2016 NSFC ANNUAL REPORT

National Natural Science Foundation of China

2016 NSFC

National Natural Science Foundation of China

Preface

In 2016, under the robust leadership of the CPC Central Committee and the State Council, the National Natural Science Foundation of China (NSFC) thoroughly implemented the spirit of the 18th CPC National Congress, the 3rd, 4th, 5th and 6th Plenary Sessions of the 18th CPC Central Committee as well as the series of speeches by XI Jinping, General Secretary of the CPC Central Committee, solidly held studies of the theoretical and practical issues of party building, seized the Central Special Inspection as an opportunity, strengthened Party's leadership, comprehensively strengthened Party discipline, focused on party building to promote performance, focused on planning to promote development and focused on the Party's stule of work to acquire greater achieviments, achieving new developments in various aspects and realizing a favorable start for the 13th Five-Year Plan of National Natural Science Fund.

YANG Wei , President
National Natural Science Foundation of China

Implement CPC Central Committee's important decisions and deployments, and solidly promote comprehensive strengthening of Party discipline. The spirit of the 6th plenary session of the 18th Central Committee and theoretical and practical issues of party building are closely combined, and "four awarenesses" are reinforced. NSFC will unwaveringly keep up with the CPC Central Committee with XI Jinping at the core, and strengthen Party building and the overall business deployment. The consciousness of managing National Natural Science Fund from political altitudes will be continuously enhanced. NSFC will practically reinforce Party building and construct new structure of administration and party building. NSFC has closely coordinated with the Eighth Central Leading Group for Inspection, the Fifth Inspection Group of Work Committee of Central Government Departments and the National Audit Office of the PRC during the inspection and auditing, with "four awarenesses" as the post, Party constitution, rules and disciplines as the rulers, comprehensively conducting in-depth inspection into problems, adhering to the principle of inspecting and rectification simultaneously and immediately.

Enhance the strategic deployment, and implement the 13th Five-Year Plan. The strategic objectives are determined. To accord with the "Three Step Progression" in building a global S&T power, NSFC has put forth the "three parallels" in basic research, namely parallel in total quantity, parallel in contribution and parallel in sources, fostering and shaping leading

The Forensic Medicine Research on Human Injury

Promoting The Belt and Road Cooperation and Creating Win-win Relationship between Science-Talent-Development

Mathematical Techniques for Medical Image Analysis and Processing that Support Precision Medical Care

The Basic Theory and Key Technology of Intelligent Manufacturing System for Raw Material Industry

The Dynamic Modification of Biological Macromolecules and Chemical Intervention

Serving Science: Interdisciplinary Discussion

The New Generation Integrated Energy Power System

The Frontier and Cross-Cognitive Neuroscience

development, emphasizing on strategic orientation, with definite orientation of cohesive forward deployment, cohesive scientific breakthrough and cohesive precise management. In comprehensively fostering source innovation, strategic layout is strengthened, and new development ideas are implemented. NSFC will hold the source innovation orientation, promote innovative development and coordinated development, and support green, open and shared development. NSFC will implement development missions, stick to objective-oriented planning and reinforce strategic deployment in prioritized research areas, promoting major mission and policy implementation in an orderly fashion.

Comprehensively support basic research and strengthen basis for source innovation. Program funding is planned as a whole, with emphasis on the basis. The General Program granted 16,934 awards, with a total funding of 10.175 billion yuan for direct costs. The Key Program granted 612 awards with a total funding of 1.715 billion yuan for direct costs. NSFC combines national strategic needs, strengthens the deployment of Key Program and Major Research Plans, reinforcing strategic coordination and perfecting joint funding mechanism. NSFC continues to conduct joint strategic research with CAS and CAE and broadens the joint funding scale, signing strategic cooperative agreement with Science and Technology Committee of Central Military Commission, signing or re-signing NSFC-Shenzhen Robot Basic Research Center Program, NSFC-Shandong Joint Fund, NSFC-Yalong River Joint Fund and High-speed Train Basic Research Joint Fund. NSFC supports Beijing and Shanghai to comprehensively strengthen S&T Innovative Center. NSFC reinforces international cooperation to better merge into the global innovation networks. By far, NSFC has concluded 86 cooperative agreements with partners in 44 countries and regions across the globe. In 2016, NSFC funded 251 substantial joint research programs with 34 funding agencies, with a total funding of 541 million yuan.

Jointly foster innovative talent, and promote constructing of S&T innovative teams. NSFC emphasizes on innovative talent and continues to increase funding intensity. The Young Scientists Fund granted 16,112 awards, with a total funding of 3.117 billion yuan for direct costs. The Fund for Less Developed Regions granted 2,872 awards with a total funding of 1.091 billion yuan for direct costs. NSFC fostered excellent talents, exerting the role of high-level guidance. The Excellent Young Scientists Fund funded 400 projects, with a total funding of 520 million yuan; the National Science Fund for Distinguished Young Scholars funded 198 new projects, with a total funding of 679 million yuan. NSFC continues to support innovative research groups, foster excellent teams, modify funding management mechanism and prioritize talent development environment, and continues to organize the submission and evaluation for Youth Program for "Thousand Talents Program".

Forward deplay important strategic areas, and serve the innovation-driven development. NSFC focuses on XI Jinping's important speech at the National S&T Innovation Conference, aims at important strategic areas, coheres strategic S&T powers, and uses forward exploration to cultivate thoughts, opening up new directions, exerting the source effect in leading national major S&T plan deployment and promoting the recovery of real economy. NSFC faces with the national major strategic demands and solves S&T challenges, focusing on key scientific issues such as deep sea, sea and space, deep ground and deep blue, increasing funding intensity. NSFC faces the main battle field for economic and societal development, strengthens basic research deployment in important national economy and the people's livelihood and reinforces the supply capability at the source. NSFC supports green development, serves to construct beautiful China and supports researchers to conduct basic research on ecological civilization.

Deepen reforms on funding management, and build a favorable environment for innovation. NSFC builds a complete regulation system, promotes governing the National Natural Science Fund by law, protects and promotes source innovation by law, perfecting performance evaluation system and promoting S&T evaluation system reforms. NSFC innovates in the funding management, promotes "delegating rights, standardizing regulations, satisfying service and effective results" reform, and further builds a favorable funding environment. The management of the registered institutes is reinforced, normalized mechanism is perfected, and legal training is reinforced. The promoting and sharing service system is perfected, achievement transfer and transformation is promoted. NSFC maintains the scientific integrity, optimizes the academic environment, continuously strengthens construction of academic integrity and S&T ethics construction, and severely handles scientific misconduct. The Supervision Committee severely handles 91 people charged with academic misconduct and 3 registered institutes, repealing 33 NSFC projects.

In 2017, with President XI Jinping's new concepts, new thoughts and new strategy on science innovation as guidance, NSFC will steadily complete all work, use the inspection and rectification as an opportunity, continues to strengthen administration, party construction and political guarantee. NSFC emphasizes on "three cohesions", strategic guidance and steadily implements the 13th Five-Year Plan. NSFC coordinates annual funding plan, focuses on frontier basic research, leads scientific breakthroughs, adheres to talent as the driving force and strengthens intelligence support. NSFC faces the strategic needs, promotes crossing and merging, reforms the mechanism and structure, brings vigor to innovation, strengthens self-construction and optimizes the academic environment.

NSFC has seen thirty years of excellence and strives to be the birthplace for innovation. NSFC

is starting afresh at the 30th anniversary and the new march towards a global S&T power. The glorious NSFC mission comes with great responsibility. We shall closely unite around the Party Central Committee with XI Jinping at the core, stay true to the original mission, reform and endeavor, comprehensively build the innovation capacity at the source, make efforts to build a favorable environment for innovation, endlessly elevate the quality and performance of S&T source, making new historical contributions to achieving the China's bright prospect on the road to revival.

Jan. 2017

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Part 1

NSFC Major Events in 2016

January

Jan. 7 Vice President LIU Congqiang and MA Zhiyi, Chairman of the Executive Committee of the Science and Technology Development Fund of Macao Special Administrative Region (FDCT), signed the *NSFC-FDCT Memorandum of Understanding on S&T Cooperation and Exchange*.

NSFC and FDCT sign the *MOU on S&T Cooperation and Exchange* in Beijing

Jan. 8 President YANG Wei attended the National Science and Technology Awards Ceremony of 2015.

Jan. 11 Vice President GAO Ruiping attended the National Conference for Science and Technology Work of 2016.

Jan. 15 President YANG Wei attended the National Conference of Heads of the Organization Department.

Jan. 15 Vice President GAO Ruiping attended the 30th Meeting for Party's Work & the 28th Meeting of Discipline Inspection of Central State Organs.

Jan. 19 NSFC held the annual performance appraisal meeting for the centrally managed Leading Group and other leading cadres & the meeting of implementing "One Reporting and Two Appraisals" in the selection and appointment of cadres. President YANG Wei, Secretary of the NSFC Leading Group, summed up the work on behalf of the leading group and made a special report on the selection and appointment of cadres. Members of the NSFC Leading Group and representatives from Division II of the No. 4 Bureau of Cadres of the Organization Department of the CPC Central Committee attended the meeting.

February

Feb. 2 The meeting of the NSFC CPC Leading Group made the decision to dissolve the Bureau of Discipline Inspection, Supervision and Auditing and set up the Office of Research Integrity that is responsible for the promotion of research integrity, the supervision and auditing of research funding and the internal audit of related work.

Feb. 3 President YANG Wei attended the progress report meeting of the "Strategic Research for China's Engineering Science and Technology 2035".

Feb. 17 Vice President SHEN Yan attended the national awards ceremony for the nationwide selection of "Scientific Research Star Models".

Feb. 22 President YANG Wei gave a joint interview to five media including the People's Daily. He talked about the funding achievements of the National Natural Science Fund during the 12th Five-Year Plan period, NSFC's development planning for the 13th Five-Year Plan period and the current development of basic research in China.

Feb. 23 An NSFC delegation led by President

President YANG Wei gives a joint interview to five media including People's Daily

YANG Wei visited the National Center for Protein Sciences.

Feb. 24–26 President YANG Wei and Vice President YAO Jiannian attended the 19th meeting of the Standing Committee of 12th National People's Congress.

Feb. 29 Vice President GAO Ruiping attended the Meeting Celebrating the International Women's Day and the National Awards Ceremony for "March 8 Red Flag Bearers".

Feb. 29 The kick-off meeting of Key Projects of the Joint Fund for Advanced Manufacturing Technology for Aerospace Industry funded in 2015 was held in Xi'an. President YANG Wei and LEI Fanpei, Board Chairman of the China Aerospace Science and Technology Corporation, attended the meeting and made remarks.

March

Mar. 3–14 Vice President GAO Wen attended the 4th Session of the 12th CPPCC National Committee.

Mar. 4–16 President YANG Wei, Vice Presidents SHEN Yan and YAO Jiannian attended the 4th Session of the 12th National People's Congress.

Mar. 14 The Signing Ceremony of *NSFC-Shenzhen Agreement on the Joint Funding of Basic Research Center of Robots* was held in Beijing. President YANG Wei, Vice President GAO Wen and GAO Ruiping, Secretary of Shenzhen Municipal Party Committee MA Xingrui, Mayer of Shenzhen Municipal Government XU Qin and Executive Deputy Mayer of Shenzhen Municipal Government ZHANG Hu attended the ceremony. Vice President GAO Ruiping and Executive Deputy Mayer ZHANG Hu signed on the agreement on behalf of the two sides.

Mar. 16 President YANG Wei chaired the meeting to convey the essence of the 4th Session of the 12th CPPCC National Committee and the 4th Session of the 12th National People's Congress to all NSFC staff. Vice President SHEN Yan and YAO Jiannian conveyed the essence of the 4th Session of the 12th National People's Congress and Vice President GAO Wen conveyed the essence of the 4th Session of the 12th CPPCC National Committee.

NSFC holds the meeting to convey the essence of the 4th Session of the 12th CPPCC National Committee and the 4th Session of the 12th National People's Congress to all staffs

Mar. 17 All secret-related personnel led by Vice President HE Minghong attended the training and examination organized by National Administration for the Protection of State Secrets.

Mar. 18 Vice President HE Minghong and GAO Ruiping paid an inspection visit to the receiving site for applications of 2016.

Mar. 20 NSFC annual application closed and a total of 172,833 applications were received.

Mar. 23 Vice President HE Minghong attended the meeting of Leading Team of the National Publicity and Education of Science Ethics.

Mar. 24 Vice President SHEN Yan attended the18th Annual L'ORÉAL-UNESCO for Women in Science Ceremony held in Paris.

Mar. 27–31 Vice President GAO Ruiping paid a visit to Israel and attended the 2nd Meeting of China-Israel Joint Committee on Innovation Cooperation jointly chaired by Vice Premier LIU Yandong and Prime Minister Netanyahu of Israel.

Mar. 29 The 4th Plenary Session of the 7th NSFC General Assembly was held in Beijing. Members of the 7th NSFC General Assembly attended the meeting. Members of the 4th NSFC Supervision Committee were also invited. The meeting deliberated and approved the work report titled *Implementing the Five Development Concepts, Highlighting Strategic Orientation, Continuously Improving the Capacity of Providing Sources for Innovation-driven Development* delivered by President YANG Wei, the report titled *Improving Academic Misconduct Disciplinary Mechanism, Enhancing Research Integrity, Steadily Advancing the Supervision of National Natural Science Fund* delivered by President CHEN Yiyu of the NSFC Supervision Committee and the *Report on the 2016 Budget and Funding Schemes of the National Natural Science Fund and the Implementation of the 2015 Budget and Funding Schemes* submitted in writing. The Plenary Meeting was also debriefed by Vice President GAO Wen on the *Formulation of the 13th Five-Year Development Plan of the National Natural Science Fund (draft)* and approved *the 13th Five-Year Development Plan of the National Natural Science Fund*. The meeting was chaired by Vice President SHEN Yan.

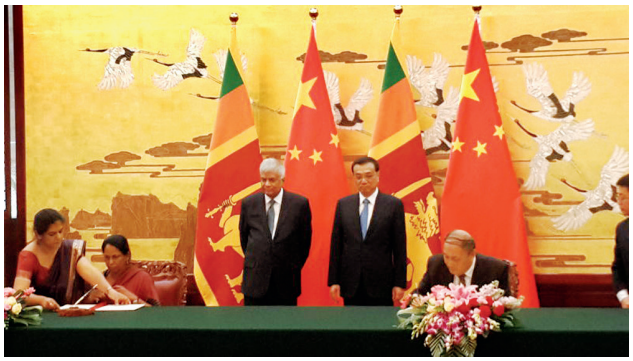
The 4th Plenary Session of the 7th NSFC General Assembly is held in Beijing

Mar. 29–30 The 8th Plenary Session of the 4th Supervision Committee of NSFC was held. Members of the Supervision Committee were debriefed by the Office of Supervision Committee on the investigation of research misconduct cases and the working plan of supervision on review meetings in 2016. The meeting approved the investigation report and the working plan. Professor CHEN Yiyu, President of the Supervision Committee, chaired the meeting and NSFC Vice President HE Minghong attended the meeting.

April

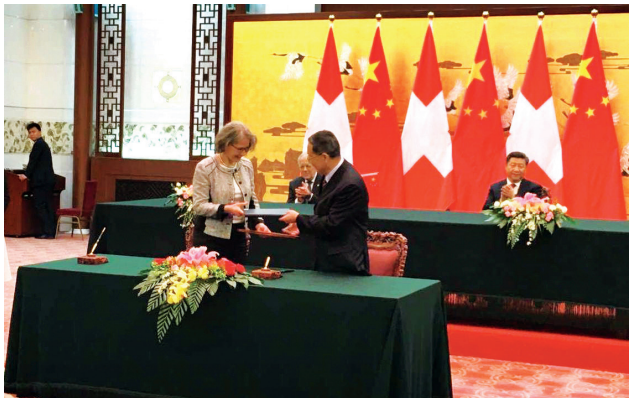
Apr. 1 President YANG Wei chaired a thematic seminar on studies on theoretical and practical issues related to Party building. Professor HU Jianmiao, Director of the Department of Law of the Chinese Academy of Governance, gave a detailed interpretation of the *Implementation Outline for Building a Government Ruled by Law* to all NSFC staff.

Apr. 7 President YANG Wei and Ms. Sirimali Fernando, President of the National Science Foundation of Sri Lanka, signed at the Great Hall of the People the *Memorandum of Understanding on Scientific and Technological Cooperation between NSFC and NSF of Sri Lanka*. Premier LI Keqiang and Premier Ranil Wickremesinghe of Sri Lanka jointly witnessed the signing of the MoU.



NSFC and NSF of Sri Lanka sign *MoU on Scientific and Technological Cooperation* in Beijing

Apr. 8 Vice President SHEN Yan and Katharina Fromm, Vice President of the National Research Council of Swiss National Science Foundation (SNSF), signed at the Great Hall of the People the *NSFC-SNSF Memorandum of Understanding on Collaboration*. President XI Jinping and Swiss President Johann Schneider-Ammann jointly witnessed the signing of the MoU.



NSFC and SNSF sign *MoU on Collaboration* in Beijing

Apr. 18 The mobilization meeting of Studies on Theoretical and Practical Issues Related to Party Building was held. President YANG Wei made a mobilization speech. Vice President HE Minghong and GAO Wen attended the meeting. Vice President GAO Ruiping chaired the meeting.

Apr. 21 A press conference on the establishment of rules and regulations of the National Natural Science Fund was held. President YANG Wei attended the press conference and made

The press conference on the establishment of rules and regulations of the National Natural Science Fund is held at NSFC

remarks. Vice President GAO Wen and GAO Ruiping answered questions from the media. The press conference was chaired by spokesman and Deputy Secretary-General HAN Yu.

Apr. 25–28 President YANG Wei and Vice President YAO Jiannian attended the 20th meeting of the Standing Committee of 12th National People's Congress.

May

May 9 President YANG Wei attended the National Video Conference on Streamlining Administration, Delegating Power, Strengthening Regulation and Improving Service Reform.

May 24 The Summary Meeting of the Submission of 2016 National Natural Science Fund Applications was held in Dalian. Vice President GAO Ruiping attended the meeting and made remarks. Administrators of leading institutions from the 36 regional networks nationwide and selected universities and research institutes, and representatives from the Bureau of Planning, Bureau of Finance, Bureau of International Cooperation, Information Center, Logistic Service Center and NSFC scientific departments attended the meeting.

May 29 President YANG Wei and Vice President YAO Jiannian attended the 15th Meeting of the Standing Committee of the 8th National Committee of the China Association for Science and Technology.

May 30–Jun. 3 President YANG Wei and Vice President SHEN Yan, YAO Jiannian, HE Minghong, LIU Congqiang, GAO Wen, GAO Ruiping attended the National Conference on Science and Technology, the Biennial Conference of Chinese Academy of Sciences and Chinese Academy of Engineering, and the 9th National Congress of the China Association for Science and Technology.

June

Jun. 14 NSFC held a press conference at the press conference hall of the State Council Information Office. Vice President GAO Wen and

The Summary Meeting of the Submission of 2016 National Natural Science Fund Applications is held in Dalian

NSFC holds a press conference at the press conference hall of the State Council Information Office

Deputy Secretary-General HAN Yu introduced the *13th Five-Year Development Plan of the National Natural Science Fund* and answered questions from the media.

Jun. 17 President YANG Wei was interviewed by People's Daily Online and gave a thorough interpretation of the *13th Five-Year Development Plan of the National Natural Science Fund*.

Jun. 18 President YANG Wei attended the 4th Meeting of the Advisory Committee on Development of the Chinese Academy of Sciences.

Jun. 18–21 A delegation led by President YANG Wei paid a visit to Hong Kong SAR. President Yang attended the signing ceremony of the *Collaborative Agreement between Hong Kong, Macao and Taiwan Affairs Office of NSFC and Beijing-Hong Kong Academic Exchange Center*. He also met with Nicholas W. Yang, Secretary for Innovation and Technology of the Hong Kong Special Administrative Region, and Benjamin Wah, Chairman of the Research Grants Council of Hong Kong.

President YANG Wei visits the Hong Kong Special Administrative Region

Jun. 21 Vice President SHEN Yan attended the acceptance testing meeting of Photoelectric Super Resolution Biological Micro-Image Formation System, a project of the Special Fund for Research on National Major Research Instruments (departmental recommendation).

Jun. 23 Vice President GAO Wen attended the strategic cooperation symposium between NSFC and the State Administration of Science, Technology and Industry for National Defense.

Jun. 24 Vice President GAO Ruiping attended the Awards Conference for Outstanding Party Members, Faithful Party Workers and Excellent Primary-Level Party Organizations of Central State Organs.

Jun. 27 Vice President GAO Ruiping attended the founding conference of the Consortium of Academic Societies for Civil-Military Integration.

July

Jul. 1 Celebration for the 95th Anniversary of the Founding of the Communist Party of China & the Awards Ceremony for Outstanding Party Members, Faithful Party Workers and Excellent Primary-Level Party Organizations from 2011 to 2015 was held at NSFC. President YANG Wei, Secretary of the NSFC CPC Leading Group, made remarks. Members of the NSFC CPC Leading Group including Vice President SHEN Yan, HE Minghong and GAO Wen and GUO Xiaoyue from the CCDI Discipline Inspection Group attended the meeting. The meeting was chaired by Vice President GAO Ruiping, member of the NSFC CPC Leading Group and Secretary of NSFC Party Committee.

NSFC holds the Celebration for the 95th Anniversary of the Founding of the Communist Party of China & the Award Ceremony for Outstanding Party Members, Faithful Party Workers and Excellent Primary-Level Party Organizations

Jul. 4 President YANG Wei and Vice President GAO Ruiping attended the thematic meeting titled “50 Years with the Party” organized by the Party Branch of Retired Staff.

Jul. 5 The 7th NSFC Executive Committee Meeting (enlarged session) approved the launching of two Major Research Plan Programs: “Basic Theories and Key Technologies of Coexisting-Cooperative-Cognitive Robots” and “Mechanism of Organ Aging and Degeneration”.

Jul. 9 Vice President GAO Wen attended the 2nd plenary session of the Strategic Planning Committee of Science, Technology and Industry for National Defense.

Jul. 12–14 The 2016 review meeting of the Special Fund for Research on National Major Research Instruments (free application) was held in Beijing. Vice President GAO Ruiping attended the meeting.

Jul. 13 The NSFC CPC Leading Group held a study meeting of the Leading Party Group and the Central Party Group (enlarged session) to learn the essence of the speech of General Secretary XI Jinping at the ceremony marking the 95th anniversary of the founding of the Communist Party of China. President YANG Wei, Secretary of the NSFC CPC Leading Group, chaired the meeting. Members of the NSFC CPC Leading Group and heads of administrative bureaus and scientific departments attended the meeting. XUAN Hongyun, Deputy Director of the CCDI Discipline Inspection Group, and representatives from the Coordination Group on Studies on Theoretical and Practical Issues Related to Party Building of the Organization Department of the CPC Central Committee and State Organs Work Committee were also invited to the meeting.

NSFC holds a study meeting of the Leading Party Group and the Central Party Group (enlarged session) to learn the essence of the speech of General Secretary XI Jinping at the ceremony marking the 95th anniversary of the founding of the Communist Party of China

Jul. 13 Vice President GAO Ruiping chaired the liaison meeting between NSFC Coordination Group of studies on Theoritical and Practical Issues on Party Building and the Coordination Group of studies on Theoritical and Practical Issues on Party Building Studies of the Organization Department of the CPC Central Committee.

Jul. 20 The NSFC CPC Leading Group held a study meeting of the Leading Party Group and the Central Party Group (enlarged session). President YANG Wei, Secretary of the NSFC CPC Leading Group, chaired the meeting. GUO Xiangyuan, Director of the CCDI Discipline Inspection Group, gave a lecture titled *Comprehensively Implementing the Responsibility to Strengthen Party Discipline, Making the Party Rules More Strict than the Law* to all NSFC staff.

Jul. 21–22 The 2016 review meeting of the Special Fund for Research on National Major Research Instruments (departmental recommendation) was held in Beijing. President YANG Wei chaired the meeting and made remarks at the opening ceremony. Vice President GAO Ruiping attended the meeting.

2016 review meeting of the Special Fund for Research on National Major Research Instruments (departmental recommendation) is held in Beijing

Jul. 28 Vice President YAO Jiannian attended the 5th Meeting of the NSFC-CAS Joint Leading Group of Strategic Research on Disciplinary Development.

Jul. 28 The review committee meeting of Basic Research Center Program of 2016 was held in Beijing. President YANG Wei introduced the background, positioning and principles of Basic Research Center Program at the opening ceremony and called on the reviewers to pay more attention to frontier researches and interdisciplinary researches and to ensure fairness in evaluation. Vice President GAO Ruiping chaired the opening ceremony.

The review committee meeting of Basic Research Center Program of 2016 is held in Beijing

August

Aug. 3 *Strategic Cooperation Agreement between NSFC and Science & Technology Commission of the CPC Central Military Commission* was signed in Beijing. President YANG Wei, Vice President GAO Ruiping, Chairman LIU Guozhi and Vice Chairman HE Fuchu of the Science & Technology Commission of the CPC Central Military Commission attended the signing ceremony.

Aug. 4–5 The joint working meeting of the Joint Fund to Promote Cross-Strait Scientific and Technological Cooperation, the NSFC-Zhejiang Joint Fund for the Integration of Industrialization and Informatization, the NSFC-Xinjiang Joint Fund, the NSFC-Yunnan Joint Fund and the NSFC-

Liaoning Joint Fund in 2016 was held in Beijing. President YANG Wei chaired the meeting.

The joint working meeting of the NSFC-Liaoning Joint Fund is held in Beijing

Aug. 12 The Meeting of the Standing Committee of NSFC Supervision Committee was held. Members of the Standing Committee were debriefed by the Office of Supervision Committee on the investigation of cases applied for reconsideration. The investigation report was approved. President CHEN Yiyu of the NSFC Supervision Committee chaired the meeting. NSFC Vice President HE Minghong attended the meeting.

Aug. 19 President YANG Wei attended the National Hygiene and Health Conference.

Aug. 24 NSFC held a press conference on the funding progress of National Natural Science Fund projects in 2016. Vice President GAO Ruiping attended the press conference. The conference was chaired by spokesman and Deputy Secretary-General HAN Yu.

Aug. 25 Vice President SHEN Yan attended the founding conference of the Strategic Research Institute of Disruptive Technology.

NSFC holds a press conference on the funding progress of National Natural Science Fund projects in 2016

Aug. 25–26 The joint working meeting of the Joint Fund for the Innovation and Development of China Automobile Industry, the NSFC-GenerTec Joint Fund for Basic Research, the NSFC-Shanxi Joint Fund for Coal-Based Low-Carbon Technology, the NSFC-Guangdong Joint Fund and the NSFC-Henan Joint Fund was held in Beijing. Vice President GAO Ruiping chaired the meeting.

Aug. 31 Vice President HE Minghong addressed all secret-related personnel and gave a training presentation on secret protection.

September

Sep. 6 The 10th NSFC Executive Committee Meeting approved the launching of 3 Basic Research Center Programs: "Geometry, Analysis, and Computation on Manifolds", "Frontier Research in Chemical Dynamics" and "Craton Destruction and Terrestrial Life Evolution".

Sep. 7 NSFC held an unveiling ceremony for portraits of previous NSFC Presidents. President YANG Wei attended and made remarks. Vice

President GAO Ruiping presided over the ceremony.

Sep. 7 The *Agreement on the Joint Fund of Basic Research of Express Railway (the 2nd phase)* between NSFC and China Railway was signed in Beijing. Vice President GAO Ruiping and LU Chunfang, Vice General Manager of China Railway, attended the ceremony and signed on the agreement.

NSFC and China Railway sign *the Agreement on the Joint Fund of Basic Research of Express Railway (the 2nd phase)*

Sep. 8 The *Strategic Cooperation Framework Agreement between NSFC and Springer Nature* was signed in Beijing by President YANG Wei and Stefan von Holtzbrinck, Chairman of Springer Nature and Chief Executive Officer of Holtzbrinck Publishing Group.

Sep. 8 President YANG Wei chaired a symposium with a delegation led by GUO Xiangyuan, Director of the CCDI Discipline Inspection Group to MOST, on management and supervision of scientific research projects and prevention and control of corruption. Vice President GAO Ruiping, Deputy Secretary-General HAN Yu, Deputy Director HE Zhenfu and XUAN Hongyun of the CCDI Discipline Inspection Group attended the symposium.

Sep. 12 The 9th Plenary Session of the 4th Supervision Committee of NSFC was held. Members of the Supervision Committee were debriefed by the Office of Supervision Committee on the investigation of research misconduct cases. President CHEN Yiyu of the Supervision Committee chaired the meeting. NSFC Vice President HE Minghong and Deputy Director XUAN Hongyun of the CCDI Discipline Inspection Group attended the meeting.

Sep. 12 President YANG Wei, Secretary of the NSFC CPC Leading Group, attended the founding conference of NSFC Science Communication Center and made remarks. Vice President GAO Wen, member of the NSFC CPC Leading Group, chaired the conference.

Sep. 14 Vice President GAO Ruiping gave a Party lecture titled *Staying True to the Original Aspiration and Keeping Marching Forward* to Party members from Party branches of the Bureau of Planning, the Bureau of Finance, Party Committee, Department of Chemistry and Department of Engineering and Material Sciences.

Sep. 14 The 5th Discipline Inspection Team of the Central State Organs Work Committee informed NSFC of the results of a special inspection. WU Haiying, Deputy Secretary of the Commission for Discipline Inspection of Central State Organs, attended the meeting and made remarks. MA Mingwei, Head of the 5th Discipline Inspection Team of the Central State Organs Work Committee, conveyed the inspection results to NSFC on behalf of the 5th Discipline Inspection Team. President YANG Wei made summery remarks and Vice President GAO Ruiping made a position statement on behalf of NSFC.

The 5th Discipline Inspection Team of the Central State Organs Work Committee informs NSFC of the results of a special inspection

Sep. 21 Vice President HE Minghong gave a Party lecture titled *Keeping in Mind Our Mission and Exemplarily Performing Our Duties* to Party members from Party branches of the General Office and Logistic Service Center.

Sep. 21 Vice President GAO Ruiping attended the national videoconference on the supervision of the implementation of "Two-Way Random Inspection and Publishing Inspection results to guarantee transparency".

Sep. 22 The review committee meeting of 2016 National Science Fund for Distinguished Young Scholars was held in Beijing. President YANG Wei attended the meeting and made remarks. Vice President GAO Ruiping attended the meeting.

Sep. 26-28 The panel review meeting and steering committee meeting of the NSFC-Henan Joint Fund, the NSFC-Xinjiang Joint Fund and the Joint Fund to Promote Cross-Strait Scientific and Technological Cooperation of 2016 was held in Zhengzhou. President YANG Wei and Vice President GAO Ruiping attended the meeting.

Sep. 29 The signing ceremony of the *Agreement of the NSFC-Shandong Joint Fund (the 2nd phase)* was held in Jinan. President YANG Wei, Vice President GAO Ruiping, Governor GUO Shuqing and Vice Governor WANG Shujian of Shandong Province attended the ceremony. Vice President GAO Ruiping and Vice Governor WANG Shujian signed the agreement on behalf of NSFC and the People's Government of Shandong Province.

The signing ceremony of the *Agreement of the NSFC-Shandong Joint Fund (the 2nd phase)* is held in Jinan

October

Oct. 10 President YANG Wei gave a Party lecture titled *Upholding Ethics and Integrity: a Philosophy of Moral Character Cultivation for Administrators and Scholars* to Party members from Party branches of the Bureau of Planning, the Bureau of Personnel, Department of Mathematical and Physical Sciences and Department of Management Sciences.

Oct. 11 The 11th NSFC Executive Committee Meeting (enlarged session) approved the launching of two Major Research Plan Programs: "New Multi-Dimensional Optical Field Manipulation Physics and Application" and "Mechanism Underlying the Cycling of Earth Elements Driven by Microbes in Hydrosphere".

Oct. 11 Vice President GAO Ruiping met with WU Degang, member of the Standing Committee of Gansu Provincial Party Committee and Director of the Organization Department of Gansu Provincial Party Committee, and HAO Yuan, Vice Governor of Gansu Province.

Oct. 12–15 The panel review meeting and steering committee meeting of the NSFC-Liaoning Joint Fund, the NSFC-Yunnan Joint Fund and the NSFC-Zhejiang Joint Fund for the Integration of Industrialization and Informatization of 2016 was held in Shenyang. President YANG Wei and Vice President GAO Ruiping attended the meeting.

Oct. 19 President YANG Wei chaired the 2016 Forum of "National Natural Science Fund and I". Academician ZHANG Jie, President of Shanghai Jiao Tong University, delivered a keynote presentation titled *Taking People as the Most Valuable Asset and Perfecting Incentive Mechanism: Marching toward the Goal of Innovation-Oriented University*.

Oct. 20 President YANG Wei met with a delegation led by SUN Qin, Chairman of China National Nuclear Corporation and Secretary of its Party Committee.

President YANG Wei meets with SUN Qin, Chairman of China National Nuclear Corporation and Secretary of its Party Committee

Oct. 21 Vice President YAO Jiannian attended the Awards Ceremony of the 2016 Prize for Scientific and Technological Progress of Ho Leung Ho Lee Foundation and gave awards to laureates.

Oct. 24–27 President YANG Wei attended the 6th Plenary Session of the 18th CPC Central Committee.

Oct. 25 The panel review meeting and steering committee meeting of the Joint Fund for the Innovation and Development of China Automobile Industry of 2016 was held in Beijing. Vice President GAO Ruiping chaired the meeting.

Oct. 26–27 The Appraisal Meeting of the Science Fund for Creative Research Groups of 2016 was held in Beijing. Vice President GAO Ruiping attended the meeting and made remarks.

Oct. 28 NSFC held a meeting of all Party members. President YANG Wei, Secretary of the NSFC CPC Leading Group, conveyed the essence of the 6th Plenary Session of the 18th CPC Central Committee. Members of the NSFC CPC Leading Group SHEN Yan, HE Minghong, LIU Congqiang and GAO Wen attended the meeting. Vice President GAO Ruiping, member of the NSFC CPC Leading Group, chaired the meeting.

President YANG Wei, Secretary of the NSFC CPC Leading Group, conveys the essence of the 6th Plenary Session of the 18th CPC Central Committee

President YANG Wei meets with Professor Venki Ramakrishnan, President of the Royal Society of UK

Oct. 28 President YANG Wei attended the Forum on Frontiers of Science and Technology with the theme of *Research on the Development Strategy of S&T Journals of China*, and delivered a keynote presentation titled *Taking Quality as the Foundation of a Country, Integrity as the Foundation of a University and Openness as the Foundation of a Journal*.

November

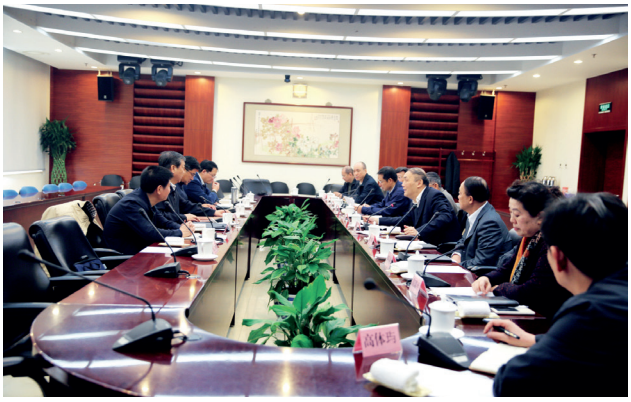
Nov. 2 President YANG Wei met with Professor Venki Ramakrishnan, President of the Royal Society of UK.

Nov. 7 The steering committee meeting of the NSFC-GenerTec Joint Fund for Basic Research of 2016 was held in Beijing. Vice President GAO Ruiping chaired the meeting.

Nov. 9 The Mobilization Meeting of the Special Inspection of the NSFC CPC Leading Group by the 8th Central Inspection Team was held. NING Yanling, Director of the 8th Central Inspection Team, made remarks about the upcoming inspection work. Head of the Office of the Central Leading Group for Inspection Work made requests of cooperation with the Inspection Team on the inspection work. President YANG Wei, Secretary of the NSFC CPC Leading Group, chaired the meeting and made a position statement. Deputy Director XUE Li, QING He and other members of the 8th Central Inspection Team, Deputy Director XUAN Hongyun of the CCDI Discipline Inspection Group to MOST, NSFC Vice Presidents and heads of divisions, bureaus and scientific departments attended the meeting.

The Mobilization Meeting of the Special Inspection of the NSFC CPC Leading Group by the 8th Central Inspection Team is held at NSFC

Nov. 10 President YANG Wei chaired the meeting between NSFC leading members and WANG Binyi, Director of the CCDI Discipline Inspection Group to MOST.



President YANG Wei chairs the meeting between NSFC leading members and WANG Binyi, Director of the CCDI Discipline Inspection Group to MOST

Nov. 10–11 The panel review meeting and steering committee meeting of NSFC-Guangdong Joint Fund and NSFC-Shanxi Joint Fund of 2016, the Joint Meeting of the NSFC-Shenzhen Basic Research Center of Robots Program and the Steering Committee Meeting of the NSFC-Guangdong Big Data Research Center Program were held in Guangzhou.

Nov. 10–13 President YANG Wei attended the 14th Meeting of Heads of Research Councils in Asia held in Hangzhou.

Nov. 14 The NSFC CPC Leading Group held a study meeting of the Leading Party Group and the Central Party Group (enlarged session) and invited Professor ZHU Lingjun, Deputy Director of the Department of Party Building of the Party School of the CPC Central Committee, to give a presentation with the theme of *Learning the Essence of the 6th Plenary Session of the 18th CPC Central Committee, Comprehensively Strengthening Party Discipline* to all Party members and cadres. President YANG Wei, Secretary of the NSFC CPC Leading Group, chaired the meeting. Vice President SHEN Yan, YAO Jiannian, HE Minghong, LIU Congqiang, GAO Wen and GAO Ruiping attended the meeting.

The Meeting of the NSFC CPC Leading Group and the Central Party Group (enlarged session) invites Professor ZHU Lingjun of the Party School of the CPC Central Committee to give a presentation with the theme of *Learning the Essence of the 6th Plenary Session of the 18th CPC Central Committee, Comprehensively Strengthening Party Discipline*

Nov. 14 The 13th NSFC Executive Committee Meeting approved the registration of 296 institutions as host institutions.

Nov. 15–16 NSFC CPC Leading Group held an enlarged session to learn and implement the essence of the 6th Plenary Session of the 18th CPC Central Committee. President YANG Wei, Secretary of the NSFC CPC Leading Group, chaired the meeting and made a mobilization speech. Members of NSFC Leading Group attended the meeting.

The NSFC CPC Leading Group Meeting (enlarged session) is held to learn and implement the essence of the 6th Plenary Session of the 18th CPC Central Committee

Nov. 21–22 The interview meeting for "Thousand Talent Program for Young Scholars" of 2016 was held in Beijing. President YANG Wei attended the meeting and made remarks at the opening ceremony. Vice President GAO Ruiping attended the meeting.

Nov. 22–23 NSFC held a theory discussion meeting of the thorough learning and implementation of the essence of the National Conference on Science and Technology, the Biennial Conference of Chinese Academy of Sciences and Chinese Academy of Engineering, and the 9th National Congress of the China Association for Science and Technology. President YANG Wei chaired the meeting and made remarks. Other members of the NSFC Leading Group and Deputy Director XUAN Hongyun of the CCDI Discipline Inspection Group attended the meeting.

NSFC holds a theory discussion meeting of the thorough learning and implementation of the essence of the National Conference on Science and Technology, the Biennial Conference of Chinese Academy of Sciences and Chinese Academy of Engineering, and the 9th National Congress of the China Association for Science and Technology

Nov. 24 The review meeting of the NSFC-CASC Joint Fund for Advanced Manufacturing Technology for Aerospace Industry of 2016 was held in Beijing. Vice President YAO Jiannian and XU Qiang, Vice President of the China Aerospace Science and Technology Corporation, attended the meeting and made remarks.

Nov. 24–25 The appraisal meeting of the first group of Major Research Plan projects implemented during the 11th Five Year Plan period was held in Beijing. President YANG Wei and Vice President GAO Ruiping attended the meeting.

Nov. 27 The panel review meeting and steering committee meeting of the NSFC-Shenzhen Basic Research Center of Robots Program of 2016 was held in Beijing. President YANG Wei, Vice President GAO Ruiping and ZHANG Hu, Executive Vice Major of Shenzhen, attended the meeting.

December

Dec. 12 NSFC held the 2016 briefing on safeguarding scientific ethics and opposing research misconducts. NSFC President YANG Wei, President of NSFC Supervision Committee CHEN

Yiyu, NSFC Vice President HE Minghong attended the briefing and answered questions from the media. The briefing was chaired by Spokesman and Deputy Secretary-General HAN Yu.

Dec. 13 The 2016 Meeting of the Management of National Natural Science Fund was held in Beijing. President YANG Wei attended the meeting and made remarks. Vice President YAO Jiannian, HE Minghong, LIU Congqiang, GAO Wen and GAO Ruiping attended the meeting. The meeting recognized the work of host institutions, regional networks and administrators who made outstanding achievements during the 12th Five-Year Plan period and made planning for the submission and receiving of proposals in 2017. More than 200 representatives from 115 host institutions and 29 S&T departments of local governments attended the meeting.

The 2016 Meeting of the Management of National Natural Science Fund is held in Beijing

Dec. 15 The panel review meeting and steering committee meeting of the NSFC-Guizhou Scientific Research Center on Karst Science of 2016 was held in Beijing. Vice President GAO Ruiping attended the meeting.

Dec. 19–25 President YANG Wei, Vice President SHEN Yan and YAO Jiannian attended the 25th meeting of the Standing Committee of 12th National People's Congress.

Dec. 21 Vice President GAO Ruiping attended the Training of the Management of National Natural Science Fund for NSFC Staff of 2017 and made a mobilization speech.

Dec. 23 Vice President GAO Ruiping attended the National Awards Conference for Outstanding Organizations and Excellent Individuals of Retired Staff Affairs and the National Conference of Directors of Bureaus of Retired Staff Affairs.

Dec. 26 President YANG Wei gave a joint interview to Guangming Daily, Science and Technology Daily and China Science Daily. He talked about the achievements of National Natural Science Fund in boosting basic research of China, facilitating the development of basic research talent, promoting disciplinary crossing and integration and building up new international cooperation relations.

