling characteristics of pebble-bed HTGR core: microscopic heat transfer pattern of HTGR core; coupling mechanism and contribution of complex multi-field heat transfer system; characteristics, equivalence, test method and calculation of high temperature radiation heat transfer.

14. Dynamic performance of viscoelastic composite thin shell (E05)

Viscoelastic model of composite materials; modal characteristics of viscoelastic circular tube of composite materials; stability of viscoelastic circular tube of composite material under long time and high stress state.

15. Interface behavior and radiation damage behavior of the coating on the surface of accident tolerant fuel cladding (E01, E02 or E13)

The stability, compatibility and physical properties of the interface between the zirconium-based cladding and the coating; the influence of neutron radiation and thermal shock on the thermodynamic properties of the coating; the radiation damage behavior and irradiation stability of the coating; the in-situ characterization of the synergistic effect of displacement damage and hydrogen-helium behavior under the condition of multi-field coupling.

16. Micro-scale damage mechanism and macro and micro-scale performance of ceramic nuclear fuel (E02 or E13)

The damage mechanics of ceramic nuclear fuel; the evolution mechanism of micro defects in the damage process and the micro physical mechanism in the damage process; the simulation of the micro process and macro responses of materials under different loading conditions at the atomic and molecular scales.

17. Preparation of high entropy alloy coating in Pb-Bi and the adaptability of Pb-Bi based environment (E01)

Preparation technology of high-entropy alloy film on the surface of ferrite/martensitic steel; mechanism of film structure evolution and strengthening and toughening; structure characteristics and bonding properties of film-based interface in Pb-Bi based environment.

18. Fretting corrosion mechanism and behavior characteristics of PWR rod cluster fuel assembly (E05)

The corrosion mechanism of fuel rods and support structure in PWR; the behavior characteristics of fuel rod vibration and the interaction between the fuel rods with the support structure; the analysis technology of fuel rod fretting corrosion.

19. Mechanism and method of airborne thermal infrared hyperspectral quantitative lithology identification for uranium exploration (D01, D02 or D04)

The temperature and emissivity separation technology of different phase airborne thermal infrared hyperspectral data; the model of quantitative content estimation of silica, feldspar and other minerals based on airborne thermal infrared hyperspectral data; the mechanism and method of quantitative lithology identification based on airborne thermal infrared hyperspectral data.

20. Radioisotope separation mechanism based on new isotope separation materials (A05)

The isotope separation mechanism and functional modification of new isotope separation materials; the adsorption behavior and mechanism of new isotope separation materials toward Lu-177 and Yb-176; the separation performance of new isotope separation materials toward Yb-176 and Lu-177.

21. Performance and mechanism of extraction and separation of actinide, strontium, and cesium ions by new ligands in post-treatment solution (B06 or E04)

New ligands for the extraction and separation of actinide, strontium, cesium ions from nitric acid medium; new ligands for the separation and mutual separation of trivalent Ln-An group.

22. Process and mechanism of electron gain and loss of radioactive solution components caused by radiation (B06)

Numerical relationship between the absorbed dose of radiation and the

decomposition rate of components of radioactive solution and its simulation; analysis of the changes in Re (Tc) and Ru valence state and species; the valence states and forms of iodine in the gas, liquid and solid phases in the post-treatment process.

23. Study on the volatilization or deposition behavior of actinides and key fission product elements in glass melts (B06)

The gas-liquid/solid two-phase distribution and form of volatile elements; the aggregation behavior and form of precious metals; the distribution and form of lanthanide and transition metal elements.

24. Performance and mechanism of the separation of actinides and fission gases by new solid-phase separation materials (B06)

The structure-activity relationship and mechanism of advanced materials such as MOF and COF for the separation of actinide and fission product elements; and the structure-activity relationship and mechanism of two-dimensional layered nanocomposites for the separation of actinide and fission product elements.

25. Migration and mass transfer mechanism of water solution in surrounding rock fracture under multi-field coupling conditions (D02)

The mechanism of mass transfer via medium in surrounding rock fractures under multi-field coupling conditions; and radionuclide migration mechanism in rock fractures.

26. Radiation damage mechanism and damage assessment method of new photoelectric devices such as CCD and light-emitting diodes (A05)

Displacement damage mechanism of CCD in a radiation environment; damage effect assessment method for CCD in a radiation environment; displacement damage mechanism of LED in a radiation environment; damage effect assessment method of LED in a radiation environment.

27. Non-equilibrium sorption mechanism of radionuclide migration in the environment (D02, D03 or D07)

The change of radionuclide species in different environments; the non-equilibrium sorption characteristics of storage mediums for different species of radionuclide; the coupling model of radionuclide migration by non-equilibrium sorption.

28. Dynamic transfer behavior of C-14 and I-129 of airborne effluents in plants (B06)

The transfer and absorption of C-14 and I-129 of airborne effluents in plants; the dynamic model and key parameters of the air-plant transfer of C-14 and I-129.

29. Metakinetis and biophysical mechanism of transuranic nuclides in vivo (B06)

The metabolism of transuranic nuclides in vivo; the biophysical mechanism of internal exposure of transuranic nuclides.

30. Formation characteristics and behavior of radioactive aerosols (B06)

Generation mechanism and particle size distribution of transuranic nuclide aerosols in workplace; new technology for measuring the activity and concentration of transuranic nuclide aerosols; the deposition pattern of Cs (cesium) and Sr (strontium) aerosols under different meteorological conditions; enrichment and migration of Cs and Sr aerosols in plants.

31. Health effects of long-term low-dose irradiation and its biological mechanism (B06)

The establishment of epidemiology database of the population exposed to low-dose

radiation and analysis of the relations between low-dose exposure and health risks; the health effects and mechanism of low-dose radiation on blood system or immune system.

32. Coupling mechanism of physical-chemical flow fields of in-situ leaching uranium mining in deep sandstone-type uranium deposits (D02 or D03)

Physical and chemical properties of deep sandstone-type uranium ore; methods and mechanism of reservoir reconstruction of deep low-permeability sandstone-type uranium deposits; coupling mechanism of the seepage field, the disposal field and the leach field during the in-situ leaching of deep sandstone-type uranium deposits.

33. Mechanism of uranium/rare earth-associated mining resources and mechanism of processing and smelting polymetallic ores (D02)

Test and extraction of genetic characteristics of uranium/rare earth-associated polymetallic ores; factors and mechanism affecting mineral separation and leaching outcome; the influencing factors and mechanism of the separation and extraction of useful metals from complex leaching solution of polymetallic ore.

34. The vertical migration mechanism of Radon in sandstone-type uranium deposits (D02 or D03)

The occurrence state and distribution of uranium, radium and radon in the surface cover of sandstone-type uranium deposit; the vertical migration of radon in sandstone-type uranium deposit and the mechanism of abnormal mineral characterization of radon in sandstone-type uranium deposit.

35. The vertical migration mechanism of uranium and associated elements in sandstone-type uranium deposits (D02 or D03)

The occurrence state and distribution of uranium and its associated elements in the surface cover of sandstone-type uranium deposits, the vertical migration mechanism and regularity of uranium and its associated elements, and the influencing factors of abnormal mineral characterization.

36. The irradiation damage mechanism of reactor pressure vessel/fuel assembly components produced by 3D printing (A05)

The damage mechanism and defect evolution of 3D printed reactor pressure vessel/fuel assembly during irradiation; and the influences of irradiation defects on the mechanical and thermodynamic properties of 3D printed reactor pressure vessel/fuel assembly components.

37. The plastic deformation mechanism and processability of N36 zirconium alloy (E04 or E05)

The influences of plastic deformation and heat treatment on the texture and second phase of N36 Zr alloy strip and the underlying mechanism; the mutual solubility, wear and failure mechanism under continuous high-speed impact; the influences and mechanism of the hedge process and process parameters of N36 strip structure.

NSFC-Guangdong Joint Fund

The third phase of the NSFC-Guangdong Joint Fund is jointly established by NSFC and the People's Government of Guangdong Province (NSFC-Guangdong Joint Fund) from 2016 to 2020. It aims at giving full play to the guiding role of NSFC, attracting and

gathering outstanding scientists all over the country, solving the major S&T issues and key technology problems concerning the strategic development of economy, society and science and technology in Guangdong Province and its surrounding areas. It tries to promote the development of science and technology and build up the team of talents in Guangdong Province, enhance the independent innovation capability and international competitiveness of universities and research institutes in Guangdong Province, and promote the sustainable development of economy and society of Guangdong Province.

NSFC-Guangdong Joint Fund calls for proposals of Key Project or Integration Project in 2020. Key Project provides an average direct funding of 3 million yuan per project for four years; integration Project provides an average direct funding of 14 million yuan for four years. Any eligible scientists and technicians across the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Integration Projects

i. South China Sea-oriented information sensing and communication fusion optical network

On the basis of new undersea cable network, proposals should carry out a new generation of communication and information sensing intelligent optical cable research, explore new undersea optical cable communication mechanisms and technologies, expand the ability of undersea optical cable sensing and perception of surrounding physical information, and look for ways to integrate sensors in undersea optical cable transmission systems. Proposals should study the principle and technology of optical cable sensing information and the technology of submarine signal transmission in the complex environment of the ocean floor, propose and implement a solution for the efficient multiplexing transmission of sensor signals and communication signals in the optical cable. And realize the application of new optical cable transmission technology in marine communication and information perception, show the large-capacity, secure optical communication and sensing integrated system based on smart optical cable, in order to master the core technology of large-capacity information transmission and perception of marine physical information on submarine optical cable and lay the foundation for their application. Main research areas include:

1. Physical state sensing and disturbance field detection based on submarine communication cable

Proposals should explore new methods of using existing submarine communication optical cables and networks to realize the physical state of the optical cables and detect the surrounding disturbed physical fields, develop new theories and methods for the efficient transmission and acquisition of physical ocean information; study the comprehensive sensing methods of physical state information such as distributed vibration, temperature, and strain based on existing submarine optical cables, and overcome the long-distance, high spatial resolution, high sensitivity, continuous parameter measurement of undersea optical cable distributed detection technology to achieve the monitoring of physical status of submarine cables, undersea seismic observation and marine large-scale biological monitoring.

2. Optical performance monitoring of submarine optical networks

Proposals should study the low-cost and fast monitoring methods for optical performance of submarine communication cables, develop monitoring technologies that accurately evaluate the optical power, wavelength, and dispersion performance of deep-sea communication cables; explore the changing mechanism and monitoring technology of optical performance parameters of the submarine optical network; study optical performance monitoring equipment based on blind estimation and/or training sequences; study the application of optical performance monitoring in the submarine optical network.

3. Key devices and technologies for submarine high-speed chaotic optical communication

Proposals should study the principle and system design of high-speed chaotic communication based on submarine optical cables, explore the technology of Gbps key generation and distribution based on hardware encryption, and study the structure and design of high-speed optical transceiver modules with large key spaces.

4. Information Transmission, Sensing and Signal Processing in Submarine Optical Cable Space Division Multiplexing System

Proposals should study the high-speed and large-capacity backhaul technology of the communication and sensing signals of the undersea optical cable, study the space division multiplexing technology of the undersea smart optical cable, and analyze the communication and sensing utilities that support large capacity, long distance, low power consumption, high sensitivity and accuracy optical fiber technology, research on new optical fibers and new devices that support the new air-division/analog-division communication sensor fusion system; study the digital signal processing technologies for the new air-division/analog-division communication sensor fusion system.

Integration Project should include the above-mentioned four research aspects, carry out in-depth and systematic research focusing on the project theme of "South China Sea-oriented information sensing and communication fusion optical network", and research results should include principles, methods, technology, devices as well as patents.

ii. Research on Key Materials and Basic Scientific Problems for Emergency Protection

In line with the major needs of emergency response and public safety, proposals should carry out research on basic scientific issues of key materials for emergency protection, develop nanocellulose-based high-efficiency filter materials, biomass-based adsorption materials, and multifunctional composite paper-based materials, explore effective methods for improving the efficiency of material protection, integrated assembly, and recycling, reveal the mechanism of competition and suppression of pollutants in materials, establish methods for the evaluation of materials, and solve common basic scientific problems of key materials for emergency protection. Main research areas include:

1. Preparation technology and performance regulation of nano cellulose filter material

Proposals should research on high-efficiency nanocellulose filter material for nuclear biochemical aerosol, explore the controllable nanometerization and surface interface control method of cellulose, and the preparation method of air filter material with high filtration efficiency and low resistance, reveal the mechanism of nanometer size effect, slip flow effect and stacking mode, and establish the filtration theory and effective protection mechanism of nanocellulose composites for aerosols.