President YANG Wei gives a joint interview to Guangming Daily, Science and Technology Daily and China Science Daily.

Dec. 26 Vice President GAO Wen attended the 5th Plenary Session of the Education, Science, Culture, Health and Sports Committee of CPPCC National Committee.

Dec. 28 President YANG Wei and Vice President GAO Ruiping visited the exhibition of achievements of China aerospace science and technology during the 12th Five-Year Plan period.

Part 2

Project Review

2.1 Breakthrough achieved in laser driven wake-field acceleration of electrons

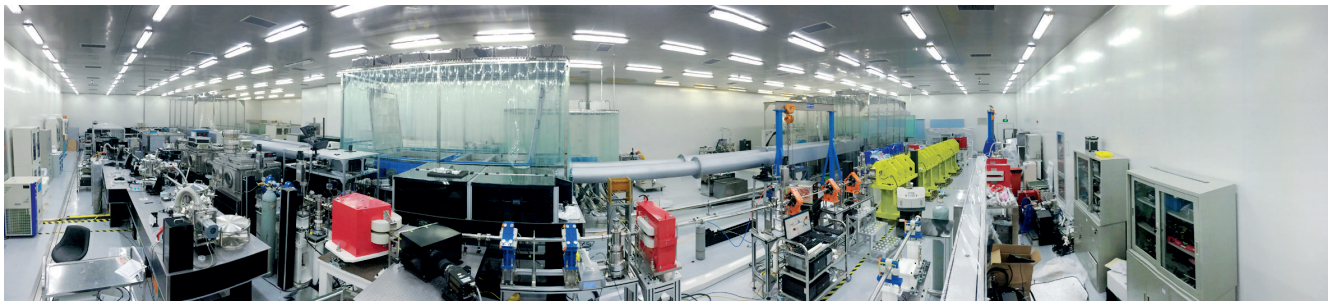


Figure 1. The experimental setup.

With the support of National Major Scientific Instrument Development Project of National Natural Science Foundation of China, a team led by Academician XU Zhizhan and Professor LI Ruxin with the State Key Laboratory of High Field Laser Physics at Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, has achieved a breakthrough in the generation of high brightness and high quality electron beam via wake-field acceleration driven ultrafast ultra-intense laser pulses. The results were published and highlighted as Editors' Suggestion in *Physics Review Letter*.

The development of compact, low-cost, laser driven particle accelerators has been pursued by scientists for decades. The ultrahigh accelerating gradient of laser driven wake-field acceleration (LWFA) of electrons of the order of 100 GV/m makes the LWFA very attractive as a compact electron accelerator with great impacts in the future synchrotron radiation facilities, free electron lasers and high energy physics researches. The past decade has witnessed remarkable progress in the field of LWFA, with significant challenges in the generation of high quality high energy electron beams and substantial limitations in the application of LWFAs.

In recent years this team has conducted creative researches in LWFA of electrons. They demonstrated for the first time the generation of GeV-level high electron beams via the cascaded acceleration of two-stage LWFAs in *Physics Review Letter*. By designing a structured gas density profile between the dual-stage gas jets, they recently demonstrated a new scheme of the cascaded LWFA via manipulating electron injection, quasi-phase-stable acceleration, electron seeding in different periods of the wake-field, as well as controlling energy chirp reversal for realizing energy spread compression. High-quality electron beams with energies in the range of 200–600 MeV, 0.4%–1.2% rms energy spread, 10–80 pC charge, and 0.2 mrad rms divergence are experimentally obtained in this new cascaded acceleration scheme. The maximum 6D brightness B6D;n which

is defined as the peak current in the electron beam core divided by the product of the rms transverse normalized emittances and the fractional energy spread rms in units of 0.1%, is estimated as $10^{15\text{-}16}$ A/m^2/0.1%, which is comparable with the typical brightness of electron beams from state-of-the-art linac drivers. The achieved electron quality could meet the requirement for realizing a high-gain soft x-ray free electron laser if using a transverse gradient undulator. Three-dimensional particle-in-cell simulations support this attractive cascaded LWFA scheme for generating controllable high-quality e-beams.

Using these high quality electron beams and back Compton scattering scheme, they also produced tunable quasi-monochromatic MeV γ-rays with a peak brilliance of ~3×1022 photons s^{-1}mm^{-2}mrad^{-2} 0.1% BW. It is one order of magnitude higher than ever reported value of its kinds in MeV regime. This compact ultrahigh brilliance γ-ray source may provide applications in nuclear resonance fluorescence, x-ray radiology and ultrafast pump-probe nondestructive inspection.

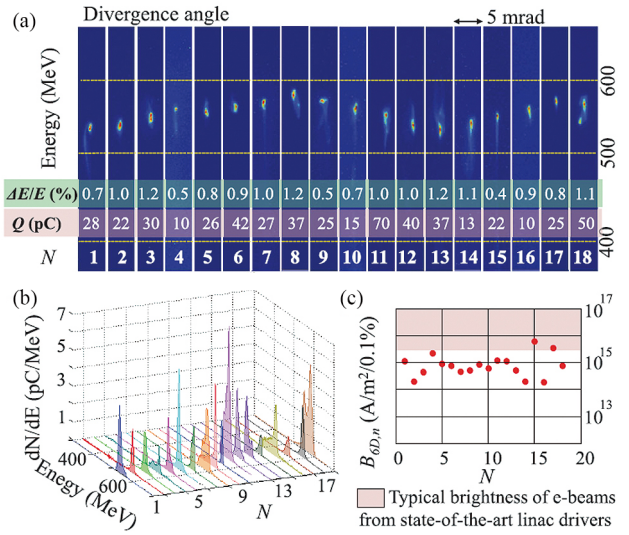


Figure 2. (a) Measured energy, relative energy spread, charge, and divergence of high quality electron beams; (b) The corresponding energy spectra of (a); (c) The corresponding 6-dimentional brightness of the electron beams, which are comparable with the typical brightness of electron beams from state-of-the-art linac drivers.

2.2 Direct evidence of multiple star-forming events in star clusters

Star clusters are stellar systems composed of tens to millions of stars. Current consensus of star cluster formation implies that their stars should have formed in a single at the time of cluster formation: stars in star clusters can only form once. The first-generation stars will inject energy into the gas present in the cluster by means of stellar radiation, outflows and supernova explosions, leading to quick exhaustion of any gas left following the initial star-formation event in a cluster. If there is no remaining gas, a star cluster will not be able to form a next generation of stars.

However, observational evidence has shown that stars in the old globular clusters in our Milky Way are not so simple. It seems that they contain two or more stellar generations. This raises doubts about the scenario in which star clusters form all of their stars in an initial episode of star

formation. However, because of a lack of direct observational evidence in support of multiple star-forming events in relatively young star clusters, the viability of scenarios in which stars are formed over extended periods is still an open question. A Chinese research team led by DENG Licai which is composed of astronomers from Peking University and the National Astronomical Observatories, Chinese Academy of Sciences, reported their discovery of multiple star-forming events in young clusters.

In order to avoid the obscuring effects of dust in the Milky Way's disk, the Chinese team focused their efforts on the Magellanic Clouds, two small satellite galaxies of our Milky Way. The Large and Small Magellanic Clouds contain numerous relatively young yet massive clusters. Three of these clusters, NGC 1783, NGC 1806 and NGC 411, were their main focus. To their surprise, they found that stars in these clusters cannot be described by a single isochrone. Instead, the HR diagrams of these clusters exhibit two or three obvious stellar populations of different ages, requiring two or three isochrones to fully describe their stellar distributions (Figure 1). These results clearly suggest that these three relatively young clusters have undergone more than one star-forming event during their recent evolutionary history.

The team next compared the observational results to proposed scenarios that aim at explaining the presence of multiple stellar populations in globular clusters. Based on these scenarios, only an initially extremely massive cluster would be able to retain the runaway gas from supernova explosions or common stellar outflows. This gas would then be collected in the cluster center and perhaps proceed to form new stars. This means that second stellar generation stars should be characterized by a more compact configuration than the first-generation stars. However, the team found that the new stellar-generation stars are actually distributed in a more extended fashion, which is in conflict with all traditional scenarios. The team speculated that may imply that the new stars originate from external molecular gas rather than from their initial natal cloud of gas. A possible explanation involves collisions between the star clusters and molecular clouds located along a cluster's orbit in its host galaxy.

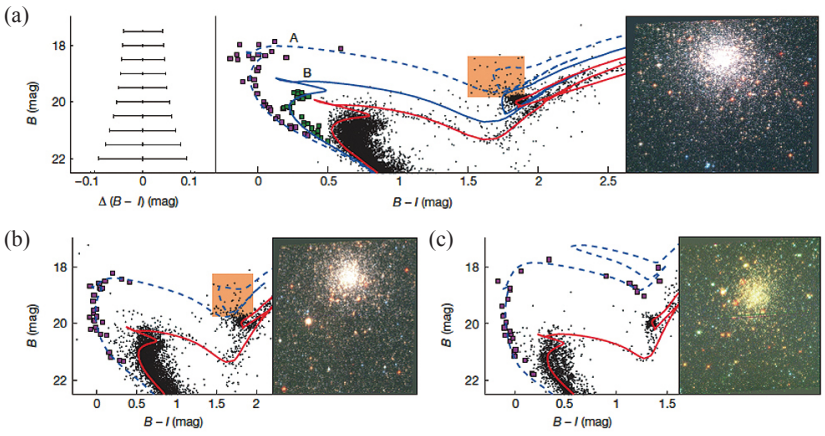


Figure 1. (a) star cluster NGC 1783;
(b) star cluster NGC 1806;
(c) star cluster NGC 411;
All the three star clusters show that except the early-formed stars, the new sfellor generation stars (e.g. NGC 1783) require additional isochrones to describe their stellar distribution.

2.3 Advances in the direct production of lower olefins via syngas conversion

Lower olefins, generally refer to ethylene, propylene and butylene, are basic building blocks in chemistry industry, which are traditionally produced from thermal or catalytic cracking of naphtha and oil refining process. With the rapid depletion of the limited petroleum reserves, there is an urgent need for processes that can produce lower olefins from alternative feedstocks. The syngas, which is a promising alternative feedstock as it can be obtained from reforming of natural gas, gasification of coal or biomass, can be transformed into lower olefins through indirect or direct reaction. The indirect process mainly refers to the methanol to olefins (MTO) technology, of which methanol is first produced by syngas and further dehydrated to olefins.

In order to simplify the industry process of MTO for direct production of lower olefins via syngas, scientists always devote to find out a bifunctional catalyst system with two components to couple the methanol synthesis and C-C coupling. Recently, BAO Xinhe, et al., from Dalian Institute of Chemical Physics, Chinese Academy of Sciences reported that $ZnCrO_x$/MSAPO exhibited very high selectivity toward lower olefins. It was suggested that the partially reduced oxide surface ($ZnCrO_x$) activated CO and H_2 to form ketene which was subsequently converted into olefins in the zeolite pores. WANG Ye, et al., from Xiamen University also reported a similar result using a ZnZr/ SAPO-34 bifunctional catalyst.

Fischer–Tropsch to olefins (FTO) reaction is very similar to typical Fischer–Tropsch (FT) process. Fe-based FTO catalysts are always studied and some promising results have been achieved. The outstanding result reported by de Jong, et al., using Fe-based catalysts promoted by S and Na and supported by α-alumina or carbon nanofiber, exhibited a selectivity of lower olefins up to 61 C%. However, these reactions normally need temperatures of 300–350°C, which would cause carbon deposition on the catalyst surface and catalyst sintering, deactivating the catalyst and shortening its lifetime. In addition, the hydrocarbons obtained with the FTO process typically follow the so-called Anderson–Schulz–Flory (ASF) distribution, which would lead to rather high CH_4 selectivity. With the goal of high selectivity to lower olefin, low methane selectivity and high stability simultaneously, it is necessary to develop new FTO catalyst which deviate from ASF distribution at mild reaction conditions.

It is widely accepted that metallic Co prefers to produce heavy hydrocarbons with high selectivity C_{5+} paraffin. Co_2C, which is always considered as one of the main deactivation reasons for Co-based FT reaction, possessed very low activity for Co hydrogenation reaction with methane and carbon dioxide as the main products. However, Zhong's and Sun's groups from CAS Key Laboratory of Low-Carbon Conversion Science and Engineering now report that (Figure 1), under mild reaction conditions (250°C, 1–5 bar), Co_2C nanoprisms catalyze the syngas conversion

with high selectivity for the production of lower olefins (60 C%), while generating little methane (5.0 C%), with the ratio of olefin/paraffin amongst the C_2–C_4 products being as high as 30 (Figure 2). The product distribution deviates markedly from the classical ASF distribution with the highest selectivity to propylene. Based on detailed structure characterization and DFT calculations, it was suggested there existed a strong facet effect for Co_2C nanoparticles during syngas conversion. Specifically, the {101} and {020} facets of Co_2C are beneficial for the production of olefins and inhibit the formation of methane.

This is a groundbreaking contribution that will deepen the understanding of Fischer–Tropsch process. The high activity, selectivity and stability at mild reaction conditions suggest immense potential industrial application. As Professor Michael Claeys has said in the NEWS & VIEWS in *Nature*, "their potential impact cannot be overestimated: they might open up pathways for the development of greatly improved systems for producing valuable chemicals from a variety of carbon sources" and "Zhong et al. have thrown open the reaction's treasure chest, and added fresh momentum to research into methods for making olefins from synthesis gas".

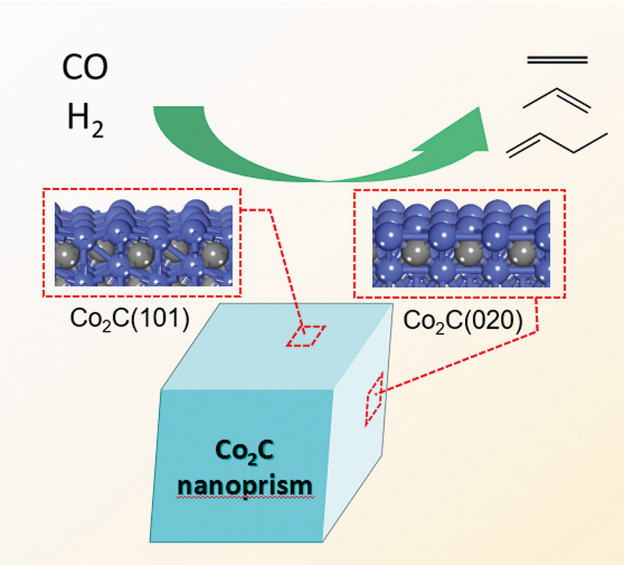


Figure 1. Co_2C nanoprisms with the exposed facets of {101} and {020} for direct production of olefins via syngas with high selectivity.

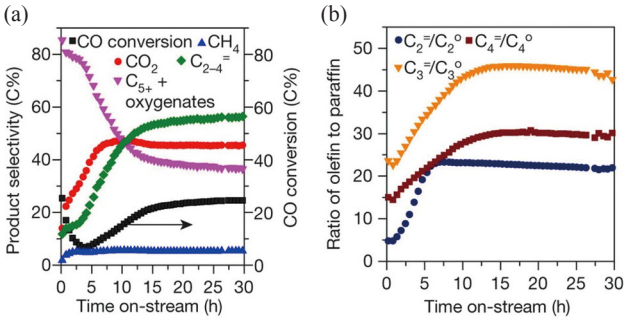


Figure 2. Catalytic performance of Co_2C nanoprisms. (a) CO conversion and products selectivity as time on stream. (b) Ratio of olefin to paraffin as time on stream.

2.4 Breakthrough in ethylene/acetylene separation

In recently years, society increasingly depends upon gases like hydrogen, natural gas, shale gas and ethylene as chemical raw materials and energy fuels. In 2011, the International Energy Agency (IEA) issued a special report "Golden Age of Gas", means that the "age of gas" has dawned. This era creates an urgent demand for the energy-efficient technology for gas separation and storage, such as purification of natural gas, separation and storage of hydrogen, separation of light hydrocarbons, and capture of carbon dioxide.

The trade-off between separation selectivity and uptake capacity has been identified as a major barrier toward efficient separation and purification of gas. Ethylene is the most produced organic compound in the world. The production capacity of ethylene reached 160 million tons in 2015. The separation and purification of ethylene is quite difficult and challenging due to similar molecular structures, especially for the elimination of trace acetylene. The current separation methods include selective hydrogenation of acetylene and solvent absorption. However, these methods always consume a large amount of energy and solvent. Therefore, there is an urgent demand for the development of novel methods for the separation of ethylene and acetylene.

In response to this problem, XING Huabin's group from Zhejiang University and their collaborators from University of Limerick and University of Texas-San Antonio for the first time present a novel strategy for the separation of ethylene and acetylene using ionic hybrid porous materials. Unprecedented selectivity for acetylene over ethylene is achieved through the strong hydrogen-bonding interactions between acetylene and inorganic anions. Precise control of the pore size and pore chemistry of the SIFSIX materials enables the efficient uptake of acetylene through the cooperative host-guest and/or guest-guest interactions. This novel strategy not only enables the selective recognition of target gas, but also enhances the uptake capacity for specific gas. More excitingly, they observed for the first time "acetylene clusters" from high-resolution neutron powder diffraction and provide a deeper insight into the nature of the gas-adsorbent interaction.

Their efficiency for the separation of acetylene/ethylene mixtures was demonstrated by experimental breakthrough curves. In the important process of the removal of trace acetylene from ethylene, the acetylene uptake capacity of the hybrid porous material is 5.7 times as much as the ever reported best-performing materials. This study sets new benchmark in the separation of acetylene/ethylene. These findings not only indicate a new path forward for acetylene capture/separation but also demonstrate how a design or crystal engineering approach can be used generally to develop new families of hybrid porous materials for important gas separations.

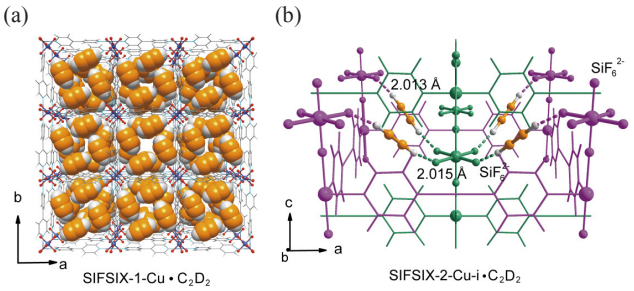


Figure 1. The Neutron crystal structure of C_2H_2 and hybrid porous materials (a) SIFSIX-1-Cu•4C_2D_2; (b) SIFSIX-2-Cu-i•C_2H_2.

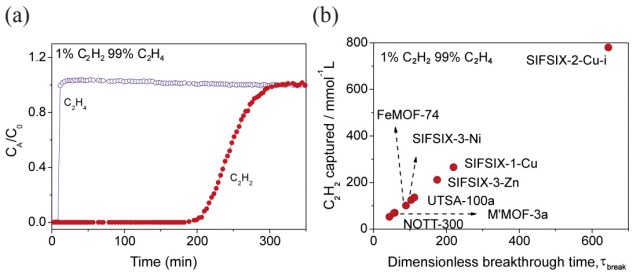


Figure 2. (a) Breakthrough curves for C_2H_2/C_2H_4 (1/99) mixtures in fixed-bed adsorption; (b) Comparison of the breakthrough time and adsorption capacity of SIFSIX materials versus previously reported materials.

2.5 Chinese researchers make major breakthroughs in plant hormone research

Understanding of hormone perception is central to comprehending hormone action. Enormous efforts made by biologists over the past century have revealed a reversible ligand-receptor interaction for all the hormones: active form of hormone non-covalently binds its receptor to trigger hormone signal transduction, and reversibly dissociates from its receptor without being altered.

During the past few decades, perception mechanisms have been revealed for the nine main classes of plant hormones including auxin, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, salicylic acid, jasmonates and strigolactones. Under the financial supports mainly from National Natural Science Foundation of China (NSFC), the research group of Professor XIE Daoxin at Tsinghua University has defined the receptors for jasmonate and strigolactone, revealed molecular basis for jasmonate signal transduction, and uncovered a novel perception mechanism that integrates both "substrate-enzyme" and "ligand-receptor" interactions.

1. Jasmonate regulates plant defense responses against biotic and abiotic stress, and controls many plant developmental processes such as fertility and senescence. Professor Xie and his colleagues have defined the receptor for jasmonate and revealed the molecular mechanisms of jasmonate-regulated plant fertility, leaf senescence, defense and many other important biological processes (Figure 1).

i) Professor Xie and coworkers have previously identified the F-box protein COI1 in *Science* and *Plant Cell*. Under the supportive grants mainly from NSFC, they have continuously revealed that COI1 assembles into the SCF E3 ubiquitin ligase complex to maintain its homeostasis in planta, and defined COI1 as a receptor for jasmonate: COI1 follows the

rule of the reversible ligand-receptor interaction to reversibly bind the bioactive form of jasmonate (JA-Ile) and regulate plant development and defense in *Plant Cell*.

ii) Professor Xie and colleagues have discovered a series of key factors in the jasmonate pathway to reveal the signal transduction mechanisms of jasmonate-regulated plant growth, seedling development, anthocyanin accumulation, trichome initiation, male fertility, leaf senescence and plant defense. They have elucidated the mechanisms underlying the crosstalk between jasmonate and other plant hormones to modulate plant development and defense in *Molecular Cell*, *Plant Cell*, *PLoS Genetics*, *Curr Opin Plant Biol*, and *Cell Research*. Recently, they have discovered new forms of bioactive jasmonate (JA-Leu, JA-Val, JA-Met and JA-Ala) in planta, and revealed the structural characteristics of bioactive jasmonate in *Plant Physiol*. These original important works are mainly supported by NSFC.

2. Strigolactones (SLs) is a new class of plant hormones that regulate plant branching and architecture to determine crop yield. Meanwhile, strigolactones also act as rhizosphere signals to modulate the interactions between host plants and symbiotic fungi as well as parasitic weeds. Professor Xie and coworkers have discovered the active form of strigolactone, defined the receptor for SL, and revealed a novel perception mechanism that integrates both "substrate-enzyme" and "ligand-receptor" interactions.

i) Under the support from NSFC, the researchers mainly from the laboratories of Professors XIE Daoxin and RAO Zihe have cooperatively found the active form of strigolactone CLIM, defined D14 as the SL receptor in plants, and revealed the novel irreversible "substrate-enzyme-ligand-receptor" hormone perception mechanism: the strigolactone receptor D14 acts as a novel type of hormone receptor with dual roles to generate and perceive the active form of hormone; D14 hydrolyzes different strigolactone molecules into the same active molecule CLIM, irreversibly binds CLIM through covalent bonds, triggers signal transduction to regulate plant branching, and eventually degrades CLIM into an inactive product D-OH (Figure 2) in *Nature*.

ii) Under the support from NSFC, Xie group has further defined ShHTL7 as the SL receptor in parasitic weeds. ShHTL7 perceives strigolactones through the novel type of irreversible "substrate-enzyme-ligand-receptor" hormone perception mechnism: ShHTL7 hydrolyzes strigolactones into the active molecule CLIM, irreversibly binds CLIM through covalent bonds and triggers signal transduction to regulate seed germination of parasitic weeds (Figure 3) in *Cell Research*.

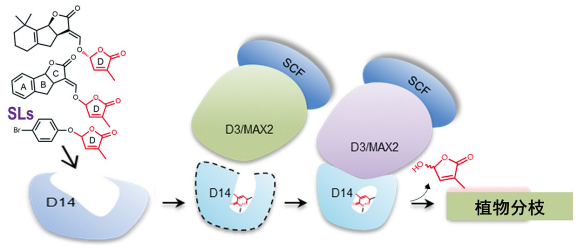


Figure 1. Proposed perception mechanism of strigolactone-regulated plant branching.

Figure 2. Proposed perception mechanism of strigolactone-regulated weed seed germination.

2.6 Chinese scientists achieved important research progress in plant immunity regulated by pathogens

Phytophthora is a group of notorious microbial pathogens which infect nearly all the dicot plants, putting a detrimental effect on global food security, health security and ecological security. Due to historical issues, the fundamental research on Phytophthora biology is severely less developed compared to other plant pathogens. Lacking efficient chemicals, pathogen evolves rapidly, and crop resistance is easily broken down are serious problems in agricultural production now. Since the release of the first Phytophthora genome in 2006, one of the most striking features of these pathogens is the genome encode large amount of effector genes. These effector genes are considered as important players applied by pathogens to regulate host immunity. The study of effector biology is not only beneficial to understand the basis of field disease at theoretical level, but also have great potential to provide clues and materials for disease management.

A research team in Nanjing Agricultural University led by Professor WANG Yuanchao, a grantee of National Science Fund for Distinguished Young Scholars, focuse their research on effector biology during plant-microbe interaction for decades. The team have published more than 100 peer reviewed publications on international journals, such as *Plant Cell*, *Nature Communications* and *PLoS Pathogens*. Professor Wang is ranked as the top Chinese scientist in the plant oomycete field in terms of publication efficiency and citations. He has been invited to give plenary talks in many international conferences, such as IIX International Molecular Plant-Microbe Interaction Conference (Portland, U.S.), and received a broad range of recognitions by international academic community.

In 2011, the team found a new avirulence effector gene Avr3b from Phytophthora sojae, which is the causal agent of soybean root rot disease. Avr3b encodes a functional NUDIX hydrolase. The effector is delivered by pathogen into host cell to mimic plant immune negative regulator to disrupt the homeostasis of immune signals such as ADPR and NADH, which is a new strategy evolved by plant pathogens in *PLoS Pathogens*. Following this publication, several overseas groups have reported similar mechanisms in pathogens of rice blast, flax rust and some others. This piece of works has been evaluated and highly recommended by plant pathologists Sophien Kamoun and Paul Birch. In 2015, this group reported another work that the freshly secreted Avr3b protein does not have Nudix hydrolase activity. However, pathogen could recruit plant endogenous cyclophilin protein to maturate the enzymatic activity of Nudix effector, and eventually suppress host immunity. This report uncovers a new mechanism that pathogen utilizes host post translational modifying system to activate the virulence, providing theoretical evidence to

further disease management in *PLoS Pathogens*.

ER stress response is a key component in plant immunity. However, it remains unclear how pathogen manipulates host ER stress response to infect. This team discovered that an effector shares similar N-terminal with Avr3b, and it could bind and stabilize an ER chaperon protein BiP, to suppress ER response evoked by pathogen infection. This study uncovers a roadmap that pathogen manipulates host ER stress monitoring network to regulate host immunity, providing new ideas for crop genetic improvement in *Nature Communications*.

Recently, this group found that Nudix-like effector genes are wildly distributed in pathogenic oomycete, fungi and bacteria. A common knowledge is that effector genes are normally selected and specialized during evolution, conserved genes across the kingdoms provide us with excellent opportunity to study microbial pathogenesis and plant immunity. It has been proved in several pathosystems that Nudix effectors are virulence factors, indicating different pathogens share similar pathogenesis strategy. In consideration of these progresses, the team is invited to write a review to summarize current study and provide thoughts for the next phase of study in *PLoS Pathogens*.

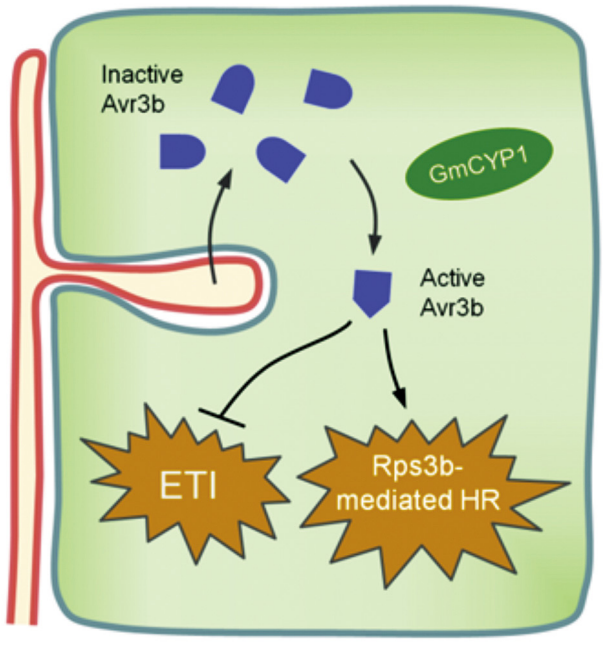


Figure1. Phytophthora recruits plant endogenous cyclophilin protein to maturate the enzymatic activity of Nudix.

2.7 Chinese scientists succeed in resolving hematopoietic stem cell formation at single-cell resolution

Hematopoietic stem cells (HSC) are stem cells of all blood cells in mammals, including human beings. Transplantation of single HSC can produce all types of blood cells in the body for a lifetime, thus playing a vital role in the maintenance and homeostasis of blood system. Precise separation of single functional stem cells is a prerequisite for subsequent studies. As the most representative cell type of stem cell research, HSC has been widely investigated. However, in the early stage

of embryonic development, the study of origin of HSC is extremely difficult due to the sparse number and the lack of specific surface markers.

Recently, Professor LIU Bing's group from Affiliated Hospital of Academy of Military Medical Sciences (307 Hospital of PLA), Professor TANG Fuchou's group from Biodynamic Optical Imaging Center of Peking University, and Professor YUAN Weiping's group from Institute of Hematology and Blood Diseases Hospital of Chinese Academy of Medical Sciences collaborated closely and for the first time systematically resolved the origin of mouse embryonic HSC at the single-cell resolution. In May 19, 2016, this important discovery was online published as research article in *Nature*. This is also the first publication of China's hematologists in this journal, which greatly promoted the field of hematopoietic stem cell development in the world. Professor Liu's group first screened a new specific surface marker through massive preliminary work.

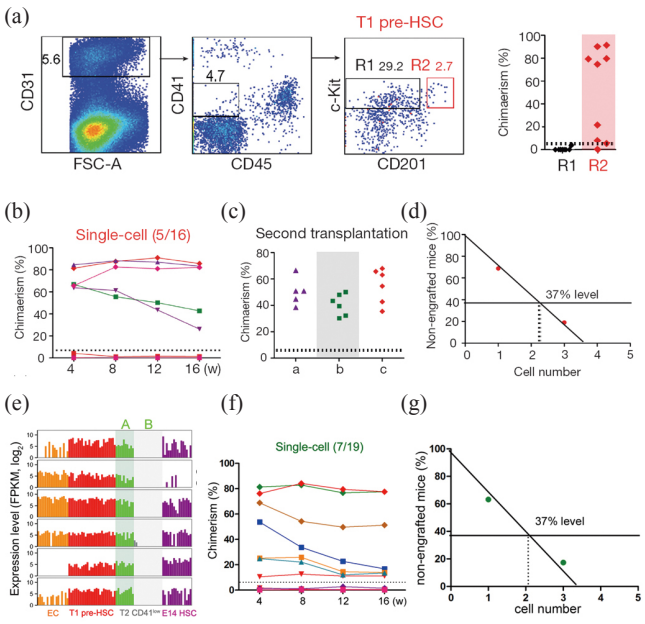


Figure 1. High-precision separation and functional identification of Type I and Type II pre-HSC at single cell resolution. (a) CD201 highly enriched Type I pre-HSC; (b) The single-cell transplantation efficiency of CD201 enriched Type I pre-HSC was up to 30%; (c) Secondary transplantation showed that CD201 enriched Type I pre-HSC has self-renewing capability; (d) The frequency of CD201 enriched Type I pre-HSC is 1/2.3 by limiting dilution analysis; (e) Single-cell sequencing revealed the heterogeneity of Type II pre-HSC; (f) Single-cell transplantation verified that CD201 highly enriched Type II pre-HSC; (g) The frequency of CD201 enriched Type II pre-HSC is 1/2.1 by limiting dilution analysis.

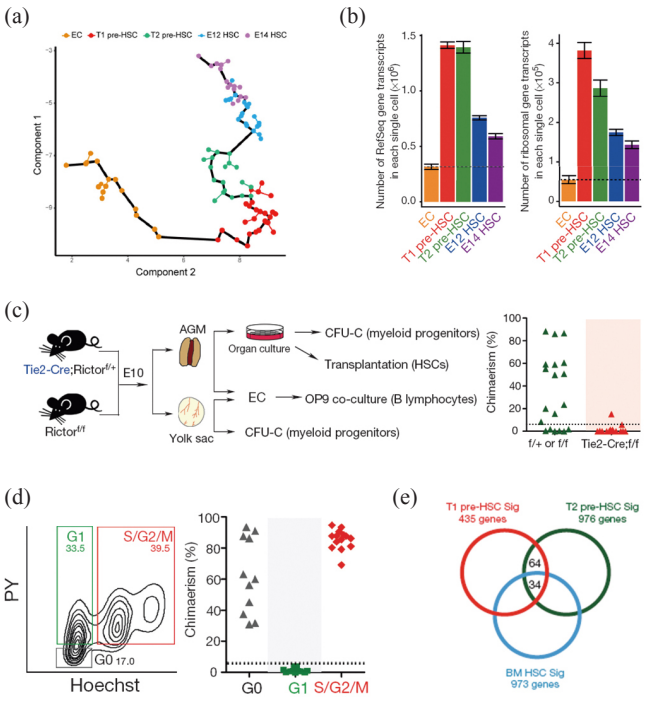


Figure 2. Single-cell transcriptome sequencing reveals the core signature of pre-HSC. (a) Pseudo-time analysis of HSC development by the Monocle method; (b) High transcriptional activity of pre-HSC; (c) Conditional knockout mice model reveals the pivotal role of mTORC2 in HSC formation; (d) The proliferation ability of functional pre-HSC; (e) 98 core signature genes of pre-HSC were identified by in-depth comparative analysis of single-cell transcriptome sequencing data of related cell groups.

Combining their innovated single-cell co-culture/transplantation system, they ultimately captured the single pre-hematopoietic stem cell (pre-HSC) at up to 30% purity. This is the first time for successful isolation of extremely rare pre-HSC at high-precision in early embryo development since 1996, when the single adult mouse bone marrow HSC was isolated. Then Professor Liu's group cooperated with Professor Tang's group to analyze five key types of cells during HSC development (vascular endothelial cells, type I and type II pre-HSCs, embryo day 12 and 14 HSCs) using high-throughput single-cell transcriptome sequencing. The data revealed the unique features of pre-HSCs, including transcriptional machinery, arterial signature, metabolism state, signaling pathway, and transcription factor network. Based on these findings, Professor Liu's group further collaborated with Professor Yuan's group, using vascular endothelial cell- and hematopoietic cell-specific knockouts of Rictor gene, illustrating the pivotal role of mTORC2 signaling pathways in HSC formation. Finally, by in-depth comparative analysis of single-cell transcriptome sequencing data of related cell groups, 98 core signature genes of pre-HSC were identified.

This research builds the basis for elucidating the intrinsic regulatory mechanisms during HSC formation in mammals, including humans, and also provides new clues and ideas for directed differentiation of pluripotent stem cells to hematopoietic stem cells, as well as the regeneration of hematopoietic stem cells in vitro.

2.8 Important advancements made by Chinese researchers in reconstructions of East Asian continental blocks in supercontinent Pangea

A supercontinent is a large landmass encompassing almost all continental blocks during a period in Earth's history. Continental blocks came together to assemble a supercontinent by collision as a result of plate tectonics. Available data indicate that there were only a few supercontinents that formed during the 4.57 billion years (Ga) long Earth's history, including supercontinents Columbia (or called Nuna), Rodinia and Pangea, of which, Pangea is the youngest superconinent in Earth's history and its main body formed by assembly of Gondwana and Laurasia about 300−250 million years (Ma) ago. As supported by volumious evidence from reliable geological, paleomagnetic and paleontonlogical data, configurations of major continental blocks in Pangea have been widely accepted. However, controversy has long surrounded the reconstructions of East Asian blocks (North China, South China, Tarim, Qaidam, North Qiangtang, South Qiangtang, Indochina, Lahsa, Sibumasu, etc.) in Pangea. So far, nearly all Pangea

reconstructions assume that continental blocks in East Asia had never become parts of the Pangea before its breakup. In these reconstruction models, configurations of East Asian blocks in Pangea were mainly based on geological and paleomagnetic data before the 1990's but did not fully consider recent data and achievements made by Chinese researchers about collisional mountain belts between continental blocks in East Asia. For these reasons, the National Natural Science Foundation of China (NSFC) set up a Major NSFC Program entitled "Reconstructions of East Asian Continental Blocks in Pangea" that was started in January 2012, led by Professor ZHAO Guochun (Chief Principal Scientist) from Northwest University and University of Hong Kong, together with other four sub-project leaders including Professors WANG Yuejun (Sun Yat-sen University), HUANG Baochun (Peking Univesity), DONG Yunpeng (Northwest University) and LI Sanzhong (China University of Ocean). On the basis of summarzing and integrating previous data, this Major NSFC Program was aimed to carry out detailed field-based structural, metamorphic, geochemical, geochronological, paleomagnetic and paleontonological investigations on key segments of the Central Asian Orogenic Belt, Central China Orogenic Belt and East Paleo-Tethys Belt, which assembled continental blocks in East Asia, in order to determine the timing and processes of opening and closuring of the Paleo-Asian Ocean, Proto-Tethyan Ocean, Qin-Qi-Kun Ocean and Paleo-Tethyan Ocean. The results of this NSFC Major Program will not only answer where, when and how continental blocks in East Asia were assembled and whether or not they had bcome parts of the Pangea supercontient before its breakup, but will also improve and develop the theory of plate tectonics. During the past five years, the researchers have made the following important advancements in the reconstruction of East Asian continental blocks in Pangea:

(1) Demarcating the north and south boundaries of the Proto-Tethyan Ocean in East Asia, determinign the ocean-continent spatial framework before and after the closure of the ocean, and proposing that the north boundary of the Proto-Tethyan Ocean changed with time from the Kuanping Ocean in the north during early Paleozoic time to the Shangdan Ocean in the south during later Paleozoic time;

(2) Demonstrating that Tarim and North China amalgamated to Siberia at 300 Ma and 250 Ma, respectivley, with the closure of the Paleo-Asian Ocean along the West and East Tianshan-Beishan-Solonker sutures, indicating that Tarim and North China were part of the main body of Pangea;

(3) Determing that the Lahsa-South Qiangtang and Sibumasu blocks collieded with the North Qiangtang and South China (including Yangtze, Cathaysia and Indochina) blocks about 230–250 Ma ago, with the closure of the East Paleo-Tethys Ocean along the Longmucuo-Shuanghu-Changning-Menglian-Inthanon suture belt, leading to the formation of the united South China continent;

(4) Confirming that the united single East Asian Continent formed by the final collision of South and North China at about 220–240 Ma, with the final closure of the Qin-Qi-Kun Ocean along the West and East Kunlung-Mianlue-Dabie-Sulu suture belt; and

(5) Confirming with paleomagnetic data that the East Asian continental blocks were fused together as a single continent that became part

of Pangea by 220 Ma.

On the basis of above results and advancements, the researchers have established a new configuration of supercontinent Pangea with East Asian continental blocks as part of its main body. In addition, the researchers have applied G-Plate to produce a series of recontruction maps showing the evolution of the East Asian continental blocks from the breakup of Rodinia to the assembly of Pangea. The achievements of this NSFC Major Program are reflected by 180 SCI papers published in leading international journals and a Special Issue entitled "Reconstructions of East Asian Continental Blocks in Pangea" in *Earth-Science Reviews* (in press), one of the highest-impact journals in earth sciences.

Figure 1. A new configuration of supercontinent Pangea with East Asian continental blocks as part of its main body, proposed by the researchers of a Major NSFC Program entitled "Reconstructions of East Asian Continental blocks in Pangea" (Note: The latitudes of continental blocks in the figure are just schematic).

2.9 Chinese scientists demonstrated the key mechanism behind geothermostat

It seems that the Earth is the only planet that is habitable for life in our solar system. The adjacent Mars and Venus are either too cold or too hot. Habitability of the Earth is related to the so-called geothermostat, in which the negative feedback between the concentration of atmospheric CO_2 and the rate of rock dissolution plays a central role. The carbonic acid made by the dissolution of atmospheric CO_2 in water dissolves rocks on the Earth surface, a process called chemical weathering. As expect, rate of chemical reaction is higher in higher temperature under usual conditions. A hot climate would increase the rate chemical weathering so that more CO_2 can be removed, which in turn cool down the Earth's temperature. In contrast, the weathering removal of CO_2 would largely decrease under a cold climate so that the CO_2 introduced by volcanic degassing can accumulate, which finally warms up the climate. Thus, the key to understand the geothermostat is if the rate of chemical weathering is truly controlled by temperature.

Increasing mineral dissolution rate with increasing temperature can be simply observed in laboratory by the scientists. However, the relationship between rock dissolution and

temperature is not straightforward in field settings. Complicating factors include the precipitation, land cover, soil erosion, etc. More importantly, different rock types show very different weathering resistance. Researches based on a monolithology may help to reduce the complexity. Recently, under the support from National Natural Science Foundation of China (NSFC), a group led by Professor LI Gaojun in Nanjing University has compiled fluxes of dissolved inorganic carbon of the rivers in 37 basaltic regions globally. They found out that the rate of CO_2 removal associated with basalt weathering is highly correlated with temperature (Figure 1(a)), which confirms the key mechanism of geothermostat.

One of the reasons that lead to this finding is the usage of basaltic catchments. Compared to other rock types such as granite, basalt has much higher degree of homogeneity across spatial scale. More importantly, this research separates the inactive volcanic fields from the active ones. Active volcanic fields have much higher weathering rate due to factors such as hydrothermal activities so that the correlation between weathering rate and temperature is not clear. Active volcanic fields mostly sit in oceanic environments with higher altitude and thus precipitation amount, which may have caused the misleading positive correlation between runoff and weathering rate in previous studies (Figure 1(b)). However, if only the inactive volcanic fields were considered, rock-weathering rate is highly correlated with temperature. The long-term observation of Chinese basaltic catchments in the Key Lab of Surficial Geochemistry of Ministry of Education is the base for this finding.

This research also provides a theoretical support for the secular equilibrium of carbon cycle. The group led by Professor Li has used the isotopic records of seawater to reconstruct the evolution of Cenozoic carbon cycle. They found out that weathering of continental silicate and oceanic island basalt evolves in opposite direction. Continental weathering increases progressively in response to Tibetan uplift, which leads to decline of atmospheric CO_2 level and temperature. Meanwhile, the decreasing temperature reduces the rate of basalt weathering until the increasing CO_2 drawdown of continental weathering is compensated by the decreased basalt weathering. Thus, basalt weathering is the key to maintain the long-term balance of carbon cycle. The finding of temperature dependence of basalt weathering has important implication for the carbon capture and storage technique based on dissolution of silicate mineral developing in Professor Li's group. Removal of CO_2 by accelerated basalt dissolution mimics the natural processes, and thus can be regarded as a safe approach to capture and store the CO_2.

The above-mentioned researches have been published in highly influential international journals such as *Earth and Planetary Science Letters*, *Geochimica et Cosmochimica Acta*, and *Nature* as corresponding authors.

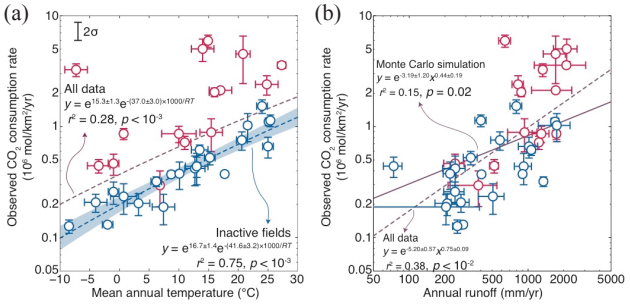


Figure 1. CO_2 consumption rate associated with basalt weathering plotting against temperature (a) and runoff (b).

2.10 Breakthroughs on physical chemistry of organic field-effect transistors

The first appearance of organic field-effect transistor (OFET) could be tracked back to last century in the 1980s. The discovery and development of "conducting polymers" have shocked the world. Traditional beliefs of insulating polymers were overthrown, since they could be conductive as good as silver after appropriate doping. The amazing progress not only enriched the database of novel materials, but also advanced their potential applications, e.g., in light-emitting diodes and field-effect transistors.

Since the concept of "chemical synthesis" first proposed by Jns Jakob Berzelius in 1806, it opened the door of artificial "man-made" materials. Near 30 million new molecules have been designed and synthesized. And over 5000 organic semiconductors have been generated since the concept of "organic semiconductor" first addressed by Hiroo Inokuchi (Japanese scientist, foreign fellow of CAS) in 1950s. However, a long standing issue like a persistent ailment is that few organic semiconductors reported with the data of charge carrier mobility, and even fewer with high enough mobility for practical applications (e.g., over or comparable with that of amorphous silicon). The bottleneck for this case is due to the absence of fitting methods to reveal intrinsic properties of organic semiconductors. Traditionally, organic thin films are adopted to investigate the property of organic semiconductors. However, morphology issues such as grain size, boundaries and crystallinity significantly influence the properties of organic thin films and lower their reproducibility, so that the data come from different groups are different even the target is the same material. Hence, organic thin films cannot meet the goal to reveal the intrinsic properties of organic semiconductors, resulting in low-directed design of new organic semiconductors.

Organic single crystals are the best candidates to reveal intrinsic properties of organic materials. However, it is challenging to grow large organic single crystals for devices, even millimeter-sized crystals, because of the weak interaction between molecules in organic semiconductors. Most organic crystals exist as nanometer- or micrometer-sized "small" crystals with irregular shapes, and they are very fragile. Traditional micro-fabrication techniques, such as electron-beam or focused ion beam deposition, could damage organic crystals easily and bring contaminates unavoidably, which limits their application in organic single crystal devices. Hence, the study of organic semiconducting crystals has encountered us over half century as a long-standing and big challenge, and it has significantly hindered the development of high performance organic semiconductors and devices.

The first study of OFETs in China was pioneered by HU Wenping, et al., since he joined in Institute of Chemistry, Chinese Academy of Sciences in 1996, followed by the first paper on OFETs in China at the beginning of 1997 in Physics. In 2004, they further took the world leading research of OFETs based on

nanometer- or micrometer-sized "small" crystals, wherein the "small" crystals with regular shapes were successfully grown by physical "epitaxy" or chemical molecular self-assembly, and OFETs were fabricated cleverly by novel developed "organic ribbon mask technique". It results in the efficient evaluation of intrinsic properties of organic semiconductors by such undamaged "small" crystals and the further guidance of rational design and development of high performance organic semiconductors. Indeed, at the beginning of 2013, there were 57 organic semiconductors with mobility over or comparable with that of amorphous silicon in the world, and 15 candidates were reported by Hu, et al., such as dibenzo[d,d'] thieno[3,2-b;4,5-b'] dithiopheneand and alpha-titanyl phthalocyanine. It established their deep esteem in the world of OFETs.

Notably, the breakthroughs of high performance organic semiconductors greatly promoted the development of OFETs and contributed to lots fundamental issues in this field. For instance, a long-standing issue in OFETs is the thickness of conducting channel in OFETs, which has been argued for decades from monolayer to several or even several tens molecular layers. Hu, et al., proved that a molecular monolayer was sufficient to function as an ideal conducting channel in an OFET based on the molecular monolayer two-dimensional crystals, which first answered this controversial question clearly. Moreover, the charge and exciton interfacial behavior in conducting channel or between two organic semiconductors are also highly challenging due to the interfacial complex for accurate studying. Hu, et al., made the breakthrough by configuring out the first organic single crystal heterojunction of CuPc and F_{16}CuPc and using their single crystalline perfect interfaces to study charge and exciton interfacial behavior, which led to creative inventions such as organic single crystal phototransistors.

These breakthroughs led to 20 papers published in *J. Am. Chem. Soc.*, *Adv. Mater.*, *Acc. Chem. Res.* and *Chem. Rev.* with citation of 2703 times (close date Dec. 31, 2015). And they were highly highlighted by world leading scientists such as Henning Sirringhaus (Cambridge University, Fellow of Royal Society), Klaus Muellen (director of the Max Planck Institute for Polymer Research and the Fellow European Academy of Sciences), Zhenan Bao (Stanford University, Fellow of the American Academy of Engineering). They commented the research as "the first", "open a new door", etc., for the high performance organic semiconductors, and praised the device as "the best", "the highest performance", etc., which confirmed the originality and significance of these breakthroughs for the world OFETs.

In summary, the breakthroughs on "physical chemistry of organic field-effect transistors" provide us new strategies for design and synthesis of novel organic field-effect materials, new approaches for investigation of materials physical chemical properties, and new ideals for constructing high-performance OFETs and corresponding functional devices. These works, have contributed and will continuously contribute greatly to the development of organic field-effect materials and devices. These works have been supported by Natural Science Foundation of China and others, and awarded as the 2nd class National Natural Science Award in 2016.

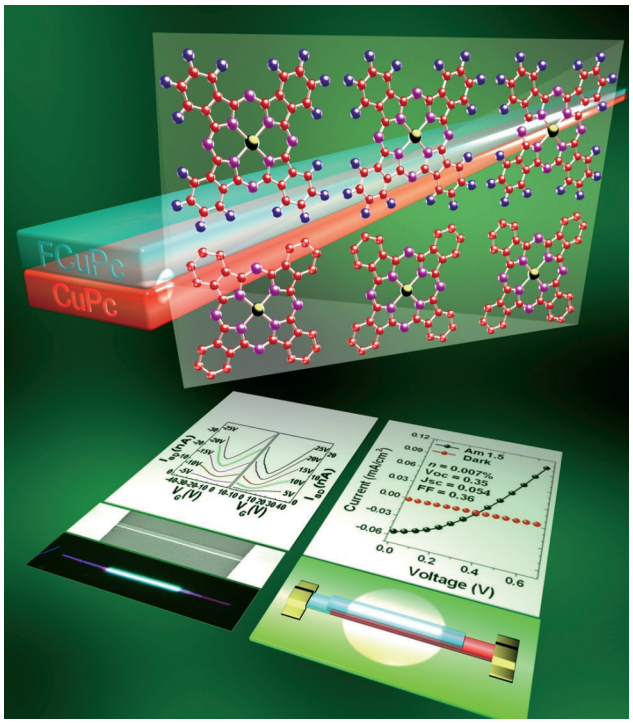


Figure 1. Organic single crystal heterojunctions of CuPc and F_{16}CuPc and their corresponding OFETs and photovoltaic devices.

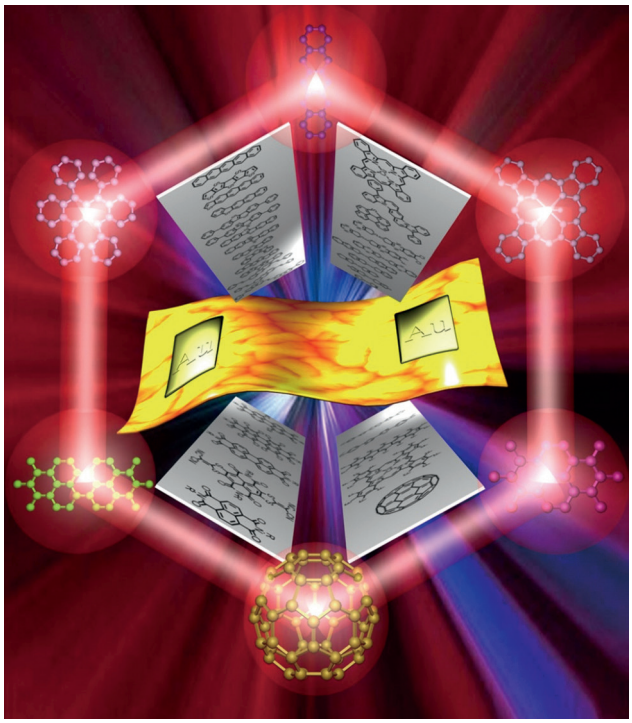


Figure 2. High performance organic semiconductors and OFETs.

2.11 Innovation and integrated design of lower mobility parallel mechanisms

Lower mobility parallel mechanisms (LMPM) have drawn continuous attentions from both academia and industry because of the unique characteristics in terms of speed, accuracy, stiffness and dynamic behaviors compared with their counterparts with serial architectures, and found ever-wider applications in many sectors, or such as large structural components machining in aircraft industry and fact pick-and-place manipulations in food and pharmaceutical industries, for example.

Supported by the NSFC Key program project, the team led by Professor HUANG Tian has focused upon fundamentals and key issues of innovation and integrated design of LMPM. The following achievements have been made.

With the aid of Grossmann line geometry, a simple and effective approach for type synthesis of LMPM is proposed. The method features the description of both mobility and constraints

using line clusters, leading to the invention of a number of useful LMPM. Drawing mainly on screw theory, the team investigates in depth the properties of twist/wrench subspaces of lower mobility kinematic chains, presenting a brand new and complete theoretical package for force/motion transmissibility analysis, an important issue in singularity avoidance and dimensional optimization of complicated robotic mechanisms.

The team proposes a hierarchical architecture for integrated design of LMPM using CAD/CAE software, leading to the development of two useful design tools, i.e., software for conceptual design with the capabilities of fast sculpture modeling and kinematic analysis, and the one for detailed design with the functionality of rapid stiffness, rigid/elastic dynamic performance evaluation over the entire workspace.

The team proposes a novel approach for the integrated design of high-speed pick-and-place parallel robots having SCARA motions, which enables the dimensions, structures and motor sizing to be designed simultaneously. Consequently, a well-engineered prototype (see Figure 1) has been built.

The team has also developed a 5-DOF hybrid kinematic machine especially designed for ultra-precision polishing of non-spherical surface of optical lens (see Figure 2). The relevant technologies have already been transferred to industries for realistic applications.

The research received a few prestigious awards, including one State Science and Technology Prize (2nd Class), and two at Provencal level (1st Class). Two young colleagues have been granted with NSFC Distinguished Young Scholars, and one with NSFC Outstanding Young Scholar apart from many other honorable titles. The team published 34 out of 54 papers in total in prestigious journals at international level in conjunction with 4 books/book chapters. The team filed 18 Chinese patents and IPR of other types. In the past five years, the team organized 4 NSFC sponsored international conferences and workshops, and was invited to deliver 6 keynote speeches at international conferences held in China and abroad.

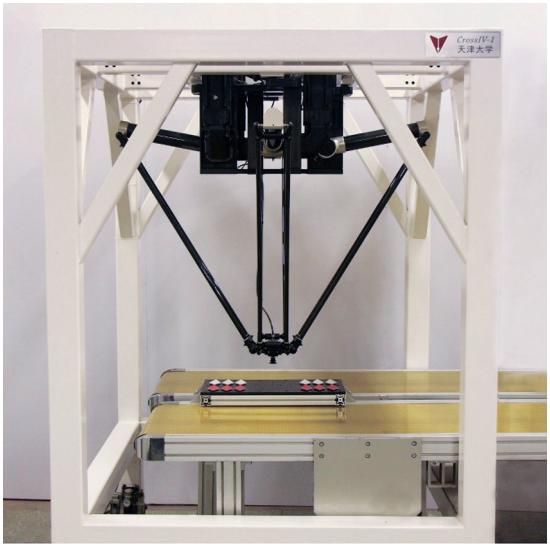


Figure 1. 4-DOF pick-and-place parallel robot.

Figure 2. 5-DOF hybrid robot.

2.12 Creative fruits on brushless permanent magnet machines strong fault-tolerance and wide adjustable-speed have been achieved by Chinese academics

As a core international competitiveness, electrical machine and system is not only key equipment of power and energy, but also the core of traffic transportation, advanced manufacturing, and national defense industry. However, the common problems associated with the electrical machines in China, including low operation efficiency, poor reliability, low power density, and narrow adjustable-speed, etc., have become one of the main bottlenecks restricting the developments of high-end equipment. Although the traditional permanent magnet (PM) brushless machines can realize high efficiency, the magnets located in rotor lead to the difficulty for cooling and the risk of demagnetization due to high temperature, limiting the further improvement of power density of PM machine. In addition, the mechanical strength of rotor is relatively weak, resulting in low reliability. The loading capability is poor and the torque ripple is high under fault conditions. The air-gap flux density due to magnets is uncontrollable and the speed regulation capability is weak. Hence, how to break through the technical bottlenecks mentioned above is not only the difficulty and key point of academic research in the field of electrical machines, but also the major national demands of strategic emerging industries, including electric vehicles, aeronautics and astronautics.

The research group led by Professor CHENG Ming from Southeast University broke through the operation principle of traditional "two-side magnetic fields" electrical machines, and proposed the basic concept of a novel "single-side magnetic field" stator-permanent magnet brushless machines, where a complete theory system including design, analysis and control of this breed of machines has been built, as well as the strong fault-tolerance and wide adjustable-speed techniques are invented. A series of creative fruits integrating both theory and technique are achieved based on the published 81 papers indexed by SCI and issued 40 patents. The detailed fruits are as follows:

1. The underlying mechanism of the energy conversion by the interaction between constant stator-excited magneto-motive force and the alternating permeance due to rotor saliency has been revealed. Then, several novel topologies having multi excitation sources located in stator have been proposed, and the demerits of traditional permanent magnet machines are overcome, resulting in not only the improved power density, but also the foundation for strong fault-tolerance and wide adjustable-speed.

2. The redundant hot-backup design method and fault-tolerant operation theory have been developed, where the isolation between phase windings can be strengthened, and the short-circuited currents are reduced by employing the dual-channel windings, redundant excitations, dual armature windings, compensated windings,

fault-tolerant tooth, and modular design. In addition, the problems of poor fault-tolerant capability and large torque ripple under faulty conditions can be solved by inventing the fault-tolerant operation strategies including reconfiguration of magnetic field, minimum copper loss, minimum switching vectors, and harmonics injection.

3. The direct regulation techniques for air-gap flux-density have been proposed, including split windings, series hybrid, parallel excitation, bypass flux-regulation, and magnetic memory. Moreover, the strategies of dynamic regulation of magnetized status, on-line efficiency optimization, and magnetic field zone control, are proposed to realize the high-efficiency operation, where the magnetic field can be strengthened and weakened under low and high speeds, respectively.

Meanwhile, combination with the requirements of the applications including electric vehicles, onboard actuation system, elevator, mobile generator, and linear propulsion, the rules and techniques for the industrialization have been investigated in depth, and outstanding economy and social benefits have been achieved.

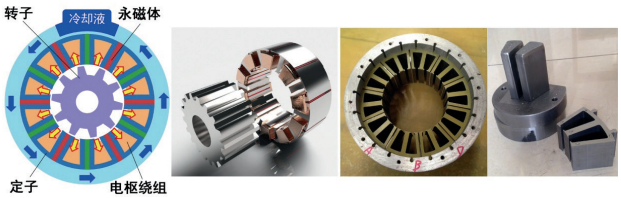


Figure 1. The operation principle, topology and modular manufacturing of "single-side magnetic field" stator permanent magnet brushless machines.

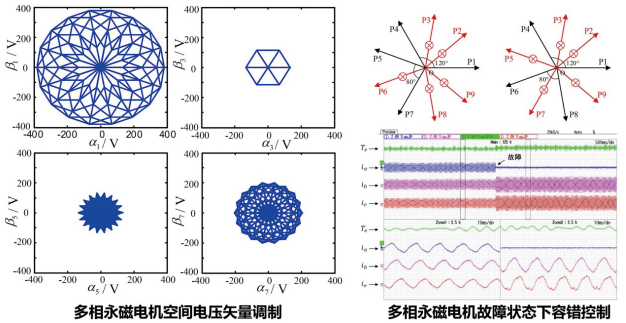


Figure 2. Control strategy of stator permanent magnet brushless machines.

2.13 Significant progress by Chinese scholars in mobility management for future information networks

Professor CHEN Shanzhi is the director of a research team in China Academy of Telecommunication Technology (CATT). Professor Chen and his team have been the leading researchers in the area of mobility management in the last ten years. Mobility is envisioned to be the key driving force of mobile network evolution and has become an essential capability of the mobile networks. Mobility in future information networks will present its diversity features among not only people but also machines and services, not only for communication handovers, but also for computations and storage resource migrations. However, the existing mobility management

technologies suffer from the problems including function redundancy, system complexity, and inefficiency. Professor Chen's team proposed mobility driven network (MDN) as the abstractions of entities, functions, and principles of mobility managements. MDN elaborates the scientific problems of mobility management; MDN presents a new mobility driven network architecture; and MDN uses decoupling methodology which decouples identity-location, control-forwarding, and service devices. The research results are published in *IEEE Network Magazine*, and were recommended as the key article on the magazine's website. The book, *Mobility Management: Principle, Technology and Applications*, has been published by Springer in 2016, which regards it as the first book dedicated to mobility management theory and technology.

Based on the temporal-spatial complexity, as the mobility behavior of mobility entities, Chen's team conducted researches on mobility behavior analysis and modeling. The features and patterns of mobility behaviors were applied in network technology optimizations such as opportunistic data transmission, D2D communication, and date offloading, etc.

In the fixed-mobile convergence network (FMC), the heterogeneous network's transmission capability is inadequate to meet the diverse QoS requirements of mobile service. Chen's team proposed an intelligent coordinating method of multi-connection communications and common key technologies. It helped a lot in coping with the problem of the cooperative control and sharing of the network resources in multipath transmission. This method has been applied in 4G VoLTE (Voice over LTE) test and deployed in multi operator networks.

In order to improve the irregular boundaries of location areas and the frequently handovers in ultra-dense network (UDN), Chen's team proposed a novel architecture of the user-centric UDN (UUDN). Through location update-and-handover control based on dynamic cell grouping, UUDN achieved its intelligence and virtualization in local mobility managements. LTE-Hi (LTE Hotspot/indoor) aims to provide higher performance in hotspots and indoor environments by exploiting wider transmission bandwidth in higher frequency band(s) and it is seamlessly integrated with conventional LTE macro-cells. The LTE-Hi base stations developed by Chen's team are adapted and implemented in 4G TD-LTE networks. Moreover, Chen's team applied TD-LTE, a 4G international standard led by China, into vehicular networks. LTE-V was proposed for V2X (Vehicle-to-Everything) communications and has become a strong competitor against IEEE 802.11p.

Related achievements were published in international authoritative journals, including *IEEE Communications Magazine*, *IEEE Wireless Communications*, *IEEE Network Magazine* and *IEEE Transactions on Vehicular Technology*. Over the past years, all these papers achieved and kept the top 30 on IEEE article download score (IEEE top download 100 papers), and attracted wide attentions by experts and scholars all over the world. The MDN architecture and method have been used by OEMs for systems including 4G TD-LTE, ultra-dense networking, high-speed railway broadband mobile communications, and emergency communications.

2.14 Scholars made significant progresses on low complexity encoding and decoding of Polar codes

Channel coding is a basic way to ensure reliable information transmission over noisy and interference channel. It has been one of the fundamental components of communication theory, and also a field with fierce competition in global communication standardization. Polar codes, invented by Erdal Arıkan of Bilkent University in Turkey in 2008, were another breakthrough in channel coding after Turbo codes and LDPC codes. As the first codes that have been theoretically proved to be able to achieve the Shannon channel capacity, Polar codes have shown very good performances. On the very morning of Nov. 17, 2016, at the 3GPP RAN1 87 Meeting, the Polar code scheme, mainly proposed by Huawei and other major institutions, was finally chosen as the short code solution for the control channel of 5G eMBB (enhanced mobile broadband) scenario, which greatly raises the profiles of Chinese telecommunication industry in 5G research and development.

The major metrics considered in 5G channel coding standardization are a candidate code's performance, complexity and adaptability as well as flexibility in design and realization. Although Polar codes have excellent properties like capacity-achievable and sequentially decodable, they generally have low polarization rate in noisy channel, and cannot compete with LDPC when using the simple successive interference cancellation decoding. Hence in practice they require more complicated decoding algorithms like list decoding which usually brings extra cost and difficulty in chip design as well as prohibitive decoding latency. On the other hand, although Arıkan has shown that systematic Polar codes have better performance than their non-systematic counterpart, they may have larger encoding complexity and there lacks a unified encoding architecture for systematic and non-systematic Polar codes.

A research group of Zhejiang University, led by Professor ZHANG Zhaoyang, takes a solid step forward in solving the above problems. In their study of list decoding of Polar codes, they observed for the first time that, error propagation behaviors are quite different for correct and incorrect paths, i.e., with high probability, a correct path does not split while an incorrect path will split almost surely in the successive decoding. Based on this, they proposed a new splitting rule for the list decoder, which significantly reduces the unnecessary splits during the list decoding. Meanwhile, they found and proved that at a certain position, according to this rule, the decoding paths will converge to a single path with probability 1, i.e., the decoding turns to be the basic successive interference cancellation thereafter without any performance loss. This further greatly reduces the decoding complexity and latency. Simulation results show that decoding complexity can be reduced by as much as 80% in typical scenarios. This work provides strong supports for Polar codes' application in 5G high throughput,

low latency and lower power scenarios.

Moreover, Zhang's group also brought out an encoding structure for systematic Polar codes, which has the minimum memory cost (N bits) and the minimum computing cost (N/2 * logN XOR operations). They also provided a parallel encoder, which also requires only the above cost. More significantly, the systematic and non-systematic codes can share the same architecture, which provides a way to incorporate different Polar encoders into a single design with low hardware complexity and thus further facilitates its practical implementation.

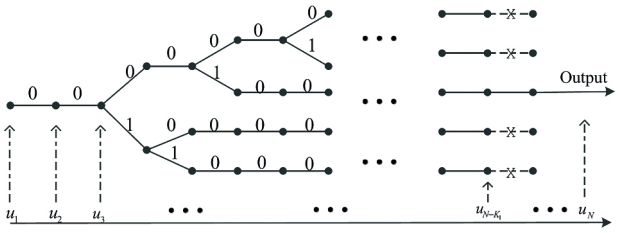


Figure 1. Illustration of the path splitting process under the new splitting rule.

2.15 Chinese scholars have achieved progress in the study of corporate collaboration of emission reduction

Traditionally, carbon emission reduction (CER) independently taken by single industrial firm has disadvantages in high investments, low reduction efficiency and lack of emission reduction resources. Corporate practices on CER are not only determined by corporate organizational factors, but also influenced by their related firms within their industrial chains. It is possible to integrate and utilize the resources from different firms on industrial chains by cooperating with them, so as to reduce the CER cost and improve the CER efficiency. However, inter-firm cooperation on CER within industrial chain is a new topic for most industrial firms. There are not many successful experiences for reference, and the corresponding theories are also insufficient. Professor WANG Zhaohua and Dr. ZHANG Bin from Beijing Institute of Technology, have designed and constructed corporate collaboration mechanism for CER based on industrial chains. They have provided a new perspective for corporate CER collaboration. Their research is supported by National Natural Science Foundation of China.

Initially, according to the institute theory and resource based review, their study constructs a concept model to discuss the relationship among the inter-firm collaboration, determinants and firms' performance. After identifying the determinants of inter-firm collaboration on emission reduction, they further verify its effects on improving firms' performance. The results show that the inter-firm collaboration on CHG reduction is a new topic for many industrial firms in China, with significant industrial differences. The main driver for the inter-firm collaboration is from the low carbon demand from the market. However, governmental

regulations play limited role in promoting the inter-firm collaboration.

Moreover, their study initially provides three basic patterns for the inter-firm collaboration on carbon emission. Each pattern could not only be considered as the independent inter-firm collaboration format, but also the basic components of the inter-firm collaboration style. Any complicated inter-firm collaboration style for carbon reduction could be decomposed into the three basic patterns.

Also, their study use game theory and system dynamics model to simulate the governmental decision making process on promoting inter-firm collaboration of emission reduction. It provides the evolutionary path for the changes of industrial firms' strategies on the collaboration, under different scenarios of policy profile. There are three policy tools considered in their analysis: carbon emission cap design, rewards and punishment policy, monitoring policy. They provide a comparison on the effects between the fixed emission cap policy and changeable emission cap policy. The policy delaying effect is also introduced in their analysis. Moreover, in the simulation model, dynamic probability distribution function is used to reflect the volatility of carbon emission so as to avoid the shortage of fixed carbon emission level.

Additionally, their study investigates how to share the benefits from carbon emission reduction on the prerequisite of carbon trading. They build Shapley model to identify each participant's benefits on the basis of their contribution to the total carbon emission reduction. The commitment cost and risk are also considered as modified index, which are also introduced in the sharing model. Particularly, they considered the internal transactions between the collaborators during the design of modified index of commitment cost. They not only provide theoretical support for how to share the carbon benefits during the collaboration, but also give a proactive vision for the construction of carbon market in China.

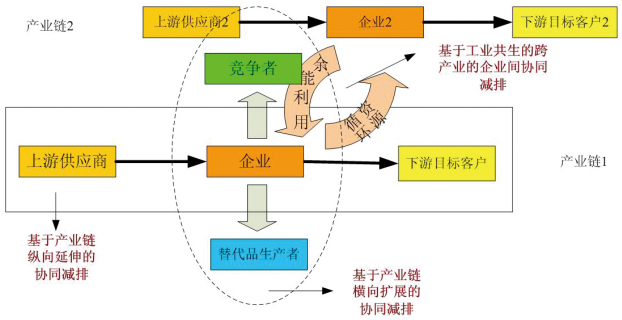


Figure 1. Basic model of inter-firm CER collaboration.

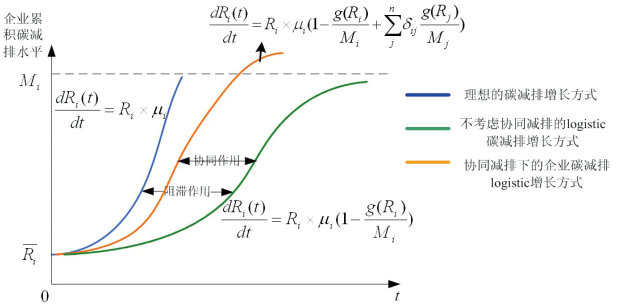


Figure 2. Logistic model of inter-firm CER collaboration.

2.16 Chinese scholars made breakthrough results on nonlinear panel data modeling: Theory and methodologies

Panel data have become more and more available and popular in China due to the fast economy growth and social changes in the rent years. In academic, the key challenge for the Chinese econometricians is how to build a theoretical and methodological system for analyzing panel data with some complexities such as nonlinearity and heterogeneity as well as cross-sectional dependence. Of course, this also is one of international research frontiers in econometrics. The main econometric task is to to build a nonlinear model for panel data and to estimate the functionals involved in the nonlinear model using some nonparametric methods as well as to conduct some specification tests to see if the model fits well with the economic theory. More importantly, of interest is how to apply the proposed modeling procedures to solve real problems. Econometrics in China is lagged behind due to many reasons so that there is a big gap between the Chinese scholars and others from outside. However, for the young generation, they are working hard to catch up and fill the gap. Recently, the research team led by Professor CAI Zongwu and Professor FANG Ying (termed as Cai-Fang Team) at Xiamen University, including their PhD students and young research fellows, is working very hard to build a theoretical and methodological modeling system for nonlinear panel data models. Indeed, so far they have done a great job and obtained some breakthrough results which are in the international frontier and highly recognized in the international community.

First, Cai-Fang Team considers the following nonlinear panel data model:

$$y_{it} = \alpha_i + m(x_{it}) + u_{it},\ 1 \le i \le N,\ 1 \le t \le T, \qquad (1)$$

where y_{it} is the dependent variable, x_{it} is a vector of independent variables, α_i is the individual effect, and $m(\cdot)$ is unknown regression function. The key issue is how to estimate the unknown regression function $m(\cdot)$ in econometrics. But, the difficulty is that the classical methods such as differencing approach for linear models fail in this case because the model in (1) is nonlinear. If the differencing approach together with a nonparametric method would be still used to estimate $m(\cdot)$, the resulting estimation would not perform well. By assuming that α_i is a fixed effect or correlated random effect by allowing α_i to be correlated with $\{x_{it},\ 1 \le t \le T\}$, Henderson, Carroll and Li (2008) considered a nonlinear panel model with correlated random effect or fixed effect and proposed using an iterative algorithm to compute the nonparametric estimation of $m(\cdot)$. However, their method relies on a "good" initial value. Therefore, they suggested using a series approximation approach and a backfitting procedure to obtain the initial value and also, the paper did not provide a theory to justify the proposed estimation procedure. Additionally, Cai and Li (2008) studied a functional coefficient panel data model with endogenous variables and proposed the so-called nonparametric generalized method of moments to estimate the

coefficient functionals. But their model does not include the individual effect. Different from the current literature, Cai-Fang Team studied a class of nonlinear panel models and proposed a new estimation approach of consisting of three steps as follows: first, searching for the stochastic fixed point, and then, taking a difference using the fixed point as a base, and finally, employing a nonparametric method to estimate $m(\cdot)$. Theoretically, they studied the large sample properties of the proposed estimation procedure and finally, they considered some specification tests. These results are highly recognized internationally.

It is well known that a conditional mean model like (1) can not capture some important features for economic and financial data due to their heterogeneity and asymmetric characteristic. To overcome these problems, one might use a quantile regression technique. The question arises is how to generalize a quantile regression model to analyze panel data. This is a hot research topic in the international frontier. Surpringly, there is no result in the literature available for nonlinear quantile regression model for panel data. Koenker (2004) was the first attempt to consider a linear quantile panel model and proposed a complex estimation procedure by using some optimization algorithm, whereas Abrevaya and Dahl (2008) considered a linear quantile panel with correlated random effect and they used this model to capture the unobserved heterogeneity among childbearing women to isolate the causal effects of smoking and prenatal care on birth outcomes (such as birthweight). Recently, Cai-Fang Team studied the following semiparametric panel model for panel data with correlated random effect:

$$q_\tau(u_{it}, x_{it}, z_{it}, \alpha_i) = \alpha_i + \beta_\tau^T x_{it} + \gamma_\tau(u_{it})^T z_{it}, \quad 1 \le i \le N,\ 1 \le t \le T, \tag{2}$$

where $q_\tau(u_{it}, x_{it}, z_{it}, \alpha_i)$ is the τth conditional quantile of y_{it} given u_{it}, x_{it}, z_{it} and α_i; that is,

$$P(y_{it} \le q_\tau(u_{it}, x_{it}, z_{it}, \alpha_i) \mid u_{it}, x_{it}, z_{it}, \alpha_i) = \tau,$$

and u_{it}, x_{it}, and z_{it} are covariates. Here, model (2) allows a more general form of α_i to be correlated with u_{it}, x_{it}, and z_{it} so that the model is flexible enough in real applications. They proposed an integrated quasi-likelihood estimation procedure to estimate parameters β_τ and coefficient functionals $\gamma_\tau(\cdot)$ in model (2). Also, they investigated the large sample theory for the proposed estimators. Model (2) is the first nonlinear quantile regression model for panel data in the literature. This research not only develops quantile regression modeling but also provides some theoretical and methodological foundations to the quantile treatment effect (QTE) in the micro-econometrics literature. More importantly, it is of interest in real applications. For example, Cai-Fang Team used model (2) to study how the foreign direct investment (FDI) has an impact on the economy growth in the host country. Interestingly, one of main findings is that the impact of the FDI on the economy growth is nonlinear and it is different for different countries and it varies at the different initial states of the economy in the host country. For details about this empirical study, it is referred to Figure 1. This research is pioneer in this area and it fills a gap in the literature.

When model (1) or (2) is applied to real applications in economics and finance, it is often to find that the cross-sectional dependence exits; that is $\{y_{it}\}$ are correlated cross i. How to characterize this correlation is another hot current research topic in econometrics. Therefore, scholars

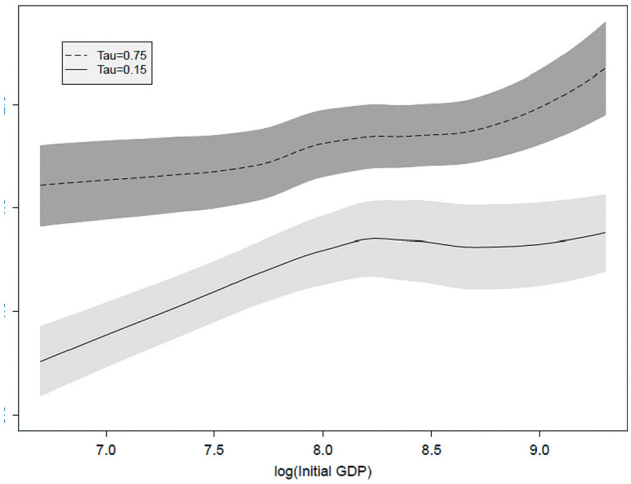


Figure 1. This figure demonstrates the empirical example for study how the FDI has an impact on the economy growth in the host country. The nonparametric estimated curves of the coefficient functionals $\gamma_1, \tau(\cdot)$ of FDI in model (2) are displayed together with the 90% pointwise confidence intervals with bias ignored. The solid line (below one) is for the 15% quantile, representing countries with the slow economy growth rate. The dashed line (above one) is the 75% quantile, standing for countries with fast economy growth rate. One can observe clearly that the FDI has a different impact on the economy growth rate for different countries and different states of economy in the host country.

in the world are now searching for new ideas and/or tools to generalize the existing theories and methodologies to panel models with cross-sectional dependence. To characterize the cross-sectional dependence, in addition to spatial approach, the factor method becomes popular in applications. Recently, Cai-Fang Team studied the following semiparametric factor panel model with cross-sectional dependence:

$$y_{it} = \beta_i^T x_{it} + \gamma_i(u_{it})^T z_{it} + \theta_i^T f_{1t} + \upsilon_{it}, \quad 1 \le i \le N,\ 1 \le t \le T, \tag{3}$$

where f_{1t} is a vector of unobservable factors, and υ_{it}, x_{it}, z_{it} are covariates. Clearly, the unobservable factors f_{1t} in (3) make $\{y_{it}\}$ to be dependent over i. The question now is how to deal with f_{it} in practice. To estimate f_{1t} using the observed information, Pesaran (2006) proposed pioneerly the so-called "common correlated effect" (CCE) method, whereas Bai (2009) initiated using the well-known method: principle component analysis (PCA). However, both papers focused only on a linear model; that is, there is no the second term on the right hand side of (3). By contrast, in view of the CCE approach, Cai-Fang Term studied the model in (3) with a nonparametric part. First, they modified the classical profile least squares method and then developed the estimation procedure to estimate both parameters β_i and coefficient functionals $\gamma_i(\cdot)$. Also, they derived the asymptotic theories of the proposed estimators and considered some statistical inferences. This research is highly appreciated internationally.

2.17 Chinese scholars made important scientific breakthrough of novel mechanisms underlying cardiometabolic diseases

China has made significant advances in medical research and patient care in recent decades, but its expanding economy and rapidly aging population, as well as lifestyle changes, have produced a growing burden of noncommunicable diseases, including cardiovascular disease, stroke, and diabetes, namely cardiometabolic diseases. Cardiometabolic diseases are the most serious threaten to human health. In particular, cardiovascular diseases, including cardiac disease and stroke, have been the leading cause of death in China. Equally important, metabolic diseases, such as metabolic syndrome and diabetes, become a serious epidemic in China. Currently, there are more than 100 million Chinese afflicted from diabetes. Cardiovascular and metabolic diseases are interwoven and often occur as a cluster of diseases. Metabolic diseases greatly increase the incidence and severity of cardiovascular diseases, and cardiovascular diseases are the most common complications of metabolic disorders. However, effective preventions and treatments for these diseases are the important unmet medical needs in China and around the world. Thus, it is important to investigate the fundamental underlying mechanisms and find novel therapeutic strategy to cope with these diseases.

MG53 is a cardiac and skeletal muscle specific protein, which was first reported in 2009. Over the past decade, Dr. XIAO RuiPing and her colleagues at Peking University have systemically studied the role of MG53 and the mechanism of actions in the pathogenesis of cardiometabolic diseases.

First, Xiao, et al., have shown that MG53 is a key endogenous cardioprotective factor. In the cardiomyocytes, MG53 acts as a scaffold protein, and plays an essential role in ischemic preconditioning- and postconditioning-mediated cardioprotection. Thus, MG53 provides a novel means to protect the heart against multiple insulting factors, including acute myocardial infarction, ischemia/reperfusion injury and myocardial toxic drugs.

More recently, Dr. Xiao's group has demonstrated that MG53 is an E3 ligase which mediates the degradation of the key molecules of insulin signaling, resulting in whole body insulin resistance and metabolic disorders. Furthermore, they have shown that skeletal muscle insulin resistance is the earliest and most primary pathogenic factor of metabolic syndrome and resultant diabetes and its cardiovascular complications. For instance, MG53 also impairs cell lipid as well as glucose metabolism and plays a crucial role in the development of diabetic cardiomyopathy and fatty liver. Taken together, MG53 regulates both glucose and lipid metabolism, and participates in the pathogenesis of multiple metabolic diseases and their cardiovascular complications.

In summary, these findings not only define MG53 as a multifunctional protein which exerts

dual functions, cardiac protection and insulin resistance, via different mechanisms. As an E3 ligase, MG53 is a powerful regulator of insulin sensitivity, as a central mechanism underlying defective insulin response and whole-body metabolic disorders, marking MG53 E3 ligase as an important therapeutic target for the treatment of diverse metabolic diseases and associated cardiovascular complications. Meanwhile, as a scaffold protein, MG53 is involved in cardiac ischemic preconditioning and postconditioning. Thus, targeting MG53 different functions may produce multiple novel therapies for cardiometabolic diseases. These studies are supported by NSFC and other national grants.

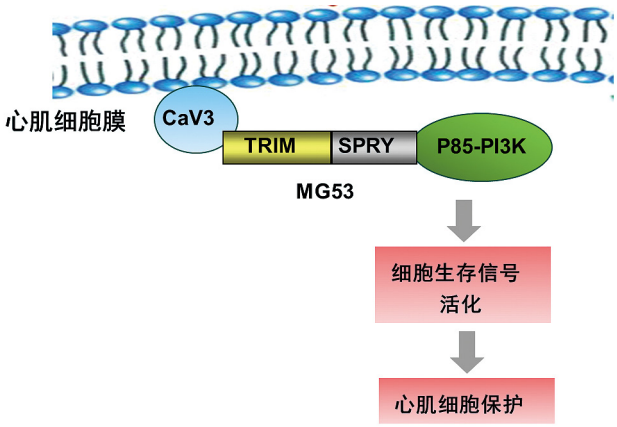


Figure 1. MA53, acting as a scaffold protein, activates cell survival signal pathway to protect cardiomyocytes from injury.

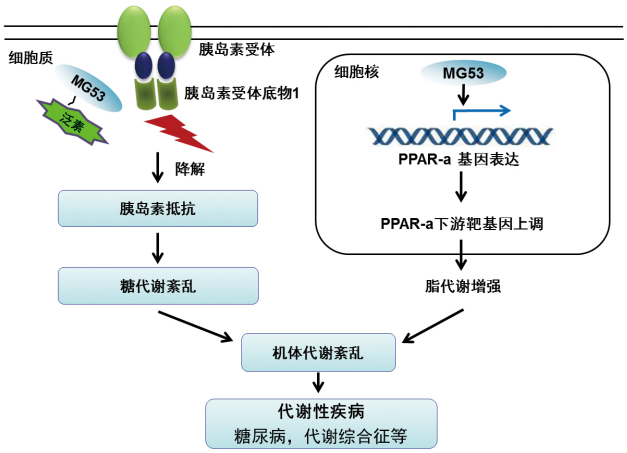


Figure 2. ME53 can cause metabolic diseases such as diabetes and metabolic syndrome not only through impairing the host glucose metabolism by degrading key molecules in the insulin signal pathway, but also through regulating the transcript of regulatory factors involved in lipid metabolism.

2.18 Chinese scholars made important research progress on brain iron metabolism after intracerebral hemorrhage

Intracerebral hemorrhage (ICH), is one of an important subtype of acute stroke characterized by high mortality, high morbidity and high disability, and is the leading cause for the death and disability of our urban and rural residents. However, there are still no effective medical treatments available to improve the outcomes of patients with ICH, which brought a heavy burden on families and societies. Thereby, elucidating the development mechanisms of ICH, and finding out the key injury factors may provide novel methods and therapeutic targets for ICH.

Professor YANG Qingwu (Department of Neurology, Xinqiao Hospital, the Third Military Medical University) and his research team are occupied in the molecular mechanism research of innate immune inflammatory signaling of acute vascular diseases (ACD). After decade of efforts, they elucidated the key initial mechanism of inflammatory injury in ACD, and the first to report the TLR2/TLR4 heterodimer mediated inflammation aggravated brain injury after ICH in 2014, and these results gained extensive attention in the innate immune research field and promoted the understanding of upstream initial mechanisms of inflammatory injury after ACD.