2. Construction and structure of new adsorption materials and regulation of its performance

Proposals should study the high-efficiency biomass porous carbon adsorption materials for chemical poisonous gas, explore the microstructure control methods of biomass porous carbon materials, study the principles and methods of surface modification and interface regulation of porous materials, clarify the interaction mechanism between materials and harmful gases, break through the key methods to increase adsorption capacity and selectivity, and establish the theory of material adsorption on harmful gases.

3. Preparation and in situ regeneration of paper-based composite materials for emergency protection

Combining the above research results, proposals are expected to, through the directional structure design and modern engineering technology, realize the preparation of paper-based composite protective materials with high efficiency, high selectivity, high stability, and long service life. Proposals should study the method of solving the contradiction between selectivity and broad-spectrum protection through the integrated assembly of multiple layers of different functional materials and achieve a method for unified function, and explore effective ways of in-situ regeneration of paper-based composite materials, and reveal the in-situ detoxification mechanism of pollutants.

4. Multi-pollutant competition inhibition mechanism and integrated protection system

Proposals should study the types and components of pollutants in emergency protection applications and the effects of multi-pollutant competition and suppression mechanism on the performance of materials, and reveal the competition and suppression mechanisms of pollutants. Proposals should develop a small space pollution generation platform for experiments that simulates typical emergency situations, and explore the synergy of environment, materials and pollutants in a variety of application environments.

Integration Project should include the above-mentioned four research areas, carry out in-depth and systematic research focusing on the project theme of "Research on Basic Scientific Issues of Critical Materials for Emergency Protection", and research results should include principles, methods, technology, devices as well as patents.

II. Key Supporting Project

i. The intelligent Information Processing and New Generation Communication

1. Research on streaming media and brain-like intelligent processing

Proposals should focus on common scientific issues such as streaming media and brain-like intelligent processing, system learning and decision-making, and exploring complex artificial intelligence problem solutions from the perspective of cognition and information processing, research on media security, information cognition, and system decision-making research theories and methods. Main research areas include:

- (1) Video perception and tamper detection theory;
- (2) Key technologies for brain-like information recognition and learning;
- (3) Intelligent decision theory and method of the system;
- (4) Large-scale data-driven machine learning theory and method.

2. Research on Key Technologies of Future Communication Networks

In response to the needs of 5G and future communication networks featuring high

speed, security, and efficiency, proposals should study the core issues of network technologies, communication technologies, and information processing technologies for next-generation networks. Main research areas include:

- (1) Low-latency high-security IoT technology;
- (2) Network Cognition and Mobile Computing Theory;
- (3) Key technologies for future communication antennas and networking.

3. New Generation Information Processing Technology

Focusing on the requirements of Guangdong Province in information processing technology, proposals should carry out research on the new generation of information processing technology such as graphic image information calculation, group intelligence network system, system game and decision, network intelligent analysis and calculation.

Main research areas include:

- (1) Key technologies for graph sensing and coupled computing;
- (2) Group intelligence network system and information security technology;
- (3) System game and key technology decisions;
- (4) Intelligent computing and public opinion analysis methods and technologies.

4. Machine perception, control, and decision

Focusing on hot research issues such as intelligent perception, the Internet of Things, and robots, proposals are expected to carry out research on key technologies such as robotic vision and hearing, and optimization of machine systems, improve Guangdong Province's research advantages in areas such as intelligent manufacturing, smart medical treatment, and ocean exploration, and provide a theoretical support for promoting industrial upgrading.

Main research areas include:

- (1) Visual and auditory perception and understanding of robots;
- (2) Theory and method of optimal decision in unmanned machine system.

5. Optical communication, mass storage and chip technology

Proposals are expected to study the relevant basic theory and key technology research on the core issues and application requirements of information perception, information transmission, signal perception, information storage, and smart chips.

- (1) Highly reliable and large-scale information perception technology;
- (2) Low-loss fiber preparation and sensor network technology;
- (3) Low power consumption and ultra-high density storage technology;
- (4) New high-speed and safe smart chip technology.

ii. Advanced materials and intelligent precision manufacturing

1. Photoelectric conversion materials and new energy materials

Proposals are expected to focus on the development needs of the new generation of information technology and new energy, carry out related research on photoelectric conversion materials, high-efficiency hydrogen energy materials, battery materials and devices, establish new theories, new mechanisms, new methods, and new processes to achieve the overall improvement of material performance. Main research areas include:

- (1) Material basis for efficient and safe use of hydrogen energy;
- (2) Key materials and interface control mechanisms for high-efficiency solid-state batteries;
- (3) Frontier exploration of new principles of photoelectric conversion materials and devices.

2. High-performance building materials/coating materials

Proposals are expected to focus on sustainable development needs in the areas of green construction, resources and environment, and marine engineering in the Guangdong-Hong Kong-Macao Greater Bay Area, carry out basic and applied basic research on high-performance green building materials, multi-functional coating materials, and ecological energy-saving preparation technologies to establish new methods, new theories, new mechanisms and new technologies for high performance and multifunctional green building/coating materials. Main research areas include:

- (1) High-performance building materials and structures of solid waste composite-based geopolymers;
- (2) Cement-based 3D printed building materials;
- (3) A new generation of new architectural coating materials.

3. Biomedical materials

Proposals are expected to focus on the development demand for new-generation biomedical materials in terms of safety and environmental protection, carry out in-depth research on anti-biomaterials, 3D printed tissue regenerative medical engineering materials, and drug delivery biomedical materials, establish new theories, mechanisms, methods and processes to achieve the transformation and improvement of material properties. Main research areas include:

- (1) New anti-bacterial antibacterial and disinfection materials;
- (2) 3D printed bio-gels or rigid biomedical materials;
- (3) Drug delivery and delivery of biomedical materials.

4. Efficient Precision Manufacturing

Proposals are expected to carry out high-precision and efficient machining theoretical research about difficult-to-machine materials and complex feature parts involved in aerospace, artificial intelligence, driverless cars, large-scale integrated circuits, energy saving and new energy, and focus on revealing the coordinated regulatory mechanisms of process, structure and performance. At the same time, in combination with the new technology needs in the advanced manufacturing field in recent years, more in-depth research should be carried out in terms of multi-energy field special processing, surface strengthening, new additive manufacturing and other process mechanisms. Main research areas include:

- (1) Precision/ultra-precision machining mechanism for difficult-to-machine materials and complex feature parts;
- (2) Multi-energy field special processing and surface strengthening process mechanism;
- (3) New principles and processes for additive manufacturing.

5. Common key issues of intelligent manufacturing equipment

Proposals are expected to focus on the smart manufacturing equipment (including smart robots) that in urgent need of breakthroughs of technical barriers in the high-end manufacturing field, research on the precision manufacturing process mechanism and optimization design methods of key components for transmission, sensing, motion control and other functions. At the same time, in-depth research should be conducted on modeling, simulation and operation optimization methods of intelligent manufacturing systems, intelligent perception and intelligent decision-making methods of manufacturing processes, and online monitoring and fault diagnosis methods. Main research areas include:

- (1) Design and manufacturing theory and method for key components of intelligent manufacturing equipment;
- (2) Optimization algorithm and precise control of intelligent manufacturing system.

NSFC-Yunnan Joint Fund

The third phase of the NSFC-Yunnan Joint Fund is jointly established by NSFC and the Yunnan Provincial Government. It aims at maximizing the guiding role of the National Natural Science Fund, attracting and bringing together talented scientists across the country to carry out basic researches on important scientific issues and key technical problems that are closely related to the socio-economic and S&T development of Yunnan and surrounding regions, boosting the development of science and technology and the growth of scientific talents in Yunnan, improving the indigenous innovation capability and international competitiveness of universities and research institutes of Yunnan and promoting the sustainable development of regional economy and society.

In 2020, the NSFC-Yunnan Joint Fund calls for proposals of Key Project in the following priority research areas. Average funding (direct costs) for each project will be 2.4 million for 4 years. The NSFC-Yunnan Joint Fund is open to all researchers across China. Qualified researchers all over the country are welcomed to apply for this fund according to the research scope and requirements listed in this *Guide*.

I. Biodiversity conservation (L06)

i. Biodiversity

Proposals are encouraged to focus on the biological groups with distinctive characteristics in Yunnan and surrounding biodiversity hotspots, study the formation mechanism and adaptive evolution of species, population and the ecosystem diversity, biological resource protection, biological invasion and ecological security.

Priority research areas:

1. Exploration, evaluation and protection of important biological resources in Yunnan (C0101, C0206 or C0409)

Proposals are expected to carry out multi-level and in-depth rescue investigations on the diversity of important biological resources (such as animals, plants, fungi, lichens, algae, microorganisms, etc.) with distinctive characteristics in Yunnan, as well as utilization and evaluation of these resources; carry out research on the important genetic functions and metabolites of biological groups with distinctive characteristics, analyze the molecular mechanism and adaptive evolution mechanism of key traits; reveal and evaluate the potential application value of biological resources and provide a scientific basis for the exploration, protection and utilization of important biological resources.

2. Pattern and dynamics of biodiversity in Yunnan (C03101)

Proposals are expected to focus on biodiversity hotspots in Yunnan, South Asia, Southeast Asia and the mountainous areas of Yunnan, study the spatial and temporal characteristics of the formation and adaptation of biodiversity of typical biological groups in Yunnan, the formation process of important traits at the species and population level and their impact on speciation, and the coexistence mechanism of related species; clarify the

network structure of specialized and generalized species interaction on species coexistence and differentiation; study the biodiversity gradient distribution pattern and maintenance mechanism, the response mechanism of biodiversity to climate change, the relationship between biodiversity and ecosystem function from the multi-dimensional perspectives such as the species, the biological lineage, the functional traits and so on, so as to provide a scientific basis for the ecological protection of Southwest China and border areas and the development of the region under the Belt and Road framework.

3. Influences of biological gene flow on the formation and maintenance of biodiversity in the mountainous areas of Southwest China (C03101)

Proposals are expected to focus on the characteristics of biological population diversity in the mountainous area of Southwest China, study the influences of gene flow caused by outcrossing, inbreeding, mixing and horizontal gene transfer on the genetic diversity of species, analyze the contribution of gene flow to speciation and adaptation of species, advance the understanding of the occurrence and maintenance mechanism of species diversity, so as to provide a scientific basis for regional species diversity protection.

4. The impact of invasive species on biodiversity of Yunnan and invasive species prevention and control strategies (C03102)

Proposals are expected to systematically study the species and scope of biological invasion, biological invasion pathways and mechanism, and the influences of invasive species on the ecosystem; establish the quantitative evaluation index system and risk warning map of biological invasion; and provide a scientific basis for effective prevention and control of invasive species and the establishment of biological control measures under the Belt and Road framework.

ii. Agricultural and forest resources

In view of the demand of Yunnan's socioeconomic development, proposals are expected to focus on important agricultural and forest resources in Yunnan, and conduct research on exploration and utilization of key genes of germplasm resources, pest/disease control and prevention, the sustainable development of agricultural and forestry ecosystem, formation and regulation of good traits of agricultural and forestry food with distinctive characteristics.

Priority research areas:

1. Exploration and utilization of genes of key traits of important agricultural and forestry biological resources with distinctive characteristics in Yunnan (C1304, C1305, C1501, C1502, C1503, C1504, C1506, C1702 or C1703)

In view of the development demand of modern agricultural industry with distinctive characteristics of the Yunnan Plateau, proposals are expected to focus on the main crops (rice, corn, tuber crops, wheat, beans, sugarcane, rape, etc.), characteristic crops (tea, flowers, vegetables, fruits, nuts, coffee, traditional Chinese medicine, industrial marijuana, etc.), characteristic livestock and poultry (pig, chicken, cattle, sheep, etc.), insect resources, and microbial resources, identify and utilize the genes of important traits and functional components, study the formation mechanism of important quality, and provide theoretical basis and germplasm resources for the development of characteristic agricultural industry with distinctive characteristics of the Yunnan Plateau.

2. Disaster mechanism and prevention and control strategy of important pests in agriculture and forestry in Yunnan (C1401, C1402, C1609, C1802 or C1804)

Proposals are expected to focus on important pests (fungi, oomycetes, viruses, nematodes, bacteria, weeds, injurious insects, especially the fall armyworm and borers) of agriculture and forestry in Yunnan, study the damage mechanism, disaster reduction mechanism, and biological control mechanism of pest damage to the agroforestry ecosystems; or focus on the harmful pathogens (African swine fever, toxoplasma gondii, cattle tuberculosis, bird flu, porcine reproductive and respiratory syndrome, porcine circovirus diseases and etc.) that seriously threaten the health of animals, study their population distribution, epidemic transmission, pathogenic mechanism, and the mechanism of their transmission between animals and human, and provide the theoretical basis for the prevention and control of important agriculture and forestry pests in Yunnan

3. Functions and the functional mechanism of important agroforestry ecosystems in Yunnan (C0306)

Proposals are expected to focus on Yunnan's important agroforestry ecosystems and provide the theoretical basis for the function maintenance and restoration of important agroforestry ecosystems in Yunnan. Topics includes: the ecological adaptability mechanism of agroforestry biological resources based on the interactions of crop, soil, and microorganisms; the effects of rhizosphere microorganisms, allelochemicals, and the environment on the continuous cropping obstacles; and the environmental effects and mechanism of no-till farmland ecosystem of perennial crops (fruit tree, tea, rubber, sugarcane, perennial rice, etc.).

4. Quality formation and control mechanism of agricultural and forestry products with distinctive characteristics of Yunnan (C2005)

Proposals are expected to focus on the quality and flavor formation in food processing, active factors, and usage discovery of agricultural products with distinctive characteristics of Yunnan and provide the theoretical basis for the development of green food industry in Yunnan. Topics include: the basic research on the change of chemical composition and flavor formation, the transformation and regulation of active factors, the change and regulation of microorganisms, and the control of food safety in the processing of agricultural products with distinctive characteristics.

II. Resources and environment (L03)

i. The formation mechanism of Yunnan's dominant mineral resources and the environmental effect of mineral resource exploitation

Priority research areas:

1. The metallogenic theory and new exploration method of mineral resources with distinctive characteristics of Yunnan (D02 or D03)

Yunnan has a unique geological structure, which forms unique large-scale and super large-scale ore deposits, featured by scarce minerals and strategic minerals, and corresponding metallogenic systems. Proposals are expected to explore the universality and uniqueness of Yunnan's metallogenic system, reveal the internal structure and genesis of the metallogenic systems with different geological structural background, establish models for the prediction and exploration of deep minerals, and provide the scientific basis for the increase of resource reserves.

2. Environmental effects and pollution control of mineral resource exploitation in Yunnan (D07)

The exploitation of mineral resources represented by nonferrous metals and phosphate ores and pollution caused in the process are the prominent problems threatening the ecological environment of Yunnan. Proposals are expected to combine the environmental problems of the mining area left over by history with regional ecological problems, study the pollution mechanism and ecological effect of toxic and harmful metal elements and phosphorus loss in typical mining areas, analyze the coupling mechanism of regional ecological restoration and pollution prevention and control, and provide theoretical guidance for pollution control in mining areas.

ii. Environmental evolution and its ecological effect

Priority research areas:

1. Evolution of the earth environment in Yunnan and biological responses to the evolution (D01, D02 or D07)

Yunnan is located in the southeast edge of the Qinghai-Tibet Plateau, and the evolution of the earth environment determined the biological diversity of Yunnan and the relations between human and land. Proposals are expected to study the changes of global environment in the history, explore the changes of paleoenvironment and their impact on biological diversity and early human activities, and provide the scientific basis for the adaptation of living creatures and human society to global changes.

2. Occurrence mechanism, monitoring, early warning, prevention and control of major natural disasters in Yunnan (D02, D05 or D07)

Special geological, geographical and climatic conditions of Yunnan lead to frequent natural disasters. Proposals are expected to study the induced factors, disaster mechanism, monitoring, early warning and prevention of meteorological disasters, floods, earthquakes, landslides, mudslides and forest fires, and provide scientific basis for disaster reduction and prevention in Yunnan.

iii. Environmental restoration and management

Priority research areas:

1. Environmental effect and regulation of agricultural production process in Yunnan (D01 or D07)

The high background value of harmful elements is a serious problem of Yunnan. Due to the poor management of chemical fertilizers and pesticides, agricultural production is facing severe environmental safety problems. Proposals are expected to study the mechanism and environmental effect of the migration and enrichment of toxic and harmful elements in farmland, the environmental effect of pesticides and fertilizers, and search for new approaches of different agricultural production processes and straw resource utilization.

2. Ecological restoration of vulnerable ecosystems in Yunnan (D01 or D07)

Yunnan is located in the upper reaches of six major rivers and is a key spot of the ecological barrier between China and South/Southeast Asia. In order to provide theoretical guidance for the restoration of fragile ecosystems, proposals are expected to study the degradation process of fragile ecosystems and its impact on water environment in Yunnan, and reveal the main environmental control factors and mechanisms of different restoration methods.

iv. The key ecological environment problems in Yunnan and their responses to climate change

Priority research areas:

1. Ecosystem service functions and maintenance mechanism of main river basins in Yunnan (D01)

Yunnan is located in the upper reaches of several major rivers and has an important ecological location and outstanding ecosystem service functions, which is the basis for maintaining the economic and social development of Yunnan and surrounding areas. Proposals are expected to study the ecosystem service functions and maintenance mechanism, analyze the ecological contribution of the upstream ecological protection to the downstream area, and lay the foundation for the upstream ecological environment protection and the building of an eco-compensation mechanism.

2. Response and feedback of Yunnan ecosystems to climate change (D01 or D05)

In the context of global climate change, different types of forestry ecosystems in Yunnan have shown new changes. Proposals are expected to analyze the characteristics and ecological effects of moisture change of typical ecosystems in Yunnan, establish the response model of Yunnan forestry ecosystems to global changes; study the carbon sink effect of main forestry ecosystems in Yunnan, reveal the response mechanism of forestry ecosystems to environmental changes, and provide a scientific basis for decision making related to carbon emission reduction.

III. Comprehensive utilization of mineral resources and new materials (L07)

To meet the development demand of new material industries in Yunnan, proposals are expected to focus on theory, methods and cutting-edge technologies and key scientific problems in the green utilization of advantageous mineral resources and typical secondary resources.

i. Green development and utilization of complex non-ferrous mineral resources and secondary resources

Priority research areas:

1. New methods of green beneficiation and smelting of low-grade associated mineral resources in Yunnan (E04)

To meet the major demand for green development of low-grade associated rare earth, tin, aluminum, copper, lead and zinc resources in Yunnan, proposals are expected to focus on new green beneficiation and smelting technologies for complex non-ferrous metal mineral resources, develop the basic theory of new green beneficiation and smelting technology, explore new methods of green beneficiation and smelting of aluminum, copper, tin, lead and zinc and their associated non-ferrous metals, so as to provide the theoretical and technical basis for green development and utilization of mineral resources.

2. Utilization and harmless treatment/resource utilization and source reduction of solid wastes in beneficiation and smelting of mineral resources (E04 or E10)

Proposals are expected to focus on the key technical problems in the recovery and utilization of a large number of wastes containing valuable metals and non-metals generated in the mining and smelting of mineral resources in Yunnan, conduct basic research on the recycling technology of wastes from the beneficiation and smelting of aluminum, copper,

lead, zinc, tin, germanium and silicon, realize the recovery and utilization of valuable metals and their intermediate wastes, and reduce the impact on the environment.

3. The green and efficient utilization of secondary rare and precious metal resources in Yunnan (E04)

To solve the shortage problem of rare and precious metal resources in China and make full use of the technical and industrial advantages of Yunnan in terms of the recovery and utilization of secondary rare and precious metal resources, proposals are expected to study the new mechanism and new technologies on the green recovery of secondary rare and precious metal resources, and provide theoretical and technical support for the clean, efficient enrichment and extraction of rare and precious metals.

ii. New materials and devices

Priority research areas:

1. New energy materials and devices (E01, E02, E03, E06 or E13)

Proposals are expected to utilize the advantageous resources of Yunnan, focus on the basic research of new photoelectric materials, new energy battery materials, new energy storage electrode materials and their applications; solve scientific problems such as material design and structure, the light-heat-electricity conversion properties and surface interface effects of, and the temperature stability of new materials, and improve the energy conversion and storage efficiency of new materials.

2. The high performance multi-purpose gas sensing materials and devices (E01, E02, E03, E04 or E13)

To meet the demand of environment protection, pollution gas detection and the development of applicable gas sensors, proposals are expected to study the micro mechanism of gas sensors, explore the influences of material structure on gas sorption, electron transmission and gas sensing performance, solve the key scientific problems of high-performance multi-purpose sensor materials and devices that can detect a variety of toxic and harmful gases at the same time, so as to provide new methods, materials and devices for the high-sensitivity and high-selectivity real-time detection of toxic and harmful gases.

3. The design, preparation and application of nonferrous metal functional materials (E01, E04 or E13)

Proposals are expected to focus on the design and preparation technology of rare and precious metal electrical contact materials, and provide theoretical guidance for the component design optimization and key preparation technology of new materials. Topics include: the design, thermodynamic calculation and phase diagram construction of electrical contact alloy materials; the structure-activity relationship of material composition, microstructure, processing and performance; the establishment of material parameter database.

4. The design, preparation and application of high-strength and high-conductivity metal matrix composite (E01, E02 or E04)

Proposals are expected to focus on the basic research of component compatibility, bonding characteristics, scale and composite effect of metal matrix composite, explore the internal relations between the bonding mechanism of composite interface and the strengthening and toughening mechanism, set up the composite structure models, study the micro mechanism of in-situ reaction and solid-state phase transformation in the preparation

process, and the structure-activity relationship between the mechanical and electrical properties and the microstructure of high-strength and high-conductivity metal matrix composite.

IV. Population and health (L02)

i. Basic researches on discovery of active substances and development of vaccines aiming at major human diseases using medicinal resources with distinctive characteristics in Yunnan

Priority research areas:

1. Discovery, formation mechanism, structure optimization, function and pharmacological mechanism of active substances of biological resources with distinctive characteristics in Yunnan (H30)

Priority will be given to interdisciplinary research and research on mechanism of action, or application of new theories, technologies and methods. However, research on the pre-approval standardization and pharmaceutical process of new drugs is not qualified for funding. Proposals are expected to focus on in-depth study of the structure, function, molecular transformation and action mechanism of active substances based on the specific interaction mechanism between active molecules and targets, especially the natural active products from Yunnan's characteristic biological resources with a good basis of previous research.

2. Vaccine innovation and candidate drugs based on experimental animal resources with distinctive characteristics in Yunnan and pathogens of cross-border diseases (H19)

Proposals are expected to select safe and effective bacteria and strains based on subcultured pathogens, identify immune protective antigens and virulence related genes, and pave the way for the development of innovative vaccines with independent intellectual property rights. Priority will be given to in vivo passage of bacteria and virus strains using Yunnan's unique experimental animals, as well as the assessment of the immune protective effect and safety of vaccines. The joint fund also encourages applied basic research of innovative vaccines and new drugs that has a good previous research basis, promotes academic-industry collaboration, and can substantially contribute to human health.

3. Effectiveness, material basis and pharmacological mechanism of ethnic medicine and Chinese traditional medicine with distinctive characteristics in Yunnan (H28)

Priority will be given to interdisciplinary cooperative research using multidisciplinary theories, methods, techniques and means based on the theory and practices of traditional Chinese medicine including ethnic minority traditional medicine, especially the use of new technologies and methods to explain the effectiveness of Yunnan's ethnic traditional medicine and traditional Chinese medicine. Proposals are expected to conduct in-depth basic research on the standard varieties, material basis, pharmacological mechanism and efficacy of traditional Chinese medicinal materials and decoction pieces, and ethnic minority traditional medicine such as single prescription, famous prescription, clinical prescription and hospital preparation.