Increasing evidence shows that the hemoglobin from erythrocytes would be degraded within a short time into iron after ICH, and the iron not only caused oxidative brain injury or direct neurotoxicity to aggravate brain injury, but also led to recognition impairment. Accordingly, reducing the accumulative brain iron would become a new treatment strategy for ICH. Although application of iron chelators showed significantly reduced brain iron accumulation after ICH, the results of effects of reducing brain iron were inconsistent. The failure of that may be due to the unclear mechanisms of brain iron metabolism after ICH, which may largely limit the development of drugs that could promote brain iron efflux. Therefore, Professor Yang and his colleagues via elucidating the brain iron metabolism provide new strategies of promoting brain iron efflux for ICH treatment.

In the newest research, Professor Yang and his colleagues used the mouse ICH models to investigate the role of hepcidin in brain iron metabolism. Using the hepcidin knockout mice and parabiosis models, the results showed that increased astrocyte hepcidin and serum hepcidin significantly inhibited brain iron efflux after ICH, which aggravated neurological deficits and recognition impairment. Furthermore, they found that TLR4/MyD88-mediated inflammatory signaling markedly increased hepcidin expression that resulted in brain iron accumulation aggravation to deteriorate the brain injury and cognition impairment induced by ICH. While, application of TLR4 antagonist significantly decreased the hepcidin expression and promoted the accumulative brain iron efflux into circulation, which pronouncedly ameliorated brain injury and cognition impairment after ICH (Figure 1). This research enriches the understanding of brain iron metabolism, provides new potential therapeutic target for the development of novel drugs to reduce brain iron after ICH, and also provides new

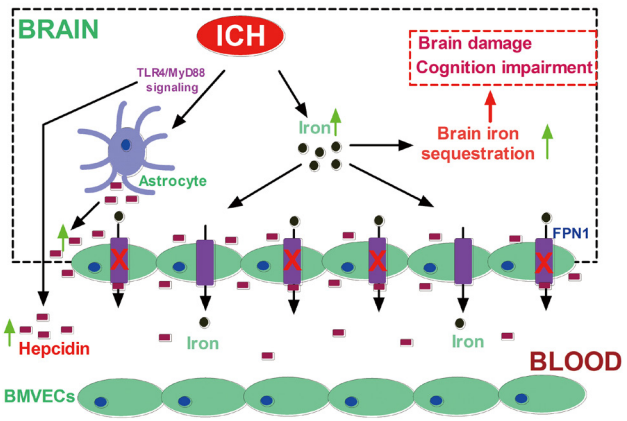


Figure 1. The activated TLR4/MyD88 signaling after ICH increased hepcidin in brain astrocytes and serum, which binds to FPN1 and induce FPN1 internalization and degradation to prevent brain iron efflux into circulation that result in increasing of intracellular sequestration of iron within the CNS. Finally, the increased accumulation of brain iron aggravates oxidative brain injury and cognition impairment.

methods for the treatment of iron-related brain diseases.

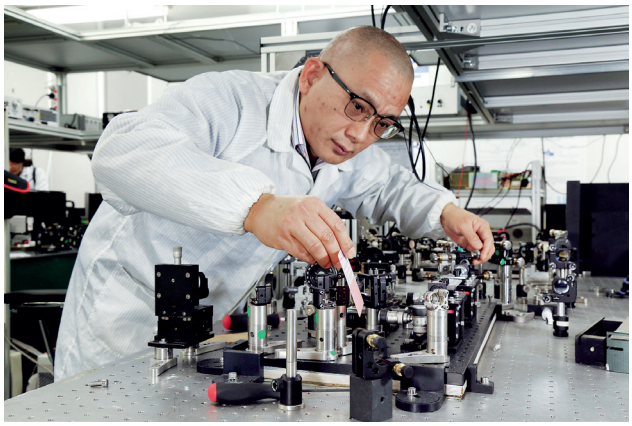
After decade of efforts, Professor Yang and his colleagues by elucidating the initial mechanism of inflammatory injury to illuminate the mechanism of brain iron metabolism regulated by inflammation after ICH, systematically uncovered the key mechanisms of brain injury induced by ICH, and laid a solid foundation for the clinical transformation of ICH treatment.

Part 3

Introduction on Selected Principal Investigators of the Science Fund for Creative Research Groups

3.1 Professor ZENG Heping

State Key Lab of Precision Spectroscopy, East China Normal University
PI of the Science Fund for Creative Research Groups in 2016



The Creative Research Group led by Professor ZENG Heping focuses on the research of precision spectroscopy and dynamics of molecules.

Professor ZENG Heping, Changjiang Scholar, was one of the grantees of the National Science Fund for Distinguished Young Scholars. He was awarded the OSA fellowship in 2016 "for significant contributions to the understanding of ultrafast molecular processes in intense laser fields, and for sustained technical development of high-power ultrashort fiber lasers and infrared single-photon detection".

Aimed at the basic physics questions of precision spectroscopy and measurement of molecules with ultra-high resolution in time, frequency and space domain, the group members have developed novel experimental methods and scientific equipment to realize high precision and sensitivity and achieve several innovative results. The group has been formed on the basis of long-term cooperation, including 6 professors working on the research frontiers of precision spectroscopy and dynamics of molecules. The group devotes to the basic natural science research as well as scientific instrument developments and application explorations. The group members have been funded by National Science Fund for Distinguished Young Scholars, National Science Fund for Excellent Young Scholars, Thousand Youth Talents Plan, National Youth Top-Notch Talents, Shanghai Auroras, Shanghai Rising Stars, and so on. The average age of the Creative Research Group is 39. In the recent 5 years, they have 2 papers published in *Science*, 15 in *Physical Review Letters*, 3 in *Nature* Series and so forth.

The Creative Research Group has several important scientific achievements in the field of precision and ultrasensitive spectroscopy. They developed a technique of attosecond coincidence angular streaking, providing a powerful tool to investigate attosecond dynamics of electrons in molecules using femtosecond laser pulses. They experimentally verified the scenario of electron-localization assisted enhanced ionization of molecules after its observation more than 20 years ago by measuring two electrons and ions ejected from a single molecule. They successfully developed and realized the technique of

molecular ultrafast buffer for optical information storage and display, which was afterwards highlighted by *Nature Photonics* with a two-page article. They developed high-power optical comb of hundreds of Watt with precise temporal control. They achieveed innovative techniques of infrared single-photon detection inventing various kinds of single-photon detectors of striking performance, and demonstrated ultra-sensitive mid-infrared photon detection and imaging to the quantum limit of single photons. The group reported on experimental observation of the Efimovian expansion in scale-invariant Fermi gases and demonstrated the first expansion dynamics of a quantum many-body system with the temporal discrete scaling symmetry, which was published in *Science*.

The Creative Research Group will further investigate the electron-ion three-dimensional multi-particle coincidence measurement, the precision control of the infrared optical comb in time and frequency domain, and the all-optical controlled Femi gas. Combined with the cutting edge techniques in ultra-fast lasers, ultra-cold atoms and ultra-intensive detection, they will continue to study the multi-particle physical dynamics, quantum manipulation and precision spectroscopy of molecules with ultra-high resolution in time, frequency and space domain. They are aiming at the image of molecule orbital and structure with attosecond temporal resolution and sub-nanometer spatial resolution, the macro and micro precision measurement of the Femi gas with optical combs and ultra-fast lasers, and the precision spectroscopy and imaging of molecules at few photon level via optical comb control and ultrasensitive detection. In this way, they would like to contribute to the innovation of high-resolution molecule manipulation in time, frequency and space as well as the observation of molecule interactions.

3.2 Professor LU Xiyun

School of Engineering Science, University of Science and Technology of China
PI of the Science Fund for Creative Research Groups in 2016

The research group on "Complex flows with vortices and interfaces" led by Professor LU Xiyun has been funded by the Science Fund for Creative Research Groups in 2016.

Professor LU Xiyun was the Changjiang Scholars Distinguished Professor, the winner of the National Science Fund for Distinguished Young Scholars, the leader of the Innovative Research Team of the Ministry of Education of China, and the member of 5th and 6th Advisory Committee of the Department of Mathematics and Physics of NSFC. His research findings are described in over 200 archival journal papers.

This Creative Research Group has been focused on the research fields of the complex flows involving vortices and interfaces, which exist widely in engineering, such as aeronautics, astronautics and ocean engineering, and in nature, such as swimming or flying animal locomotion through fluid. With academic expertise of each group member and extensive collaborations, this group has developed rapidly under the supports of a series of funds from NSFC. The group has dedicated to the frontier fields related to unsteady flow and vortex dynamics, multiphase and multicomponent fluid flow interfaces, fluid-flexible-body coupling dynamics. The group consists of 3 winners of the National Science Fund for Distinguished Young Scholars, 1 winner for the Excellent Young Scholars Fund by NSFC, and other excellent researchers. In the past five years, the members of this group have published over 160 SCI papers, including 25 papers in *Journal of Fluid Mechanics*, which is the leading international journal in fluid mechanics and its relevant field.

This group has reached outstanding achievements in fundamentals and applications, which can be briefly described as follows. (1) In the field of unsteady flow and vortex dynamics, the group members derived the governing equations for the three invariants of the velocity gradient tensor and systematically revealed the dynamical characteristics and physical mechanisms of compressible flows. The group members also proposed a new method for designing the converging shock tube based on shock dynamics theory and further built up a series of experimental platforms for investigating the interactions

between converging shock waves and interfaces. (2) In the field of multiphase and multicomponent fluid flow interfaces, the group members proposed a new model for three-phase contact line on both smooth and rough solid surface, and revealed the mechanisms of film morphology transition in dynamic wetting and the interaction mechanism between moving objective and fluid interface. Furthermore, the group members implemented a new experimental approach for precisely generating controllable interfaces and proposed a theory on the linear growth of three-dimensional perturbations based on experimental results. (3) In the field of fluid-flexible-body coupling dynamics, the group members proposed a vorticity impulse theory in finite domain and provided the method for the calculation of the forces and the work on a moving deformable body based on the kinematic information of flow field in a finite domain surrounding it. Moreover, the group extracted some simplified biological propulsion models from complex animal swimming and flight, and revealed the intrinsic relationship between animal flapping-based mode and the propulsion efficiency.

This Creative Research Group will further focus on the complex flows with vorticities and interfaces of high-speed flow, multiphase and multicomponent fluid flow, and fluid-solid interaction flow, in order to achieve innovative results with high international reputation and to promote their research capacity for the contribution to the great needs of the country and society. The group members will aim to develop themselves into a creative research group with international prestige and to foster outstanding innovative researchers.

3.3 Professor YU Jihong

College of Chemistry, Jilin University
PI of the Science Fund for Creative Research Groups in 2016

The Porous Functional Materials Research Team led by Professor YU Jihong was granted by the 2016 Innovative Research Groups Project of National Natural Science Foundation of China.

Professor YU Jihong tears number of demestic and international academic titles, such as Academician of Chinese Academy of Sciences, Academician of the Academy of Sciences for the Developing World, Former Chief Scientist for National Program on Key Basic Research Project (namely, 973 Program), Academic Leader of the Program for Changjiang Scholars and Innovative Research Team in University, Associate Editor of *Chemical Science of the Royal Society of Chemistry*, member of International Zeolite Association Council, and Chief Scientist of National Key Research and Development Plan.

In response to the national strategic demand of sustainable development in petrochemical and fine chemical industries, the Porous Functional Materials Innovative Research Team, which focuses on the synthesis and preparation of porous functional materials with highly effective catalysis, adsorption, and separation properties, has formed naturally under the strong support by the National Natural Science Foundation of China. The team members include 2 academicians of the Chinese Academy of Sciences, 2 awardees of Excellant Young Scientists Fund, 2 awardees of The Recruitment Program of Global Youth Experts, and 5 awardees of New Century Excellent Talents by the Ministry of Education. In the past five years, the research team has published 308 SCI-indexed papers in journals such as *Science*, *J. Am. Chem. Soc.*, *Angew. Chem. Int. Ed.*, *Nat. Commun.*, etc., and 5 books, and obtained 21 authorized China Invention Patents. In 2012, part of the research achievements by the team won the 2nd Prize of National Natural Science Award.

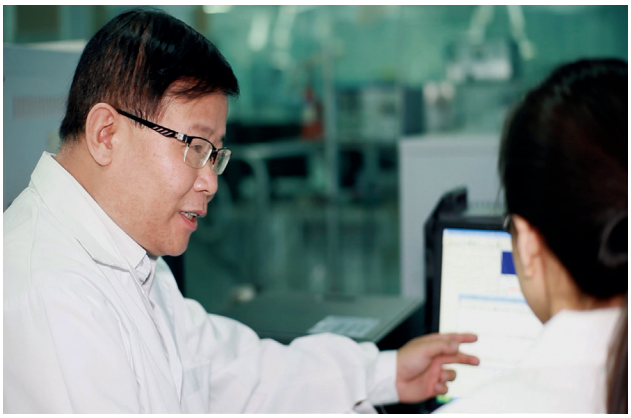
The research team has obtained a series of research achievements in the structural design of porous crystalline materials, construction of novel porous materials, and the modulation of their catalysis, adsorption and separation properties, which mainly include: a) By studying the structural chemistry of microporous crystalline materials, the team has developed a computer program for the structural design of microporous crystalline

materials, discovered the local interatomic distance rules to evaluate the feasibility of zeolite structures, and developed computer programs for high-throughput prediction and screening of zeolite structures. b) The team has designed and synthesized several novel zeolites, COF and MOF materials, developed the functionalization strategy for property modulation and optimization of porous materials. c) The team has found the accelerated crystallization of zeolites via hydroxyl free radicals for the first time. This discovery was published in *Science*.

In order to address key scientific issues in the development of porous catalytic and adsorption separation materials, such as templating mechanism, metal-ligand assembly rule, channel-confined effect, and the modulation mechanism of functional sites on properties, the team intends to study the formation mechanism and structure-function patterns of porous functional materials, as well as the structural design and rational synthesis of novel porous functional materials and their catalysis, adsorption and separation properties. The team aims to explore new methods and technologies for the synthesis and preparation of porous function materials, and to obtain a series of novel porous materials with highly effective catalytic, adsorption, and separation properties, which may yield innovative research results with international influences and thus enhance the comprehensive research capacity of porous functional materials and the ability of independent innovation of china. Meanwhile, the team will build an international first-class research base to attract and cultivate young talent team with international impact, which will make a contribution to the sustainable development of national economy and social progress.

3.4 Professor YUAN Yingjin

School of Chemical Engineering and Technology, Tianjin University
PI of the Science Fund for Creative Research Groups in 2016



Led by Professor YUAN Yingjin, a creative Research Team on "Synthetic Biology and Bioprocessing" was supported by NSFC in 2016.

Professor YUAN Yingjin is the awardee of National Science Fund for Distinguisked Young Scholars and the chief scientist of the 973 program "Design and Synthesis of Artificial Microbial Consortia".

Synthetic biology is the biological engineering, which is the intentional design, reform, or even remake of biological entities and has become the frontier of biochemical engineering. Led by Professor YUAN Yingjin, Tianjin University pioneered the studies of synthetic biology in China, assembled a group of young experts on synthetic biology, and has naturally formed a synergistic team focusing on "Synthetic Biology and Bioprocessing" upon the long-term collaboration among team members.

Together with his collaborators around the world, Professor YUAN Yingjin promoted the "Synthetic Yeast Genome Project Sc2.0" international collaboration project. The group chemically synthesized, assembled, and incorporated designer chromosome synV and synX of Saccharomyces cerevisiae. A highly efficient mapping strategy was developed to identify bugs, and after accurate debugging process a high fitness to a variety of culture conditions was achieved by the artificial synV and synX strains. The approach developed by the team established a universal strategy for chemically synthesized genome. The artificial biosynthesis of odd-chain fatty alcohols and salvianic acid A, and the electrically driven cell factories with reinforced electron transfer system were also successfully designed and reconstructed. These fundamental achievements provided novel solutions to key technical bottlenecks in artificial cell factory construction, which facilitated the achievement of industrial applications of non-grain fuel ethanol with outstanding contribution to chemical industry. The group also paid special attention to personnel training and development. In the recent few years, four members were awarded the Naticnal Science Fund for Distinguished Young Scholars, several members from National One-Thousand Overseas Youth Plan joined the team. International

recognition of the team has allowed the group to carry out cooperation broadly with international top scientific community.

In the next six years, the group will mainly focus on the following two topics: the design and synthesis of rearranged artificial genomic by gene clustering; the fast and accurate reconstruction of artificial cell factories. The team members expect firstly to achieve breakthroughs in fundamental theories of synthetic biology; secondly to build a series of artificial cell factories with great values to meet the national important demands, such as the bioprocess intensification, the energy-saving and emission-reduction, the efficient utilization of waste resources, etc., and promote the industrialization of various important pharmaceuticals, energy products and chemicals; and lastly to promote the development of synthetic biology in China and establish an international research center of synthetic biology.

3.5 Professor ZHOU Qi

Institute of Zoology, Chinese Academy of Sciences
PI of the Science Fund for Creative Research Groups in 2016

The research group on "Stem Cells and Regenerative Medicine" led by Professor ZHOU Qi has received the Science Fund for Creative Research Groups in 2016, National Natural Science Foundation of China.

ZHOU Qi, Professor, now is an academicien of CAS, the chief scientist of the National Basic Research Program "Non-human primate models for cellular pluripotency and human diseases research", and the chief scientist of the Strategic Priority Research Program "Stem cell and regenerative medicine research" of CAS. He is also the president of the Chinese Society for Stem Cell Research, and the chairman of the International Stem Cell Forum. To date, Professor Zhou has published over 140 research papers in the field of stem cell research and regenerative medicine.

The Creative Research Group on "Stem Cells and Regenerative Medicine" aims to tackle some critical scientific questions in the field of stem cells and regenerative medicine, and to fulfill the major requirements of the country on public health. The research group focuses on the basic theories of stem cell fate regulation, new technologies of obtaining cells, and translation and application of stem cells. It is a creative group with compatible goals, specific direction and complementary strengths. The group consists of researchers covering the fields of cloning, stem cell research, neural development and transdifferentiation, neural directed differentiation and evaluation, stem cell immunity and transplantation, gene editing, and animal models. The members of the group include 1 CAS member, 1 awardee of the National Science Fund for Distinguished Young Scholars, 3 awardees of the Hundred Talent Program of CAS, 1 awardee of the Thousand Talent Program for Young Outstanding Scientists, 1 awardee of the Scientific and Technological Innovation Leaders of the Ten thousand Talent Program, 1 awardee of the Young Top-notch Talent of the Ten thousand Talent Program, and 1 awardee of the Excellent Young Scientists Fund. The members of the group have published over 100 papers indexed by SCI in the past 5 years, including *Cell, Nature,* and *Science*, with more than 3,500 non-self-citations.

During the past few years, members of the

innovative research group have been working together and collaborated intensively, and carried out research on major scientific issues concerning stem cells and regenerative medicine, including cell reprogramming, pluripotency of stem cells, obtaining functional cells, establishing animal models for major human diseases, immunogenicity of stem cell transplantation. They have made a number of original research breakthroughs and established characteristic technical systems, including: (1) Achieved a number of "first" in tackling some of the most difficult questions in the field, including: obtained the first healthy animal derived from induced pluripotent stem (iPS) cells, demonstrating that iPS cells hold the similar pluripotency to ES cells; identified molecular markers for assessing pluripotency levels of stem cells; generated world-first mammalian diploid hybrid ES cells of phylogenetically distal species using haploid stem cell technology; discovered the immunogenicity of mouse and human iPS cells; achieved trans-differentiation of fibroblasts to neural cells using non-integrating technology; obtained neural cells differentiated from iPS cells. These findings answered a series of fundamental questions in life sciences. (2) Explored and took the lead in some new stem cell research fields, and developed and formed some specialty and advantages, such as in haploid stem cells, gene editing, and establishing animal models. (3) Strategically gathering resources to support innovation and translation of stem cells. Beijing stem cell bank stores a variety of pluripotent stem cells, adult stem cells, haploid stem cells, and adult cells containing genetic information of diseases. It also developed and established clinical grads stem cells, clinical grade functional cells, as well as related products. The stem cell bank also worked with relevant administrative departments and gathered extensive data for formulating standard for quality control of clinical grade cells, which has laid solid foundation for translation and clinical use of stem cells.

Based on the previous collaboration and important achievements, the creative research group will continue to concentrate on the key issues of stem cell research and its clinical translation, focusing on fundamental scientific issues such as the formation of primordial germ cells and mechanisms of meiosis, differentiation and functional specialization of neural stem cells, develop core technologies for obtaining functional gametes and neural cells, and carry out preclinical evaluation and clinical research on the basis of the stem cells obtained. By doing so, the creative research group hopes to promote the translation of stem cells from basic research to clinical application, and to achieve major theoretical breakthroughs and technological innovation, with the ultimate goals for improving public health and promoting economic and social development.

3.6 Professor LI Fuguang

Institute of Cotton Research, Chinese Academy of Agricultural Sciences
PI of the Science Fund for Creative Research Groups in 2016

With Professor LI Fuguang as the academic leader, cotton germplasm innovation and the molecular breeding of high yield varieties group was founded by the Science Fund for Creative Research Groups in 2016.

Professor LI Fuguang is the winner of National Science Fund for Distinguished Young Scholars, National Agricultural Scientific Research Talent, National Outstanding Scientific and Technical Workers and the director of State Key Laboratory of Cotton Biology.

With the development of cotton genomics, biotechnology and genetic improvement, the Innovative Research Groups of cotton germplasm innovation and the molecular breeding of high yield varieties, was formed after long-term cooperation, in which every member can bring out their academic and technical expertise. This group orients the major national demand and aims to solve the frontier scientific and technological issues in cotton production in China. The research area of the group covers multiple fields such as cotton germplasm resources, genomics, bioinformatics, molecular biology and genetic breeding. The team includes one academician of the Chinese Academy of Engineering, one winner of National Science Fund for Distinguished Young Scholars, one for National Outstanding Professional and Technical Personnel and four members of National Agricultural Research Outstanding Talents. To date, the group has been awarded by five national scientific and technological progress second prizes and one national prize for technological inventions second prize as well as published more than 30 SCI papers in well-reputed journals including *Nature Biotechnology, Nature Genetics* and others, 31 cotton varieties has been certified for commercial cotton production and made great social, economic and ecological benefits.

In recent years, the research group has gained a series of achievements in cotton genomics, genetic transformation technology and cotton breeding. It mainly includes as follows.

(1) Take the lead in cotton genome project. The A genome (Gossypium arboreum), D genome (Gossypium raimondii) and AD genome (Gossypium hirsutum) were sequenced, which fill the blank that cotton has no reference genome

and achieved international leading level.

(2) Aimed at the unstable transformation system and time consumption in cotton transformation, genetic regularity of somatic embryogenesis from the cytology, genetics, molecular biology and proteomics aspect was illuminated and large scale cotton transformation system was established. More than 2,000 transgenic materials with high application values were generated. This research promoted the application of basic research on cotton breeding.

(3) The biochemistry-assisted cotton breeding system was established, and a series of short season cotton varieties were cultivated, i.e., CRI36, etc. And wheat-cotton double cropping system is promoted through innovations. Major insect-resistant cotton varieties CRI29 and CRI41, etc., were cultivated, which accelerated the cultivation and application of domestic transgenic insect-resistant cotton. The varieties based on the transgenic materials by the group cultivated more than 100 million mu (6.6 million hectares), which is 30% of domestic insect-resistant cotton cultivated area. The group played an important role in boosting up the market share from 5% to 98% of domestic insect-resistant cotton.

The group is aiming at the major problems that limited cotton production under the diverse situation. They are focusing on the interaction of cotton fiber quality and architecture. The team is going to comprehensively apply interdisciplinary research methods to resolve the interaction of fiber formation and architecture buildup, and proposing new approach for cotton genetic improvement, creating new materials with better fiber quality and suitable for machine-picking and cultivating good quality and low production cost major cotton varieties. The team expects to provide scientific and technological support for the solution of major production problems in the county, i.e., low quality raw cotton fiber and high production cost.

3.7 Professor PAN Yongxin

Institute of Geology and Geophysics, Chinese Academy of Sciences
PI of the Science Fund for Creative Research Groups in 2016

The interdisciplinary research team led by Professor PAN Yongxin focusing on variation of earth's magnetic field and its biospheric effects, has been supported by the Science Fund for Creative Research Groups in 2016. This group consists of 10 interdisciplinary researchers of paleomagnetism, biogeomagnetism, geobiology and space physics, including 4 awardees of National Science Fund for Distinguished Young Scholars and 1 receipient of Excellent Young Scientists Fund, all from the Institute of Geology and Geophysics, Chinese Academy of Sciences.

Dr. Pan has set up the first biogeomagnetism group in China, and set up the France-China Bio-Mineralization and Nano-Structures Laboratory for international collaboration between China and France. In the past decade, they have made great efforts in cross-disciplinary studies between geomagnetism and biology. Their achieved scientific findings include (1) established a world leading interdisciplinary research platform, the first biogeomagnetism lab in China, developing new methods allowing to decipher the biomineralization and magnetotaxis mechanism, (2) developed high-quality magnetostratigraphy dating for sedimentary basins and new determinations of reliable Cenozoic and Mesozoic paleointensity, and (3) found possible correlation between the oxygen escape during geomagnetic reversals and mass extinction. From 2011 to 2015, this group has published 160 peer-reviewed papers, in international main-stream journals, warranted 3 national patents and published 3 special issues in prestigious international journals.

In this new project, the research group will carry out edge-cutting and systematic investigations on various effects of changes of geomagnetic field on biosphere over different timescales, from experimental simulations to geologic records, from animals to microbes. This will catalyze the development of biogeomagnetism and cross-disciplinary research, and deepen our understanding of the effects of Earth's deep interior processes on biosphere evolution.

3.8 Professor QIN Boqiang

Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences
PI of the Science Fund for Creative Research Groups in 2016

The research group entitled "Lake environmental change and its ecological system response" led by Professor QIN Boqiang, was supported by the Science Fund for Creative Research Groups in 2016.

Professor QIN Boqiang, awarded by National Science Fund for Distinguished Young Scholars, has been selected as the 100 Talents Program of the Chinese Academy of Sciences. Professor Qin serves as the chairman of the lake and wetland branch of the Geographical Society of China, member of Chinese Ecosystem Research Network (CERN) scientific committee, and member of the water pollution prevention and control expert committee in Suzhou and Wuxi, Jiangsu Province. To date, Professor Qin has published more than 160 SCI papers.

Lake, known as the pearl of the earth, is important and valuable resource for human beings and has a variety of ecological functions. However, lakes in China are facing the dual pressures from environmental pollution and ecosystem degradation. The innovative research group which is gradually shaped to meet the urgent national needs of lake pollution control and ecological protection, consists of 4 National Science Fund for Distinguished Young Scholars and 1 NSFC Excellent Young Scientist. In addition, the members of the innovative research group have ever taken charge of 863 High-Tech Program and 973 Program. At present, the innovative research group has gradually developed into a world-known group covering all branches of limnology and enjoying a high reputation around the world. During the last five years, the group members published a total of 386 papers, including 260 SCI papers published on *ISME*, *GCB*, and *RSE*, etc. These papers have been cited for more than 6,760 times by international academic journals such as *Science*. Among the 6,760 citations, 6,104 times are cited by other researchers. The group has won five national and provincial awards, and twelve national invention patents.

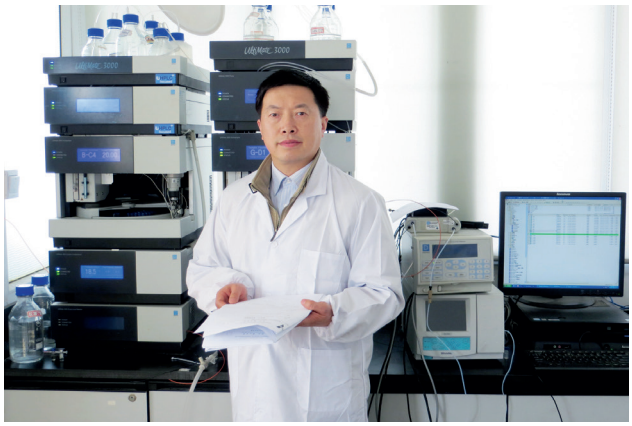
At the same time, focusing on the dual influences of climate change and human activities on lake ecosystems, the group innovated new techniques and approaches to characterize and assess lake ecosystems, investigate the response

and feedback mechanisms of lake ecosystems, and present control and management measures to lake pollution and ecological restoration.

The group revealed how the dual pressures of climate change and human activities have impacted the structure and function of lake ecosystems. The group further elucidated the response and feedback mechanisms of the expansion of algal-dominated ecosystems and the degradation of macrophytic-dominated ecosystems driven by climate change and lake eutrophication. An eco-environment model of shallow lakes coupling the hydraulic driving process and the migration and transformation processes of biogenic elements has been developed to forecast algae bloom in Taihu Lake. They introduced a strategy approach for lake eutrophication control, water quality improvement, and ecological restoration. Basic theories, innovative study methods and applications practices presented by this group are currently leading the development of limnology in China, and has made significant contributions to major environmental issues in China, such as eutrophication control. Research findings obtained by the group on shallow lakes will further develop and improve international limnology discipline.

3.9 Professor LIU Changsheng

School of Materials Science and Engineering, East China University of Science and Technology
PI of the Science Fund for Creative Research Groups in 2016



With the leadership of Professor LIU Changsheng, the innovative research group on "Inorganic nano-scaled biomaterials" has been awarded by the National Natural Science Foundation of China in 2016.

Professor LIU Changsheng, National Science Fund for Distinguished Youth Scholars, Changjiang Scholar Distinguished Professor, Chief Scientist of National Basic Research Program, member of the department of Materials Science and Technology Committee of Ministry of Education, Chairman of Nanometer biological materials branch of Chinese Society for Biomaterials, has published over 200 articles on international core journals.

The innovative research group on "Inorganic nano-scaled biomaterials" aims at the great clinic demands, focuses on key scientific issues of the controllable preparation and activation modification of inorganic nano-scaled biomaterials, and has been forming into an interdisciplinary, mutually beneficial research team with the research area from fundamental research to practical application under the support of the National Natural Science Foundation of China. Researchers in the group cover the fields of biomaterials, material chemical engineering, inorganic materials, and physical chemistry, etc., including 4 winners of National Science Fund for Distinguished Youth Scholars, 3 Changjiang Scholar Distinguished Professors, 1 Chief Scientist of National Basic Research Program, and 1 Thousand Youth Talent. In the past five years, the research group has published more than 480 articles on international core journals, and gained more than 13,800 times SCI citations. The group has won the second prize of the National Natural Science Award and four first prizes of provincial Natural Science Award.

This research group has been committed to the researches of the controllable preparation and biological regulation of the biomaterials. A series of results including biomimetic synthesis, bioactive modification and assembly of surface/interface and nano effects of materials have been achieved. (1) Mimicking the composition and structure of bone tissues, the transforming rules and mechanisms of calcium/phosphate-based materials in liquid/solid and solid/liquid/solid, and

tissue formation in vivo were deeply investigated, and therefore successfully developed the new type of self-setting calcium phosphate cements as bone repair materials, which was approved by SFDA and has been used widely in clinic. By using a copolymer-interface-induced reaction, the controllable synthesis of large-sized mesoporous (>10 nm) and hierarchical porous materials, and functionalization and immobilization in the mesopores have been achieved; (2) rhBMP-2 with high bioactivity and purity was successfully manufactured via Prokaryotic expression system. The fundamental principles of surface/interface-regulated the bioactivity and the structure of BMP-2 molecule were identified. An rhBMP-2-loaded bioactive artificial bone has been successfully developed and authorized by SFDA. (3) The biological effects of hierarchical micro-/nano-scaled structures have been systematically investigated. The synergetic effects of the trimodal porous scaffolds on osteogenic differentiation and bone formation were illuminated. A nano-scaled hydroxyapatite-induced biological effect and specific properties, and the underlying mechanisms were elucidated.

Addressing the clinical challenges of the limited regenerative capacities of the aging patients, the research group will launch researches on in-situ activated bone tissue regeneration. Breakthroughs are expected in key scientific issues and new technologies of controllable preparation of materials, modification of surface/interface, controlled release of growth factors and drugs, and gene transfections, etc. Novel world-leading tissue repairing material/equipment with high bioactivity and multi-functions will be developed so as to provide new solutions to clinical treatment of aging bone diseases. The continued research contributions from this research group will undoubtedly benefit the health care and medical industry nationally and internationally.

3.10 Professor YAN Jianhua

School of Energy Engineering, Zhejiang University
PI of the Science Fund for Creative Research Groups in 2016

Professor YAN Jianhua holds the titles of Changjiang Scholar and "973 program" Chief Scientist. His major is Energy and Environmental Engineering, mainly focusing on the high-efficiency utilization of solid wastes as clean energy. As one of the three group leaders, he was awarded the National Science and Technology Progress Award (Innovation Group) in 2016. Being the first completed person or co-leader, he was awarded two Second Class Prizes of National Science and Technology Progress Award. Professor Yan is the director of National Engineering Laboratory of MSW Incineration Technology and Equipment. He is a member of Discipline Appraisal Division of the State Council. He is also serving as the chairman of Zhejiang Provincial Association of Renewable Energy and Zhejiang Provincial Association of Waste Treatment and Resource Utilization.

The Innovative Research Group of the National Natural Science Foundation of China on the topic of "Thermal conversion mechanism and clean utilization of solid fuels with complex components" includes 1 academician of the Chinese Academy of Engineering, 5 Changjiang Scholars, 4 Winners of National Science Fund for Distinguished Young Scholars, 3 "973 program" Chief Scientists, 3 National Science and Technology Innovation Leading Talents, 2 National Youth Talents, 2 Winners of National Science Fund for Excellent Young Scholars, 6 National Hundreds and Thousands Talents, and 11 New Century Talents of Ministry of Education. The group has been awarded with Model of Labor Collective of Zhejiang Province twice. The group has published 542 SCI-indexed papers in the past 5 years with SCI other-citation of 4,828 times, and 29 books. Two group members were listed as highly cited scientists by international institutions, and 11 group members have been appointed as associate editors-in-chief or editorial board members of international academic journals. The group members have been invited to give 45 keynote presentations at international conferences, and the group has organized international mainstream conferences for 18 times. The group was responsible for 10 national and industry standards and 218 authorized invention patents. Professor. Yan's group was awarded 14 National Science and

Technology Awards, including 1 National Science and Technology Progress Award (Innovation Group) in 2016, and 5 Chinese Patent Excellence Awards.

With the conception of "Seeking Truth, Being Unity, Pursuing Innovation", the group focused on the great national demand combined with international academic frontier, emphasized group cross cooperation, paid attention to innovative talent cultivation, kept on combining theory and practice, and laid emphasis on extensive international cooperation. According to China's coal-dominated energy structure, the group developed Clean Utilization of Coal and Efficient Power Generation Technology. The Coal Water Slurry Combustion Technology takes the leading role in the world, which has been applied to the world's largest 200MWe coal water slurry power plant. The group created a new way to generate electricity by the combination of clean power generation and coal utilization, and the National Collaborative Innovation Center which takes "three elite schools plus four central enterprises" as the core was founded. For the pollution and ecological damage caused by improper disposal of various types of wastes, the group developed Waste and Biomass Incineration Power Generation Technology. MSW Circulating Bed Incineration Power Generation Technology is listed as one of the four mainstream technologies for the solid waste thermo-treatment, while Biomass Fluidized Bed Direct Combustion Power Generation Power Plant with the maximum capacity was built. Aiming at addressing the air pollution problems brought by the emission from China's power plant boilers, the group developed Pollution Control Technology in the power production processes, making the emission of the atmospheric pollutants from coal-fired power plant superior to the emission standards of natural gas fired power plant. And the research on dioxin emission and control together with on-line dioxin detection for waste incineration is at the leading level internationally. The group also came up with the Computer Aided Testing (CAT) theory and advanced testing methods for energy conversion processes, and some key fundamental problems in the engineering gas-solid two-phase flow were explored, which has been recognized by academic circles home and abroad.

The group will closely center on the topic of thermal conversion mechanism and clean utilization of solid fuels with complex components, to further strengthen the research and technology development of the efficient and clean conversion technology of conventional energy resources, to further explore new energy technologies such as biomass energy, solar energy, hydrogen energy, energy storage and so on. The group will strive to achieve research results with important international impact.

3.11 Professor FENG Xiating

Institute of Rock and Soil Mechanics, Chinese Academy of Sciences
PI of the Science Fund for Creative Research Groups in 2016

Professor Feng is the President of International Society of Rock Mechanics (2011-2015), the board member of Federation of International Geo-engineering Societies, President of Chinese Society for Rock Mechanics and Engineering and Director of State Key Laboratory of Geomechanics and Geotechnical Engineering. He is the Distinguished Young Scholar supported by National Natural Science Foundation of China, the Changjiang Scholars Distinguished Professor, the leading talent supported by Key Talent Project and the chief scientist of National 973 Program. He has won 3 National Science and Technology Progress Second Awards and authored or co-authored more than 160 technical papers indexed by SCI.

The research group supported by National Natural Science Foundation of China focuses on difficulties and bottleneck of the basic research on the safety of rock engineering and meet the significant national demands as the construction and development of rock engineering in China. Among the group members, six scientists received the National Science Fund for Distinguished Young Scholars, one scientist received the National Science Foundation for Excellent Young Scholars, nine scientists were appointed by Hundred Talents Program of the Chinese Academy of Sciences and three scientists were appointed by Key Talent Project and so on. In the last five years, the core members have owned 225 technical papers indexed by SCI and cited 2,080 times, and received 3 National Science and Technology Progress Awards as the first complete unit.

After more than 10 years' joint research, the group has made great progress on identification method of rockmass mechanical parameters, the safety analysis and control theory and the associated technology of rock engineering. It mainly includes: (1) The true triaxial experiment technology under high stresses which could investigate the complete stress-strain curves of hard rock has been developed, and the true triaxial experiment method has been built; the incompatibility of the characteristics and laws of the rock deformation and failure in large complex deep rock engineering have been revealed; an intelligent identification method of mechanical parameters has been proposed, considering the

evolution of the rock damage degree. (2) The safety analysis method of the rock engineering in the complex conditions has been built; a new index integrating the degradation model, failure approach index (FAI) and local energy release rate (LERR) has been proposed and a continuum–discontinuum numerical analysis method based on elasto-plastic cellular automaton has been developed; fracture medium mechanics model based on DDA has been developed and the CDDA method based on the latest complementary theory; rock mass equivalent medium method based on virtual wave concept and temporal recursive method which considering the two-dimensional propagation law of the stress waves have been proposed. (3) Focused on the optimization design of large caverns, high slope and deeply seated tunnel, the dynamic disaster such as rock burst in deeply seated engineering, the dynamic safety and control of the nuclear bedrock, the stability of underground gas storages and the frozen heave mechanism and seismic design of the highway tunnels like Motuo in complex geological conditions, the associated evolution mechanism and laws have been revealed; the safety control and optimization design theory and technology have been developed.

The group will continue to focus on the basic research of "Analysis and Control of Safety of Major Rock Engineering" by the prediction and control of the process of crack development of the deep engineering under special conditions, facing the problems of national major engineering constructions and the international forefront issues in rock mechanics. It will make the original and world advanced achievements and provide a strong theoretical and technical supports for the safety of rock engineering projects at great depth, such as hydropower engineering, mines, shale gas extraction and so on.

3.12 Professor WANG Zhanshan

School of Physics Science and Engineering, Tongji University
PI of the Science Fund for Creative Research Groups in 2016

The Creative Research Group on "Key Technologies of High Power Laser Components" led by Professor WANG Zhanshan was granted by the National Science Foundation of China in 2016.

Proffessor WANG Zhanshan, winner of National Science Fund for Distinguished Young Scholars, Changjiang Scholars, SPIE (the International Society for Optics and Photonics) Fellow, panelist of National Science and Technology Major Project, focus on the precision optical devices and systems. He has published more than 100 SCI-indexed papers and received almost 50 invention patents. The Ministry of Education has awarded him the first prize of Technology Invention Awards in 2015 and Shanghai government has awarded him the second prize of Technology Invention Awards in 2011.

To fulfill the requirements from the laser fusion, tactical laser systems, ultra-intense lasers, etc., the Creative Research Group of "Key Technologies of High Power Laser Components" carried out application-driven and future-oriented studies of basic science and key technologies of high power laser components. The Creative Research Group came into being naturally during the long-term close cooperation, and it evolved with support of a series of projects from the National Science Fund. The Creative Research Group is comprised of researchers with backgrounds of materials, components, electromagnetic field manipulation, laser-matter interaction and so on. The team has 1 academician of Chinese Academy of Engineering, 3 winners of National Science Fund for Distinguished Young Scholars, 1 Changjiang Scholars, 1 principle investigator of 973 project, and 1 winner of National Science Foundation for Outstanding Youth Foundation. In the past 5 years, the Creative Research Group published more than 200 papers in journals like *Physical Review Letters*, *Light*: *Science & Applications* and so on.

In recent years, the group carried out collaborative and innovative studies on the fundamental principles, key technologies, and engineering applications of high power laser components. A lot of achievements have been obtained in laser crystals, laser coatings and electromagnetic field manipulation. (1) On the scales of atom, molecule and group, a new

method to control the strong coupling between rare earth ions and crystal field and to modulate local coordination structure has been proposed. The Na, Yb:CaF2, Yb:GSO and other new crystals have been developed and successfully used in the high power laser systems. (2) A new concept aiming at integrated and quantitative process control was proposed to fabricate laser coatings. Technology breakthroughs, such as iterative etching of substrates, ultrasonic cleaning of substrates, coating preparation, etc., offer a new path for the deterministic improvement of the laser damage resistance of laser coatings. (3) To overcome the challenging issue of controlling defects with micrometer and nanometer sizes, engineered defects were used to establish the physical model of electric-field enhancement at defects. This clarified the mechanism of defect-induced electric-field enhancement and the resulting laser-induced damage. Based on the physical model, new approaches like coating design and special fabrication technology have been proposed to manipulate electric-field enhancement, which increased the laser-induced damage threshold by a factor more than 10. The laser components developed by the Creative Research Group have been successfully used in laser fusion facility, laser weapon, laser radar, etc.

A new generation of materials results in a new generation of components and then leads to a new generation of equipment. This concept not only made a great achievement of the previous laser technologies but also provides guidance for the development of future laser technologies. The Creative Research Group will carry out innovative and interdisciplinary researches that focus on the laser crystals, laser coatings and microstructure manipulation. The group expects to achieve a series of original achievements, to realize different kinds of key components with international leading level, to provide new scientific concepts and key components to accomplish the leaping development of laser technologies in China, and to develop a Creative Research Group with international impact.