4. The conservation and sustainable utilization of medicinal animals and plants with distinctive characteristics in Yunnan (H28)

Topics include: the introduction of traditional Chinese medicinal animals and plants in Yunnan; the selection and breeding of excellent medicinal materials; the establishment of standardized breeding techniques; the discovery of alternative resources; and the further study of new technologies and methods for regulating the content of medicinal ingredients.

ii. The pathogenesis, prevention and treatment of high-incidence diseases and major diseases in Yunnan

Priority research areas:

1. Researches on high-incidence diseases, endemic diseases, genetic diseases, drug addiction and withdrawal in Yunnan (H)

Topics include: the epidemiological characteristics and pathogenesis of the high-incidence diseases, endemic diseases, genetic diseases, and drug addiction; the molecular mechanism of the occurrence and development of the high-incidence diseases, endemic diseases, genetic diseases, and drug addiction; key therapeutic targets, early diagnostic markers, prognostic factors and drugs; and translational medicine research from laboratory to clinical practice.

2. The pathogenesis, prevention and treatment of insect borne tropical diseases and major infectious diseases in Yunnan and cross-border regions (H19)

Topics include: basic biological and basic medical research on the pathogenesis and comprehensive control of insect borne tropical diseases and major infectious diseases that seriously threat Yunnan, Southeast Asia and South Asia subcontinent; the discovery of unknown or new pathogens based on pathogen vectors in close contact with people.

V. Sustainable development and regional cooperation of Yunnan and South Asia and Southeast Asia (G03 or G04)

In order to promote the sustainable development of Yunnan and South/Southeast Asia guided by the “golden principles” of extensive consultation, joint contribution and shared benefits, the Joint Fund calls for proposals that respond to the demand of building Yunnan into a hub radiating to South Asia and Southeast Asia, conduct basic, forward-looking and interdisciplinary research on key issues such as Yunnan’s economic cooperation with South Asia and Southeast Asia, scientific and technological innovation, industrial transfer to Yunnan and the high-quality development of Yunnan.

Priority research areas:

1. Key problems and breakthrough path of regional economic cooperation between Yunnan and South/Southeast Asia (G03001)

Topics include: the sustainable development of regional economic cooperation between Yunnan and South Asia and Southeast Asia and the driving mechanism for inclusive growth; the cooperation mechanism and sustainable development of green energy industry between Yunnan and South Asia and Southeast Asia; the implementation mechanism and coordinated optimization path of green supply chain between Yunnan and South Asia and Southeast Asia; the bottleneck of regional financial cooperation between Yunnan and South Asia and Southeast Asia, the realization mechanism and risk prevention of yuan regionalization; and the international production capacity cooperation mode and improvement strategy of regional value chain between Yunnan and South Asia and Southeast Asia.

2. Policies, mechanisms and paths of Yunnan in undertaking industrial transfer

(G03002)

Topics include: the advantages of Yunnan and South/Southeast Asia in undertaking industrial transfer under the background of industrial transformation and upgrading and industrial transfer from the eastern regions of China; the dynamic changes of Yunnan's comparative advantages and the reshaping of Yunnan's advantages in terms of industrial foundation, spatial location, development environment, etc.; the bottlenecks, obstacles and shortcomings of Yunnan in undertaking industrial transfer from the eastern region, paths to overcome these bottlenecks and shortcomings and supporting policy system; and the key areas, methods and two-way interactive mechanism of undertaking industrial transfer in Yunnan.

3. Mechanism to advance the science and technology cooperation between Yunnan and South/Southeast Asia (G0404 or G0405)

Topics include: the basis and existing problems of scientific and technological cooperation between Yunnan and South/Southeast Asia based on the characteristics of multi-national and multi-dimensional integration of Yunnan's scientific and technological impact and innovation facing south Asia and Southeast Asia; the level and regularity of scientific and technological development of South/Southeast Asian countries, demand and influencing factors of scientific and technological cooperation, and the innovation mechanism and path of cooperation; the mechanisms and trends of transnational transformation and application of scientific and technological achievements; the key areas of scientific and technological cooperation between Yunnan and South/Southeast Asia. The proposals are expected to provide theoretical support for the scientific and technological cooperation between Yunnan and South Asia and Southeast Asia.

NSFC-Xinjiang Joint Fund

The second phase of the NSFC-Xinjiang Joint Fund is jointly established by NSFC and the Peoples' Government of Xinjiang Uygur Autonomous Region for the period from 2016 to 2020 to implement the guidelines of the National Working Conference on Scientific and Educational Assistance to Xinjiang. It aims at making full use of the guiding role of the National Natural Science Fund, attracting and bringing together a number of talented scientists to work in Xinjiang, boosting the development of science and technology and the growth of scientific talents in Xinjiang, improving innovation capabilities of universities and research institutes in Xinjiang and promoting the sustainable development of Xinjiang's economy and society.

In 2020, the NSFC-Xinjiang Joint Fund calls for proposals of Fostering Project, Key Project and Special Grant for Local Young Talents in the following priority research areas. For Fostering Project, the average funding (direct costs) for each project will be 600,000 yuan for 3 years; for Key Project, the average funding (direct costs) for each project will be 2.8 million yuan for 4 years. Special Grant for Local Young Talents supports researchers with outstanding achievements in basic research in Xinjiang to conduct innovative research within the scope outlined in the *Guide*. It supports up to 2 local young researchers under the age 45 in each priority research area, with a funding of 900,000 yuan (direct costs) for 4 years. The NSFC-Xinjiang Joint Fund is open to all Chinese researchers. Qualified

researchers are welcomed to apply for this fund according to the research scope and requirements listed in the *Guide*.

I. Agriculture, biodiversity and biological resources (L10)

1. Agriculture

(1) The demand regularity and efficient utilization mechanism of water and nutrient of crops with distinctive characteristics in Xinjiang (C1510)

(2) Microbial transformation mechanism of straw returning and partial replacement of chemical fertilizer by organic livestock and poultry manure in Xinjiang (C1508)

(3) The mechanism of quality change and regulation in the process of storage, processing and circulation of famous fruits, vegetables and livestock and poultry products in Xinjiang (C2005 or C2006)

(4) Prediction and control of diseases and pests in agriculture (C1401, C1402, C1405 or C1406)

2. Biodiversity and biological resources

(1) The invasion, spread and migration of invasive species in Xinjiang and monitoring, early warning and prevention and control mechanism of invasive species (C03102)

(2) Genetic diversity, gene mining of important traits, stress resistance mechanism and development of new germplasm of biological resources with distinctive characteristics in Xinjiang (C1304)

(3) Evolution and classification of important biological communities in Xinjiang and Central Asia (C0402)

(4) Biodiversity and ecological function of biological crusts in desert soil (C03101)

(5) The diverse adaptation mechanism of desert plants in arid, saline, alkaline and barren environment (C02006)

(6) Microbial diversity in special environment of Xinjiang (C0101)

II. Ecological environment, water resources and mineral resources (L08)

1. Ecological environment (D01 or D07)

(1) The spatial-temporal pattern and driving mechanism of desertification in Xinjiang

(2) Ecological protection of major projects in desert area and the ecological restoration of degraded desert vegetation

(3) The structure, function and ecological process of the inland river basin ecosystem in arid areas

(4) The cycling process and efficient utilization mechanism of nutrients in degraded grassland ecosystem in mountainous areas

(5) Analysis and risk control of groundwater pollution in oasis

(6) The diffusion environment and prevention and control strategy of urban pollutants in Xinjiang

(7) The long-term influences of changes in water consumption pattern and irrigation mode on oasis ecological stability

(8) The impact of human activities on large wild animals and wildlife conservation biology in Xinjiang and its neighboring areas

(9) The occurrence mechanism and evolution trend of natural disasters in arid areas

of Xinjiang

2. Water resources (D01, D02 or D07)

(1) The connectivity of the river-lake-reservoir system and the spatially balanced allocation of water resources in the inland river basin of arid area

(2) The irrigation efficiency and water saving potentials of oasis intercropping system

(3) The plant-soil-groundwater bonds and their interaction mechanism of desert riparian forest in arid area

(4) Allocation and regulation of water resources in arid areas based on ecosystem services

(5) The mechanism of sediment treatment of surface water for high-efficiency water-saving irrigation in Xinjiang

3. Mineral resources (D02 or D03)

(1) The enrichment pattern, in-situ analysis and exploration technology of dominant and key mineral resources in Xinjiang

(2) The metallogenic mechanism and deep mineral prospecting and prediction of large amount minerals in important deposit-intensive area of Xinjiang

(3) The magmatic tectonic setting, metallogenic event analysis and the subduction-accretion metallogenic process of the key metal mineralization events in the important metallogenic belt of Xinjiang

(4) Hydrocarbon generation mechanism and occurrence pattern of shale oil in Xinjiang

(5) The formation mechanism of coal and gas in steep and weakly cemented coal seam in Xinjiang

(6) Remote sensing technology for the inversion and high-precision exploration of geochemical ore-forming element

(7) Paleogeographic reconstruction of the structure and lithofacies of the Tarim Basin and analysis of the metallogenic environment

III. Comprehensive utilization of mineral resources and new materials (L07)

(1) Basic research on coal-based hydrocracking technology (E04 or E06)

(2) Basic research on reservoir characteristics and development technology of conglomerate reservoir in Xinjiang (E04)

(3) Key technologies of the development of middle and low rank coalbed methane in Xinjiang (E04)

(4) The harmless treatment of solid wastes in the beneficiation and smelting of mineral resources and the efficient utilization of mineral resources (including secondary resources) (E04 or E10)

(5) The controllable preparation of fiber materials based on mineral resources in Xinjiang (E02, E04 or E13)

(6) Preparation of magnesium-based functional materials based on magnesite resources in Xinjiang (E01, E02, E04 or E13)

(7) Preparation of coal tar pitch-based porous carbon materials based on coals in Xinjiang (E02 or E13)

IV. Information security (L05)

- (1) The real-time analysis method of large-scale multi-source cross-network data based on supercomputing (F02)
- (2) Detection and recognition of false information on social networks (F02)
- (3) Analysis and prediction of network user behaviors and situation in Xinjiang (F02)
- (4) Non-contact collection and recognition of biometrics (F06)
- (5) Intelligent early warning and decision method for emergencies based on multiple language and video image (F02)
- (6) Intention analysis based on modeling and recognition of microexpression (F06)
- (7) Content analysis of multilingual texts in Xinjiang (F02)
- (8) Intelligent real-time 3D reconstruction and analysis of large-scale scenes based on 1 billion pixel imaging (F02)
- (9) Brain-inspired intelligent edge information processing of specific behaviors in densely populated areas (F06)

NSFC-Henan Joint Fund

The second phase of the NSFC-Henan Joint Fund is jointly established by NSFC and the People's Government of Henan Province (NSFC-Henan Joint Fund) from 2016 to 2020. It aims at giving full play of the guiding role of NSFC, attracting and gathering outstanding scientists all over the country, solving the major S&T issues and key technology problems concerning the strategic development of economy, society and science and technology in Henan Province and its surrounding areas. It tries to attract, cultivate, and gather groups of scientific talents to Henan Province, enhance the independent innovation capability of universities and research institutes in Henan province, and promote the sustainable development of economy and society of Henan province.

NSFC-Henan Joint Fund calls for proposals of Fostering Project and Key Project from four priority research areas in 2020. Fostering Project provides an average direct funding of 500,000 yuan per project for three years; Key Project provides an average direct funding of 2.2 million yuan per project for four years. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Biology and Agriculture

1. Key Project

Proposals are expected to focus on Henan's main crops as research objects, carry out basic research on nutritional quality of wheat, corn yield and disease resistance, rice oil photosynthesis, the analysis of special oil crops such as sesame, peanut and other oil crops and green pest control in agriculture. Proposals should carry out research on the healthy breeding of livestock and poultry, the pathogenicity and immune mechanisms of livestock epidemic diseases; study the soil micro-ecological balance and health mechanism of the tidal flat area of the Yellow River. Main research areas include:

- (1) Molecular basis of wheat nutrition quality (C13002);

(2) Regulating mechanism for corn grain filling and dehydration in Huang-Huai region;

(3) Cloning and analysis of genetic mechanism of broad-spectrum disease resistance genes in maize in Huang-Huai region;

(4) The molecular mechanism of photosynthesis and high photosynthesis utilization in rice;

(5) Molecular mechanism for the formation and regulation of important traits of Henan peculiar oil crops;

(6) The adaptation/resistance mechanism of crop pests to toxic substances;

(7) Pathogenicity and immune mechanism of major livestock diseases;

(8) Soil micro-ecological balance and health mechanism in the Yellow River tidal flat area.

2. Fostering Project

Proposals are expected to study physiological and molecular mechanisms of crops responding to abiotic stress; molecular mechanisms of fine quality formation of wheat, corn and other food crops; nutritional, quality and active ingredient action mechanisms and regulatory mechanisms of characteristic agricultural products; gene excavation and regulatory mechanisms of important quality traits in the rice of South Henan province; pathogenicity and immune evasion mechanism of zoonotic diseases; development and efficient utilization of functional microbial resources; biodiversity and its formation mechanism in Henan region; high-quality and high-yield mechanism of edible fungi; maintenance of physiological and quality characteristics of main agricultural products after harvest; causes, molecular mechanisms and green prevention and control of agricultural biological disasters; causes, molecular mechanisms and green prevention and control of agricultural biological disasters; high-throughput phenotypic analysis of plant development.

II. Population and Health

1. Key Project

Proposals are expected to carry out relevant basic and clinical basic research about the occurrence, development, diagnosis, treatment and prevention of high-incidence and major diseases in Henan, in order to seek new targets for treatment, new drugs and new plans for prevention and treatment; to focus on occupational health and safety, and research on chromium exposure and the occurrence of lung cancer and its mechanism. Main research areas include:

(1) Molecular mechanism of multi-stage evolution of esophageal cancer;

(2) The mechanism of glial cell senescence in the occurrence and prevention of Alzheimer's disease;

(3) Study on the epigenetic pathogenesis of cardiac remodeling histones;

(4) Study on the mechanism of non-coding RNA molecular network to regulate diabetic nephropathy;

(5) Selection of CAR-T treatment targets for lymphoma and study of antitumor effect;

(6) Study on the inhibitory neural circuit mechanism of perioperative neurocognitive disorder;

(7) Research on long-acting protein drugs for chronic pain;

(8) Study on the mechanism of occupational chromium exposure to lung cancer;

(9) Construction of mammalian cell efficient expression system and molecular mechanism

2. Fostering Project

Proposals are expected to research on the pathogenesis of local high incidence malignant tumors and its early diagnosis; the pathogenesis of major infectious diseases and their prevention and control strategies; basic research on drug resistance mechanisms of important pathogenic bacteria and new antibacterial molecules; mechanisms and early stages intervention strategies of secondary vascular or organ lesions in diabetes; the role and mechanism of neurodevelopmental disorders in the occurrence and development of schizophrenia; the molecular mechanisms in reproductive health protection and prevention and control of major birth defects; repair and regeneration mechanisms of organ aging and injury; new targets for drug therapy discovery and innovative drug research; new diagnostic methods and technologies based on molecular imaging; the conservation and sustainable use of Chinese medicinal materials produced in Henan province; the mechanism of traditional Chinese medicine in treating chronic major diseases.

III. New Materials and Advanced Manufacturing

1. Key Project

Proposals are expected to focus on Henan's characteristics and advantageous industries, including the design, preparation, and performance characterization of advanced materials such as two-dimensional materials, photorefractive materials, thermoelectric materials, energy storage materials, and recycled fibers; carry out basic research on spiral bevel gear near-net-shape forming, injection molding, composite processing theory and equipment technology. Main research areas include:

(1) Design and green preparation of two-dimensional Mo and W transition metal compounds;

(2) Preparation of recycled fiber by ionic liquid method;

(3) Near-net forming of spiral bevel gear;

(4) Injection molding of ultra-large-volume deep-cavity shell;

(5) Organic photorefractive material for holographic imaging;

(6) MXene-based heterostructure energy storage material;

(7) Precision and efficient composite machining theory and equipment technology for difficult-to-machine materials;

(8) Design, preparation and performance regulation of environmentally friendly thermoelectric materials.

2. Fostering Project

Proposals are expected to study the optoelectronic, thermoelectric, and energy storage materials and devices based on Henan's superior resources; design, preparation, and processing of new materials such as metamaterials and graphene; science and new technologies for the preparation of biomedical, intelligent, and biomimetic materials; the preparation of carbon-fixed cementitious materials from red mud; (electrical, magnetic, and mechanical) auxiliary material preparation technology and modification mechanism; advanced forming and additive manufacturing equipment technology; reliability and life of materials and components under multiple load conditions; the mechanism of laser brazed diamond; high-quality metal structural materials for rail transit; new principles and methods of precision driving/transmission systems for industrial robots; new topological structures

and control methods of magnetic levitation motors; protective development and environmental effects of Henan mineral resources.

IV. Chemistry

1. Key Project

To meet the needs of Henan province, proposals are expected to carry out basic research in related fields such as water purification, visible light catalysis, chalcogen molybdenum and tungsten-based transition metal materials, photovoltaic molecule design, lithium liquid flow batteries, and artificial enzyme catalysis mechanisms. Main research areas include:

- (1) Removal of pollutants from industrial wastewater;
- (2) Visible light organic catalysis;
- (3) Band Structure Modulation and Performance Optimization of Molybdenum Tungsten Metal Chalcogenide;
- (4) Design, synthesis and optoelectronic properties of aromatic heterocyclic molecules based on new structure;
- (5) Ion transfer-reaction coupling and regulation mechanism of lithium liquid flow battery;
- (6) Theoretical study of the mechanism of the artificial enzyme-catalyzed reaction.

2. Fostering Project

Proposals are expected to study the preparation and performance of new photocatalytic materials; design, synthesis and performance of functionally oriented new compounds; preparation and performance of green chemical media; molecular design and mechanism of high-energy battery-related chemical materials; construction and performance of monetary metal cluster materials research; synthesis and application of new boron-based materials; new strategies for activation and utilization of inert chemical bonds; green sustainable synthesis of organic functional molecules; design, synthesis, and performance of new nucleoside analogs; chemical biology of unnatural base codes science; green utilization of resources such as e-waste and waste chemicals.

Joint Fund to Promote Cross-Strait Scientific and Technological Cooperation

The second phase of the Joint Fund to Promote Cross-strait Scientific and Technological Cooperation is jointly established by NSFC and the Fujian Provincial Government for the period from 2016 to 2020. It aims at making full use of the guiding role of the National Natural Science Fund, attracting and gathering scientists across the Taiwan Strait to conduct S&T cooperation, solving major scientific issues and key technological problems mutually concerned by Fujian and Taiwan, boosting the growth of scientific talents, improving innovation capabilities of the cross-strait economic zone and promoting the sustainable development of regional economy and society.

In 2020, the Joint Fund calls for proposals of Key Project in the following priority research areas. Average funding (direct costs) for each project will be 2.8 million yuan for 4

years. The joint fund is open to all Chinese researchers. Qualified researchers are welcomed to apply for this fund according to the research scope and requirements listed in this Guide.

I. Agriculture (L01)

1. Molecular mechanism of the biosynthesis, accumulation and regulation of functional components of plants with distinctive characteristics in Fujian and Taiwan (C0206)

Proposals are expected to focus on the high-quality germplasm resources of plants with distinctive characteristics in Fujian and Taiwan, and provide theoretical basis and high-quality germplasm (gene) resources for the breeding and improvement of functional components of plants. Topics include: the influencing factors of the functional components that promote human health (polysaccharide, EGCG, tea polyphenol, carotene, anthocyanin, resveratrol, ursolic acid, sulforaphane, etc.); the biosynthesis of the functional components; the molecular mechanism of functional component transportation, accumulation and regulation; key genes of the functional components; the relevant signal transduction and genetic regulation networks.

2. Molecular analysis of the economic characters of important aquatic organisms in Fujian and Taiwan (C1902)

Proposals are expected to focus on the important aquatic organisms in Fujian and Taiwan, especially their economic characters such as the quality, yield, disease resistance, feed utilization efficiency and reproduction, analyze the genetic basis of these characters using technologies of genetics, genomics and gene editing, clarify the molecular mechanism of the formation of important traits, explore important functional genes and regulatory elements, and provide a scientific basis for molecular breeding.

3. Chemical fingerprint in the processing and quality control of economic animals and plants with distinctive characteristics in Fujian and Taiwan (C2111)

Proposals are expected to focus on characteristic economic animals and plants (tea, livestock and poultry, aquatic animals, etc.) in Fujian and Taiwan, study the chemical fingerprint characteristics related to germplasm resources, environmental adaptability and processing quality, and reveal the chemical basis of the influences of Fujian and Taiwan's environment, material pretreatment and fingerprint on the processing process and quality control of characteristic economic animal and plant products.

4. Molecular mechanism of high-yield and high-quality traits and environmental adaptability of important crops in Fujian and Taiwan and germplasm innovation (C1305)

Proposals are expected to focus on the important crops in Fujian and Taiwan, and provide the theoretical basis and germplasm resources for regional planting of important crops. Topics include: the molecular biological basis of the formation of important traits related to the yield, quality and environmental adaptability; the key genes, signal pathways and genetic regulation mechanism of important traits; new strategies of molecular breeding to improve important traits; and the creation of high-yield, high-quality and strong-adaptability crop strains.

5. Pathogenic mechanism and host immunoprotection mechanism of main pathogens of important farmed animals in Fujian and Taiwan (C1802, C1803, C1804, C1805 or C1906)

Proposals are expected to focus on important farmed animals in Fujian and Taiwan,

study the pathogenic mechanism of important pathogens, explore the variation pattern of pathogens and the mechanism of escaping host immunity, reveal the interaction between pathogens and hosts and the immune mechanism of protection against pathogen infection, and conduct applied basic research on the disease prevention and control technology of important farmed animals in Fujian and Taiwan.

6. Spread, damage and prevention and control of major diseases and pests of important crops in Fujian and Taiwan (C1401, C1402)

Proposals are expected to focus on important crops diseases and pests in Fujian and Taiwan, study the biological basis of pest spread and damage, analyze the molecular mechanism of the interaction among pests, hosts and media, search for effective pest-resistant genes, develop environmental-friendly pesticides, put forward the strategies of ecological prevention and control of pests, and provide a scientific basis for the green and safe production of important crops at both sides of the Taiwan Strait.

II. New materials and advanced manufacturing (L04)

1. Advanced manufacturing and non-destructive monitoring of the third generation semiconductor wafer (E02, E05 or E13)

Proposals are expected to study the crystal structure of wide bandgap semiconductor materials and the constitutive relations of semiconductor materials, carry out applied basic research on the multi-scale, multi physical-field properties of semiconductor materials, the mechanism of efficient and high-precision material removal, and the non-destructive test of photoelectric geometric and mechanical properties of materials, so as to provide strategic support for the preparation and application of high performance devices in 5G communication, new energy vehicles, and aerospace.

2. Design, manufacturing and service performance evaluation of carbon fiber components and equipment (E02, E03, E05 or E13)

Proposals are expected to focus on the manufacturing of carbon fiber parts and equipment in the fields of automobile, aviation, ship, robot, etc., study new theory and methods of the design, manufacturing and service performance evaluation of carbon fiber parts and equipment, and reveal the relations between material, manufacturing, and service performance and the underlying mechanisms.

3. Lightweight design and dynamic characteristics of hybrid CNC machine tools (E05)

To meet the demand of the "lightweight, flexible, high-precision and fast" CNC equipment for the complex surface processing of stone and wood, proposals are expected to study the correlation between the design parameters and the service performance index of the hybrid machine tools, the lightweight design of hybrid CNC machine tools and the stability of high-speed cutting by the hybrid machine tools.