3.13 Professor LIAO Guisheng

School of Electronic Engineering,
Xidian University
PI of the Science Fund for Creative
Research Groups in 2016

The research group on "Fundamental Theory and Key Techniques of Radar Cognitive Detection, Imaging and Identification" with Professor LIAO Guisheng as the academic leader was supported by National Natural Science Innovation Research Group in 2016.

Professor LIAO Guisheng as the National Distinguished Young Scholar, Distinguished Professor of the Changjiang Scholars, the New Century National Hundred, Thousand and Ten Thousand Talent, has already published more than 150 SCI papers, and authorized more than 50 patents.

With the continuous improvement of national technical requirements for radar, the innovation group focusing on "Fundamental Theory and Key Technology on Radar Cognitive Detection, Imaging and Identification" devotes to basic theory and key technology study in radar signal processing with the support by National Laboratory of Radar Signal Processing. These members of the innovation group carry out close cooperation and grow up gradually in three mutually supportive research fields of radar detection, imaging and identification with strong support from a series of National Natural Science Fund projects. This group is a young research team, including three winners of National Science Fund for Distinguished Young Scholars, four Distinguished Professors of the Changjiang Scholars and the New Century National Hundred, Thousand and Ten Thousand Talent, as well as a group of outstanding young talents (five National Outstanding Youth, Thousand Youth Talents, Young Changjiang Scholars, Young Top-Notch Talent, New Century Excellent Talents, and National Excellent Doctoral Dissertation Winners).

In recent years, this group has made a series of contributions in basic theory on radar signal processing and broke through a lot of key technique barries, mainly including three aspects as follows. (1) In the field of target detection: this group has proposed the space-time adaptive moving target detection theory and methods, which offered the key techniques for clutter suppression of high-speed platform radar and successfully applied to airborne early warning radar; A new system of sparse array integrated pulse aperture meter-wave radar is proposed to

realize the effective detection and high precision measurement of low radar observable target; a dynamic signal detection method based on complex propagation channel characteristic matching enhancement and intelligent anti-jamming is proposed, which improves the performance of over-the-horizon radar (OTHR). (2) In the field of radar imaging: This group achieved a breakthrough in estimation and compensation of motion parameters based on received data, realized the continuous and high quality SAR imaging under the bumping condition of the radar platform, and obtained the high resolution ISAR image of the non-cooperative military target for the first time in China. (3) In the field of identification: The sparse sensing model is established, and the feature extraction and SAR image interpretation method are proposed in the background of signal distortion and complex clutter noise to achieve robust feature extraction, image interpretation and target recognition with small samples. Consequently, this group was awarded with the second prize of National Award for Natural Sciences, the first prize of the National Science and Technology Progress Awards, the second prize of the National Technological Invention Award.

In future, the advanced radar will face new type of targets and more complex electronic interference. This group will explore the coupling scattering mechanism among targets, complex ground/sea environment and propagation channels, break through key technologies on cognitive detection, imaging and identification for stealthy, hypersonic and other new type of targets, support the development of new electronic equipment and cultivation of high-level talent.

3.14 Professor ZENG Dajun

Institute of Automation, Chinese Academy of Sciences
PI of the Science Fund for Creative Research Groups in 2016

The research group led by Professor ZENG Dajun received the Science Fund for Creative Research Groups grant in 2016. This group's research area is Big Data-Driven Security Informatics.

Professor Zeng was awarded National Science Fund for Distinguished Young Scholars. He was also part of the Hundred Talent Program of the Chinese Academy of Sciences, and the country's Ten Thousand Talent Program. He is currently the Deputy Director of the State Key Laboratory of Management and Control for Complex Systems, and the Director of the Internet Big Data and Security Informatics Research Center. He serves as a consulting expert of the NSFC Major Research Plan "Big Data-Driven Management and Decision Science Research". Professor Zeng was elected as IEEE Fellow in 2015. He currently serves as the President of the IEEE Intelligent Transportation Systems Society and the Editor-in-Chief of IEEE Intelligent Systems. Professor Zeng has published more than 300 research papers and received a number of scientific research awards and prizes.

Security informatics research hinges on a multidisciplinary approach, crossing cutting management sciences, systems science, and information technology (IT). Professor Zeng's group aims to develop big data-driven approaches to enable better perception, analysis, understanding, reasoning, and decision making in security applications. The research results are expected to benefit practitioners. To meet strategically important security challenges, this "Big Data-Driven Security Informatics" group will carry out research to advance fundamental theories of Security Informatics, develop key technology innovations, and conduct application-driven systems efforts.

The members of Professor Zeng's group have diverse but complementary academic backgrounds ranging from management sciences, decision sciences, to IT. In recent years, this group has conducted fruitful research and development work on Internet Big Data Analysis and Security Informatics, with real-world impact. The group has published 239 international journal papers and 329 international conference papers. The number of total citations provided by Web of Science has exceeded 1,500. The group has also published 40 monographs and book chapters, and has led or

participated in 25 national scientific research projects. The main achievements include: (1) In-depth and systematic theoretical research on deep analysis and understanding of social media, mining of open-source data, analysis of new media communications, and development of infectious disease informatics methods; (2) Technical approaches for open-source big data and security information collection, awareness, fusion, analysis, processing, and recommendation; and (3) a number of significant application-oriented findings in the fields of new media, public health, and open-source data analysis through cooperation with practitioners.

Under the support of the Science Fund for Creative Research Group, Professor Zeng's group plans to focus on fundamental theories and key technologies in the field of Internet big data and security informatics. The group will strive to achieve innovative breakthroughs in Intelligence and Security Informatics, Predictive Analytics, Infectious Disease Informatics and Biosecurity, Cognitive Computing, Dynamic Social Network Analysis. The research output will help strengthen the big data processing capabilities of the practitioners and train the talents in the related important emerging areas.

3.15 Professor GAO Ziyou

School of Traffic and Transportation, Beijing Jiaotong University
PI of the Science Fund for Creative Research Groups in 2016

The creative research group led by Professor GAO Ziyou, on "urban transportation management theory and method" was funded by the Science Fund for Creative Research Groups in 2016.

Professor GAO Ziyou was awarded as Changjiang Scholar by Ministry of Education and funded by National Science Fund for Distinguished Young Scholars. He is the chief scientist of the 973 project, dedicated to studying key traffic bottlenecks issues in big cities. He is also an expert in the System Science Committee and the State Council Academic Degree Committee. He serves as the president of Society of Management Science and Engineering of China, and the vice president of Systems Engineering Society of China and Chinese Society of Optimization, Overall Planning and Economic Mathematics. He has published more than 260 SCI-indexed papers, and achieved one Second-Class Award of National Natural Science, two First-Class Awards of Natural Sciences by the Ministry of Education, Fudan Management Excellence Award, etc.

The innovation research group on "urban traffic management theory and method" focuses on the substantial demand in the development of cities and makes explorations in the theories and methods in key scientific problems in urban traffic management. The members in the group have close collaborations with each other to develop the research platform during the past twenty years, and are sustainably funded by National Natural Science Fund. The innovation research group includes two professors awarded by National Science Fund for the Distinguished Young Scholars, two professors awarded by Changjing Scholars, two professors awarded by Youth Changjiang Scholars, one professor awarded by Youth Thousand Talents Program, three members with the award of the national excellent PhD dissertations, and eleven professors awarded by New Century Talent Supporting Project by the Ministry of Education. The group members have published more than 300 international papers in the high quality transportation journals, including Operations Research, Transportation Science, Transportation Research Part B, and these papers have been cited for more than 3,200 times by other researchers.

From three aspects of urban road traffic management, urban rail traffic management and the complexity of urban traffic system, the innovation research group developed mathematical models to study the temporal-spatial evolution and distribution of urban traffic flow as well as their applications. The studies include (i) according to the characteristics of urban traffic flow in China, the research group proposed the road mixed traffic flow dynamic models for formulizing the traffic spatial-temporal distribution and the dynamic models for describing the patterns on the forming, transmission and dissipation of urban traffic congestion; (ii) corresponding to the characteristics of high density, short station interval and high random dynamics of urban rail transportation systems, the research group systematically explored the method, theory and integrated model for the organization, optimization and operation control of urban rail transit and investigated the optimal design issues in the traffic hub network for connecting road system and rail transit system; (iii) considering the characteristics of randomness, dynamics and complexity of the urban transportation systems and the high-density feature of crowd behavior, the research group studied the capacity of urban traffic network, the pedestrian flow movement patterns and the dynamic traffic evacuation process in the large transportation hubs. Moreover, multiple important empirical and applied studies were conducted by the research group, including Beijing's bus dispatching command system, the traffic congestion evaluation system and urban transit operation system.

Facing the emerging demand of national new urbanization strategy, the innovation research group focuses on identifying the scientific problems from the practical urban traffic management and dealing with the challenges through innovative research, theoretical development and practical application. In the next six years, the research group will deeply devote themselves to theory and method studies on the city clusters' integrated transportation systems management towards the new urbanization strategy of China.

3.16 Professor CAO Wuchun

Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences
PI of the Science Fund for Creative Research Groups in 2016

The research group on discovery and tracing of natural focus diseases, led by Professor CAO Wuchun, was granted with Creative Research Groups by the National Natural Science Foundation of China in 2016.

Professor CAO Wuchun has obtained the National Science Fund for Distinguished Young Scholars, and been selected for State Talents Project as the Outstanding Middle-Aged and Young Expert. He has been granted WU Jieping–Paul Janssen Medical & Pharmaceutical Award, Public Health & Preventive Medicine Development Contribution Award, Outstanding Specialist Award of PLA, the First-class Merits, and the First-class National Prize for Progress in Science & Technology. He has published 192 papers in SCI journals with a total impact factor of 1,127. He is one of the most cited Chinese researchers in the field of medicine in 2014 and 2015 with the H factor of 41. Professor. Cao is the convener of Appraising Group for Preventive Medicine, the Academic Degree Committee of the State Council.

The research group is composed of scientists in the field of epidemiology, microbiology, bioinformatics and spectrum geography from the State Key Laboratory of Pathogen and Biosecurity, including a winner of the National Science Fund for Distinguished Young Scholars, two winners of the National Science Fund for Excellent Young Scholars, a selected person for the State Talents Project, a Leading Talent in Science and Technology of PLA, a Tiptop Talent in Science and Technology of PLA, a Golden Star and two New Stars for Scientific Research granted by the General Logistic Department of PLA, and five New Stars for Science & Technology granted by Beijing Government. Since 2011, the research group has published 255 papers on the international peer-reviewed journals, including *New England Journal of Medicine, Nature, Lancet Infectious Diseases, Cell Stem Cells, British Medical Journal, Annals of Internal Medicine, Cell Research and PNAS* with a total impact factor of 1,236. The total citation was over 2,900 in the recent five years.

The research group has focused on discovery and tracing of natural focus diseases, which show significance in the aspects of public health and national biosecurity. Since 2011, they have first

discovered 5 emerging tick-borne diseases in the world, and characterized the pathogens as well as natural foci. The other 3 emerging tick-borne diseases have been first reported out of Europe. They have clarified the genomic diversity and evolution of Ebola virus in Sierra Leone, and characterized transmission dynamics and intervention effectiveness of Ebola virus disease. They first identified nosocomial transmission of avian influenza A (H7N9) virus in a hospital, and provided evidence of person to person transmission between unrelated individuals. In China, they first isolated 4 strains of Zika virus, and proved that the virus could pass through the placental barrier to cause abnormal development of fetus mice.

The research group will take full advantage of their established research platforms to do studies on recognition and identification of novel pathogens, discovery and confirmation of natural foci, evaluation of vector competent, analyses of genetic diversity and evolutionary dynamics of pathogens, and prediction of epidemical trends. Their goal is to take the lead in the research field in the world to provide scientific and technological supports for state biosecurity.

3.17 Professor QI Hai

School of Medicine, Tsinghua University
PI of the Science Fund for Creative Research Groups in 2016

Professor Qi is a recipient of Changjiang Scholar, an NSFC Distinguished Young Scholar, an Outstanding Talents of the New Century of Ministry of Education of China, the Young Leader in Scientific and Technological Innovation award from the Ministry of Science & Technology of China and the Principal Scientist of MOST 973 project Regulation and reconstruction of protective humoral immunity in chronic viral infections.

Members of the Dynamic Cellular Immunobiology of Humoral Immune Regulation creative research group possess interdisciplinary and complimentary expertise across a wide range of research topics. Previous and ongoing collaborations among these researchers have led to significant discoveries in the field of humoral immune regulation and the establishment of technical platforms in intravital 2-photon microscopy, single-cell and single-molecule imaging, cellular mechanics, synthetic chemistry and photo-manipulation for dynamic immunobiological studies.

Recent discoveries made by the team in the field of humoral immune regulation include: (1) a novel motility-driving function of the classical co-stimulatory molecule ICOS and the unexpected dependence of Tfh development on antigen non-presenting bystander B cells; (2) a novel mechanism of memory B cell activation by which acidic phospholipids govern the enhanced activation of the IgG-B cell receptor; (3) development of the first 2-photon activatable chemokine system that permits real-time manipulation of lymphocyte positioning in vivo by light, enabling investigation of niche-specific lymphocyte behaviors in vivo; (4) a photoactivatable antigen system to examine B cell probing termination and the B cell receptor sorting mechanisms during B cell activation.

Future efforts of the team will be focused on humoral immune regulation and the germinal center reaction, aiming to dissect dynamic immunobiology of helper T cells, B cells, and dendritic cells, the three most important cell types of humoral immune regulation. Specifically, the team aims to unravel mechanisms by which follicular T helper cells control affinity maturation, to understand how signal transduction in germinal center B cells control fate determination, and to reveal how dendritic

cells regulate the generation of follicular T helper and T regulatory cells. These research efforts are expected to lead to better understanding of humoral immunity and potentially improved vaccine designs and therapeutic strategies for infectious and autoimmune diseases.

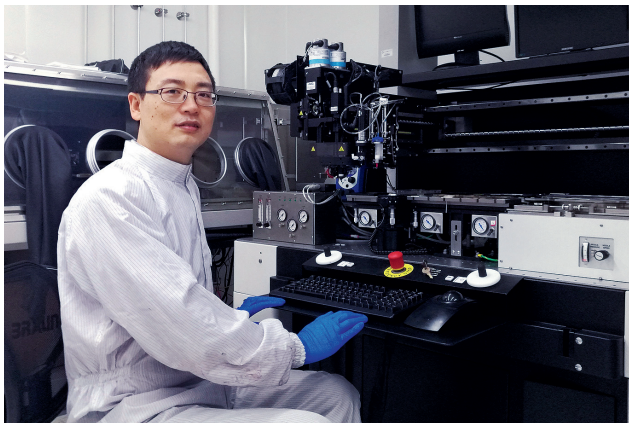
Part 4

Introduction on Selected Grantees of the National Science Fund for Distinguished Young Scholars

4.1 Professor FENG Xue

School of Aerospace Engineering, Tsinghua University

National Science Fund for Distinguished Young Scholars in 2016



Professor FENG Xue has been devoted to the research in key mechanical issues concerning aerospace thermal protection and stretchable and flexible electronics. Advanced experimental methods and technologies, instruments and micro-devices have been investigated and realized with respect to unusual environment with high/ultra-high temperature and stretchable or ultra-flexible conditions. The fundamental science in materials/structures' failure in unusual environments has been investigated as well. The main achievements include:

1. The adaptive imaging method for high speed fluid and high temperature environment has been developed to simultaneously measure samples' morphology, oxidation and ablation, deformation and temperature field and so on. The independent R&D of testing instrument for high/ultra-high temperature has enabled the first in-situ observation of hypersonic thermal protection ground test. This system and corresponding measuring techniques have been widely adopted by the key national institutes in defense.

2. The high temperature oxidation experimental method based on laser interference has been developed, as well as the mechanical-chemical coupling models to explain the fluctuation and release mechanism of oxidation stress. High temperature structural materials such as C/SiC have been studied offering significant guidance to thermal protective materials' design and optimization considering the thermal-mechanical-oxidation coupling effects.

3. Mechanics-based theories and fabrication strategies for stretchable and flexible micro-devices have been established, and multifunctional devices have been developed to integrate with human body and tissues with natural and intimate adhesion. The proposed transfer printing technique has become the standard fabrication method for stretchable and flexible inorganic devices. Series of flexible electronics devices have been successfully used in the applications such as diagnosing and managing cardiovascular diseases, and physiological parameter measurement of special personnel at training and service, etc. These works provide new methods to endow traditional inorganic semiconductor devices with flexibility

and stretchability.

4. Thin-film/interfacial mechanical theory and experimental methods for flexible electronic devices has been developed, together with systematic assessing techniques for stress in thin film growth and structure failure of flexible electronics. These works lay the solid foundation for the reliability assessment of flexible electronic devices both in theory and techniques.

In the recent 5 years, Professor Feng has published more than 60 SCI-indexed papers in journals such as *J. Mech. Phys. Solids, J. Appl. Mech., Opt. Lett., ACS Nano, IEEE EDL* and so on. And 18 national patents and 3 national defense patents have been issued. He has been awarded the First Prize of Science and Technology of Mechanical Industry in 2016 (ranking No. 1).

With the funding of National Science Fund for Distinguished Young Scholars, Professor Feng will continue the research in the measurement techniques and failure mechanism for the mechanical-chemical coupling behavior of materials in fluid-solid-thermal coupled environment at high temperature, to develop the advanced full-field and in-situ measurement methods based on the images and spectrum at high temperature, and investigate into the mechanical-chemical coupling mechanism in the fluid-solid-thermal coupled environment as well as the failure mechanism.

4.2 Professor PENG Haiping

School of Physical Sciences, University of Science and Technology of China

National Science Fund for Distinguished Young Scholars in 2016

Professor PENG Haiping's research field is the high-energy particle physics experiment, mainly engaged in data analysis, software development, and novel detectors exploiting, etc.

The main research results include:

Made distinguish contribution on the discovery of Zc particles and studying their properties at BESIII experiment, especially in the discoveries of charged Zc(4025) and neutral Zc(3900) charmonium-like particle in the decays e+e-→πDD* and e+e-→$\pi^0\pi^0$J/Ψ, respectively, which provide important results on the nature of Zc family particle. Measured the production cross section of e+e-→ηJ/Ψ with much improved precision, providing valuable experimental results in the understanding the properties of charmonium-like Y particle. A series of investigations on the charmonium-like particles play a key role in searching for the exotic states and inspection of quantum chromodynamics theory.

Study the light hadron spectroscopy at BESIII experiment, including the confirmation of the existence of X(1810) state in the decay J/Ψ→γωΦ and exploit its nature, and observation of the decay of J/Ψ→p$\bar{p}a_0$(980). All these results are very important for studying of light hadron spectroscopy, searching for the exotic hadronic states as well as chiral symmetry theory.

Study the charmonium physics at BESIII experiment, including the observation of ηc(2S) decaying to KsK±ϖϖϖ final states, the studying of χcJ→η'KK/ΦK*K/pnϖ, etc. These studies provide very helpful approaches for the test of charmonium decay mechanism, exploiting the role of color octet mechanism in the P wave charmonium decay.

At ATLAS experiment on Large Hadron Collider, made great effort on the studying of the performance of missing transverse energy, measuring of pp→WW production cross section and the anomalous triple-Gauge-Boson coupling, searching for the new physics, e.g., excite states of lepton/quack, micro-black hole.

Due to the outstanding contributions and active efforts by himself and his team, Professor Peng was appointed as the convener of light hadron group in 2011, physics coordinator of BESIII experiment in 2013. In 2015, he was elected as

co-spokesperson of BESIII collaboration. Professor Peng's research work and contributions are well recognized by domestic and foreign colleagues. He has been invited to report his research results in the international conferences many times, including a plenary talk "The progress of hadron spectroscopy" at the 37th International Conference of high energy physics (ICHEP, 2014).

With the support of the National Science Fund for Distinguished Young Scholors, Professor Peng will continue his research career in BESIII collaboration, including searching for the new physics, studying the hadron spectroscopy, and exploiting the decay mechanism of charmed baryons, etc. He will also carry out the pre-studying for the novel detection techniques and experimental methods, e.g., the crystal thermal radiation detector based on the mK-cryogenic platform, which can serve the frontier of scientific research such as the direct detection of dark matter, the measurement of neutrino less double beta decay. He has been playing leading role in the BESIII experiment and keeping actively participating in the pre-investigation on accelerator particle physic in China post BESIII era.

4.3 Professor CHEN Liwei

Suzhou Institute of Nanotech and Nanobionics, Chinese Academy of Sciences
National Science Fund for Distinguished Young Scholars in 2016

Professor CHEN Liwei's research focuses on in-situ functional scanning probe microscopy (SPM) on surface and interfaces in energy nanotechnology. His major achievements include:

1. Developed a novel functional SPM imaging technique, Dielectric force microscopy (DFM). Demonstrated contactless probing of nanomaterials conductivity, such as distinguishing metallic and semiconducting single-walled carbon nanotubes, identifying the charge carrier type in nanotubes and nanowires, studying electron transfer at gas-nanowire interface, etc. The method was highlighted by *Nature Nanotechnology*. Zhenan Bao group at Stanford adopted the DFM technique for the characterization of their CNT samples and published collaborative results.

2. Developed the scanning Kelvin probe microscopy technique and used it to observe the interfacial electrical dipole moment of interlayers in thin-film organic photovoltaic devices. Furthermore, ion-beam polishing technique was used to prepare cross-sectional samples of PV cells while keeping the operating status of the cell. SKPM was then used to image the vacuum level alignment across the depth of the device in-operando. This approach can be generalized to other vertical stacked devices, which are enclosed by the top and bottom electrodes and are otherwise difficult to study the interfaces within.

3. Developed solution phase in-situ imaging and force spectroscopy for electrolyte/electrode interfaces in lithium ion batteries. Established the AFM imaging and force spectroscopy methodology for investigating the morphological evolution and the mechanical properties of solid electrolyte interphase.

4. Systematically investigated the effects of materials and interfacial structure on the performances of Li-S batteries. Demonstrated theoretical specific capacity and charge/discharge behavior of elemental S. Prepared 12 Ah pouch Li-S batteries with energy density greater than 350 Wh/kg and cycle life greater than 60 cycles.

With the support of the National Science Fund for Distinguished Young Scholars, Professor Chen will continue to develop novel functional SPM

techniques and apply them to the investigation of energy nanomaterials and nano devices. A new high-resolution UHV-AFM system with in-situ sample preparation chamber and DFM/SKPM imaging modes is being constructed and it is expected to be part of an open user facility at SINANO. The instrument and the related new SPM technique is expected to provide mechanistic studies for the R&D of a variety of nano devices.

4.4 Professor XIE Tao

College of Chemical and Biological Engineering, Zhejiang University
National Science Fund for Distinguished Young Scholars in 2016

Professor XIE Tao's research focuses on multifunctional stimuli-responsive polymers including shape memory polymers (SMP), responsive hydrogels, and ultrafast multi-dimensional printing. His notable research achievements include:

Discovery of thermadapt SMPs. This class of new SMPs contains dynamic covalent linkages in the networks, resulting in unique permanent shape reconfigurability that is distinctive from the two existing classes of SMPs (thermoplastic and thermoset). Such a new material property opens up new possibility in device applications involving sophisticated permanent shapes.

Discovery of multi-shape memory effect, elucidation of its molecular nature, and development of the remote actuation strategies. This work significantly extends the versatility of SMPs, which previously could only fix one or two temporary shapes.

Pioneering development of SMP based bio-inspired smart reversible adhesives. Most recent work further extends their utility towards advanced manufacturing, specifically programmable high yield transfer printing of flexible electronics.

Development of an ultrafast digital fabrication method for multi-dimensional polymers. The method combines the fast light curing of polymers with digital light control to yield 2D polymer films that can change shape into highly controllable 3D objects. The method omits the time consuming layer by layer process of typical 3D printing, leading to a record printing speed (less than 5 seconds). It further allows additional dimensions (time evolving shape changing properties) to be introduced via the selection of the printing materials.

Overall, Professor Xie's recent research work has resulted in publications in various prestigious journals including *Nature, Science Advances, Advanced Materials*, and *Angew. Chem*. He is also an inventor for over 70 granted patents. His research has been highlighted by various international journals/magazines including *Nature, Science, MIT Technology Review, Chemical and Engineering News, Chemistry Word,* etc. His recent awards include 2013 R&D 100 Award and 2011 List of Innovations That Could Change the Way

You Manufacture (by Society of Manufacturing Engineering). He currently serves as the Associate Editor for *ACS Applied Materials Interfaces* and Principal Editor for *Journal of Materials Research*.

With the financial support from the National Science Fund for Distinguished Scholars, Professor Xie aims to continue his research in multifunctional polymer materials. Building upon the fundamental understanding of the structure property correlation, his goal is to discover new enabling molecular mechanisms that can result in unprecedented material properties. Through multi-interdisciplinary collaborations, he wishes to explore novel applications in diverse engineering fields including biomedical devices and advanced manufacturing.

4.5 Professor ZHOU Dawang

School of Life Sciences, Xiamen University
National Science Fund for Distinguished Young Scholars in 2016

Professor Zhou has a long-standing interest in the functions of the Hippo Pathway in immune regulation and tissue onogenesis. Key contributions from his lab are listed below:

a) Found that Mst1, the key kinase of the Hippo Pathway, is important in controlling T cell proliferation and activation. Mst1 deficient mice display a reduction of naïve T cells and an increase of effector/memory T cells, which causes severe autoimmune diseases.

b) Revealed that kinases Mst1/2 play a critical role in immune cell differentiation, adhesion and migration. The depletion of Mst1/2 in T/B cells lead to lymphopenia. They also found that knockout of the downstream kinases Ndr1/2 exhibited a similar phenotype.

c) Demonstrated that kinases Mst1 and Mst2 positively regulate phagocytic induction of reactive oxygen species and bactericidal activity. Mst1/2 deficiency in BMDM results in F-actin disorganization, low levels of bacteria phagocytosis and defective bacteria killing ability.

d) Found that kinases Mst1/2 limit liver and colon tissue growth and oncogenesis through inhibiting Yap.

e) Revealed that the Ets transcription factor GABP is required for Yap expression and deregulation of Yap gene expression is implicated in human liver tumorigenesis.

f) Uncovered a physiological role of Yap in maintaining ER homeostasis and demonstrated that the synergistic effects of Hippo signaling and PERK branch of the UPR are critical for cell fate determination during ER stress, in which the induction and activation of Yap is the key event.

g) Discovered a reversible and selective MST1/2 inhibitor, XMU-MP-1. This inhibitor displays excellent in vivo pharmacokinetics and is able to augment mouse intestinal/liver repair and regeneration.

These findings have been published in the top ranked journals including *Nature Immunology* (cover paper), *Science Transl. Med.* (cover paper), *Nature Communications*, *Cell reports* and *J. Exp. Med*. With the support of National Science Fund for Distinguished Young Scholars, Professor Zhou will continue to focus on understanding the role of the Hippo pathway in immune system and tissue oncogenesis and seek a novel therapeutic strategy for tumor immunotherapy.

4.6 Professor ZHANG Feng

State Key Laboratory of Genetic Engineering, Fudan University
National Science Fund for Distinguished Young Scholars in 2016

Professor ZHANG Feng's research on genetics focus on copy number variation (CNV) and its mutational & pathogenic mechanisms in human diseases. Since establishing the lab at Fudan University in 2009, Professor Zhang has made scientific achievements in the following fields.

(1) Systematic studies on the molecular mechanisms in CNV mutagenesis. Non-allelic homologous recombination (NAHR) is a well-known mechanism for CNV mutagenesis. Professor Zhang and his colleagues revealed the correlations between genomic repeat properties and NAHR probability (*Hum. Mol. Genet.*). They also showed that human genomic CNVs can be generated by the DNA replicative mechanisms (*Am. J. Hum. Gene*). Intriguingly, the replicative mechanisms preferentially occur as intrachromosomal events (*Hum. Mol. Genet.*). Furthermore, Zhang and his colleagues found the self-chain-induced replicative errors is a general mechanism of genome instability in human germ and somatic cells (*Hum. Mol. Genet.*). They also showed that slow DNA replication can induce CNV instability (*Hum. Mol. Genet.*).

(2) Discovery of a novel genetic mechanism of compound inheritance in congenital scoliosis. Compound inheritance was demonstrated for a rare deletion CNV and a common hypomorphic allele of the TBX6 gene in association with a common/complex disease trait—scoliosis. This compound inheritance model accounted for 8–11% of congenital scoliosis in the Chinese population studied (*New England Journal of Medicine*).

(3) Development of new technologies and methods for CNV analyses. Zhang and his colleagues developed a new method of capture and breakpoint approaching sequencing (CBAS) to efficiently obtain CNV breakpoint sequences (*Mol. Genet. Genomics*). This strategy is independent of CNV structures and applicable to various CNV types. They also developed a CNV genotyping method, AccuCopy, based on multiplex competitive amplification (*J. Hum. Genet.*). AccuCopy is an efficient and reliable method for multiplex CNV genotyping.

From 2011 to 2015, Professor Zhang published 35 papers, some of which were published in the

prestigious journals such as *New England Journal of Medicine* and *American Journal of Human Genetics*. The total citation times in the past five years are 1,562 (excluding self-citations). Professor Zhang has been honored with National Top-Notch Young Professional and Chang Jiang Young Scholar. In 2015, Professor Zhang won the Outstanding Achievements Award of WuXi PharmaTech Life Science and Chemistry Awards.

With the support of National Science Fund for Distingueshed Young Scholars, Professor Zhang will employ genetic analyses, genome editing, cell models and animal models to investigate de novo CNV mutations and their mutational & pathogenic mechanisms in human diseases, especially birth defects and human infertility. These works will facilitate molecular diagnostics and genetic counseling of CNV-related diseases.

4.7 Professor WANG Yaping

School of Geographic and Oceanographic Sciences, Nanjing University
National Science Fund for Distinguished Young Scholars in 2016

The research of Professor WANG Yaping is about estuarine and coastal sedimentary dynamics with a specific interest in the modern processes associated with sedimentary system and geomorphological evolution in tide-dominated environments. In recent years, his group has heavily focused on the sedimentary dynamic processes in the near-bottom boundary layer. The main achievements include:

1. Revealed the influence of turbulent temporal and spatial structure on the threshold starting condition of sediment movement, supplementing Shields curve and improving the simulation and prediction accuracy of sediment dynamical models. He and his collaborators found that turbulence intermittent played a fundamental role in sediment entrainment on the microscopic scale: turbulence intermittent developed well under strong tidal conditions resulting in a high water content in the sediment, which led to the occurrence of resuspension and thus the entrainment of sediment even when the current velocity is lower than the Shields threshold value.

2. Proposed a new mechanism of floc aggregation and floc settling—large flocs predominate the upper layer whereas smaller in the lower part of the water column—based on the combination of theoretical analysis and in-situ observation results thanks to the new observation technique in the near-bottom boundary layer. He and his collaborators developed a flocculation dynamic model to calculate the spatio-temporal distribution of flocculent, which serves as a theoretical guidance for the practical estuarine and coastal engineering.

3. Obtained the in situ observations for zoning features of tidal flat sediments on the macroscopic scale and put forward a new model of geomorphological evolution in the coastal zone under the influence of anthropogenic reclamation. While the continuous reclamation led to an imbalanced state, the tidal flat returned to an equilibrium state after 10 years since the cease of reclamation. Owing to the negative feedback mechanism of some large tidal in lets, the geomorphologic system is still in a steady state in spite of the significant impact of human activities. These findings provide the theoretical foundations

for the management and predictions of coastal sedimentary evolution, ecological health and sustainable development.

In the past 5 years, Professor Wang has published over 30 SCI-indexed papers in the dominant international journals (e.g., *JGR-Oceans and Marine Geology*) along with his group, two of which (published in *Marine Geology*) have been listed as high citation papers in the recent five years. In 2016 he obtained the Marine Science and Technology Award.

Under the support of the National Science Fund for Distinguished Young Scholars, Professor Wang will continue to study the evolutions and transitions of estuarine and coastal systems in responding to global climate change and human activities. Breakthroughs are expected to be made in two key processes—drag reduction in the bottom boundary layer and gravity flow in the continental shelf—laying fundaments to establish a complete material transport model and to improve the understanding of physical processes in the estuarine and coastal zone. The ultimate goal is to build a comprehensive sedimentary-hydrodynamic-geomorphic coupling model that simulate the evolution of sedimentary records under the influence of sediment supply, sea level rise, extreme event effects, etc. This study would provide invaluable references for the sustainable development management of coastal zone and the restoration of ecology system.

4.8 Professor JIANG Dabang

Institute of Atmospheric Physics, Chinese Academy of Sciences
National Science Fund for Distinguished Young Scholars in 2016

Paleoclimate modeling aims to reveal the processes and mechanisms of past climate changes and thus improve our understanding of the evolution of the earth's environment and particularly of current climate changes. Professor. JIANG Dabang has carried out a series of research work on the spatial pattern and dynamic mechanism of climate changes during past geologic ages. The main results include:

(1) Revealed that increased sea surface temperatures and reduced sea ice extents, with respect to the present day, are main factors determining the mid-Pliocene warming climate, and that the effect of both continental ice sheet changes and vegetation feedback is regional.

(2) For the last glacial maximum, Jiang's group found the significant influence of surface environment on the East Asian climate, corroborated the cooling effect of vegetation feedback at the global scale, put forward the regional climatic consequences of the physical feedback of global soils, and elucidated the dynamic mechanisms responsible for the changes in climate and frozen ground over China and in the East Asian and global monsoons.

(3) For the mid-Holocene, the team revealed the spatial pattern of changes in climate over China, the East Asian monsoon, and frozen ground in the northern hemisphere, as well as the driving mechanisms, found that orbitally induced annual and winter cooling is opposite in sign to multi-proxy data over China, and used simulations to support the hypothesis of an inter-hemispheric anti-phasing of monsoon intensity change as suggested by proxy data and reveal the underlying mechanisms of teleconnection.

In the past five years, he has published 51 papers, including 29 SCI-indexed papers, and his papers have been cited by SCI journals for 634 times, including 445 times by other researchers. He won the National Natural Science Fund for Excellert Youth Scholars in 2012, the LIU Tungsheng Prize for Young Earth Scientists in 2013, and the National Natural Science Award of China (Second Prize, Place No. 4) in 2014.

Under the support of the National Science Fund for Distinguished Young Scholars, he will continue to deepen the work of past climate

changes. Special attention will be given to the feature and dynamic mechanism of multiple climate variables during the last glacial maximum and mid-Holocene, aiming at improving our knowledge of glacial-interglacial change changes on the orbital scale.

4.9 Professor YU Xuebin

Department of Materials Science,
Fudan University
National Science Fund for Distinguished Young Scholars in 2016

Professor YU Xuebin has condueted research on metal-based hydrogen storage materials. His most significant contributions to the hydrogen storage field are:

1. By introducing NH3 into metal borohydrides, a new hydrogen storage system, metal ammine borohydrides, was developed, which holds high hydrogen capacity and ambient dehydrogenation temperature.

2. A novel solid ion-exchange route was developed for design and synthesis of a series of new metal ammine borohydrides. These newly synthesized metal ammine borohydrides possess advanced dehydrogenation properties.

3. More than 20 crystal structures of the newly synthesized hydrogen storage materials were resolved via synchrotron XRD combined with the DFT calculations. These structure data were indexed by ICDD and CCDC, respectively.

4. A synergetic strategy via functionalizing various nano-templates was adopted to achieve uniform loading of hydrogen storage materials on templates, leading to significantly improved hydrogen storage properties of various materials.

5. The structure of various hydrogen storage materials was tuned by recombination of multiple metal ions. The effect mechanism of various metal ions on the hydrogen storage properties of materials was discussed.

During the past 5 years, Professor Yu, as the corresponding author, had 80 papers published by refereed international journals, such as *Adv. Mater., J. Am. Chem. Soc., Angew. Chem. Int. Ed*. As the first inventor, he has held 9 authorized Chinese patents. His publications have a total citations of 3,500 with H-index 34. In 2014, he has been awarded by "The Second Prize in China's MOE Natural Science Award".

Funded by the National Science Fund for Distinguished Young Scholars, Professor Yu will focus on the key issue of metal-based hydrogen storage materials that are difficult to reversibly store hydrogen/lithium with high efficiency. The improved hydrogen/lithium storage properties are expected to be realized by controllable adjustment of thermodynamics and kinetics of these materials.

4.10 Professor LIU Yong

The State Key Lab of Powder Metallurgy, Central South University
National Science Fund for Distinguished Young Scholars in 2016

Professor LIU Yong is mainly engaged in the research of new powder metallurgical (P/M) materials and techniques, and has extensively studied the relationship between controlled microstructures and mechanical properties of various P/M materials, such as cemented carbides, titanium alloys and iron-based superalloys. His main contributions include:

1. On the reaction diffusion in P/M liquid-phase sintering process, he set a new empirical equation for the diffusion in liquid metals, and established a kinetic model for the formation of graded structures in cemented carbides. Based on the theoretical research, he finally invented new methods for the preparation of functionally gradient cemented carbides, and developed various mining tools and cutting inserts with high strength, high toughness and high wear resistance.

2. He has proposed new ideas on the design of P/M materials. Considering the importance of activated sintering, he indicates that the addition of elemental powders is not only to strengthen the matrix material, but also to promote the densification process. The strengthening mechanism of P/M materials can be evolved from different aspects and multi-scale through the controlling of the composition-process-structure relationship. Through the multi-component and multi-scale strengthening, new P/M titanium alloys with improved mechanical properties have been designed, which has laid a theoretical foundation for the development of new P/M materials.

3. He has opened up a new field of the hot deformation of hard-to-deform P/M materials, such as intermetallic compound and titanium matrix composites, through the combination of processing maps and microstructural observations, and revealed the hot deformation mechanism of the materials. Based on these theories, he has successfully prepared large-sized TiAl sheets and titanium alloy automobile parts, and provided new ways for the preparation of high-performance and complex-shaped P/M components.

In the past 5 years, Professor LIU Yong has published 110 papers, 2 monographs and held 15 Chinese patents. His research on the functionally gradient cemented carbides has won himself the 1st level National Science and Technology Progress

Award in China in 2011.

With the support of National Science Fund for Distinguished Young Scholars, Professor Liu is going to establish the thermodynamics and kinetics of the evolution of microstructures in titanium alloys and its composites by making use of the high flexibility of P/M. Simultaneously, the relationship model between the microstructure and the mechanical properties will be constructed, and the effect of interfacial structures on the mechanical properties will be revealed. Finally, new P/M titanium alloys and composites with high strength and high toughness will be developed.

4.11 Professor YI Tinghua

School of Civil Engineering, Dalian University of Technology
National Science Fund for Distinguished Young Scholars in 2016

Professor YI Tinghua has devoted to the researches on structural health monitoring (SHM) in the past decade, and contributed to systematic innovations in advanced sensing technology, sensor placement method, and structural performance analysis theory. His main achievement are listed below:

1. The effects of commonly used construction materials with different dielectric constants, the satellite elevation angles and the distance from the reflector to the antenna phase center, etc., on the accuracy of GPS signals are revealed. Correspondingly, an adaptive multipath error mitigation technique based on daily data correlation has been proposed to improve the positioning accuracy. The research outcomes are published in the top journals in the SHM field such as *Struct. Control Hlth*. Several papers have been rewarded as ESI highly cited papers and China's top 100 influential SCI-indexed papers.

2. Professor Yi has proposed a series of efficient criterion to handle the uncertainty issues in the external load excitation, multi-direction collaborative optimization, and balance of redundancy and coverage for optimal sensor placement in large-scale structures. Solving the problem of program coding, 0-1 change, multi-peak optimization, etc., a series of effective algorithms have been proposed by him. The research outcomes have been published in the top journals in the SHM field such as *Smart Mater. Struct.*, been rewarded as ESI highly cited papers and journal cover papers.

3. In view of the high redundancy of large structures that makes the damage identification very difficult, Professor Yi has proposed a multi-stage structural damage diagnosis method based on "energy-damage" theory, and has developed a structural damage assessment strategy based on integrated weighting theory. The research results are published in the top journals such as *Smart Struct. Syst.*, and rewarded as ESI highly cited papers, etc.

In recent five years, Professor Yi has 6 papers that are selected as ESI highly cited papers, one paper selected as China's top 100 influential SCI-indexed paper, 2 papers selected as cover paper. His research outcomes have been

applied to the health monitoring of numerous landmark engineering projects, such as the world's largest span of suspend-dome structure Dalian gymnasium. Professor Yi has been awarded the Second Prize of National Award for Technological Invention (ranked as the second receipt) and played a leading role in winning the First Prize of Huaxia Construction Science and Technology Award (the first receipt) and also other awards.

Under the support of National Science Fund for Distinguished Young Scholars, Professor Yi will continue to extensively investigate the long-term life-cycle state assessment of long-span bridges in order to satisfy the deficiency in the code of practices of "current-state based design", to build a theoretical framework on bridge characterizes change and state assessment based on monitoring data, and to provide the theoretical support to develop the "life-cycle based design" of long-span bridges and core techniques for multi-hazard mitigation.

4.12 Professor PENG Chengzhi

Hefei National Laboratory for Physical Sciences at the Microscale, University of Science and Technology of China
National Science Fund for Distinguished Young Scholars in 2016

Professor PENG Cheng-zhi's main research interests are quantum communication experiments, and he is committed to the development of practical quantum key distribution and entanglement based quantum communication. He has so far published 47 articles in the international research journals including *Nature*, *Nature Physics*, *Nature Photonics*, *PNAS* and *Physical Review Letters*. Among them, 18 out of 47 he was the (equally contributed) first author or corresponding author. Till now, his publications have been cited more than 1,200 times (ISI Web of Science). His major achievements are as follows.

1. He has realized for the first time in the world decoy-state quantum key distribution (QKD), extended the security distance of quantum communication to 100 km level which confirmed the practical prospect of quantum communication, and developed a series of metropolitan quantum communication network.

2. He has demonstrated the first entangled distribution through the atmosphere; the first free-space decoy QKD, quantum teleportation and entanglement distribution over 100-kilometer free-space channels, which verified the feasibility of the global quantum communication based on satellite platform.

For longer distance quantum communication, Professor Peng has led the research of quantum payloads in "Mozi" quantum scientific experiment satellite and the corresponding ground experimental stations. The satellite was launched in August 16, 2016, which will realize the space-earth wide-area quantum communication for the first time in the world.