4. Design, preparation and devices of advanced photoelectric materials (E01, E02, E03 or E13)

Topics include: the development of nonpolar porous gallium nitride single crystal, aluminum nitride and gallium oxide thin film substrates; the design and preparation of ultra-wide bandgap semiconductor materials; the ultra-short pulse fiber laser light source materials, single crystal fiber for solid-state laser, microcrystalline glass-ceramic phosphor for laser lighting, optical limiting film for laser protection and other materials and devices; the preparation and display of high-performance printed light-emitting crystal tube and high

stability perovskite nanocrystals.

5. Design, preparation and device of new fuel cell electrode materials (E01, E02, E06 or E13)

Proposals are expected to study the design, preparation and device research of electrode materials for ammonia fuel cell, hydrogen fuel cell and organic fuel cell.

6. Design, preparation and application of new catalytic materials for environmental refreshing (E04, E06 or E10)

Proposals are expected to conduct research on the following topics and provide a theoretical basis for the application of new environmental refreshing materials: the growth, assembly and regulation mechanism of porous two-dimensional catalytic materials based on solid precursor synthesis; the regulation and composite assembly of different catalytic components to reveal the degradation and purification mechanism of new water purification materials for oil-bearing and phenol-containing waste water; the collaborative catalytic effect of active components of two-dimensional water purification materials and the structure-activity relationship between the materials and the purification performance of oil-bearing and phenol-containing waste water.

7. Basics of precision manufacturing of components with microscale structure/flexible sensor/phase change switching device (E02, E05 or E07)

Topics include: ultrafast laser manufacturing and laser cladding additive manufacturing technology for special micro-scale key parts; the design, structural control and functionalization of new biocompatible flexible materials, the device processing and application in medical health testing; ion occupation of inorganic ferroelectric materials and its response mechanism to external fields; control mechanism and application of phase-change switching effect induced by physical fields.

8. Damage mechanism and condition monitoring of key structure components of important infrastructure such as sea-crossing bridge (E08, E09 or E11)

Topics include: the occurrence state of chloride ions in concrete and its corrosion effect on metal materials; the evolution of mechanical damage of concrete components under the coupling effect of load and environmental factors; the damage mechanism and state detection technology of key structural components of major facilities such as sea-crossing bridges.

III. Population and health (L02)

1. The epidemiology, pathogenesis, and diagnosis and treatment technology of malignant tumors in the digestive system and blood system in Fujian and Taiwan (H16 or H08)

Proposals are expected to focus on the high-incidence cancer in Fujian and Taiwan such as the gastric cancer, liver cancer, pancreatic cancer, colorectal cancer, and blood malignant tumors, carry out studies on the following topics: the population and clinical epidemiological investigation to identify the specific etiology; the pathogenic biological pathogenesis, invasion and metastasis of malignant tumor and the mechanism of anti-tumor drug resistance; the new molecular imaging technology for tumor diagnosis; and the new technology of oncolysis and immunotherapy.

2. The pathogenesis, diagnosis and treatment of high-incidence cardiovascular diseases in Fujian and Taiwan (H02)

Proposals are expected to focus on the high-incidence cardiovascular diseases in

Fujian and Taiwan, carry out studies on the following topics: the risk prediction of cardiovascular diseases in the elderly; rare arrhythmias or family inherited arrhythmias, cardiomyopathy and aortic dissection; the occurrence and development mechanism of atrial fibrillation.

3. Pathogenesis, diagnosis and treatment of common nervous system diseases in Fujian and Taiwan (H09)

Proposals are expected to focus on the common nervous system diseases in Fujian and Taiwan, including epilepsy, cognitive dysfunction and stroke, carry out studies on the following topics: to reveal the pathogenic mechanism of the nervous system diseases based on the genetic pathological examination of clinical specimens, the cell level research and the construction and analysis of animal models; the causes of side effects of drugs; new diagnosis and treatment by using brain functional imaging, brain network, and motor intervention.

4. The pathogenesis, diagnosis and treatment technology of high incidence infectious diseases in Fujian and Taiwan (H19)

5. Research on characteristic medicinal materials and new drugs in Fujian and Taiwan (H28)

Proposals are expected to carry out studies on the collection, protection, seedling, breeding and identification of characteristic Chinese traditional medicinal materials in Fujian and Taiwan, so as to provide the basis for the sustainable utilization of traditional Chinese medicine resources; select the specific components of characteristic Chinese traditional medicines from the natural medicines/plants of Fujian and Taiwan, and study the target, efficacy and mechanism of action, so as to lay the foundation for the development of new drugs.

IV. Resources and environment (L03)

1. The disaster mechanism, monitoring and early warning, and prevention and control technology of geological disasters in Fujian and Taiwan (D02, D05 or D07)

Proposals are expected to focus on the meteorological and geological conditions in Fujian and Taiwan, and provide scientific support for the improvement of disaster prevention and mitigation capacity in Fujian and Taiwan. Topics include: the effect of geological disasters caused by extreme rainfall and typhoon rainstorm on groundwater, and the disaster mechanism; the whole process simulation system of rainfall induced geological disasters; the early warning model of geological disasters and the rapid response technology of disasters.

2. The land sea interaction, coastal geomorphic evolution and their environmental effects in Fujian and Taiwan (D01, D02 or D06)

Proposals are expected to study the interaction between the land and the sea, the coastal dynamic-geomorphic evolution and the sediment adding and removal process, the migration of suspended particles, the balance of sediment budget, the source and sink of suspended matters, the key factors of underground water source, and carbon flux.

3. Environmental effects of typical pollutants of the ocean, atmosphere, lakes and reservoirs in Fujian and Taiwan, environment restoration and recycling of urban waste resources (D01, D05, D06 or D07)

Proposals are expected to address the prominent environmental problems in the sea, atmosphere, lake and reservoir water sources in Fujian and Taiwan, study the migration and

transformation pattern and environmental effects of typical/emerging environmental pollutants, and develop efficient environmental functional materials and environmental remediation technologies. Also to meet the technological demand of ecological environment restoration and the building of zero-waste city in Fujian and Taiwan, proposals are expected to study the new mode and approaches of utilization and recycling of city waste resources, and provide the theoretical basis and technical support for the restoration of regional ecological environment.

4. The evolution of hydrodynamics, typhoons, storm surges and precipitation in the Taiwan Strait and their responses to global changes (D05)

Proposals are expected to focus on major marine and meteorological disasters on both sides of the Taiwan Strait, such as typhoon, storm surge and rainstorm, study the evolution and forecast the hydrodynamic changes, the distribution of atmospheric aerosols and the climate change effect of the Taiwan Strait, and provide scientific evidences for disaster prevention and mitigation on both sides of the Taiwan Strait and the study of global climate change.

5. Carbon and nitrogen cycle in forest across the Taiwan Strait and its response to global change (D01 or D05)

Proposals are expected to study the characteristics, process and mechanism of the carbon and nitrogen cycle of marine and forest organic matters and soil on both sides of the Taiwan Strait under the background of global warming and the fluctuation of nitrogen deposition; conduct multi-scale monitoring and remote sensing of landscape, watershed and ecosystem, and provide scientific support for the construction of ecological civilization and sustainable development on both sides of the Taiwan Strait under the background of global warming.

6. The hydrological cycle, water safety and water pollution control of the Taiwan Strait under global warming (D01, D05 or D07)

Due to the significant changes in water cycle and water resource allocation, the water security of both sides of the Taiwan Strait faces severe challenges. Proposals are expected to study the effect of extreme climate and hydrological process on drinking water safety, and provide scientific evidences for the reasonable development of water resources and the improvement of drinking water quality in the context of global warming and intensified human activities.

NSFC-Shandong Joint Fund

The second phase of the NSFC-Shandong Joint Fund is jointly established by NSFC and the People's Government of Shandong Province (NSFC-Shandong Joint Fund) from 2017 to 2021. It aims at giving full play of the guiding role of NSFC, attracting and gathering outstanding scientists all over the country, promoting the development of Shandong Peninsula Independent Innovation Demonstration Zone and the Yellow River Delta Agricultural High-tech Industry Demonstration Zone, focusing on the basic research on the major S&T issues and key technology problems concerning the strategic development of economy, society and science and technology in Shandong Province and its surrounding areas. It tries to attract, cultivate, and gather groups of scientific talents to

Shandong Province, enhance the independent innovation capability and international competitiveness of universities and research institutes in Shandong province, and promote the sustainable development of economy and society of Shandong province.

NSFC-Shandong Joint Fund calls for proposals of Key Project from three priority research areas in 2020 with a direct funding of 3 million yuan per project for four years. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this Guide.

I. Geo-sciences

1. Saline soil improvement in the Yellow River Delta

Soil salinization is the main factor that restricts the development of high-efficiency ecological agriculture in the Yellow River Delta. Based on the comprehensive treatment and utilization of saline-alkali land in the Yellow River Delta, proposals are expected to research on the mechanism and key technologies for the improvement of saline-alkali land using technical methods such as engineering, agronomy, biology, and chemistry, and lay the foundation for ensuring food security and ecological security. Main research areas include:

- (1) The process and key technologies of microbial improvement of saline-alkali land;
- (2) Study on the mechanism, effect and regulation technology of soluble matter migration of saline soil in the Yellow River Delta Region;
- (3) Study on integrated management and technology model of water-fertilizer-salt integration in saline and alkaline land in the Yellow River Delta.

2. Ecological protection mechanism of Yellow River Delta Wetland

The Yellow River Delta wetland has important ecological functions, but the ecological environment is fragile. Proposals are expected to focus on the development and utilization of the resources in the region and the protection of the ecological environment, and carry out research on multi-scale ecosystems to provide scientific and technological support for the development and protection of wetlands in the Yellow River Delta. Main research areas include:

- (1) Study on ecological restoration mechanism of soil pollution in the Yellow River Delta;
- (2) Study on wetland degradation and ecological protection mechanism in the Yellow River Delta;
- (3) Study on the reconstruction of typical estuarine ecosystem and its effects on resources and environment in the Yellow River Delta;
- (4) Study on remote sensing monitoring and forecasting map of soil salinization in the Yellow River Delta.

3. Shandong offshore environment, ecology and climate

Focusing on the major needs of offshore marine ecology and environmental protection and marine development in Shandong Province, proposals are expected to conduct in-depth studies on the marine geological environment, the evolution of coastal ecosystems and disaster prevention and control, and provide scientific support for the ecological development of the offshore environment and the rational development of resources in Shandong Province. Main research areas include:

- (1) Behavioral processes and environmental effects of the coastal belt and coastal pollutants in Shandong Province;
- (2) Human activities affecting the sea environment and ecological processes and

their regulatory mechanisms;

(3) Study on the occurrence and control mechanism of typical disasters in Shandong coastal zone;

(4) Environmental effects of Shandong coastal zone and offshore marine engineering;

(5) Research on the carbon sink evolution mechanism and sink enhancement of typical ecological environment in Shandong offshore;

(6) Groundwater-seawater interaction and its water resources and environmental effects.

4. Special mineral resources in Shandong

Shandong Province and its offshore area are rich in mineral resources, and have broad development space. Focusing on the formation mechanism and efficient and safe mining of characteristic mineral resources such as offshore gold mines, underground brines, oil and gas in Shandong, proposals are expected to conduct research on the basic theory of resource formation mechanisms and exploration and development technologies to provide scientific and technological support for the rational development of resources and industrial development. Main research areas include:

(1) Formation mechanism of special mineral resources in Shandong;

(2) Key technologies for exploration and exploitation of special mineral resources in Shandong.

5. Excavation and utilization of marine biological resources

Focusing on the key technical bottlenecks in the transformation and upgrading of Shandong's marine biological industry, proposals are expected to focus on the development and utilization of strategic resources of polar, oceanic and deep-sea marine organisms, the development of biological products with high added value and independent intellectual property rights, thus comprehensively improving the utilization level of high-valued marine biological resources in Shandong and China. Main research areas include:

(1) Research on the basis and application of high-value conversion of marine biomass;

(2) Discovery of marine active lead compounds and drug creation;

(3) Life process and resource utilization of microorganisms in extreme marine environment.

6. Marine environment monitoring technology

Focusing on the common needs of marine environmental elements with different characteristics under complex marine environment, and the implementation of "transparent ocean" major projects, proposals are expected to develop new theories, technologies, and methods suitable for the observation, information extraction and analysis of target with different characteristics, and conduct research on related key core technologies. Main research areas include:

(1) New ocean observation technology for "transparent ocean";

(2) Real-time observation technology for deep-water aquaculture;

(3) Real-time online monitoring technology of ecological environment in Shandong coastal waters.

II. Engineering and Materials Sciences

1. Marine materials

Various materials under the marine environment are the basis for marine development and protection. Based on the demand for key basic materials of engineering construction and resource development in the marine environment, proposals are expected to conduct basic research on the design, preparation and application of new materials for different purposes such as marine engineering equipment, marine engineering construction, marine monitoring, and resource utilization, and effectively solve the material bottlenecks in marine equipment research and development, marine engineering development, and marine resource utilization. Main research areas include:

- (1) High-performance metal materials and their adaptability to the marine environment;
- (2) Design and preparation of high durability marine engineering materials;
- (3) Marine anticorrosive and antifouling material and its application;
- (4) Low-pressure high-efficiency membrane materials and components for seawater desalination.

2. Marine engineering

The complex and changeable marine environment has posed great challenges to the construction of marine engineering. Focusing on the needs of marine engineering construction in Shandong Province, proposals are expected to carry out basic research on the application of modern engineering technology in subsea tunnels, coastal engineering and deep-sea platforms. Main research areas include:

- (1) Subsea tunnel construction and operation safety technology;
- (2) Coastal engineering environmental disasters and countermeasures;
- (3) Efficient construction and control of deep sea oil and gas wellbore;
- (4) Key technologies for safety protection and restoration of marine structures;
- (5) Key technologies of intelligent large-scale aquaculture platform project of the yellow sea cold water group.

3. Marine equipment

The level of marine development equipment reflects the strength of the nation's marine development. Proposals are expected to be focusing on the major demand for marine equipment and the development of key common technologies, such as offshore oil and gas exploration, efficient use of marine renewable energy resources, and seawater desalination, and provide support for mastering marine development and marine resource utilization equipment core technologies, and break through the bottleneck of independent design and manufacturing. Main research areas include:

- (1) Key technologies for offshore oil and gas exploration platforms;
- (2) Key technologies for deep sea carrying and operating equipment;
- (3) Core technology and equipment for desalination of industrial water;
- (4) Renewable marine energy capture and utilization technology;
- (5) Key technologies for ship power exhaust gas treatment;
- (6) Research on key technology of underwater vehicle;
- (7) Marine equipment energy supply theory and key technologies.

III. Information Science

1. System modeling and control

System modeling and control is the core of efficient use of inspection/observation data and data drive. Proposals are expected to be focusing on the major requirements for system modeling and control technologies in marine development, observation and computation applications, and conduct research on the application of marine ecological environment modeling and analysis, core systems and algorithms for information processing systems, and realize intelligent, accurate and real-time marine observation and development activities. Main research areas include:

- (1) Analysis and forecast of fractal theory of ocean information;
- (2) Theory and technology of core control system for underwater operating robots;
- (3) Super-computing model and key algorithm based on ocean applications.

2. Information Sensing and Exchange

Information sensing and exchange and sensing technologies are the core technology components of marine equipment. In response to major needs in marine monitoring, marine instrumentation, and other aspects, proposals are expected to research on marine environmental sensor acquisition and transmission, and provide scientific and technological support for improving the level of marine equipment technology and improving ocean observation capabilities. Main research areas include:

- (1) Development of new sensors in marine environment;
- (2) Data acquisition and transmission technology for underwater equipment;
- (3) Information detection technology for complex marine geological environment;
- (4) Channel model and key technologies of new marine communication network.

3. Basic theories and key technologies of artificial intelligence

Artificial intelligence is the core technology for realizing the intelligent ocean technology revolution with a wide range of applications in the marine field. Proposals are expected to conduct research on the basic theories and key technologies of big data and artificial intelligence around marine development and protection, marine observation, and maritime security, solve the common, critical and cutting-edge issues in the development of the marine economy and smart ocean, and provide support for the transformation and upgrading and rapid development of the marine industry. The main research areas include:

- (1) Research on key technologies of big data acquisition and processing in marine field;
- (2) Basic theories and key technologies of artificial intelligence in marine development and protection

NSFC-Shenzhen Robotics Research Center Program

The Program is jointly established by NSFC and the People's Government of Shenzhen Municipal (Robotics Research Center Project) from 2016 to 2020. It aims at giving full play to the guiding role of NSFC, attracting national excellent talents in the

robotics research area, to jointly solve the cutting-age issues and key technology problems in robotics research, and promote the sound and rapid development of robotic industry.

The Robotics Research Center Project calls for proposals of Integration Project or Key Project from the following priority areas with an average direct funding of 12 million yuan per project for four years for integration projects, and an average direct funding of 3 million yuan per project for four years for key programs. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Integration Project

i. Key components and basic software of 3C robot

With 3C robot key components and basic software as the research target, proposals should focus on research of the core software and hardware such as servo drive, vision/tactile sensing, end-executing and intelligent control, etc., to build a 3C robot system to achieve rapid and accurate assembly of tiny/shaped/flexible components, and demonstration application of key processes such as efficient polishing and polishing of structural/appearance parts. The main research areas include:

1. Electromagnetic servo drive/micro drive technology and components

Proposals should study the electromagnetic composite configuration, and high-performance electromagnetic drive technology and components that meet the requirements of fast high accuracy and low fluctuation; study the large-stroke micro-drive technology and components, and the high-precision and stable motion control method of the micro-driver.

2. High-precision and compact 3D vision/tactile sensing technology and components

Proposals should study the high-precision 3D active vision sensing methods and devices adapted to strong disturbance conditions; study flexible 3D haptic array sensing technologies and devices.

3. End execution technologies and components for key assembly processes

Proposals should study the mechanical mechanism of key assembly processes; study the compact intelligent end effector and its operation method for typical mobile phone assembly scenarios constrained by small and complicated workspaces.

4. Intelligent control method and software for precision operation

Proposals should study highly robust on-line fault prediction and correction methods that can quickly adapt to changes in the operating environment to achieve real-time monitoring and correction of the 3C precision assembly process; study the force/position hybrid control theory and methods of 3C structural parts/exterior parts fine grinding.

5. 3C robot system integration and application demonstration

Proposals should complete software and hardware system integration, carry out key process applications demonstration such as precision assembly of micro/profiled/flexible components, and engage in force control polishing demonstration applications.

The integration program projects should include the above five research areas at the same time, and carry out in-depth systematic research on the key components and basic software of 3C robots to create innovative results and demonstration systems.

ii. Key technologies for bionic sensing, learning, homeworking, and multi-robot

intelligent collaboration

Focusing on the major scientific issues of intelligent collaborative and efficient operation of robots in complex environments, proposals are expected to carry out relevant basic research such as visual and auditory collaborative perception and intelligent guidance in complex environments, self-growth network learning, human-like smart operations and security control, and multi-robot intelligent collaborative operations. It should break and solve the bottleneck problem that restricts the development of mobile bionic robots, and provide theoretical basis and method support for robot intelligent cooperative operations. The main research areas include:

1. Theories and methods of robot visual and auditory collaborative perception and intelligent guidance in complex environments

Proposals should study the theory and method of multi-modal, dynamic information fusion based on audiovisual hearing, to achieve efficient and robust robotic perception and guidance in complex environments.

2. Theories and methods of rapid robot learning and knowledge transfer

Proposals should study the rapid growth of sub-networks incorporating task feature constraints and multi-sub-network data fusion and stitching methods to achieve robot task learning, knowledge accumulation, and knowledge transfer.

3. Robot operation planning and safety control strategy based on human dynamics

Based on the human body dynamics model, proposals should study the complex mapping methods between human dynamics and robot dynamics, and construct a human-knowledge-based action knowledge base to realize efficient and safe human-robot operation.

4. Multi-robot intelligent cooperative operation theory and method

Proposals should study the theory of multi-robot dynamic orchestration and autonomous distributed decision-making, and research on the intelligent collaborative operation and optimal control methods of multi-robots under the conditions of conflict resolution and weakening information, and realize multi-robot intelligent collaborative operations.

5. Mobile bionic robot system integration and intelligent collaborative application verification

In line with emergency rescue unstructured environments and complex mission scenarios, proposals should develop biped, quadruped and other mobile robot systems with the characteristics of bionic perception learning and bionic operations, and carry out application verification on intelligent collaboration of multiple robots.

The integration program project should include the above five research areas at the same time, and carry out in-depth systematic research on key topics such as bionic perception learning, bionic operations, and multi-robot intelligent collaboration to create innovative results and demonstration systems.

iii. Fidelity coring robot system in moon-based environment

Focusing on the major tasks of the lunar exploration project, proposals should aim at exploring and exploiting the lunar mineral resources and deepening the earth-moon evolution mechanism, study the key technology of the lunar-based in-situ fidelity coring

and the coring robot system to achieve a large depth (15 to 20 meters) fidelity core exploration. The main research areas include:

1. Lunar soil and moon rock simulation methods and basic physical and mechanical characteristics

Proposals should study the simulation principle, materials and methods of lunar soil and lunar rock, reveal its basic physical and mechanical characteristics, and realize multi-parameter simulation and preparation of lunar soil and lunar rock.

2. The principle of deep-fidelity coring and the coring robot system

Proposals should study the principle of fidelity coring and precise control of in-situ environment under special environment of moon-based environment, develop a deep-fidelity coring robot system, and realize deep self-digging fidelity coring (heat preservation, pressure preservation, quality preservation, moisturization, and gloss retention) in the moon-based environment.

3. Lunar-based fidelity coring while drilling and protecting mechanism

Proposals should study the principle and technology of wall protection during the moon-based fidelity core-drilling process, and develop an intelligent mechanical device while drilling and protecting, to achieve a complete and continuous core coring at a large depth of lunar soil and moon rock.

4. Lunar-based rock core fidelity storage method and transport robot system

Proposals should study lunar soil and lunar rock in-situ fidelity packaging storage methods, develop in-situ fidelity storage devices and core transportation robot systems to achieve fidelity packaging and displacement of lunar soil and lunar rock samples in a moon-based environment.

5. Integration and display of fidelity coring system under moon-based simulation environment

Proposals should integrate and simulate the lunar-based deep-fidelity coring system under the moon-based environment simulation module, and complete the verification and display of the in-situ fidelity coring, protection while drilling and core transportation of the moon-based environment.

The integration program project should include the above five research areas at the same time, and carry out in-depth systematic research on the theme of “Fidelity coring robot system in the moon-based environment” to create an innovative result and demonstration system.

II. Key Project

1. Basic robot parts

To meet the needs of the development of the robot industry, proposals should research into the scientific issues and key technologies in the design and manufacturing of basic components such as actuators, controllers, sensors, and end-effectors. The main research directions include:

- (1) High-performance robot control system;
- (2) High-precision angular displacement sensor of robot joint structures;
- (3) Three-dimensional vision sensor of the robot;
- (4) End effector of surgical robot.

2. Common supporting technology of robot

Proposals should focus on robot perception and understanding, human-computer

interaction, judgment and decision-making, execution control, etc., and study common supporting technologies and methods required for robot system integration and application. The main research directions include:

(1) Robot perception and target recognition methods under outdoor complex visual conditions;

(2) Autonomous learning methods for robot operation;

(3) Flexible wearable sensing interacts naturally with human-machine.

3. Industrial robot

Proposals should focus on the strategic needs of Shenzhen's high-tech manufacturing industry, research on key technologies for high-precision, intelligent industrial robots, adapt to new flexible, fast, and accurate manufacturing models, and promote the popularity of industrial robots. The main research directions include:

(1) Precision machining robot;

(2) Precision assembly robot.

4. Medical service robot

Proposals should focus on the extensive demand for intelligent robots in medical services, home services and other fields in Shenzhen, the study key technologies of various types of service robots. The main research directions include:

(1) Intelligent TCM diagnosis robot;

(2) Specialized medical surgical robot;

(3) Micro-nano operation robot for biomedicine;

(4) Home nursing care robot.

5. Special robot

In view of the extensive demand for machines to replace humans under special conditions, proposals should study key robotics technologies in the fields of aerospace, marine engineering, energy and power, security and disaster relief, and other key technologies for new-type robots, such as soft-bodied and micro-orientation robots. The main research directions include:

(1) Special robots for nuclear power industry;

(2) Under-water robots;

(3) Space on-orbit assembly robots;

(4) Robots operating in narrow spaces;

(5) Soft-bodied robots;

(6) Intelligent micro-robot.