To further show the impact of his major achievements, we would like to briefly mention the following facts: his work in the field of quantum optics and quantum information has been selected for one time annual highlights by Nature as "Features of the Year 2012", one time annual highlights by the American Physics Society's as "Highlights of the Year 2013". Furthermore, his work has been selected for two times "The Top Ten Annual Scientific and Technological Progresses in China" by the academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering. Due to the systematic research

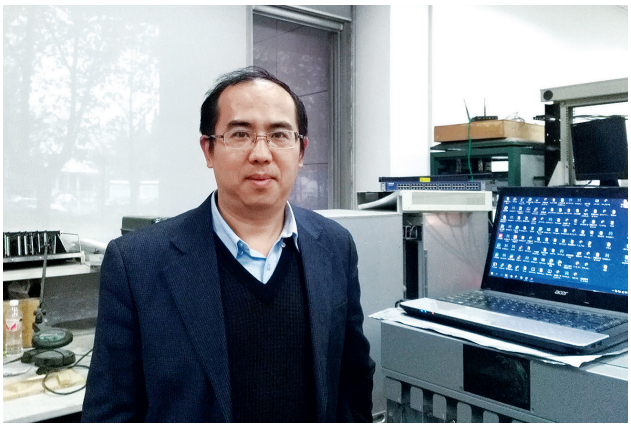
work on long-distance quantum communication, Professor PENG Chengzhi won the first Tan Kah Kee Young Scientist Award and the 13th Chinese Youth Science and Technology Award. In 2015, he won the 1st class National Natural Science Award (second accomplisher) and the 1st class Military Science and Technology Progress Award (sixth accomplisher) together with the team.

Under the support of the National Science Fund for Distinguished Young Scholars, Professor Peng will continue to explore the field of quantum keys distribution in daylights, which will break the restrictions of existing quantum communication that can only work in the shadow of the earth. It will contribute to the development of quantum-satellite constellation, and provide new research methods to the longer distance and more practical global-covering quantum communication network.

4.13 Professor XU Mingwei

Department of Computer Science and Technology, Tsinghua University

National Science Fund for Distinguished Young Scholars in 2016



Professor XU Mingwei won the National Science Fund for Distinguished Young Scholars in 2016. His research interests include the theoretical foundation of Internet routing, and the development of Internet standards and high performance routers. The following are his major achievements.

1. Self-healing Routing and Secure Routing. (1) He systematically studied network failures in CNGI-CERNET2 network and observed that the failure probabilities of links were heavy-tail. Based on the observation, he proposed an approach of selective routing protection that reduced the cost of routing protection while ensuring the high effectiveness. (2) He proposed E-Cycle, an enhanced protection cycle providing unified protection for intra- and inter-domain routing. In particular, it enables both node and link protection. (3) He developed a lightweight secure BGP approach called TBGP that was built upon the trusted computing technology. TBGP ensures inter-domain routing security by building a transitive trust relationship among all routers on a routing path.

2. Scalable Routing and Multipath TCP. (1) He proposed the first next hop-selectable FIB aggregation scheme that could aggregate routing entries with different next hops and achieve around 90% aggregation rate. (2) He developed a two-dimensional routing architecture that enabled packet forwarding based on both source and destination addresses. In particular, it provides flexible routing selection as well as ensuring trust of IP addresses and traceability of Internet attacks. (3) He proposed and proved the multipath congestion equality principle, and developed the weighted Vegas MPTCP algorithm for fine-grained load balance according to packet queuing delays. He also proposed an explicit multipath congestion control algorithm XMP, which balanced throughput with latency. XMP outperforms the existing multipath congestion control algorithms and effectively addresses the problem of TCP Incast.

3. IPv4/IPv6 Transition and High Performance Router. (1) He proposed an IPv4-over-IPv6 multicast transition mechanism for mesh model, and developed together with the partners the first RFC

of IETF standard track for IPv4/IPv6 transition in China. Moreover, he developed gateways for IPv4/IPv6 transition that have been deployed in more than 100 campus networks. (2) He developed the first high performance IPv6 core routers in China that were certified by Ministry of Industry and Information and have been widely deployed in ISPs.

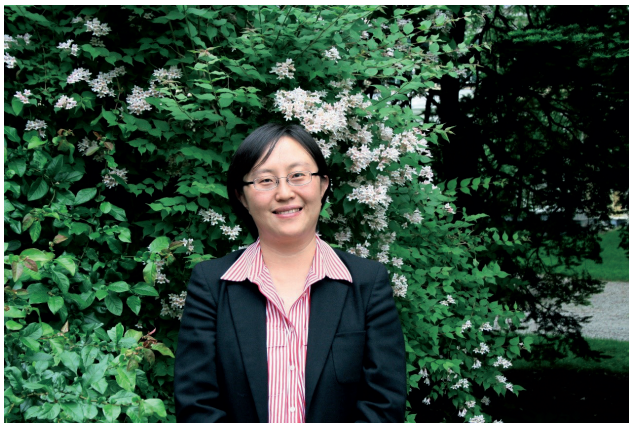
More than 30 papers have been published on top journals and conferences of his research fields in recent five years. What is more, Professor Xu has won the second award of National Award for Science and Technology Progress three times, the second award of National Award for Technological Invention one time, New Century Talents Award by Ministry of Education, Youth Achievement Award by Mao Yi-Sheng Foundation in Science and Technology Education, and Young Computer Scientist Award by China Computer Federation.

With the support of National Science Fund for Distinguished Young Scholars, Professor Xu will continue his research on large scale routing algorithms and mechanisms. Specially, he will focus on addressing the key problems of energy-efficiency, scalability, flexible routing and multipath transport in data center networks, and aim to produce high quality research outputs and develop the corresponding international standards, which will generate significant impacts on both academia and industry.

4.14 Professor ZHENG Siqi

Department of Construction Management, School of Civil Engineering, Tsinghua University

National Science Fund for Distinguished Young Scholars in 2016



Professor ZHENG Siqi's primary research area centers on the key policy issues and the behavioral foundations of urban development, housing markets, and sustainability in China, and by extension, in rapidly developing countries.

Professor ZHENG Siqi has published one book in English (Princeton University Press), two books in Chinese, three book chapters, over 30 peer-reviewed international journal papers, and more than 80 Chinese journal papers, with ample domestic and international influence. Presently (February 2017), she has 3,345 Google Scholar citations with an h-index of 29. Professor Zheng was acknowledged as Distinguished Young Scholar in 2016, and an Excellent Young Scholar in 2013, in the field of management science, economics, and public policy by the National Natural Science Foundation of China. She was also selected as one in the Ten Thousand Talents by the State Council of China in 2015, and as a Youth Yangtze River Scholar by China's Ministry of Education in 2016. In 2016 she was selected as a Weimer School Fellow by the Weimer School of Advanced Studies of the Homer Hoyt Institute. This selection is based on mid-career level academic accomplishment, recognizing "individuals who have made significant contributions to the development and dissemination of knowledge in real estate, land economics, and related fields."

Below are the three areas Professor Zheng focuses on:

(1) Urban Amenities and Housing Markets in Chinese Cities

With policy relaxation on the "hukou" system (local residential permit) and the liberalization of the labor and land markets since the 1980s, Chinese urbanites have more choice over where to work and live, both within and across cities. This provides a good opportunity to use statistical techniques to measure differentials in housing prices capturing differences in non-market urban amenities. Using housing and land sales data sets in Chinese cities, Professor Zheng's work employs the hedonic method and Geographic Information Systems (GIS) techniques to estimate the capitalization effects of local public goods.

(2) Transportation and Land Use in Urban Areas in China

In the past fifteen years, Chinese cities have experienced massive transportation infrastructure investments. This rapid expansion has dramatically reshaped the geography of jobs, housing, and consumption activities in the cities, and Professor Zheng have carefully studied those effects. High speed rail has also been introduced in China, as a way to mitigate the cost of mega city growth. One of Professor Zheng's papers in PNAS, documents that this transport innovation has been associated with rising real estate prices in the nearby secondary cities, which supports the claim that the bullet trains are playing an important role in integrating China's cities into a system of open cities.

(3) Environmental Quality of China's Urbanization

In Chinese cities, the new cohorts of urbanites are richer and better educated. Professor Zheng's research has shown that Chinese urban households are willing to pay higher housing prices to live in the cities and locations with better environmental quality, and that such demand has increased over time. She also studies how Chinese city leaders are responding to this rising demand for "greenness".

4.15 Professor ZHOU Peng

College of Economics and Management, Nanjing University of Aeronautics and Astronautics

National Science Fund for Distinguished Young Scholars in 2016

Professor Zhou works in the area of energy economics, policy and management, with particular emphasis on developing novel methods and tools for assessing energy and environmental efficiency and examining the allocation of emission reduction responsibility. His main research achievements are as follows.

1. Professor Zhou for the first time pointed out that it is necessary to incorporate undesirable outputs such as carbon dioxide emissions in modeling economy-wide energy efficiency performance with frontier models, which helps to resolve the weakness of conventional total factor energy efficiency models for not considering the heterogenicity in energy consumption structure. Since then, most total factor energy efficiency studies published in international journals have followed the idea to consider undesirable outputs in their models. After that, he proposed the concept of "energy congestion" as well as the nonparametric frontier models for measuring energy congestion. The work helps discriminate between structural inefficiency and technical inefficiency in energy consumption, which is very useful for improving the accuracy of energy efficiency assessment and designing more individualized energy efficiency policy.

2. Professor Zhou first proposed the concept and models of total factor carbon emission performance, which helps reduce the bias in using simple indicators such as total carbon emissions and carbon intensity measure carbon efficiency due to the ignorance of the substitutability between input factors. To examine the impacts of technology-related factors on the change of carbon dioxide emissions, Professor Zhou developed a production-theoretic decomposition analysis approach on the basis of multi-output production theory and coined the terminology PDA. The PDA approach has become the third popular methodology after index decomposition analysis (IDA) and structural decomposition analysis (SDA) in energy decomposition analysis.

3. Professor Zhou used the variation in emission abatement cost as a criterion to evaluate different methods for emissions allowance allocation and found that the criterion based on historical emissions seems to be fairer compared to other

criteria. Using the potential output maximization as an efficiency criterion, he developed several efficiency models for examining the optimal path for controlling carbon dioxide emissions in China. His research works shows that modest total quantity control policy would not affect economic output and developed regions should take emission responsibility earlier than less developed regions.

In the past five years, Professor Zhou as the first or corresponding author published over 20 peer-reviewed articles in international journals such as *Ecological Economics* and *Energy Economics*, of which over ten were list as ESI highly cited papers. He was awarded as the Youth Science and Technology Award for System Science and System Engineering, the MOE Outstanding Achievement Award for Scientific Research (Humanities and Social Science), etc. He was listed in the 2014 and 2015 Most Cited Chinese Researchers released by Elsevier, and honored to be the first Chinese Associate Editor of the journal *Energy Policy*.

With the financial support of the National Science Fund for Distinguished Young Scholars, Professor Zhou will continuously study the theory and methods for measuring energy and environmental efficiency, estimating the marginal abatement costs of carbon dioxide emissions and allocating energy conservation and emission reduction responsibility. He will also investigate on the potential impacts of energy conservation and emission reduction policies on the behavior of firms and consumers, which may provide a foundation for understanding the mechanism of interactions between macro-level energy conservation and emission reduction policies and micro-level low-carbon and green behaviors.

4.16 Professor WANG Hui

Peking University People's Hospital,
Peking University
National Science Fund for Distinguished Young Scholars in 2016

Dr. WANG Hui specializes in clinical microbiology with an expertise in antimicrobial resistance and antibiotic resistance mechanisms. She has a long-standing interest in elucidating the molecular epidemiology and the mechanisms of antimicrobial resistance of clinical significant pathogens. Dr. Wang has made great contributions in the following areas:

1. Dr. Wang, for the first time in China, identified the prevalent clone and the population structure of methicillin-resistant S. aureus (MRSA) in both hospital and community settings. In addition, she elucidated the origin and evolution pathway of MRSA, providing genetic evidence for control of transmission and clone evolution of MRSA between different species. More importantly, Dr. Wang is a heterogeneous vancomycin-intermediate S. aureus (hVISA) pioneer. Dr. Wang, for the first time, demonstrated the prevalence of hVISA in China by utilizing a novel method for hVISA detection. Moreover, subsequent work from her lab revealed several critical hVISA-related proteins, greatly advancing the hVISA research field in China.

2. Dr. Wang elucidated the resistance determinants, dynamics of resistance elements, transmission mechanisms and high-risk clone of carbapenem-resistant Enterobacteriaceae (CRE). She demonstrated the evolution of major gene clusters and identified novel resistance islands and resistance genes in carbapenem-resistant Acinetobacter baumannii (CRAB). Those findings provide critical evidence in the development of the guidelines for control of antimicrobial-resistant bacteria.

3. Dr. Wang, for the first time in China, established a novel evaluation system for novel antimicrobials by integrating antimicrobial resistance surveillance network, genotypic bacterial bank, meta-analysis and standard antimicrobial susceptibility testing, providing evidence-based medicine approach for clinical application of new antibiotics.

Dr. Wang has published 68 papers in SCI-indexed renowned journals (such as *Clin. Infect. Dis., Antimicrob Agents Chemother*), with overall citations of 1,635, and high-citations (H) index of 23. Her publications were cited by several high impact journals, including *NEJM, Nature* and *Lancet* for

14 times. Three papers were cited by F1000 Prime. A total of nine papers were highly cited papers in ESI database (top 10%), of which two were top 1% and one was top 0.1%. She was a co-author in an invited review published in *Lancet Infectious Diseases*. She participated in the development of 16 international and national guidelines and expert consensus. Among them, she led in the development of 3 national guidelines. Dr. Wang is a member of Breakpoint Working Group of the Antimicrobial Susceptibility Testing Subcommittee of Clinical and Laboratory Standards Institute (CLSI), the only representative from Asia. In addition, she participated in the development of 4 international standards. Dr. Wang was awarded the National Scientific and Technological Progress Second Prize (as the third author).

With the support from National Science Fund for Distinguished Young Scholars, Dr. Wang will continue focusing on the resistance mechanisms of clinical significant drug-resistant pathogens. In addition, she will further elucidate the acquisition of resistance of new antimicrobials, the gene regulator network of determining resistance element, the stability of resistance and genetic mechanism, providing evidence and rationale to predict the trend of resistance development, making appropriate therapy and developing novel antimicrobials.

4.17 Professor ZHANG Zhanjun

School of Brain and Cognitive Sciences, the State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University

National Science Fund for Distinguished Young Scholars in 2016

Professor ZHANG Zhanjun's current research focuses on the cognitive aging and brain health, and studying the mechanism of the cognitive abilities and brain characteristics in elderly, establishing the early warning system of Mild Cognitive Impairment (MCI) and employing the traditional Chinese medicine (TCM) treatment. Since 2008, Professor Zhang initiated the Beijing Aging Brain Rejuvenation Initiative (BABRI) project. The innovative achievements include:

1. Based on the community cohort studies, Professor Zhang established a large sample longitudinal and multi-dimensional database for elderly brain health. The studies also showcased MCI incidence rate in the Beijing urban area, and found that hypertension, diabetes and cerebrovascular diseases are the risk factors of MCI, but mental activities and social interactive activities are the protective factors.

2. Professor Zhang and his colleagues established a Beijing population norm for cognitive aging, and described the cognitive trajectory during normal brain aging, which could provide a scientific basis for determining the critical period of cognitive aging and the early warning system of MCI.

3. More systematical researches which focused on the multiple neuroimaging characteristics of MCI patients and high risk population (including diabetes, silent stroke, hypertension and high-risk genotypes) have shown the disconnections both in brain function and structure networks.

4. The "brain network disconnection" is a common neurological feature of MCI and high risk population. Combined the brain collaterals theory of TCM, it is first proposed that "diseased collaterals" is the core pathogenesis of MCI. In addition, Professor Zhang first use the visualization tools for neuroimaging to describe the regulation mechanism of the drugs on the brain, which provides an important research paradigm for the early prevention and control process of the TCM intervention of Alzheimer's Disease (AD).

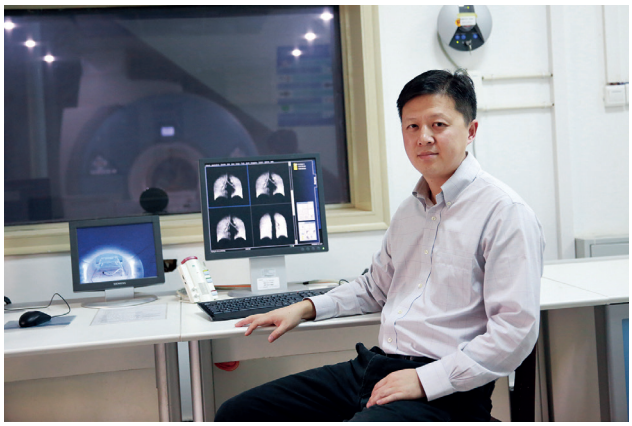
Professor Zhang has published 95 papers (total IF 239.136), and 50 of which as the corresponding or first author (including 12 top journal papers, the highest IF is 9.1) in the peer-reviewed international

journals, including *Diabetes, The Journal of Neuroscience, Stroke* and so on. Furthermore, the applicant has been granted 5 national invention patents, and rewarded as the New Century Excellent Talents by the Ministry of Education of China and achieved National Excellent Doctoral Dissertation Award.

With supported by National Science Fund for Distinguished Young Scholars, Professor Zhang will continue to promote the clinical and longitudinal cohort study in Beijing communities, explores the important biomarkers for MCI, interprets and enriches the brain collaterals of TCM using the cutting-edge scientific methods, and provides the theoretic support for the TCM treatment and neuroscience research on MCI.

4.18 Professor ZHOU Xin

Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences
National Science Fund for Distinguished Young Scholars in 2016



Professor ZHOU Xin is interested in ultrasensitive magnetic resonance imaging (MRI) instruments, techniques and methodology for advanced medical research. Coupling with multifunctional biosensors and multimodal imaging, Professor Zhou has applied the homebuilt ultrasensitive MRI instruments in pulmonary and brain diseases. The main achievements are as follows:

(1) Independently designed and built two ultrasensitive lung MRI instruments, one for animals and the other for human. These instruments enhance the MRI signal of ^{129}Xe gas more than 50,000 times, resulting in successfully obtaining the first human lung gas MRI in China, and thus "lighting up" the lung that is "dark" to the conventional MRI. The system cannot only get pulmonary structure information, but also visualize pulmonary gas-exchange function, which provide novel scientific instruments and technical methods for the diagnosis of major human lung diseases at the early stage. This achievement was selected to the 2015 annual Top Ten Technology Events in Hubei Province.

(2) Developed novel molecular imaging methods based on ultrasensitive MRI, as well as the ^{19}F MRI/fluorescence multimodal contrast agents, which can be applied to achieve the high-sensitive, real-time imaging for lung cancer cells. These contrast agents were applied to the lung adenocarcinoma research in vivo successfully. Developing a new technique for the important biomolecules (e.g., biothiols) reaction mechanism detection based on hyperpolarized ^{129}Xe, which is a noninvasive and high-sensitive MRI method.

(3) Applied ultrasensitive lung MRI instruments and multifunctional biosensors to the in vivo research of the pulmonary and brain diseases. Noninvasively and quantitatively detecting the globally or regionally physiological parameters of the lung (e.g., alveolar tissue thickness, lung gas-blood exchange time, etc.). Applied hyperpolarized ^{129}Xe MRI to the research of brain diseases (e.g., stroke) and function (pain simulation), and greatly improving the MRI detection sensitivity.

Regarding the core techniques of the instruments, 23 Chinese invention patents have been authorized, and one was awarded as "the

China Patent Excellence Award". Professor Zhou has published more than 50 articles in peer-reviewed top journals, such as *PNAS, MRM, JMRI, AC, NMR Biomed* and so on. He won the Chinese Academy of Sciences Award for Young Scientists and Wang Tianjuan Magnetic Resonance Award, and was selected to the National Program for Special Support of Eminent Professionals (National Program for Support of Top-Notch Young Professionals).

With support by the National Science Fund for Distinguished Young Scholars, Professor Zhou will continue improving ultrasensitive MRI instruments and applying them to the comprehensive and quantitative studies of chronic obstructive pulmonary disease (COPD) microstructure and function, developing novel imaging methods of COPD on the different levels of patients, animals, cells and molecules, suggesting a new imaging standard of COPD evaluation for the early diagnosis and treatment.

Part 5

Financial Statistics of NSFC's Funding in 2016

In 2016, the financial budget for NSFC was 24.871 billion yuan of which the budget for projects approved was 24.66 billion yuan. In 2016, the financial allocation for NSFC was 24.651 billion yuan with a total direct funding of 23.617 billion yuan and a total indirect funding of 1.034 billion yuan.

In 2016, the total funding for NSFC programs was 26.803 billion yuan with a total direct funding of 22.706 billion yuan and indirect funding of 4.097 billion yuan verified with 1,517 home institutions.

5.1 Financial budget and expenditure for NSFC in 2016

Statistics of Financial Budget and Expenditure for NSFC in 2016

Table 5-1 (Unit: 10,000 yuan)

Type of project	Financial budget	Financial expenditure
National Natural Science Fund	2,390,160	2,389,779
National Science Fund for Distinguished Young Scholars	73,480	72,917
National Science Fund for Fostering Talents in Basic Research	2,360	2,360
Total	2,466,000	2,465,056

5.2 NSFC funding for projects approved in 2016

Statistics of NSFC Funding for Projects Approved in 2016

Table 5-2 (Unit: 10,000 yuan)

Type of project		Projects	Approved		
			Direct funding	Indirect funding	Total
General Program		16,934	1,017,527.00	194,575.29	1,212,102.29
Key Program		612	171,535.00	32,328.92	203,863.92
Major Program		23	35,076.73	6,588.64	41,665.37
Major Research Plan		502	71,447.48	12,541.47	83,988.95
International (Regional) Joint Research Program		356	79,103.32	14,722.57	93,825.89
Young Scientists Fund		16,112	311,670.00	59,198.95	370,868.95
Fund for Less Developed Regions		2,872	109,050.00	21,051.44	130,101.44
Excellent Young Scientists Fund		400	52,000.00	8,000.00	60,000.00
National Science Fund for Distinguished Young Scholars		198	67,935.00	9,705.00	77,640.00
Science Fund for Creative Research Groups	New Project	38	38,955.00	5,565.00	44,520.00
	Extended Project	39	20,160.00	2,880.00	23,040.00

(continued)

Type of project		Projects	Approved		
			Direct funding	Indirect funding	Total
Joint Research Fund for Overseas Scholars and scholars in Hong Kong and Macao	Two-Year Project	115	2,070.00	228.00	2,298.00
	Four-Year Extended Project	20	3,600.00	400.00	4,000.00
Joint Fund		739	112,870.00	20,343.47	133,213.47
Basic Science Center Program		3	51,170.00	5,873.12	57,043.12
Special Fund for National Major Scientific Research Equipment		89	82,406.76	11,526.39	93,933.15
Projects of Emergency Management		1,179	30,937.62	3,628.24	34,565.86
Tianyuan Fund of Mathematics		253	2,500.00		2,500.00
Research Fund for International Young Scientist		117	3,000.00	542.81	3,542.81
Fund for International (Regional) Cooperation and Exchange		583	7,579.88		7,579.88
Total		41,184	2,270,593.79	409,699.31	2,680,293.10

5.3 Funds for Research Programs

General Program

Application and Funding Statistics of General Program Projects in 2016
(by Scientific Department)

Table 5-3 (Unit: 10,000 yuan)

Scientific department	Applications	Approved				Funding rate (%)
		Projects	Direct funding	Percentage of the total (%)	Average Funding per project *	
Mathematical and Physical Sciences	5,380	1,551	95,045	9.34	61.28	28.83
Chemical Sciences	6,065	1,576	101,082	9.93	64.14	25.99
Life Sciences	10,806	2,700	162,990	16.02	60.37	24.99
Earth Sciences	5,867	1,573	108,260	10.64	68.82	26.81
Engineering and Materials Sciences	13,941	2,851	176,900	17.39	62.05	20.45
Information Sciences	7,995	1,861	108,600	10.67	58.36	23.28
Management Sciences	3,676	720	34,560	3.40	48.00	19.59
Health Sciences	20,318	4,102	230,090	22.61	56.09	20.19
Total	74,048	16,934	1,017,527	100	60.09	22.87

Note: average direct funding per project = direct funding/No. of approved; funding rate = No. of approved / No. of applications*100.

There were 55,224 proposals from male PIs and 12,800 funded; 18,824 from female and 4,134 funded.

Age Distribution of Principal Investigators of General Program Projects in 2016

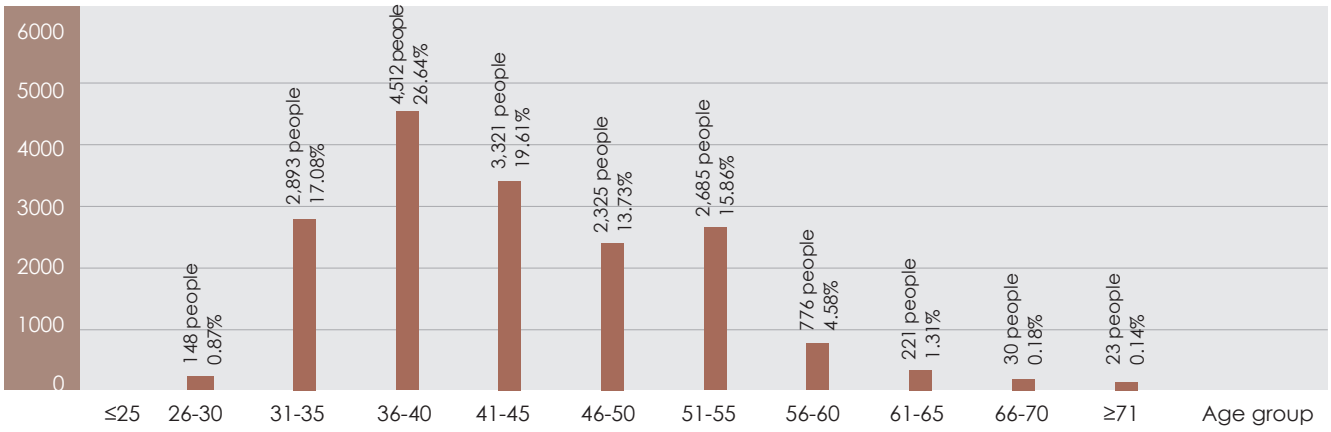


Figure 5.1 (Total 16,934)

Professional Structure of Members of Research Groups for General Program Projects in 2016

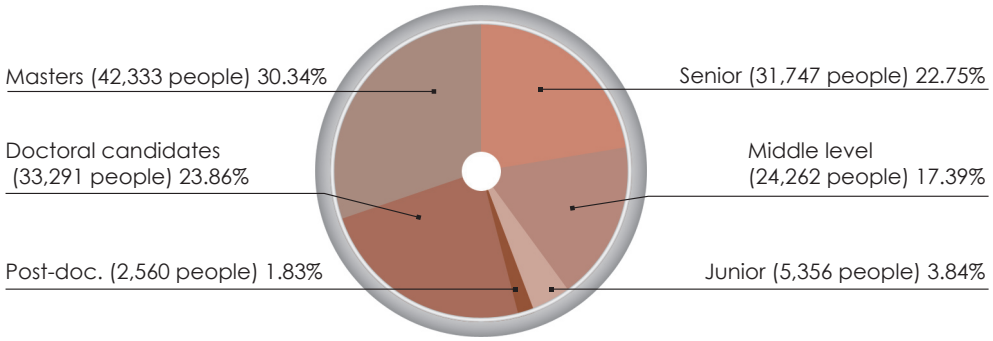


Figure 5.2 (Total 139,549)

Statistics of General Program Projects by Region in 2016

Table 5-4 (Unit: 10,000 yuan)

No.	Region	Projects	Direct funding	No.	Region	Projects	Direct funding
1	Beijing	3,339	205,078.00	17	Jilin	327	19,861.00
2	Jiangsu	1,760	105,793.60	18	Jiangxi	48	2,904.00
3	Shanghai	1,901	112,562.50	19	Henan	271	16,091.00
4	Guangdong	1,282	76,328.20	20	Gansu	199	12,877.20
5	Hubei	1,022	61,532.20	21	Yunnan	108	6,537.00
6	Shaanxi	825	49,362.30	22	Guangxi	44	2,629.00
7	Zhejiang	863	51,162.00	23	Xinjiang	40	2,444.00
8	Shandong	678	40,665.30	24	Guizhou	42	2,782.00
9	Liaoning	629	37,501.90	25	Hebei	130	7,831.30
10	Sichuan	539	31,715.50	26	Shanxi	109	6,251.00
11	Hunan	550	32,425.70	27	Inner Mongolia	14	868.00
12	Anhui	457	27,933.20	28	Hainan	20	1,240.00
13	Heilongjiang	508	30,313.30	29	Ningxia	6	327.00
14	Tianjin	455	27,278.70	30	Qinghai	7	419.00
15	Chongqing	378	21,888.60	31	Xizang	3	191.00
16	Fujian	380	22,733.50				

Key Program

Application and Funding of Key Program Projects in 2016 (by Scientific Department)

Table 5-5 (Unit: 10,000 yuan)

Scientific department	Applications	Approved			
		Projects	Direct funding	Percentage of the total (%)	Average funding per project
Mathematical and Physical Sciences	288	71	21,945	12.21	295.00
Chemical Sciences	226	61	17,748	10.35	290.95
Life Sciences	472	96	26,300	15.33	273.96
Earth Sciences	423	80	23,610	13.76	295.13
Engineering and Materials Sciences	441	90	25,970	15.14	288.56
Information Sciences	253	85	22,500	13.12	264.71
Management Sciences	87	22	5,060	2.95	230.00
Health Sciences	592	107	29,402	17.14	274.79
Total	2,782	612	171,535	100	280.29

Note: 2,420 proposals from male PIs, 538 granted; 362 from female and 74 granted.

Age Distribution of Principal Investigators of Key Program Projects in 2016

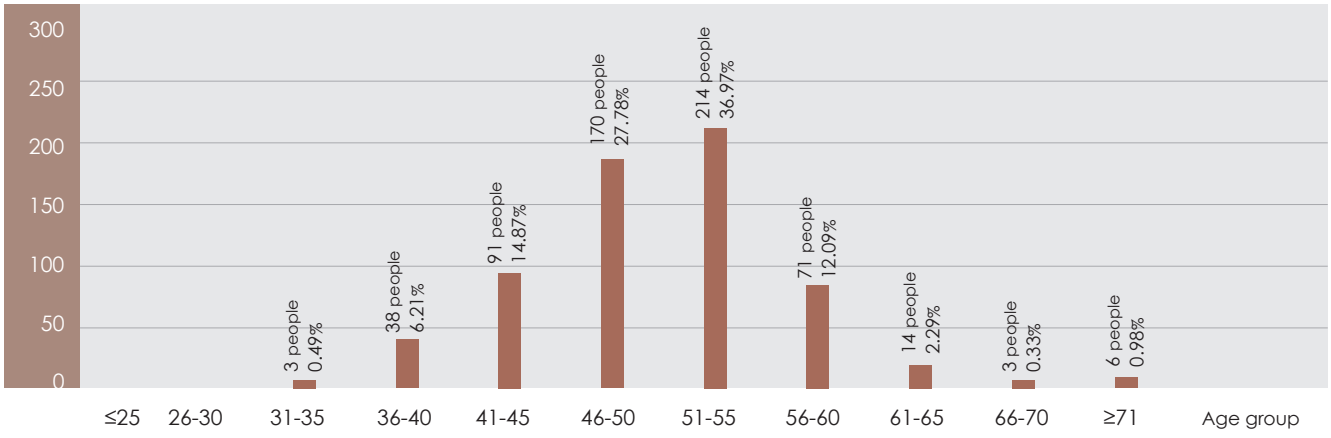


Figure 5.3 (Total 610)

Professional Structure of Members of Research Groups for Key Program Projects in 2016

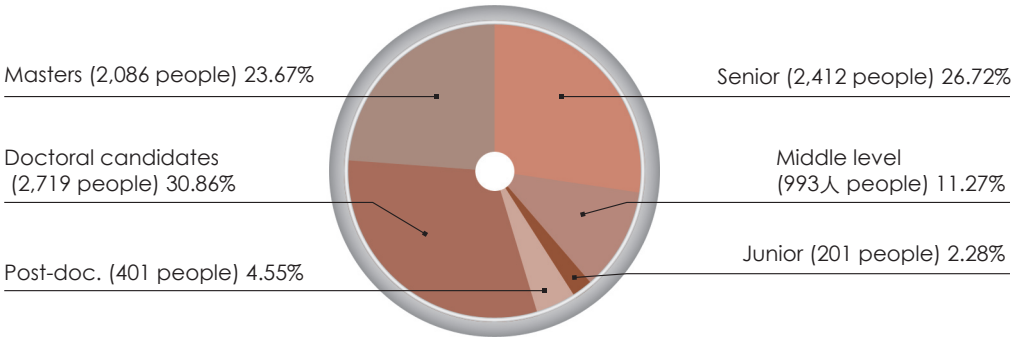


Figure 5.4 (Total 8,812)

Major Program

Funding of Major Program Projects in 2016

Table 5-6 (Unit: 10,000 yuan)

Name of project	PI	Professional title	Home institution	Direct funding
The statistical basis and analysis methods of big data	XU Zongben	Professor	Xi'an Jiaotong University	1,406.80
Studies on some physics issues associated with gravitational waves	CAI Ronggen	Professor	Institute of Theoretical Physics, Chinese Academy of Sciences	1,429.00
The evolution of photon states in space-time and the related applications	ZHU Shining	Professor	Nanjing University	1,503.45
Radiation effect mechanisms and key experimental techniques of nano-devices	CHEN Wei	Professor	Northwest Institute of Nuclear Technology	1,617.00
Study on the new metal complexes and their reactions for precise synthesis	MA Shengming	Professor	Fudan University	1,693.00
Metal complex catalyzed synthesis of well-designed macromolecule	TANG Yong	Professor	Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences	1,692.50
Fundamental studies on catalytic conversion of biomass to low molecular weight oxygenates	ZHANG Tao	Professor	Dalian Institute of Chemical Physics, Chinese Academy of Sciences	1,626.54
Basic and applied research of cotton fiber development mechanisms	ZHU Yuxian	Professor	Wuhan University	1,288.00
Molecular and cellular mechanisms of regulating lipid metabolic plasticity	LI Peng	Professor	Tsinghua University	1,285.00
Orbital-scale variability and forcing mechanism of the east Asian monsoon	GUO Zhengtang	Professor	Institute of Geology and Geophysics, Chinese Academy of Sciences	1,695.60
Enso variability and predictability	CHEN Dake	Professor	Second Institute of Oceanography of the State Oceanic Administration	1,661.70
Mechanisms for differential gas enrichment in organic-rich shales	HAO Fang	Professor	China University of Geosciences (Wuhan)	1,687.50
Formation process of Chinese cryosphere service functions and integrated regionalization	QIN Dahe	Professor	Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences	1,683.69
Novel responsive polymeric materials toward functional construction	LIU Shiyong	Professor	University of Science and Technology of China	1,500.00
On the influence of electromagnetic field on the phase transformation in metallurgy	REN Zhongming	Professor	Shanghai University	1,444.00

(continued)

Name of project	PI	Professional title	Home institution	Direct funding
Nonlinear time-varying characterization and reliable operation mechanism of high power density motor system	XIA Changliang	Professor	Tianjin Polytechnic University	1,500.00
Fundamental research on microwave photonics for distributed phase coherent imaging radar with high frequency and wide bandwidth	ZHENG Xiaoping	Professor	Tsinghua University	1,592.00
Research on software development methodology based on internet-based collective intelligence	MIE Hong	Professor	Beijing Institute of Technology	1,443.50
Aerospace control theory and methodology for capturing space tumbling target	DUAN Guangren	Professor	Harbin Institute of Technology	1,574.00
Fundamental research of attosecond optics	ZHAO Wei	Professor	Xi'an Institute of Optical Precision Machinery, Chinese Academy of Sciences	1,590.00
Engineering management research on high-end equipment manufacturing in the internet and big data era: Theory and methodology	YANG Shanlin	Professor	Hefei University of Technology	1,362.60
Research on green and low-carbon economy transformation management and policy	ZHANG Xiliang	Professor	Tsinghua University	1,358.50
Highly-efficient biomacromolecular drug delivery system	ZHANG Zhirong	Professor	Sichuan University	1,442.35
Total				35,076.73

Major research plan

Applications and Funding of Major Research Plan Projects in 2016

Table 5-7 (Unit: 10,000 yuan)

Title of project	Applications	Approved	Direct funding
Destruction of the North China craton	1	1	24.90
The structural design and controllable preparation of functionally oriented crystalline materials	216	26	2,060.00
Fundamental research on nano manufacturing	7	4	277.88
Integrated research on the eco-hydrological process of heihe basin	4	4	550.00
Fuel propagation and transmutation of advanced nuclear fission energy	1	1	300.00
Controllable self-assembly system and its functionalization	1	1	30.70
Deep sea process and evolution of the South China Sea	2	2	340.00

(continued)

Title of project	Applications	Approved	Direct funding
Regulation network and molecular mechanisms of malignant transformation of non-resolving inflammation	26	8	1,000.00
Basic algorithm and computational modeling in high performance scientific computation	33	14	2,880.00
Multi genetic function and mechanism in micro evolution process	85	19	3,000.00
The neural loop basis of emotion and memory	83	27	3,500.00
Energy-oriented photoelectric conversion materials	7	1	1,250.00
Mesoscopic mechanism and regulation in multiphase reaction process	126	24	2,500.00
Genetic network analysis of production traits of major crops	4	3	2,080.00
Accurate measurement physics	51	21	4,200.00
The change of the Tibetan Plateau land-atmosphere coupled system and its effect on global climate	27	13	2,600.00
Basic theory and key technology of space information network	34	8	3,600.00
Regulatory mechanisms of vascular homeostasis and remodeling	131	26	3,400.00
Regulatory function of non-coding RNA in the process of genetic information transfer	222	24	2,900.00
Basic research on turbulent combustion in engines	132	37	3,438.00
Regional immunological characteristics and diseases of tissue organs	184	29	3,000.00
Toxicology and health effect of air fine particulate matter	123	23	3,655.00
Basic research on the causes and coping mechanisms of atmospheric compound pollution in China	119	26	5,500.00
Catalytic science of carbon energy conversion and utilization	159	31	3,300.00
Research on big data-driven management and decision-making	262	35	2,999.00
The utilization of runoff variation and adaptability in southwest China	143	32	5,960.00
Research on fundamental theory and key technology of communion robot	182	31	4,102.00
Mechanism of organ senescence and organ degeneration	204	31	3,000.00
Total	2,569	502	71,447.48

International (Regional) Cooperation Program

Application and Funding of Projects of Key International (Regional) Joint Research Program in 2016 (by Scientific Department)

Table 5-8 (Unit: 10,000 yuan)

Scientific department	Applications	Approved				Funding rate (%)
		Projects	Direct funding	Percentage of the total (%)	Average funding per project	
Mathematical and Physical Sciences	18	4	940	3.76	235.00	22.22
Chemical Sciences	39	8	1,680	6.72	210.00	20.51
Life Sciences	89	18	4,350	17.40	241.67	20.22
Earth Sciences	62	9	2,280	9.12	253.33	14.52
Engineering and Materials Sciences	80	14	3,410	13.64	243.57	17.50
Information Sciences	105	16	3,980	15.92	248.75	15.24
Management Sciences	21	5	940	3.76	188.00	23.81
Health Sciences	196	31	7,420	29.68	239.35	15.82
Total	610	105	25,000	100	238.10	17.21

Application and Funding of Projects of International (Regional) Cooperation Program in 2016 (by Scientific Department)

Table 5-9 (Unit: 10,000 yuan)

Scientific department	Applications	Approved				
		Projects	Direct funding	Percentage of the total (%)	Average funding per project	Funding rate (%)
Mathematical and Physical Sciences	60	22	6,648.30	12.29	302.20	36.67
Chemical Sciences	116	13	3,712.10	6.86	285.55	11.21
Life Sciences	293	52	9,156.10	16.92	176.08	17.75
Earth Sciences	175	50	11,843.90	21.89	236.88	28.57
Engineering and Materials Sciences	230	26	4,937.74	9.13	189.91	11.30
Information Sciences	144	27	5,481.41	10.13	203.02	18.75
Management Sciences	85	23	3,948.65	7.30	171.68	27.06
Health Sciences	404	38	8,375.12	15.48	220.40	9.41
Total	1,507	251	54,103.32	100	215.55	16.66

Young Scientists Fund

Application and Funding of Projects of Young Scientists Fund in 2016 (by Scientific Department)

Table 5-10 (Unit: 10,000 yuan)

Scientific department	Applications	Approved				
		Projects	Direct funding	Percentage of the total (%)	Average funding per project	Funding rate (%)
Mathematical and Physical Sciences	5,470	1,630	34,090	10.94	20.91	29.80
Chemical Sciences	5,655	1,450	29,030	9.31	20.02	25.64
Life Sciences	9,916	2,208	44,170	14.17	20.00	22.27
Earth Sciences	5,697	1,622	32,080	10.29	19.78	28.47
Engineering and Materials Sciences	11,889	2,867	57,330	18.39	20.00	24.11
Information Sciences	7,510	1,918	38,380	12.31	20.01	25.54
Management Sciences	3,605	697	11,880	3.81	17.04	19.33
Health Sciences	20,657	3,720	64,710	20.76	17.40	18.01
Total	70,399	16,112	311,670	100	19.34	22.89

Note: 36,427 proposals from male PIs and 9,535 granted; 33,972 from female, 6,577 granted.

Professional Structure of Members of Research Groups for Young Scientists Fund in 2016

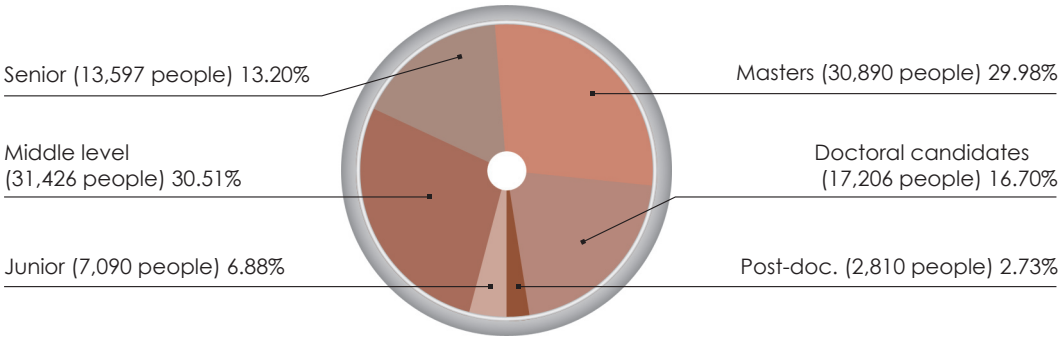


Figure 5.5 (Total 103,019)

Statistics of Projects for Young Scientists Fund by Region in 2016

Table 5-11 (Unit: 10,000 yuan)

Region	Projects	Direct funding	Region	Projects	Direct funding	Region	Projects	Direct funding
Beijing	2,282	44,176.40	Henan	522	10,179.20	Hebei	158	3,064.60
Jiangsu	1,755	33,806.50	Hunan	499	9,661.80	Jiangxi	130	2,539.60
Shanghai	1,379	26,038.00	Anhui	444	8,816.20	Yunnan	123	2,432.60
Guangdong	1,242	23,683.30	Tianjin	441	8,441.10	Guizhou	74	1,459.90
Hubei	1,037	20,040.30	Chongqing	432	8,248.50	Guangxi	68	1,331.00
Shaanxi	914	17,849.30	Fujian	377	7,312.60	Xinjiang	46	962.00
Shandong	864	16,715.70	Jilin	320	6,270.60	Hainan	45	884.00
Zhejiang	797	15,269.30	Heilongjiang	315	6,173.60	Inner Mongolia	35	699.00
Sichuan	766	15,005.20	Shanxi	210	4,173.10	Ningxia	17	330.00
Liaoning	633	12,225.60	Gansu	175	3,631.00	Qinghai	12	250.00
						Total	16,112	311,670.00

Fund for Less Developed Regions

Application and Funding of Projects of the Fund for Less Developed Regions in 2016

Table 5-12 (Unit: 10,000 yuan)

Region		Applications	Approved				Funding rate (%)
			Projects	Direct funding	Percentage of the total (%)	Average Funding per project	
Jiangxi		2,639	592	22,266.80	20.42	37.61	22.43
Yunnan		2,212	417	15,799.80	14.49	37.89	18.85
Guangxi		1,982	405	15,280.50	14.01	37.73	20.43
Xinjiang		1,661	342	13,107.30	12.02	38.33	20.59
Guizhou		1,339	263	9,942.70	9.12	37.80	19.64
Gansu		1,158	227	8,847.60	8.11	38.98	19.60
Inner Mongolia		1,171	212	8,165.40	7.49	38.52	18.10
Ningxia		704	137	5,155.80	4.73	37.63	19.46
Hainan		450	110	4,135.60	3.79	37.60	24.44
Qinghai		262	49	1,889.00	1.73	38.55	18.70
Tibet		95	27	1,038.00	0.95	38.44	28.42
Shaanxi							
	Yan'an	52	11	422.00	0.39	38.36	21.15
	Yulin	94	5	196.00	0.18	39.20	5.32

(continued)

Region		Applications	Approved				Funding rate (%)
			Projects	Direct funding	Percentage of the total (%)	Average Funding per project	
Jilin							
	Yanbian	211	45	1,679.50	1.54	37.32	21.33
Hunan							
	Xiangxi	63	16	596.00	0.55	37.25	25.40
Hubei							
	Enshi	50	14	528.00	0.48	37.71	28.00
Sichuan							
	Liangshan	6	0	0	0		
	Ganzi	2	0	0	0		
	Aba	5	0	0	0		
Total		14,156	2,872	109,050.00	100	37.97	20.29

Note: there were 9,212 applications from male applicants, of which 1,909 were funded; and 4,944 were from female applicants, of which 963 were funded.

Age Distribution of Principal Investigators of Projects of the Fund for Less Developed Regions in 2016

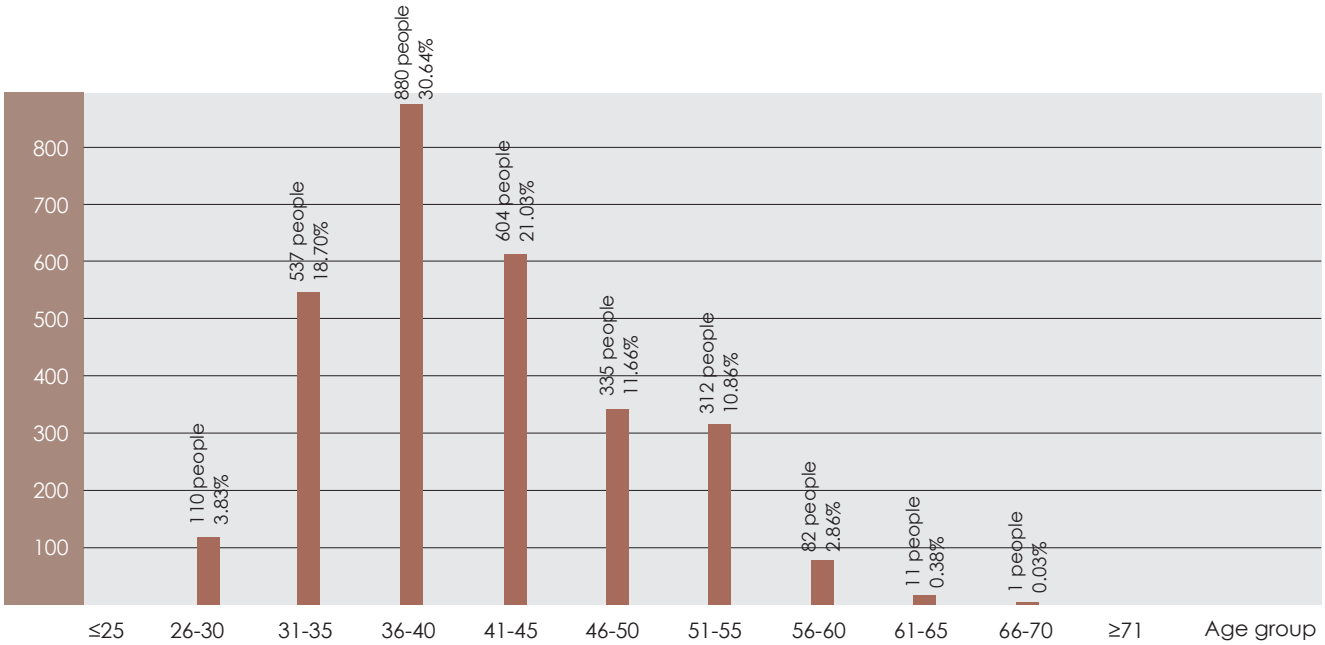


Figure 5.6 (Total 2,872)

Professional Structure of Members of Research Groups for the Fund for Less Developed Regions in 2016

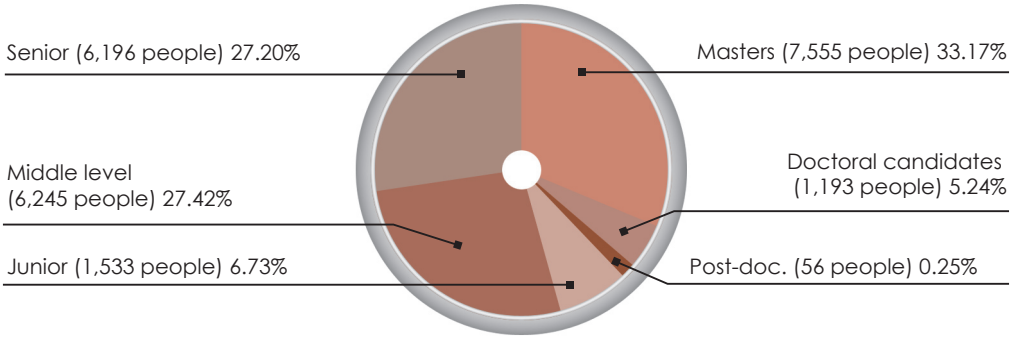


Figure 5.7 (Total 22,778)

Excellent Young Scientists Fund

Application and Funding of Projects of Excellent Young Scientists Fund in 2016 (by Scientific Department)

Table 5-13 (Unit: 10,000 yuan)

Scientific department	Applications	Approved			Funding rate (%)
		Projects	Direct funding	Percentage of the total (%)	
Mathematical and Physical Sciences	496	47	6,110	11.75	9.48
Chemical Sciences	626	57	7,410	14.25	9.11
Life Sciences	670	59	7,670	14.75	8.81
Earth Sciences	420	38	4,940	9.50	9.05
Engineering and Materials Sciences	796	73	9,490	18.25	9.17
Information Sciences	703	60	7,800	15.00	8.53
Management Sciences	140	14	1,820	3.50	10.00
Health Sciences	562	52	6,760	13.00	9.25
Total	4,413	400	52,000	100	9.06

Note: there were 3,631 applications from male applicants, of which 323 were funded; and 782 were from female applicants, of which 77 were funded.

National Science Fund for Distinguished Young Scholars

In 2016, we received 2,433 applications for National Science Fund for Distinguished Young Scholars. After review, we funded 198 people. The total direct funding was 679.35 million yuan.

Awardees of the National Science Fund for Distinguished Young Scholars in 2016

Table 5-14 (Unit: 10,000 yuan)

No.	Name	Project title	Home institution	Direct funding
1	ZHOU Yuanyang	Groups and representations	Central China Normal University	245
2	ZHANG Wenming	Dynamics of micro-electro-mechanical systems (MEMS)	Shanghai Jiao Tong University	350
3	WU Xinggang	Theory of particle physics	Chongqing University	350
4	GUO Guoping	Quantum computation based on semiconductor quantum dots	University of Science and Technology of China	350
5	ZHANG Xi	Geometric analysis	University of Science and Technology of China	245
6	PENG Haiping	Experimental particle physics	University of Science and Technology of China	350
7	DENG Youjin	Development and application of efficient Monte Carlo methods	University of Science and Technology of China	350
8	HU Jun	Nonstandard finite element methods	Peking University	245
9	WU Chenyin	Atomic molecular dynamics and ultrafast imaging driven by intense femtosecond laser fields	Peking University	350
10	HU Zhongkun	Precision gravity measurement with cold atom interferometry	Huazhong University of Science and Technology	350
11	CHEN Yan	Theoretical and computational studies on quantum many body physics	Fudan University	350
12	CHEN Yuqin*	The chemical and kinematic evolution of the Galaxy	National Astronomical Observatory of China	350
13	LI Hongquan	Harmonic analysis on manifolds	Fudan University	245
14	HAN Deren	Nonlinear programming theory and methods	Nanjing Normal University	245
15	WANG Xiangyu	Study on the origin of high energy cosmic ray and high energy neutrino and related celestial physics problems	Nanjing University	350
16	LU Minghui	Artificial band gap materials	Nanjing University	350
17	ZHANG Ping	Electronic properties of condensed matter under extreme conditions	Beijing Institute of Applied Physics and Computational Mathematics	350
18	LI Yan*	Mechanics of plant fiber reinforced composites	Tongji University	350

(continued)

No.	Name	Project title	Home institution	Direct funding
19	HU Jiansheng	Magnetic confinement plasma physics experiment	Hefei Institute of Physical Science, Chinese Academy of Sciences	350
20	FENG Xue	Experimental solid mechanics	Tsinghua University	350
21	CHEN Liewen	Heavy ion nuclear physics	Shanghai Jiao Tong University	350
22	LUO Xisheng	Experimental fluid mechanics	University of Science and Technology of China	350
23	HUANG Yong	Partial differential equation	Hunan University	245
24	QI Yingxin*	Vascular mechanobiology	Shanghai Jiao Tong University	350
25	SHEN Qilong	Organic chemistry	Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences	350
26	TIAN Shanxi	Electron-induced molecular reaction dynamics	University of Science and Technology of China	350
27	LUO Zhenghong	Polymerization reactor simulation and its application	Shanghai Jiao Tong University	350
28	ZHU Shoufei	Catalytic organic synthesis	Nankai University	350
29	XIE Tao	Shape memory polymer	Zhejiang University	350
30	LEI Xiaoguang	Small molecule probe oriented chemical biology	Peking University	350
31	LIU Xiaohua	Asymmetric synthesis	Sichuan University	350
32	LIU Zhihong	Fluorometric analysis	Wuhan University	350
33	WANG Shuxiao	Air pollution chemistry	Tsinghua University	350
34	CAO Dapeng	Chemical engineering thermodynamics and controllable preparation of nanostructured microporous materials	Beijing University of Chemical Technology	350
35	TANG Ruikang	Biological mineralization	Zhejiang University	350
36	WANG Xiayan	Micro-nano scale separation analysis	Beijing University of Chemical Technology	350
37	NIE Zongxiu	Mass spectrometry and imaging of particles	Institute of Chemistry, Chinese Academy of Sciences	350
38	LUAN Tiangang	Environmental analysis and ecological chemistry	Sun Yat-sen University	350
39	DAI Zhihui	Biochemical analysis and biological sensing	Nanjing Normal University	350
40	SONG Yufei	Polyoxometalate intercalation materials	Beijing University of Chemical Technology	350
41	ZHAO Bin	Functional coordination chemistry	Nankai University	350
42	LIU Jun	Opto-electronic Functional Polymers	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences	350

(continued)

No.	Name	Project title	Home institution	Direct funding
43	WANG Wei	Fluidization and multiphase flow reaction engineering	Institute of Process Engineering, Chinese Academy of Sciences	350
44	HE Wei	Inorganic chemistry	Tsinghua University	350
45	WEN Liping	Material physics and chemistry	Technical Institute of Physics and Chemistry, Chinese Academy of Sciences	350
46	WANG Jianguo	Application research of supported nano-metal catalysts	Zhejiang University of Technology	350
47	WANG Yawei	Environmental analytical chemistry and environmental pollution chemistry	Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences	350
48	HUO Fengwei	Coordination polymers	Nanjing University of Technology	350
49	TANG Yajie	Natural products for biological manufacturing	Hubei University of Technology	350
50	YANG Haibo	Organic supramolecules and aggregates	East China Normal University	350
51	WANG Bo	Metal-organic framework films for harmful compound capture and sensing	Beijing Institute of Technology	350
52	CHEN Liwei	Physical chemistry	Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences	350
53	LI Jinheng	Organic synthetic methodology	Nanchang Hangkong University	350
54	LI Guohui	Theoretical and computational biophysical chemistry	Dalian Institute of Chemical Physics, Chinese Academy of Sciences	350
55	LIU Jianhua	Veterinary pharmacology	South China Agricultural University	350
56	TANG Fuchou	Developmental biology	Peking University	350
57	ZHOU Dawang	Molecular immunology	Xiamen University	350
58	WANG Yiguo	Physiology and integrated biology	Tsinghua University	350
59	LYU Haidong	Visual cognitive neuroscience	Beijing Normal University	350
60	YANG Maojun	The structure and function of biological macromolecules	Tsinghua University	350
61	MAO Tonglin	Plant cell biology	China Agricultural University	350
62	ZHANG Feng	Human genomic CNVs: Mutational mechanisms and biological functions	Fudan University	350
63	DOU Daolong	Phytophthora effectors	Nanjing Agricultural University	350
64	LIU Jianxiang	Plant stress biology	Fudan University	350
65	WU Zhenlong	Monogastric animal nutrition	China Agricultural University	350
66	LUO Jie	Crop metabolomics	Central China Agricultural University	350

(continued)

No.	Name	Project title	Home institution	Direct funding
67	ZHU Chaodong	Insect systematics	Institute of Zoology, Chinese Academy of Sciences	350
68	HUANG Guanghua	Medical mycology	Institute of Microbiology, Chinese Academy of Sciences	350
69	WANG Xiaoxue	Microbial physiology and metabolism	South China Sea Institute of Oceanology , Chinese Academy of Sciences	350
70	QIN Feng*	Molecular genetics of maize drought resistance	Institute of Botany, Chinese Academy of Sciences	350
71	ZHANG Yan*	Plant reproductive biology	Shandong Agricultural University	350
72	NIU Shuli	Terrestrial ecosystem carbon cycle and global change	Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences	350
73	HUANG Zhiqun	Forest soil science	Fujian Normal University	350
74	HUANG Yihua	Structural and functional studies of membrane proteins	Institute of Biophysics, Chinese Academy of Sciences	350
75	ZHANG Lei	Cell proliferation and differentiation	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	350
76	YANG Yungui	Gene expression regulation and epigenetics	Beijing Institute of genomics, Chinese Academy of Sciences	350
77	ZENG Yi*	Regulatory mechanisms of mammary stem cells	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	350
78	QIU Zilong	The neural mechanism and non-human primate models for autism	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	350
79	ZHU Chuhong	Tissue engineering	Third Military Medical University of Chinese PLA	350
80	ZHOU Bin	Cardiovascular development and tissue regeneration	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	350
81	QIN Liping	Isotope cosmochemistry	University of Science and Technology of China	350
82	MA Jianwei	Exploration geophysics	Harbin Institute of Technology	350
83	WANG Yaping	Estuarine and coastal research: Modern processes associated with sedimentary system and geomorphological evolution in tide-dominated environments	Nanjing University	350
84	LIU Yu	Methods for geo-spatial modelling and analyzing	Peking University	350

(continued)

No.	Name	Project title	Home institution	Direct funding
85	LIU Junguo	Water resources assessment in hybrid natural-economic systems: theory and method	South University of Science and Technology of China	350
86	HUANG Xiaolong	Petrology	Guangzhou Institute of Geochemistry, Chinese Academy of Sciences	350
87	ZHANG Qiang	Anthropogenic emissions of air pollutants	Tsinghua University	350
88	ZHANG Ying	Black soil pollution and bioremediation	Northeast Agricultural University	350
89	YUAN Linwang	Geographical information system	Nanjing Normal University	350
90	JIANG Dabang	Paleoclimate modeling	The Institute of Atmospheric Physics, Chinese Academy of Sciences	350
91	CHEN Jiubin	Environmental geochemistry of metal stable isotopes	Institute of Geochemistry, Chinese Academy of Sciences	350
92	HUANG Yu	Earthquake engineering geology	Tongji University	350
93	GUO Qingjun	Stable isotope geochemistry and earth environment	Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences	350
94	FU Pingqing	Aerosol chemistry	The Institute of Atmospheric Physics, Chinese Academy of Sciences	350
95	CHEN Haishan	Land-atmosphere interaction	Nanjing University of Information Science and Technology	350
96	LIU Quanyou	Oil & gas geochemistry of hydrocarbon generation and accumulation	Research Institute of Petroleum Exploration China Petroleum and Chemical Corporation	350
97	NI Xijun	Paleoprimatology and paleoanthropology	Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences	350
98	HAN Yongming	Geochemistry of char and soot	Institute of Earth Environment, Chinese Academy of Sciences	350
99	ZHAO Liang	Smology	Institute of Geology and Geophysics, Chinese Academy of Sciences	350
100	WU Yuanbao	Petrology	China University of Geosciences (Wuhan)	350
101	HAO Qingzhen	Quaternary geology	Institute of Geology and Geophysics, Chinese Academy of Sciences	350
102	YU Wei	Polymer rheology and processing	Shanghai Jiao Tong University	350
103	LI Hanying	Organic optoelectronic materials and devices based on single-crystal composites	Zhejiang University	350

(continued)

No.	Name	Project title	Home institution	Direct funding
104	SHEN Yang	Rational design and modulation of Inorganic/ polymer composite dielectrics	Tsinghua University	350
105	LUO Xiaobing	Heat and fluid flow in device packaging	Huazhong University of Science and Technology	350
106	YU Xuebin	Metal-based hydrogen storage materials	Fudan University	350
107	NIU Junfeng	Environmental engineering	Beijing Normal University	350
108	LU Xinpei	Atmospheric pressure non-equilibrium plasmas and their biomedical applications	Huazhong University of Science and Technology	350
109	ZHANG Yongjun	Polymeric biomaterials	Nankai University	350
110	WANG Shuing	Fundamental theory and key techniques on structural health monitoring of offshore structures	Ocean University of China	350
111	ZHANG Jianmin	Discharge flood and dissipation energy and scour prevention in hydraulics engineering	Sichuan University	350
112	SU Shijian	Highly efficient organic light-emitting materials and devices	South China University of Technology	350
113	YOU Yezi	Biomedical polymer materials	University of Science and Technology of China	350
114	ZHU Jiaqi	Single crystal diamond and infrared antireflective & protective coatings	Harbin Institute of Technology	350
115	GONG Maoqiong	Research on basic thermophysical problems of low-temperature mixed-refrigeration	Technical Institute of Physics and Chemistry, Chinese Academy of Sciences	350
116	PENG Fangyu	Numerical control machining technology and equipment	Huazhong University of Science and Technology	350
117	JIA Hongjie	Stability and operation optimization of integrated energy systems	Tianjin University	350
118	WANG Huiyuan	Non-equilibrium solidification and microstructural control of lightweight alloys	Jilin University	350
119	XU Zhaodong	Anti-earthquake of structures	Southeast University	350
120	WANG Shouguo	Magnetic functional materials	University of Science and Technology Beijing	350
121	ZHAN Liangtong	Environmental geotechnics	Zhejiang University	350
122	LIU Gang	Strengthening/toughening and deformation/ fracture of metal materials	Xi'an Jiaotong University	350
123	LU Yiyu	Hydraulic measures for grid slotting and fracking to increase the permeability of coal seam	Chongqing University	350
124	ZHAN Mei*	Metal plastic forming process, die and equipment	Northwestern Polytechnical University	350

(continued)

No.	Name	Project title	Home institution	Direct funding
125	WANG Jianqiang	Vehicle intelligent safety	Tsinghua University	350
126	JIN Jian*	Design, preparation and application of polymer separation membranes	Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences	350
127	YI Tinghua	Structural health monitoring	Dalian University of Technology	350
128	LIU Naian	Wildland fire dynamics	University of Science and Technology of China	350
129	LIU Yong	Powder metallurgy	Central South University	350
130	WEI Zhenzhong	Mechanical measurement theory and technology	Beihang University	350
131	CUI Guanglei	Study on key materials of high energy density solid state lithium batteries	Qingdao Institute of Biomass Energy and Bioprocess Technology, Chinese Academy of Sciences	350
132	ZHANG Yalei	Wastewater treatment and resource recovery	Tongji University	350
133	LIU Hongzhong	Micro/nano manufacturing and control	Xi'an Jiaotong University	350
134	SHI Xun	Inorganic thermoelectric materials	Shanghai Institute of Ceramics, Chinese Academy of Sciences	350
135	HOU Jian	Oil-gas percolation mechanics in porous medium and enhanced oil recovery method	China University of Petroleum	350
136	XUE Qiang	Geotechnical mechanics and geotechnical engineering	Institute of Rock and Soil Mechanics, Chinese Academy of Sciences	350
137	WANG Jianhua	Social water cycle and high-efficiency utilization of water resources	China Institute of Water Resources and Hydropower Research	350
138	LIU Chang	Controlled synthesis and application exploration of carbon nanotubes	Institute of Metal Research, Chinese Academy of Sciences	350
139	LI Zhijun	Research on fundamental theory and key technology of human cooperative wearable rehabilitation robotics	South China University of Technology	350
140	LI Xiangyang	Theory and mechanism design for wireless network capacity, performance analysis, optimization, and assurance	University of Science and Technology of China	350
141	PENG Chengzhi	Quantum information and quantum communication	University of Science and Technology of China	350
142	WU Huaining	Intelligent control of complex dynamical systems	Beihang University	350
143	LIN Zhouchen	Image processing and pattern recognition	Peking University	350
144	XU Huailiang	Ultrafast strong-field laser nonlinear spectroscopy	Jilin University	350
145	SONG Lingyang	Wireless cooperative communication	Peking University	350

(continued)

No.	Name	Project title	Home institution	Direct funding
146	WANG Yizhou	Perceptual mechanism and computation of image structure	Peking University	350
147	MIU Feng	Research on novel electronic materials and devices for information technology	Nanjing University	350
148	CHEN Hongsheng	Novel invisibility cloak	Zhejiang University	350
149	LYU Jiancheng	Subspace learning of neural networks	Sichuan University	350
150	XU Mingwei	Theory and technology of large-scale network routing	Tsinghua University	350
151	WU Fei	Multimedia analysis	Zhejiang University	350
152	CHAI Li	Filter group frame theory and application	Wuhan University of Science and Technology	350
153	MA Kaixue	Microwave millimeter wave circuit and integrated system	University of Electronic Science and Technology	350
154	JIN Shi	On the fundamental theory and key technologies of multiple antenna wireless transmission	Northsouth University	350
155	ZHU Zhangming	Low power analog front-end integrated circuits	Xi'an University of Electronic Science and Technology	350
156	SHEN Guozhen	Flexible electronics	Institute of semiconductors, Chinese Academy of Sciences	350
157	WANG Xuesong	Theory and technology of transient polarization imaging radar	National University of Defense Technology	350
158	HAN Hongbin	Brain information extraction, processing, analysis and imaging	Peking University	350
159	XU Kun	Photonics-assisted microwave processing	Beijing University of Posts and Telecommunications	350
160	HE Jun	Novel two dimensional chalcogenide compound semiconductors: Controllable synthesis, electronic and optoelectronic devices	National Center for Nanoscience and Technology	350
161	ZENG Tao	Research on bistatic/multistatic radar system and information processing	Beijing Institute of Technology	350
162	LIU Jianguo	High speed optoelectronic devices	Institute of semiconductors, Chinese Academy of Sciences	350
163	HUANG Zhiming	Infrared and terahertz	Shanghai Institute of Technical Physics, Chinese Academy of Sciences	350
164	XIE Shaorong*	Intelligent and autonomous robots	Shanghai University	350
165	ZHAN Naijun	Formal design of complex safety-critical embedded systems	Institute of Software, Chinese Academy of Sciences	350

(continued)

No.	Name	Project title	Home institution	Direct funding
166	LI Kenli	Performance and energy highly efficient computing	Hunan University	350
167	ZHENG Siqi*	Urban development and management	Tsinghua University	245
168	JIN Qinglu	Accounting and finance research based on institution and infrastructure reform	Shanghai University of Finance and Economics	245
169	FANG Ying	Econometrics and its applications in economic management	Xiamen University	245
170	YU Miaojie	International trade and china's economic transformation and development	Peking University	245
171	ZHU Xufeng	Public management and public policy	Tsinghua University	245
172	ZHOU Peng	Energy economics and management	Nanjing University of Aeronautics and Astronautics	245
173	WANG Zhaohua	Research on energy and resource sustainable development management and policy modeling	Beijing Institute of Technology	245
174	YU Xianrui	Translational research of comprehensive surgical treatment for pancreatic cancer: from basic to clinical practice	Fudan University	350
175	JIA Lijun	Molecular biology of cancer	Fudan University	350
176	SHEN Ying	Mechanisms of cerebellar regulation in motor and neuropsychiatric disorders	Zhejiang University	350
177	XU Ming	Cardiac remodeling of heart failure	Peking University	350
178	YANG Li*	Acute kidney injury	Peking University	350
179	WANG Hui*	Clinical microbiology	Peking University	350
180	YANG Bo*	Anti-tumor pharmacology	Zhejiang University	350
181	XU Xiao	A study on the molecular mechanisms and interventions for primary disease recurrence after liver transplantation	Zhejiang University	350
182	ZHANG Zhihong*	Optical molecular imaging for tumor immunity	Huazhong University of Science and Technology	350
183	CHEN Yue	Medicinal chemistry of anti-cancer stem cells	Nankai University	350
184	WANG Ping	Tumor microenvironment and ubiquitination	Tongji University	350
185	BU Jun	Internal medicine-cardiovascular system (mechanism and intervention of coronary event continuum)	Shanghai Jiao Tong University	350
186	LI Chunying*	Dermatology	The Chinese People's Liberation Army Fourth Military Medical University	350
187	ZHANG Zhanjun	New method and new technology of traditional Chinese medicine	Beijing Normal University	350

(continued)

No.	Name	Project title	Home institution	Direct funding
188	SHI Ming	Oncology (digestive system neoplasms)	Sun Yat-sen University	350
189	ZHANG Jiyan*	Signaling events that control inflammation resolution	The Chinese People's Liberation Army Military Academy of Medical Sciences	350
190	HUANG Yuan*	Overcoming the organic and cellular barriers by efficient drug delivery system	Sichuan University	350
191	LI Chengtao	Forensic sciences	Institute of Forensic Science, Ministry of Justice	350
192	LUO Cheng	Medicinal chemistry	Shanghai Institute of Materia Medica, Chinese Academy of Sciences	350
193	FAN Zhipeng	Stomatology	Capital University of Medical Sciences	350
194	XU Qi*	Pathogenesis of major mental disorders	Institute of Basic Medical Sciences, Chinese Academy of Sciences	350
195	LIU Guanghui	Using pluripotent stem cell technique to study and treat aging-related disorders	Institute of Biophysics, Chinese Academy of Sciences	350
196	BAI Xiaochun	Mechanisms of bone and cartilage degeneration	Southern Medical University	350
197	WANG Yanjiang	Neurology	The Chinese People's Liberation Army Third Military Medical University	350
198	ZHOU Xin	Ultra-sensitive magnetic resonance imaging	Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences	350

Note: 171 projects funded from 2,120 male applicants; 27 projects funded from 313 female applicants. *female

Science Fund for Creative Research Groups

1. Newly started creative research groups

In 2016, we received 257 applications. After review, we supported 38 groups, with a total direct funding of 389.55 million yuan. Please refer to the following table for details.

Awards in the Science Fund for Creative Research Groups in 2016

Table 5-15 (Unit: 10,000 yuan)

No.	Group leader	Research direction	Home institution	Direct funding
1	ZHANG Pengjie	The large scale structure of the universe	Shanghai Jiao Tong University	1,050
2	LU Xiyun	Complex flows with vortices and interfaces	University of Science and Technology of China	1,050
3	BAO Gang	Inverse problems for partial differential equations: theory, computation and applications	Zhejiang University	735
4	ZENG Heping	Precision spectroscopy and measurement of molecules	East China Normal University	1,050
5	ZHAO Yuliang	The innovative analysis methods for studying the biological effects of nanomaterials via the synergy of Synchrotron Radiation and nuclear technology	National Center for Nanoscience and Technology	1,050
6	YU Jihong	Porous functional materials	Jilin University	1,050
7	YU Biao	The chemical biology of natural products	Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences	1,050
8	LI Jinghong	Analytical chemistry	Tsinghua University	1,050
9	CHEN Baoliang	The interfacial behaviors and regulating principles of organic pollutants in the environment	Zhejiang University	1,050
10	YUAN Yingjin	Synthetic biology and bioprocess	Tianjin University	1,050
11	YAO Xuebiao	Dynamic assembly of centromere and its regulation	University of Science and Technology of China	1,050
12	DENG Xingwang	Integration of environmental and hormonal signals to regulate plant cell elongation	Peking University	1,050
13	ZHOU Qi	Stem cell and regenerative medicine	Institute of Zoology, Chinese Academy of Sciences	1,050
14	LIU Xiaolong	Tumor immunology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	1,050
15	LI Fuguang	Cotton germplasm innovation and the molecular breeding of high yield varieties	Cotton Research Institute, Chinese Academy of Sciences	1,050
16	ZHANG Xingliang	Evolution of early organisms	Northwest University	1,050
17	YANG Xiuqun	Dynamics of the East Asian climate variability	Nanjing University	1,050
18	LI Xinrong	Ecohydrology in arid regions	Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences	1,050
19	QIN Boqiang	Lake environment change and ecosystem response	Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences	1,050

(continued)

No.	Group leader	Research direction	Home institution	Direct funding
20	PAN Yongxin	Variation of earth's magnetic field and its biospheric effects	Institute of Geology and Geophysics, Chinese Academy of Sciences	1,050
21	ZHU Min	Properties and multi-phase and multi-scale structure tuning for hydrogen or electricity storage materials	South China University of Technology	1,050
22	YAN Jianhua	Thermal conversion mechanism and clean utilization of solid fuels with complex composition	Zhejiang University	1,050
23	NIE Zuoren	Eco-materials and processing engineering	Beijing University of Technology	1,050
24	Han Xu	Analysis and optimization of vehicle crash safety	Hunan University	1,050
25	FENG Xiating	Analysis and control of safety of major rock engineering	Institute of Rock and Soil Mechanics, Chinese Academy of Sciences	1,050
26	LIU Changsheng	Inorganic nano-scaled biomaterials	East China University of Science and Technology	1,050
27	WANG Zhanshan	Researches on the high power and high energy laser components	Tongji University	1,050
28	SU Hongye	Modeling, optimization and control for complex petrochemical process	Zhejiang University	1,050
29	LYU Jinhu	Fundamental theory and applications of networked knowledge	Academy of Mathematics and Systems Science, Chinese Academy of Sciences	1,050
30	YANG Guanghua	Fault diagnosis and fault tolerant control	Northeastern University	1,050
31	LIAO Guisheng	Fundamental theory and key techniques on radar cognitive detection, imaging and recognition	Xi'an University of Electronic Science and Technology	1,050
32	GAO Ziyou	Urban transportation management theory and methodology	Beijing Jiaotong University	735
33	ZENG Dajun	Big data-driven security informatics	Institute of Automation, Chinese Academy of Sciences	735
34	HUANG Xiaojun	The applied basic research of hematopoietic stem cell transplantation	Peking University	1,050
35	GONG Qiyong	Radiology	Sichuan University	1,050
36	QI Hai	Dynamic cellular immunobiology of humoral immune regulation	Tsinghua University	1,050
37	SONG Erwei	The regulatory mechanism of inflammatory microenvironment on the progression of malignant tumor	Sun Yat-sen University	1,050
38	CAO Wuchun	Discovery and tracing of natural focus diseases	The Chinese People's Liberation Army Military Academy of Medical Sciences	1,050

2. Continued funding for creative research groups of 3-year funding

After evaluation, all 29 creative research groups obtained the first extension of funding, with total funding of 149.10 million yuan. Please refer to the following table for details.

Continued Funding for Creative Research Groups of 3-Year Funding

Table 5-16 (Unit: 10,000 yuan)

	Group leader	Research direction	Home institution	Direct funding
1	XI Nanhua	Algebra and number theory	Academy of Mathematics and System Sciences, Chinese Academy of Sciences	367.5
2	CHEN Weiqiu	Mechanics and control of intelligent materials and structures	Zhejiang University	525
3	WEI Shiqiang	Development of new methods based on synchrotron radiation facility and its application on energy materials	University of Science and Technology of China	525
4	GAO Song	The studies on the magnetism and related physical and chemical properties of molecular solids	Peking University	525
5	BAO Xinhe	Nanocatalysis in efficient utilization of carbon-based energy sources	Dalian Institute of Chemical Physics, Chinese Academy of Sciences	525
6	MAO Liqun	Analytical chemistry for living biosystems	Institute of Chemistry, Chinese Academy of Sciences	525
7	ZHU Benzhan	The environmental processes and toxicological effects of PTS	Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences	525
8	HU Zhihong	Molecular mechanisms of virus-host interaction	Wuhan Institute of Virology, Chinese Academy of Sciences	525
9	WAN Wen	Origin of genetic novelties in genomes and their significance in the evolution and adaptation of animals	Kunming Institute of Zoology, Chinese Academy of Sciences	525
10	LI Peng	Lipid homeostasis and lipidology	Tsinghua University	525
11	WU Kongming	The interaction among cotton, insect pests and natural enemies	Institute of Plant Protection, Chinese Academy of Sciences	525
12	SHI Peijun	Modelling and simulation on land surface processes	Beijing Normal University	525
13	PENG Pingan	The formation and enrichment of shale oils in lacustrine sedimentary basins of China	Guangzhou Institute of Geochemistry, Chinese Academy of Sciences	525
14	WAN Weixing	Investigation on the ionospheric variability and the relative processes	Institute of Geology and Geophysics, Chinese Academy of Sciences	525

(continued)

	Group leader	Research direction	Home institution	Direct funding
15	CHEN Dake	Toward monitoring and prediction of dynamical ocean environment	Second Institute of Oceanography of the State Oceanic Administration	525
16	TANG Shaozhong	Agricultural water transportation based on multi-process driving mechanism for improving water use efficiency	China Agricultural University	525
17	JIANG Peixue	Heat transfer theory and application	Tsinghua University	525
18	SUN Jun	Size effect on the deformation and phase transformation of materials at micro/nano-scale	Xi'an Jiaotong University	525
19	GUO Dongming	Fundamental study on the precision manufacturing theory and techniques	Dalian University of Technology	525
20	MEI Shengwei	Fundamental research on the intelligent control and dispatching of the power system integrating large scale wind and solar generation	Tsinghua University	525
21	PENG Lianmao	Theory and method for nanoscale high performance electronic and quantum devices	Peking University	525
22	CHEN Jie	Optimization control and decision of complex land weapons	Beijing Institute of Technology	525
23	GUI Weihua	Theory, technology and applications for complex nonferrous metallurgical process control	Central South University	525
24	LUO Yi	Nano-structured integrated optoelectronic devices for sustainable electronic information technologies	Tsinghua University	525
25	TANG Lixin	Theory and application on scheduling two-dimensional space and time in manufacturing and logistics systems	Northeast University	367.5
26	NING Guang	The mechanisms and intervention research on the dual defects in type 2 diabetes	Shanghai Jiao Tong University	525
27	CHEN Qianming	Applied basic research for the pathogenesis and prevention of oral premalignant lesions	Sichuan University	525
28	ZHU Weiguo	The mechanistic study on the relationship between protein posttranslational modifications and cancer development and metastasis	Peking University	525
29	JIANG Jiandong	Microbial drugs	Pharmaceutical Biotechnology Research Institute, Chinese Academy of Medical Science	525

3. Continued funding for creative research groups of 6-year funding

Among the 28 creative research group of 6-year funding, 20 of them applied for extended funding. After evaluation, 10 creative research groups obtained the second extension of funding. The total funding was 52.20 million yuan. Please see the following table for details.

Continued Funding for Creative Research Groups of 6-Year Funding

Table 5-17 (Unit: 10,000 yuan)

	Group leader	Research direction	Home institution	Direct funding
1	ZHU Shining	Study on novel optical properties of artificial micro/nano-structures	Nanjing University	525
2	SUN Shigang	Interfacial electrochemistry	Xiamen University	525
3	FANG Jingyun	Spatiotemporal patterns and ecological functions of the terrestrial vegetation in china	Peking University	525
4	SHI Yigong	Structural and mechanistic investigation of key membrane proteins	Tsinghua University	525
5	SUN Heping	Study on modern geodetic techniques and the applications in earth science	Institute of Geodesy and Geophysics, Chinese Academy of Sciences	525
6	ZHOU Yu	Multifunctional composites and relevant fundamentals for aerospace applications	Harbin Institute of Technology	525
7	ZHONG Denghua	Basic theory of great hydraulic engineering safety	Tianjin University	525
8	LU Jianhua	Broadband wireless communication theory and key technologies	Tsinghua University	525
9	GAO Fu	Molecular mechanisms of pathogenic microbe-host interactions	Institute of Microbiology, Chinese Academy of Sciences	525
10	ZHAO Minghui	Immunologic and inflammational pathogenesis of glomerular disease	Peking University	525

Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao

The Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao adopts "2+4" funding model, which means that those 2-year projects with substantial cooperation and clear potential for future development will be renewed to another 4 years.

Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao (2-year projects)

Table 5-18 (Unit: 10,000yuan)

Scientific department	Applications	Approved	
		Projects	Direct funding
Mathematical and Physical Sciences	19	9	162
Chemical Sciences	21	9	162
Life Sciences	38	16	288
Earth Sciences	19	8	144
Engineering and Material Sciences	56	18	324
Information Sciences	74	26	468
Management Sciences	38	12	216
Health Sciences	38	17	306
Total	303	115	2,070

Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao (extension to 4-year projects) in 2016

Table 5-19 (Unit: 10,000yuan)

Scientific department	Applications	Approved	
		Projects	Direct funding
Mathematical and Physical Sciences	9	2	360
Chemical Sciences	4	1	180
Life Sciences	15	4	720
Earth Sciences	6	2	360
Engineering and Material Sciences	8	3	540
Information Sciences	16	3	540
Management Sciences	5	1	180
Health Sciences	20	4	720
Total	83	20	3,600

Note: there were 331 applications from male applicants, of which 117 were funded; and 55 were from female applicants, of which 18 were funded (sum of the above two tables).

Joint Funds

Applications and Funding of Joint Funds in 2016

Table 5-20 (Unit: 10,000 yuan)

	Type of program	Applications	Approved	Direct funding
1	NSAF Joint Fund	136	50	4,200
2	Joint Fund of Iron and Steel	93	24	2,520
3	Joint Fund of Astronomy	142	42	3,360
4	NSFC-Guangdong Joint Fund	209	30	8,100
5	NSFC-Yunnan Joint Fund	149	21	4,090
6	Joint Fund of Large Science Facilities	259	76	6,720
7	NSFC-Xinjiang Joint Fund	189	52	6,720
8	NSFC-Henan Joint Fund	1,784	113	8,400
9	Joint Fund of Petrochemical Engineering, Type A	522	39	2,520
10	Joint Fund of Petrochemical Engineering, Type B①	34+82	10+10	2,520+2,520
11	Joint Fund for Promoting S&T Cooperation between Both Sides of the Strait	110	19	4,090
12	NSFC-Shandong Marine Science Center Project ②	6+4	1+4	3,500+6,490
13	Joint Fund for Qaidam Salt Lake Chemical Research	193	29	1,680
14	Joint Fund of General Technology	151	45	6,720
15	Joint Fund of Advanced Aerospace Manufacturing Technology Research	169	22	4,200
16	NSFC-Liaoning Joint Fund	40	16	4,000
17	NSFC-Zhejiang Joint Fund of Industrialization and Informatization	66	20	4,200
18	Joint Fund of China's Auto industry Innovation and Development	94	14	3,270
19	NSFC-Shanxi Joint Fund of Coal-Based Low Carbon	128	33	4,120
20	NSFC-Guangdong Big Data Science Research Center Project	32	6	4,910
21	NSFC-Guizhou Karst Science Research Center Project	8	2	5,040
22	Joint Fund of Civil Aviation Research	174	33	1,680
23	NSFC-Shenzhen Robotics Research Center Project	135	28	7,300
	Total	4,909	739	112,870

Note: ①There were 34 applications for Joint Fund of Petrochemical Engineering, Type B in 2015, and 82 applications in 2016;
②There were 6 applications for NSFC- Shandong Marine science center project in 2015, and 4 projects were from previous years.