Tianyuan Fund for Mathematics

Tianyuan Fund for Mathematics is a special fund to integrate collective wisdom of mathematicians, explore funding method that suits the unique features of mathematics, and make China a strong country in mathematics. This fund supports researchers to conduct research according to the features and need of mathematics, foster young talents, promote academic exchange, optimize research environment, spread mathematical culture and thus strengthen creativity of China in mathematics. The fund mainly provides the following 5 types of funding in 2020.

1. Tianyuan Center of Mathematics

The main objective of the Tianyuan Youth Center of Mathematics is to set up a platform for cooperative research and academic exchange. Focusing on several topics and interdisciplinary areas, the project shall foster research talents through various types of academic activities, and promote research in various branches of mathematics and interdisciplinary studies in China.

This project aims at frontier areas and important directions in mathematical research, and supports various academic exchange activities all over China, including summer schools and training of young teachers of mathematics. Applicants decide the project title. Please include the significance, scope, plan, and background of the proposed activity, and possible collaborators in the application.

We plan to fund 3 projects in 2020, including 1 project of 12 million yuan for 4 years, and 2 projects of 3 million yuan each for 1 year.

2. Tianyuan Exchange Program

The exchange program supports high level academic exchange activities. It aims at promoting in-depth level exchange and cooperation on hot spot of mathematical problems. Each program should invite world renowned mathematicians, in the form of lectures and workshop and discussion sessions.

The program should be organized by 3 to 5 organizers, who should be world famous mathematicians in the area. Applicant should be a full time working mathematician in China, and have written consent of the organizers.

Each program may only invite up to 50 participants and the duration is limited to 1 week.

The applicant may decide the topic of the application, and provide detailed information such as scientific significance, contents and objectives of exchange, and the time and name list of the participants. The funding will be 300,000 per project.

3. Tianyuan Visiting Mathematicians Program

This program aims at promoting a balanced development of mathematical research in China by supporting talented young mathematicians in less developed regions in China to work with leading mathematicians in China. The hosting institution should have good mathematical background.

Requirements on application:

(1) Joint application. Application should be submitted jointly by the visiting mathematician and the host. The visiting young mathematician should be from less developed regions and born after January 1, 1980, and the host mathematician should be national famous mathematician with international influence. The applicant should provide detailed information such as scientific significance, contents and objectives of exchange. The visiting time should not be less than 9 months.

(2) Please include a letter of promise as a supplement to the application. The letter of promise should include the terms of visiting, including salaries, working conditions and evaluations.

(3) Please include an agreement as a supplement to the application. The visitor and host should sign the agreement on contents, funding and sharing of the right of intellectual properties.

The funding will be 200,000 yuan per project for the host and 100,000 yuan per project for the visitor.

4. Special lectures on mathematics, high level workshops

Special lectures are organized for postgraduate students focusing on one or several related themes so as to introduce frontier topics in mathematical research. Lectures could include basic courses and special courses with large audience lasting for 3 weeks. Application should provide teaching outline, teaching contents and name list of the lecturers.

High level workshop programs mainly support research groups of high level and excellent mid aged and young mathematicians to sponsor workshops on clear topics and important international mathematical issues. At least one

review paper should be published after the workshop, and proceedings or papers are highly recommended.

Each project will be funded with 200,000 yuan.

5. Mathematical culture and knowledge dissemination

This category of funding provides support to publications of popular mathematical books, including domestic and translated foreign books, so as to raise the interest of primary and middle school students on learning mathematics and understanding of mathematics by the public; the publication of national influential journal related to mathematical culture, dissemination of mathematics, mathematical education and mathematical modeling, so as to improve journal quality and impact on the public; the important national activities of mathematical dissemination by universities, research institutes, science associations and mathematical society above provincial level.

The funding is for one year, and will be direct cost funding only.

Special Fund for Research on National Major Research Instruments

The Fund aims to encourage and foster the exploratory research and development of instruments with creative ideas, and major research instruments and equipment with original creative ideas, which should be based on frontier of science and national needs and guided by scientific targets, so as to provide new means and tools for scientific research and enhance indigenous innovation in China.

Projects funded by the Special Fund for Research on National Major Research Instruments comprise of departmental recommendation projects and free application projects.

Funding for Projects of Special Fund for Research on National Major Research Instruments in 2019

Unit: 10,000 yuan

	No. of applications	No. of awards	Direct cost	Average funding for direct costs
Departmental recommendation	48	3	19,990.08	6,663.36
Free application	617	82	58,350.68	711.59

The funding duration for projects of the Special Fund for Research on National Major Research Instruments is 5 years, and in general the number of collaborating institutions in one project should not exceed 5.

1. Eligibility for applicants

Applicants for the Special Fund for Research on National Major Research Instruments should:

- (i) Have the experience of conducting basic research;
- (ii) Have senior professional position (title).

Post-doctors, postgraduate students, researchers without host institutions, and researchers whose host institutions have not been registered at NSFC are not eligible for application.

2. Requirements for application

(1) For free application projects in 2020, applicants may submit research proposals via their host institutions. The budget cap for direct costs is 10 million yuan per project (excluding 10 million yuan per project).

(2) For departmental recommendation projects, the following 14 departments are entitled to recommending projects of the Special Fund for Research on National Major Research Instruments: Ministry of Education, Chinese Academy of Sciences, Ministry of Natural Resources, Ministry of Industry and Information Technology, Ministry of Ecology and Environment, Ministry of Agriculture and Rural Affairs, National Health Commission, China Earthquake Administration, State Administration for Market Regulation, China Meteorological Administration, State Oceanic Administration, China Academy of Engineering Physics, Equipment Development Department and Logistic Support Department of Central Military Commission. In 2020, the budget for direct costs of the departmental recommendation projects of the Special Fund for Research on National Major Research Instruments should be 10 million yuan or above per project.

3. Notes on application

(1) Applicants are advised to read this *Guide* carefully and prepare research proposals in accordance with the Outline of Preparation of Applications of the Special Fund for Research on National Major Research Instruments. Please choose the “Special Fund for Research on National Major Research Instruments” from the funding categories, and choose “free application” or “departmental recommendation” under the subcategory of funding. Applicants are advised to clarify the details if they are carrying out projects which have some links with the current application. Explanation of the similarities and differences in research contents between the ongoing project and the current application should be presented.

(2) For applicants and participants with senior academic positions (titles), the number of applications plus ongoing projects of the Special Fund for Research on National Major Research Instruments as well as the Special Fund for Research on National Major Research Instruments administered by the Ministry of Science and Technology should not exceed one in total.

(3) Projects of the Special Fund for Research on National Major Research Instruments are funded by the way of cost reimbursement, so applicants are advised to make their budget requests in an objective and practical manner according to the real costs of the development of instruments. NSFC will invite experts to assess the budget requests.

Appendix

Contact Information of NSFC Departments and Bureaus

Department		Tel	Department	Tel	
Department of Mathematical and Physical Sciences			Division of Interdisciplinary Research	Biophysics and Biochemistry	62329246
Division of General Affairs		62326910		Biomaterials, Imaging and Tissue Engineering	62329221
Division of Mathematical Sciences		62327178		Molecular Biology and Biotechnology	62329246
Division of Mechanics		62327179		Ecology	62329321
Division of Astronomy		62327189	Division of Environment and Ecology	Forestry and Grassland Science	62329573
Division I of Physical Sciences		62327181		Basic Agriculture and Crop Sciences	62327193
Division II of Physical Sciences		62327182		Food Sciences	62326919
Department of Chemical Sciences			Division of Agriculture and Food Sciences	Plant Protection	62328882
Division of General Affairs		62326906 62327170 62329320			
Division I	Synthetic Chemistry	62327170 62328253	Division of Agricultural Environment and Horticulture	Horticulture and Plant Nutrition	62327197
Division II	Catalysis and Surface/Interface Chemistry	62327035		Animal Husbandry	62329105
	Chemical Theory and Mechanism	62328382	Division of Agricultural Animal	Veterinary Science	62329585
Division III	Materials Chemistry and Energy Chemistry	62327111		Aquatic Science	62329105
			Department of Earth Sciences		
Division IV	Chemical Metrology	62327173	Division of General Affairs and Strategic Planning		62327157 62327531
	Environmental Chemistry	62327075	Division I	Geographical Sciences	62327161
	Chemical Biology	62327169			
Division V	Chemical Engineering and Industrial Chemistry	62327168	Division II	Geology	62327652
Department of Life Sciences				Division III	Geochemistry
Division of General Affairs		62329352 62327200 62326916	Environmental Geosciences		62327159
Division I	Microbiology	62329221	Division IV	Geophysics and Space Physics	62327619
	Botany	62329135		Division V	Marine Sciences
	Zoology	62326914	Atmospheric Sciences		62327654
Division II	Genetics and Bioinformatics	62329240	Department of Engineering and Materials Sciences		
	Cell Biology	62327213	Division of General Affairs		62326887 62326884
	Developmental Biology and Reproductive Biology	62329170	Division of Materials Science I	Metallic Materials	62328301
Immunology	62329341	Organic Polymer Materials		62327138	
Neurosciences & Psychology	62329253				
Division of Biomedicine	Physiology and Integrative Biology	62329341			

Department		Tel	Department	Tel	
Division of Materials Science II	Inorganic Non-Metallic Materials	62327144	Division V	Medical Imaging, Biomedical Engineering, Special Medicine, Forensic Medicine	62327198
Division of Engineering I	Metallurgy and Mining	62327136	Division VI	Medical Microbiology and Infectious Diseases, Movement Disorders, Trauma, Burns, Surgery, Severe Acute Medicine, Laboratory Medicine, Rehabilitation Medicine	62329131 62328775
Division of Engineering II	Mechanical Sciences and Manufacturing	62328356			
Division of Engineering III	Engineering Thermal Physics and Energy Utilization	62327135			
Division of Engineering IV	Architectural Engineering, Environmental Engineering and Civil Engineering	62327142	Division VII	Oncology I	62326924
			Division VIII	Oncology II	62329157
Division of Engineering V	Electrical Science and Engineering	62327131	Division IX	Pharmacology	62327212
	Hydro Science and Marine Engineering	62327137	Division X	Traditional Chinese Medicine, Chinese Materia Medica, Integration of Traditional Chinese Medicine and Western Medicine	62328634 62328552
Department of Information Sciences					
Division of General Affairs and Strategic Planning		62327140	Bureau of Planning		
Division I	Electronics and Information Systems	62327147	Division of General Affairs		62326980 62325277
Division II	Computer Sciences	62327807	Division of Programs		62325557 62329336
Division III	Automation Sciences	62327149	Division of Talent Fostering		62326889 62329133
Division IV	Information Devices and Optics	62327143	Division of Interdisciplinary Sciences		62328484 62326872
Department Management Sciences			Bureau of Finance		
Division of General Affairs		62326898	Division of Budgeting		62328485
Division I	Management Science and Engineering	62327156	Division of Fund Accounting		62326760 62329112 62327225 62327229
Division II	Business Management	62327152	Bureau of International Cooperation		
Division III	Macro Administration and Policy	62327155	Division of Planning		62326943 62327001
	Economic Science	62326660	Division of Asian, African and International Organizations Affairs		62325454 62326998
Department of Health Sciences			Division of American and Australasian Affairs		62325377 62326877
Division of General Affairs		62328991 62328952 62328941	Division of European Affairs		62327014 62327017
Division I	Breath, Cycling, Blood	62327215 62328962	Office of Hong Kong, Macao, and Taiwan Affairs		62327179
			Service Center of Administrative Affairs		
Division II	Digestive, Urinary, Endocrine, Eye, ENT, Oral Sciences	62328790 62329153	General Office		62327218
			Comprehensive Service		62326949
			Department of Publication		
Division III	Neurological, Psychiatric, Geriatric Medicine	62327199	General Office		62327204
			Sino-German Center for Science Promotion		
Division IV	Reproductive, Perinatal, Neonatal, Medical Immunology	62327207	Operator		82361200