Basic Science Center Project

Applications and Funding of Basic Science Center Project

Table 5-21 (Unit: 10,000 yuan)

Project No.	Title of project	PI	Home institution	Direct funding
11688101	Geometry, analysis, and computation on manifolds	ZHOU Xiangyu	Academy of Mathematics and Systems Science, Chinese Academy of Sciences	14,500
21688102	Frontier research in chemical dynamics	YANG Xueming	Dalian Institute of Chemical Physics, Chinese Academy of Sciences	18,570
41688103	Craton destruction and terrestrial life evolution	ZHOU Zhonghe	Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences	18,100

Special Fund for Development of National Major Research Instruments and Facilities

In 2016, we received 588 applications for the Special Fund for Development of National Major Research Instruments and Facilities. After expert review, we funded 85 applications, with direct funding of 553.8173 million yuan. The receiving departments recommended 59 applications. After review, we supported 4 projects, with total funding of 270.2503 million yuan.

Projects Funded for Development of National Major Research Instruments and Facilities (by application) in 2016

Table 5-22 (Unit: 10,000 yuan)

	Title of project	PI	Home institution	Direct funding
1	Development of a structural fatigue testing system under complex environment	HUANG Peiyan	South China University of Technology	740.62
2	Ultraviolet Brillouin light scattering system with spin resolved microscopy	KANG Shishou	Shandong University	650.40
3	Development of multi-function microscale observation/manipulation techniques and instrument	ZHANG Qingchuan	University of Science and Technology of China	809.75
4	An experimental equipment for intense cluster beam with well-defined particle states	HAN Min	Nanjing University	691.00
5	Ultrahigh temporal resolved photoelectron velocity map image system for investigating the ultrafast dynamics of nano-material in laser fields	LU Peixiang	Huazhong University of Science and Technology	825.20

(continued)

	Title of project	PI	Home institution	Direct funding
6	Quantum light source chips based on lithium niobate waveguide circuits	XU Ping	Nanjing University	536.00
7	Ultrafast core-level spectroscopy for atoms and molecules	DING Dajun	Jilin University	730.00
8	Table-top X-ray nanoscope based on Fourier-transform intensity correlation imaging	YU Hong	Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences	658.80
9	Off-axis aspheric sub-mirror metrology device for segmented large telescope primary with 30m aperture	LI Xinnan	Nanjing Institute of Astronomical Optics & Technology, National Astronomical Observatories, Chinese Academy of Sciences	829.49
10	In-situ nano-modulation and multifield coupling measurement system based on scanning probe	LI Jiangyu	Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences	693.70
11	Development of new and multifunctional Stokes-Mueller matrix imaging polarimeter	LI Yanqiu	Beijing Institute of Technology	647.85
12	Temporally, spatially, and energetically resolved ultrafast broad-band multiple dimensional spectroscopy	ZHENG Junrong	Peking University	765.00
13	Research and development of deep UV and multi-dimension laser confocal scanning microscopic fluorescence spectral instrument	ZHANG Yong	Xiamen University	708.12
14	High time-space resolution optical system for analyzing reactive molecules in single cell level	LIU Songqin	Southeast University	556.00
15	The manufacture of the equipment for effective disentangle polymer melt and investigate disentangle mechanism and applications	FU Qiang	Sichuan University	696.86
16	Development and applications of an in-vivo microextraction-plasmonic detection based single cell analysis system	LIU Zhen	Nanjing University	555.00
17	Development of a system for ultra-broad band photo dissociation/excitation spectroscopic study based on a Fourier-transform ion cyclotron resonance mass spectrometer	KONG Xianglei	Nankai University	395.80
18	The research and development of high throughput microbial evolutionary breeding instrument	XING Xinhui	Tsinghua University	631.79
19	Development of fluorescence/scattering high-sensitivity spectral flow cytometric system	YAN Xiaomei	Xiamen University	691.80
20	Development of a mass spectrometer for structural analysis of the biological molecules and complexes	OUYANG Zheng	Tsinghua University	626.50

(continued)

	Title of project	PI	Home institution	Direct funding
21	Development of capture instrument for primary particles in precipition reaction	LI Dianqing	Beijing University of Chemical Technology	536.49
22	Development of electrochemistry—dual polarization interferometry analyzer	YANG Xiurong	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences	629.00
23	Research on dynamic diamond anvil cell with in situ optical spectroscopy and imaging system	YANG Guoqiang	Institute of Chemistry, Chinese Academy of Sciences	593.00
24	A mass spectrometer for ion-molecule reactions under high gas-pressure and high ion-flux conditions	HE Shenggui	Institute of Chemistry, Chinese Academy of Sciences	549.35
25	Integrated multi-dimensional sensors and its application in the system of microfluidic micro-nano synthesis	WEI Qin	Jinan University	510.00
26	The measurement instrument for drugs with multiparameters based on micronano spatio-temporal sensing and 3D cell and organoid chips	WANG Ping	Zhejiang University	640.00
27	Research and development of real-time analyzing and modulating instrument for complex brain neural network	CHEN Yaowu	Zhejiang University	492.55
28	Development of a real-time quantitative protein misfolding cyclic amplification instrument for detecting A β seeds in patients with Alzheimer's disease	JIA Jianping	Capital University of Medical Sciences	733.00
29	A mechanical loading and detecting instrument of molecular biomechanics in stressed living cell	LONG Mian	Institute of Mechanics, Chinese Academy of Sciences	799.95
30	Development of a portable real-time on-board vehicle HCHO and HONO emission measurement system	ZHENG Junyu	South China University of Technology	731.96
31	Grid-based energetic neural atom (ENA) imager	ZONG Qiugang	Peking University	677.32
32	Development of large-angle white-light coronagraph for the inner-heliosphere	XIA Lidong	Shandong University	522.00
33	DUV femtosecond laser ablation plasma mass spectrometry and optical spectrum analyzer	SUN Weidong	Guangzhou Institute of Geochemistry, Chinese Academy of Sciences	791.96
34	Autonomous long-endurance marine meteorological measurement system	CHEN Hongbin	The Institute of Atmospheric Physics, Chinese Academy of Sciences	663.70
35	An all-solid-state and daytime/nighttime lidar for simultaneous and observations of horizontal wind, temperature, metal atom density and metal iron density in the mesopause region	YANG Guotao	The National Center for Space Science	748.71

(continued)

	Title of project	PI	Home institution	Direct funding
36	A test equipment with multi-field coupling of open-system for geological environment in the cold regions engineering	LING Xianchang	Harbin Institute of Technology	819.33
37	Development of a novel Faraday rotation spectroscopy instrument for the direct measurement of atmospheric HOx radicals	ZHANG Weijun	Hefei Institute of Physical Science, Chinese Academy of Sciences	732.29
38	Study on a novel high-precision laser microprobe for in situ stable isotope analysis	LI Yanhe	Institute of Mineral Resources, Chinese Academy of Sciences	308.00
39	Lidar of detecting temperature, humidity and vertical velocity of cloud base at day and night for cloud precipitation potential study	HUA Dengxin	Xi'an University of Technology	704.48
40	High precision selected-area electron beam melting forming system for manufacturing biomedical implants	XIAO Zhiyu	South China University of Technology	711.24
41	Development of a polyhedral structure high-performance molecular imaging instrument for brain science oriented research	XU Jianfeng	Huazhong University of Science and Technology	659.92
42	3D print refined prototyping system for catastrophe simulation of complex geological structure	MA Guowei	Beijing University of Technology	581.51
43	Development of nuclear magnetic resonance instrument for non-invasive monitoring of blood glucose and lipid in diabetes	YI Hong	Southeast University	660.00
44	Integrated test station of high-power hydrogen fuel cells	ZOU Zhigang	Nanjing University	687.10
45	The construction of primary constant pressure refractive index gas thermometry at the temperature from 5.0 K to 24.5561 K	LUO Ercang	Technical Institute of Physics and Chemistry, Chinese Academy of Sciences	773.76
46	The novel, high-sensitivity, wide frequency , all fiber microseismic monitoring instrument for coal and gas outburst disasters	TANG Chunan	Dalian University of Technology	720.60
47	Development and application of all modes impact fretting damage test systems under extreme environment	ZHU Minhao	Southwest Jiaotong University	710.07
48	In situ real time multiscale correlation characterization for multi-field coupling effects on metallic alloy solidification	SUN Baode	Shanghai Jiao Tong University	783.90
49	Development and application of full-view synchronized meter system for the power system spanning renewable sources, grid and loads	BI Tianshu	North China Electric Power University	654.70
50	Tunable transient photoelectrical measurement system for solar cells	MENG Qingbo	Institute of Physics, Chinese Academy of Sciences	686.90

(continued)

	Title of project	PI	Home institution	Direct funding
51	An ultra-low temperature electronic transport and in-situ Raman/Kerr measurement system for nanodevices based on low dimensional materials	ZHANG Zhidong	Institute of Metal Research, Chinese Academy of Sciences	700.00
52	Development of a broadband molecular rotational spectrometer	CHEN Qian	Nanjing University of Science and Technology	693.05
53	A gas-liquid-solid three-phase fluidization equipment with high solid holdup using electric/magnetic dual-modality tomography	WANG Chao	Tianjin university	502.00
54	Development of codec apparatus for quantum communication with planar waveguide circuit	CHEN Wei	University of Science and Technology of China	689.75
55	Ultra-long high-precision fiber-optic time and frequency transfer technologies and equipment	WU Guling	Shanghai Jiao Tong University	687.00
56	High order surface defect quantitative detecting instrument based on reverse recognition database of scatter-light electromagnetic field distribution	YANG Yongying	Zhejiang University	673.71
57	High-speed computational video imaging spectrometer	CAO Xun	Nanjing University	597.00
58	Researches on high precision absolute gravimeter and applications	WANG Lijun	Tsinghua University	616.80
59	Research on new infrared methane and carbon monoxide detector	WANG Yiding	Jilin University	191.60
60	Fully distributed fiber sensing instrument for urban underground disturbing fields	ZHANG Xuping	Nanjing University	741.24
61	Development of high-precision three-dimensional depth perception device	ZHENG Nanning	Xi'an Jiaotong University	717.00
62	Real-time, atomic scale interface spin characterization and manipulation system	ZHAO Weisheng	Beihang University	835.57
63	The spectral emissivity measurement apparatus at cryogenic temperature	LIU Yufang	Henan Normal University	735.99
64	Development of the instrument for the measurement of digital multi-beam array for 5G massive MIMO	HONG Wei	Southeast University	753.00
65	Development of middle-long wavelength infrared supercontinuum source	NIE Qiuhua	Ningbo University	585.00
66	Eye-safe long distance coherent wind lidar based on 1.645 μm all-solid-state single frequency pulse laser	GAO Chunqing	Beijing Institute of Technology	666.31
67	Fabrication of new-generation programmable all-optical signal processor based on liquid crystal on silicon	CHEN Genxiang	Minzu University of China	693.25

(continued)

	Title of project	PI	Home institution	Direct funding
68	Photoacoustic-OCT-ultrasound imager for precise diagnosis of cardiovascular vulnerable plaques	XING Da	South China Normal University	572.00
69	The magnetic anomaly detector based on vector atomic magnetometer	FU Mengyin	Nanjing University of Science and Technology	823.54
70	High-speed rotation-type maskless laser writing nanolithography system based on laser-induced transient thermal probe effect	WEI Jinsong	Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences	375.00
71	Study on an infrared dual band panoramic imaging spectrum measurement and retrieval instrument	LIANG Jingqiu	Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences	751.00
72	Research on the pipeline inspection gauges based on multi-frequency electromagnetic-holographic synergy for offshore oil and gas pipelines in service	ZHANG Huaguang	Northeast University	706.40
73	Continuously tunable infrared laser spectrometer in 4−10 μm	LIU Fengqi	Institute of Semiconductors, Chinese Academy of Sciences	564.50
74	Bionic intellisense flight instrument based space motion information	GUO Lei	Beihang University	720.31
75	Development of a non-invasive multi-channel instrument for measuring physiological and biochemical parameters in vivo	CHEN Zhencheng	Guilin University of Electronic Technology	687.50
76	Development of a microwave plasma CVD system for diamond semiconductor n type doping with high efficiency	WANG Hongxing	Xi'an Jiaotong University	685.64
77	Development of new capacitance diaphragm gauge based on MEMS technology	LI Detian	Lanzhou institute of space physics	595.70
78	An integrated intelligent experimental system for research on neural mechanism and brain-inspired computational model	QIAO Hong	Institute of Automation, Chinese Academy of Sciences	587.02
79	Development of ultrasound machine with digital breast automatic identification system	CHANG Cai	Fudan University	253.00
80	Development of cryo frequency modulation non-contact atomic force microscope for biomedical applications	SHAO Zhifeng	Shanghai Jiao Tong University	374.00
81	Development of an automatic flow cytomagnetosonoporation (FCMSP) system	QIU Bensheng	University of Science and Technology of China	609.75
82	Development and application of small-animal whole-body high-speed photoacoustic molecular imaging instrument	FANG Chihua	South Medical University	635.00
83	A power ultrasound system with adjustable output of mechanical/thermal coupling effects to study the mechanism of blood pressure control via the modification of peri	KONG Xiangqing	Nanjing Medical University	727.87

(continued)

	Title of project	PI	Home institution	Direct funding
84	The development and clinical application of multimodality digestive endoscopy	WU Kaichun	The Fourth Military Medical University	701.36
85	Research and development of image-guided interventional robotic system	LIANG Ping	Chinese PLA General Hospital	681.40

Projects Funded for Development of National Major Research Instruments and Facilities (by recommendation) in 2016

Table 5-23 (Unit: 10,000 yuan)

	Title of project	Applicant	Home institution	Direct funding
1	A synchrotron-based system with dynamic loading and in situ, real-time, X-ray characterization instrumentations for investigating deformation, damage and failure within material interiors	LUO Shengnian	Chengdu Science and Technology Development Center, Chinese Academy of Sciences	6,481.80
2	Near-field terahertz scanning tip system for high-throughput material characterization	LU Yalin	University of Science and Technology of China	6,697.12
3	Experimental research apparatus for electromagnetic science of hypersonic vehicle plasma in nearspace	BAO Weimin	Xi'an University of Electronic Science and Technology	6,712.34
4	Research and development of multi-nuclear synchronous integrated instrument for tumor molecular imaging	SHEN Baozhong	Harbin Medical University	7,133.77

Emergency Management Projects

NSFC's General Management Projects

We funded 86 projects in this category, and the total direct funding was 102.73 million yuan.

NSFC's Departmental General Management Projects

We funded 1,032 projects in this category, and the total direct funding was 182.6962 million yuan.

Soft Projects entrusted by NSFC's Functional Departments

We funded 61 soft projects or tasks in this category with total direct funding of 23.95 million yuan.

Tianyuan Fund for Mathematics

In 2016, we received 723 applications in this category, and funded 253 projects with direct funding of 25 million yuan. Among them, 211 projects of Young Mathematicians were funded with direct funding of 6.29 million yuan; 10 projects to promote interdisciplinary research were funded with direct funding of 10 million yuan; 32 projects of mathematical summer schools for graduate students, young mathematical teachers training, seminar, workshop and important academic exchange activities, and mathematical dissemination were funded with 8.71 million yuan.

Research Fund for International Young Scientists

Application and Funding of Projects of Research Fund for International Young Scientists (by Scientific Department) in 2016

Table 5-24 (Unit: 10,000 yuan)

Scientific department	Application received	Approved				Funding rate (%)
		Projects	Direct funding	Percentage of the total (%)	Average funding per project	
Mathematical and Physical Sciences	38	20	486.59	16.22	24.33	52.63
Chemical Sciences	54	23	625.09	20.84	27.18	42.59
Life Sciences	38	17	426.11	14.20	25.07	44.74
Earth Sciences	18	9	199.64	6.65	22.18	50.00
Engineering and Materials Sciences	47	22	608.84	20.29	27.67	46.81
Information Sciences	21	10	286.86	9.56	28.69	47.62
Management Sciences	7	4	56.41	1.88	14.10	57.14
Health Sciences	27	12	310.46	10.35	25.87	44.44
Total	250	117	3,000.00	100	25.64	46.80

International (Regional) Exchange Program

Application and Funding of Projects of International (Regional) Exchange Program in 2016

Table 5-25 (Unit: 10,000 yuan)

Type of project	Application received	Application accepted	Projects funded	Funding amount	Funding rate (%)
Exchange Program under Agreements/MOUs	1,721	1,226	267	3,166.64	15.51
International Conference eutside china under Agreements/MOUs	309	289	271	850.93	87.70
International Conference in china under Agreements/MOUs	109	92	43	651.57	39.45
IIASA Membership Fee	1	1	1	517.74	100.00
Sina-German Science Center Program	1	1	1	2,393.00	100.00
Total	2,141	1,609	583	7,579.88	27.23

Part 6

Completion and Evaluation of NSFC Projects

6.1 Completion of General Program Projects

Research Outputs of General Program Projects Completed in 2016

Table 6-1

Projects completed				14,965
Research outputs	Publications	Invited presentations	International conferences	24,730
			Domestic conferences	23,553
		Academic articles and monographs	International journals	116,432
			Domestic journals	68,484
			Monographs	7,184
	Technology innovation and application		Peer-reviewed applications	423
			Patents	13,188
			Technology dissemination	947
	Awards		International awards	372
			National awards	298
			Ministerial or provincial awards	1,956
Talent training			Post-docs	2,174
			PhD students	37,450
			Master students	85,745

6.2 Completion of Key Program Projects

Research Outputs of Key Program Projects Completed in 2016

Table 6-2

Projects completed				6
Research outputs	Publications	Invited presentations	International conferences	8
			Domestic conferences	14
		Academic articles and monographs	International journals	33
			Domestic journals	35
			Monographs	0
	Technology innovation and application		Peer-reviewed applications	0
			Patents	0
			Technology dissemination	0
	Awards		International awards	0
			National awards	0
			Ministerial or provincial awards	0
Talent training			Post-docs	5
			PhD students	27
			Master students	6

6.3 Completion of Major Program Projects

Research Outputs of Major Program Projects Completed in 2016

Table 6-3

Projects completed				6
Research outputs	Publications	Invited presentations	International conferences	0
			Domestic conferences	0
		Academic articles and monographs	International journals	252
			Domestic journals	121
			Monographs	63
	Technology innovation and application		Peer-reviewed applications	0
			Patents	0
			Technology dissemination	0
	Awards		International awards	0
			National awards	0
			Ministerial or provincial awards	0
Talent training			Post-docs	10
			PhD students	87
			Master students	239

6.4 Completion of Major Research Plan Projects

Research Outputs of Major Research Plan Projects Completed in 2016

Table 6-4

Projects completed				411
Research outputs	Publications	Invited presentations	International conferences	1,840
			Domestic conferences	1,355
		Academic articles and monographs	International journals	6,295
			Domestic journals	1,785
			Monographs	229
	Technology innovation and application		Peer-reviewed applications	10
			Patents	466
			Technology dissemination	9
	Awards		International awards	21
			National awards	20
			Ministerial or provincial awards	52
Talent training			Post-docs	302
			PhD students	2,944
			Master students	3,038

6.5 Completion of Young Scientists Fund Projects

Research Outputs of Young Scientists Fund Projects Completed in 2016

Table 6-5

Projects completed				14,052
Research outputs	Publications	Invited presentations	International conferences	10,943
			Domestic conferences	8,142
		Academic articles and monographs	International journals	56,076
			Domestic journals	31,999
			Monographs	5,389
	Technology innovation and application		Peer-reviewed applications	217
			Patents	6,948
			Technology dissemination	4,299
	Awards		International awards	221
			National awards	56
			Ministerial or provincial awards	870
Talent training			Post-docs	339
			PhD students	6,494
			Master students	29,353

6.6 Completion of Projects of the Fund for Less Developed Regions

Research Outputs of Projects of the Fund for Less Developed Regions Completed in 2016

Table 6-6

Projects completed				1,999
Research outputs	Publications	Invited presentations	International conferences	1,207
			Domestic conferences	1,700
		Academic articles and monographs	International journals	7,857
			Domestic journals	12,616
			Monographs	1,294
	Technology innovation and application		Peer-reviewed applications	81
			Patents	1,010
			Technology dissemination	78
	Awards		International awards	8
			National awards	6
			Ministerial or provincial awards	147
Talent training			Post-docs	50
			PhD students	999
			Master students	11,355

6.7 Completion of Projects of the Excellent Young Scientists Fund

Research Outputs of Projects of the Excellent Young Scientists Fund Completed in 2016

Table 6-7

Projects completed				400
Research outputs	Publications	Invited presentations	International conferences	1,410
			Domestic conferences	1,195
		Academic articles and monographs	International journals	5,351
			Domestic journals	891
			Monographs	173
	Technology innovation and application		Peer-reviewed applications	16
			Patents	523
			Technology dissemination	99
	Awards		International awards	56
			National awards	27
			Ministerial or provincial awards	105
Talent training			Post-docs	167
			PhD students	1,815
			Master students	2,458

6.8 Completion of Projects of the National Science Fund for Distinguished Young Scholars

Research Outputs of Projects of the National Science Fund for Distinguished Young Scholars Completed in 2016

Table 6-8

Projects completed				198
Research outputs	Publications	Invited presentations	International conferences	1,179
			Domestic conferences	856
		Academic articles and monographs	International journals	5,144
			Domestic journals	852
			Monographs	118
	Technology innovation and application		Peer-reviewed applications	2
			Patents	720
			Technology dissemination	86
	Awards		International awards	38
			National awards	29
			Ministerial or provincial awards	83
Talent training			Post-docs	222
			PhD students	2,159
			Master students	1,930

6.9 Completion of Projects of the Science Fund for Creative Research Groups

Research Outputs of Projects of the Science Fund for Creative Research Groups Completed in 2016

Table 6-9

Projects completed				123
Research outputs	Publications	Invited presentations	International conferences	2,443
			Domestic conferences	2,097
		Academic articles and monographs	International journals	10,333
			Domestic journals	1,374
			Monographs	130
	Technology innovation and application		Peer-reviewed applications	20
			Patents	2,181
			Technology dissemination	98
	Awards		International awards	66
			National awards	63
			Ministerial or provincial awards	166
Talent training			Post-docs	950
			PhD students	6,862
			Master students	9,408

6.10 Appraisal of Major Program Projects

Two Major Program projects passed the acceptance appraisal in 2016.

I. Project "the Cryptogamic Flora of China" made a taxonomical research on marine algae, freshwater algae, fungi, lichen and other cryptogamic plants in China and completed the editing of 21 volumns of the Consilio Florarum Cryptogamarum Sinicorum. Important research achievements of the project include:

1. The editing of 21 volumns of Consilio Florarum Cryptogamarum Sinicarum were completed, including 1 volumn of the Flora Algarum Marinarum Sinicarum, 2 volumns of the Flora Algarum Sinicarum Aquae Dulcis, 13 volumns of the Flora Fungorum Sinicorum and 5 volumns of the Flora Lichenum Sinicorum.

2. Eleven new genura and 160 new species of cryptogamic plants were discovered. The project provided detailed description, graphical illustration, distribution and discussion of the 2,260 species in 384 genera of cryptogamic plants in China (including 450 species in 53 genera of algae, 1,666 species in 255 genera of fungi and 544 species in 76 genera of lichen) with keys to orders, families, genera and species of cryptogamic plants.

3. The project comprehensively and systematically unveiled the biodiversity of cryptogamic plants in China, explored and reserved bioresources and laid a solid foundation for resource utilization and research on evolution theory.

II. Project "the Fauna Sinica" gathered research strengths of Zootaxa in China and build up a research & editing team with solid basis, strong capacity, rich experience and strong will. On the basis of previous work, the project completed the editing of 18 volumns of Fauna Sinica Invertebrata. Important research achievements of the project include:

1. The editing of 31 volumns of Fauna Sinica (draft) were completed. Two volumns of them have been published.

2. Twenty-five new genura and 749 new species were discovered. The project recorded 8,020 animal species and subspecies in 1,261 genera. The total number of characters of Fauna Sinica exceeded 18.84 million. The project also provided 11,281 morphological graphs amd 1,058 color photos.

3. The project collected large numbes of specimen, samples and data, increase the understanding of the biodiversity of China and laid a solid foundation for biological research in China.

6.11 Statistics of NSFC's Support to Awardees of the State Supreme Science and Technology Award of China in 2016

In 2016, two projects were awarded the State Supreme Science and Technology Award. All awardees were previously supported by NSFC grants.

NSFC's Support to Awardees of the State Supreme Science and Technology Award of China in 2016

Table 6-10

No.	Awardee	Project previously funded by NSFC
1	ZHAO Zhongxian (Institute of Physics, Chinese Academy of Sciences)	UHV low temperature system for in-situ preparation and measurement
2	TU Youyou (China Academy of Chinese Medical Science)	Studies on antimalarial mechanism of artemisinins

6.12 Statistics of NSFC's Support to Awardees of the State Natural Science Award of 2016

In 2016, one project was awarded the first prize and 41 projects were awarded the second prize of the State Natural Science Award. All awardees were previously supported by NSFC grants.

NSFC's support to Awardees of the First Prize of the State Natural Science Award of 2016

Table 6-11

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
1	A new model of neutrino oscillation discovered in daya bay nuclear reactor neutrino experiment	WANG Yifang (Institute of High Energy Physics, Chinese Academy of Sciences) CAO Jun (Institute of High Energy Physics, Chinese Academy of Sciences) YANG Changgen (Institute of High Energy Physics, Chinese Academy of Sciences) HENG Yuekun (Institute of High Energy Physics, Chinese Academy of Sciences) LI Xiaonan (Institute of High Energy Physics, Chinese Academy of Sciences)	Study of key technologies and methods for high performance neutrino detectors	21

NSFC's support to Awardees of the Second Prize of the State Natural Science Award of 2016

Table 6-12

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
1	Self-adaptation and high-accuracy numerical methods and theoretical analysis	TANG Tao (Hong Kong Baptist University)	• The numerical solution of the initial-boundary value problem and its application	2
2	Stability of Hamiltonian system in resonance	LI Yong (Jilin University)	• KAM persitence and effective stability of stochastic hamiltonian system	18
3	Quantum singularity theory	FAN Huijun (Peking University)	• Symplectic geometry and mathematical physics	4
4	Ricci flow theory and applications to geometry	ZHU Xiping (Sun Yat-sen University) CHEN Binglong (Sun Yat-sen University) DENG Shaoxiong (Sun Yat-sen University) GU Huiling (Sun Yat-sen University)	• Geometry and topology on manifolds	11

(continued)

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
5	Antimatter detection at RHIC and Hadron spectroscopy and collective properties of quark matter	MA Yugang (Shanghai Institute of Applied Physics, Chinese Academy of Sciences) CHEN Hongfang (University of Science and Technology of China) CHEN Jianping (Tsinghua University) CHEN Jinhui (Shanghai Institute of Applied Physics, Chinese Academy of Sciences) LIU Feng (Central China Normal University)	• The studies of the heavy-flavor production and search for exotic/antimatter at RHIC	33
6	Magnetic electric emergent materials and high pressure-regulated quantum tuning	JIN Changqing (Institute of Physics, Chinese Academy of Sciences) WANG Xiancheng (Institute of Physics, Chinese Academy of Sciences) LIU Qingqing (Institute of Physics, Chinese Academy of Sciences) DENG Zheng (Institute of Physics, Chinese Academy of Sciences) YU Richeng (Institute of Physics, Chinese Academy of Sciences)	• New diluted magnetic semiconductors with decoupled spin & charge doping	25
7	Mechanism and regulation of biomolecule interaction porcesss at interfaces and its application to biological analysis	FAN Chunhai (Shanghai Institute of Applied Physics, Chinese Academy of Sciences) LI Genxi (Nanjing University) SONG Shiping (Shanghai Institute of Applied Physics, Chinese Academy of Sciences) WANG Lihua (Shanghai Institute of Applied Physics, Chinese Academy of Sciences) LI Di (Shanghai Institute of Applied Physics, Chinese Academy of Sciences)	• A noval nanoscopy with multicolor imaging using fluorescence probes producing high effect of forster resonance energy transfer	24
8	New methods of carbon-carbon bonds recombination and synthesis of natural products	TU Yongqiang (Lanzhou University) FAN Chun'an (Lanzhou University) ZHANG Fumin (Lanzhou University) WANG Shaohua (Lanzhou University) ZHANG Shuyu (Lanzhou University)	• Studies on asymmetric reaction and strategy involving participation at n-atom and application for asymmetric total synthesis studies on alkaloids	26
9	Basic physics and chemistry of organic field-effect transistors	HU Wenping (Institute of Chemistry, Chinese Academy of Sciences) LIU Qunqi (Institute of Chemistry, Chinese Academy of Sciences) Li Hongxiang (Institute of Chemistry, Chinese Academy of Sciences) TANG Qingxin (Institute of Chemistry, Chinese Academy of Sciences) DONG Huanli (Institute of Chemistry, Chinese Academy of Sciences)	• Key materials and devices physcis of organic field-effect transistors	34

(continued)

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
10	Research on new methods of high-efficiency formaton of asymmetric carbon–carbon bonds	LIN Guoqiang (Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences) XU Minghua (Shanghai Institute of Materia Medica, Chinese Academy of Sciences) ZHONG Yuwu (Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences) FENG Chenguo (Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences) SUN Xingwen (Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences)	• Research on key scientific issues of chirality and chiral drugs	29
11	Design, synthesis and assembly of oxo cluster	YANG Guoyu (Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences) ZHENG Shoutian (Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences) SUN Yanqiong (Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences) ZHANG Manbo (Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences) CHENG Jianwen (Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences)	• Designed synthesis and optical-electric properties of acentric metal borates constructured from B-O cluster units	14
12	Basic research on controllable assembly and composite synthesis of chemically modified graphene	SHI Gaoquan (Tsinghua University) XU Yuxi (Tsinghua University) LI Chun (Tsinghua University) BAI Hua (Tsinghua University) WU Qiong (Tsinghua University)	• Microstructures and properties of functional polymers	17
13	Total synthesis of complex natural products with biological activity	YANG Zhen (Peking University Shenzhen Graduate School) CHEN Jiahua (Peking University) TANG Yefeng (Peking University) GONG Jianxian (Peking University Shenzhen Graduate School)	• Study towards environmental-bearing novel catalysis	21

(continued)

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
14	Relations between changes of Asian monsoon and global climate	AN Zhisheng (Institute of Earth Environment, Chinese Academy of Sciences) SUN Youbin (Institute of Earth Environment, Chinese Academy of Sciences) CAI Yanjun (Institute of Earth Environment, Chinese Academy of Sciences) ZHOU Weijian (Institute of Earth Environment, Chinese Academy of Sciences) SHEN Ji (Nanjing Institute of Geography & Limnology, Chinese Academy of Sciences)	• Asian interior aridification and westerly climate evolution since oligocene period	52
15	Process and environmental causes of mass extinctions and biotic recovery in the phanerozoic eon	XIE Shucheng (China University of Geosciences, Wuhan) LAI Xulong (China University of Geosciences, Wuhan) SONG Haijun (China University of Geosciences, Wuhan) SUN Yadong (China University of Geosciences, Wuhan) LUO Genming (China University of Geosciences, Wuhan)	• Microbial lipid response to pH and its indication to aridity and acidification in critical zones	18
16	Effect of biomembrane on marine benthic ecosystem in changing environment	QIAN Peiyuan (Hong Kong University of Science and Technology) XU Ying (Hong Kong University of Science and Technology) WANG Yong (Hong Kong University of Science and Technology) HE Lisheng (Hong Kong University of Science and Technology)	• Community structure, symbiotic relationship development and key metabolic functions of conserved microbial consortiums associated with scleractinian corals in South China Sea	4
17	Geodynamic models of large scale mineralization in East China in the Yanshan period	MAO Jingwen (Institute of Mineral Resources, Chinese Academy of Geological Sciences) CHEN Bin (Peking University) XIE Guiqing (Institute of Mineral Resources, Chinese Academy of Geological Sciences)	• Metallogeny and its geological setting of world-class Porphyry Tungsten belt in the Jiangnan Massif and its adjacent areas	17
18	Formation of tree of animals	ZHANG Xingliang (Northwest University) SHU Degan (Northwest University) LIU Jianni (Northwest University) ZHANG Zhifei (Northwest University) HAN Jian (Northwest University)	• Evolution of early organisms	24
19	Basic research on identification of environmental hazards and health risks of high risk pollutants with omics methods and its applications to pollutant control and prevention	ZHANG Xuxiang (Nanjing University) ZHANG Tong (University of Hong Kong) REN Hongqiang (Nanjing University) CHENG Shupei (Nanjing University) WU Bing (Nanjing University)	• A molecular ecological investigation on the effects of disinfection on microbial antibiotic resistance in drinking water	10

(continued)

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
20	Functions and mechanism of small RNA in plants	QI Yijun (National Institute of Biological Sciences, Beijing) BA Zhaoqing (National Institute of Biological Sciences, Beijing) YE Ruiqiang (National Institute of Biological Sciences, Beijing) WANG Xiujie (Institute of Genetics and Developmental Biology, Chinese Academy of Sciences) WU Liang (National Institute of Biological Sciences, Beijing)	• Mechanism of plant responses to biotic stress	20
21	Genetic and molecular biological basis of yield contributing traits in rice	ZHANG Qifa (Huazhong Agricultural University) XING Yongzhong (Huazhong Agricultural University) HE Yuqing (Huazhong Agricultural University) YU Sibin (Huazhong Agricultural University) Fan Chuchuan (Huazhong Agricultural University)	• Genomics and generic improvement of rice	48
22	Swine dietary amino acids metabolism and physiological function regulation	YIN Yulong (Institute of Subtropical Agriculture, Chinese Academy of Sciences) TAN Bi'e (Institute of Subtropical Agriculture, Chinese Academy of Sciences) WU Xin (Institute of Subtropical Agriculture, Chinese Academy of Sciences) KONG Xiangfeng (Institute of Subtropical Agriculture, Chinese Academy of Sciences) YAO Kang (Institute of Subtropical Agriculture, Chinese Academy of Sciences)	• Molecular mechanism of small intestinal epithelium renewal along crypt-villus axis and protein metabolism in piglets	21
23	Molecular mechanism, early warning, prevention and treatment of colorectal cancer	SHEN Zuyao (Chinese University of Hong Kong) YU Jun (Chinese University of Hong Kong) HU Jialin (Chinese University of Hong Kong) WU Zhaowen (Chinese University of Hong Kong) CHEN Jialiang (Chinese University of Hong Kong)	• effects and mechanisms of selective cyclooxygenase-2 inhibition on premalignant gastric lesions	1
24	Epigenetic mechanism of breast tumorigenesis and tumor progression	SHANG Yongfeng (Peking University) WANG Yan (Peking University) SHI Lei (Peking University) SUN Luyang (Peking University) YANG Xiaohan (Peking University)	• Molecular biology and epigenetic basis of tumorigenesis and tumor progression	22

(continued)

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
25	Theory and methods of structural modeling from image and visual apparence remodeling	GAO Xinbo (Xidian University) LI Xuelong (Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences) DENG Cheng (Xidian University) YUAN Yuan (Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences) TAO Dacheng (Hong Kong Polytechnic University)	• Visual computing and image quality assessment based on multiple space fusion	11
26	Modeling and computing theory and methods of visual scene understanding	ZHENG Nanning (Xi'an Jiaotong University) XUE Jianru (Xi'an Jiaotong University) SUN Jian (Xi'an Jiaotong University) LIU Tie (Xi'an Jiaotong University) DU Shaoyi (Xi'an Jiaotong University)	• Theory and enabling technology of intelligent processing of visual information	33
27	Synchronization, control and recognition of complex dynamic network	LYU Jinhu (Academy of Mathematics and Systems Science, Chinese Academy of Sciences) YU Wenwu (Southeast University) CHEN Guanrong (City University of Hong Kong) LU Jun'an (Wuhan University) ZHOU Jin (Wuhan University)	• Cryptanalysis and design of chaotic ciphers and its applications in multimedia secure communications	16
28	Mechanism and performance regulation of oxide-based resistive random access memory	LIU Ming (Institute of Microelectronics, Chinese Academy of Sciences) LIU Qi (Institute of Microelectronics, Chinese Academy of Sciences) GUAN Weihua (Institute of Microelectronics, Chinese Academy of Sciences) LONG Shibing (Institute of Microelectronics, Chinese Academy of Sciences) WANG Yan (Institute of Microelectronics, Chinese Academy of Sciences)	• Basic research on novel microelectronic devices integration	17
29	Carbon-based nanoelectronic devices and integration	PENG Lianmao (Peking University) ZHANG Zhiyong (Peking University) DING Li (Peking University) WANG Sheng (Peking University) LIANG Xuelei (Peking University)	• Theory and method for nanoscale high performance electronic and quantum devices	20
30	Microwave and millimeter wave-based new substrate integrated guided wave structures and devices	HONG Wei (Southeast University) HAO Zhangcheng (Southeast University) XU Feng (Nanjing University of Posts and Telecommunications) LUO Guoqing (Hangzhou Dianzi University) CHEN Jixin (Southeast University)	• Developement of the instrument for the measurement of digital multi-beam array for 5g massive MIMO	11

(continued)

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
31	Theory and formation of nonmetallic abnormal electromagnetic media	ZHOU Ji (Tsinghua University) ZHAO Qian (Tsinghua University) LI Bo (Tsinghua University) SUN Jingbo (Tsinghua University) ZONG Ruilong (Tsinghua University)	• Functional fine ceramics	19
32	Mechanism and application of long life, high temperature/ oxidation/ablation resistant coating	LI Hejun (Northwestern Polytechnical University) FU Qiangang (Northwestern Polytechnical University) LI Kezhi (Northwestern Polytechnical University) HUANG Jianfeng (Northwestern Polytechnical University) ZHANG Yulei (Northwestern Polytechnical University)	• Physico-chemical process of preparation and service of ultra-high temperature composites for areonautic and astronautic applications	23
33	New physical effects of ferroic smart materials based on manipulation of crystal defects	REN Xiaobing (Xi'an Jiaotong University) ZHANG Lixue (Xi'an Jiaotong University) DING Xiangdong (Xi'an Jiaotong University) YANG Sen (Xi'an Jiaotong University) LIU Wenfeng (Xi'an Jiaotong University)	• High-performance metal smart materials based on new principles	15
34	Mass synthesis of nanoscale building blocks and functionalization of macroscopic level assemblies	YU Shuhong (University of Science and Technology of China) LIANG Haiwei (University of Science and Technology of China) CONG Huaiping (University of Science and Technology of China) LIU Jianwei (University of Science and Technology of China) YAO Hongbin (University of Science and Technology of China)	• Synthesis of nanomaterials for energy conversion and storage	17
35	Structure design and function realization of fluorescent metal-organic frameworks	QIAN Guodong (Zhejiang University) CUI Yuanjing (Zhejiang University) YANG Yu (Zhejiang University) XU Hui (Zhejiang University) WANG Zhiyu (Zhejiang University)	• Inorganic nonmetallic optoelectronic functional materials	14
36	Preparation and synergetic mechanism of high performance composite electrode materials for energy storage	HUANG Yunhui (Huazhong University of Science and Technology) ZHOU Jun (Huazhong University of Science and Technology) HU Xianluo (Huazhong University of Science and Technology) YUAN Lixia (Huazhong University of Science and Technology) SHEN Yue (Huazhong University of Science and Technology)	• New electrode materials for low-cost sodium-ion batteries and their sodium-storage mechanism	17

(continued)

No.	Project title	Principal investigators	Projects previously funded by NSFC	Number of NSFC grants
37	Theory and efficient utilization of neutron transport in new nuclear energy systems	WU Yican (Hefei Institute of Physical Science, Chinese Academy of Sciences) QIU Lijian (Hefei Institute of Physical Science, Chinese Academy of Sciences) HUANG Qunying (Hefei Institute of Physical Science, Chinese Academy of Sciences) JIANG Jieqiong (Hefei Institute of Physical Science, Chinese Academy of Sciences) WANG Minghuang (Hefei Institute of Physical Science, Chinese Academy of Sciences)	• Research on transient safety characteristics of accelerator driven subcritical reactor	13
38	Probability density evolution theory of reability design of engineering structures	LI Jie (Tongji University) CHEN Jianbing (Tongji University) CHEN Jun (Tongji University) WU Jianying (South China University of Technology)	• Civil engineering disaster prevention	30
39	Regulation mechanism and topological construction theory of high gain power conversion	HE Xiangning (Zhejiang University) LI Wuhua (Zhejiang University) YANG Bo (Zhejiang University) ZHANG Junming (Zhejiang University) Qian Zhaoming (Zhejiang University)	• Research on operation and matching principle in multi-time scale for large-capacity hybrid power electronic Systems	21
40	Mechanism, methods and preparation of new materials of ultrafast laser micro/nano-fabrication	JIANG Lan (Beijing Institute of Technology) QU Liangti (Beijing Institute of Technology) LI Xin (Beijing Institute of Technology) WANG Sumei (Beijing Institute of Technology) LI Xiaowei (Tsinghua University)	• A novel ultrafast laser micro/nano fabrication method based on nanoscale electron dynamics control	15
41	Homotopy analysis method and its application in solving nonlinear problems in mechanics	LIAO Shijun (Shanghai Jiao Tong University)	• Studies on unified wave model and peaked/cusped solitary waves in finite water depth	6

Part 7

International (Regional) Cooperation and Exchanges

In the first year of the 13th Five-Year Plan, following the Great Power Diplomacy with Chinese characteristics, centering around the core tasks of the National Natural Science Fund, NSFC made further progresses and achievements in implementing the 13th Five-Year Development Plan of international cooperation, energetically promoting bi/multi-lateral substantial cooperation, pushing forward the "Belt and Road" Initiative, broadly conducting research and implementation of the country and region policy for international collaboration of Science Fund and strengthening communication with oversea funding agencies.

Firstly, strengthen high-level exchanges and promote strategic partnership.

High-level visits between science funding agencies indicate the significance they attach to closer and tighter mutual cooperative relations. It is a significant method to effectively establish, deepen and enhance bilateral and multilateral relations, and to raise the profile of NSFC internationally. In 2016, NSFC organized and approved 75 visits (129 person-times), including 15 high-level visits; and received 138 visits including 34 high-level visits.

In April, President YANG Wei led a delegation to Finland and the Netherlands, attending "Open Access" Workshop organized by Netherlands Research Organization (NWO) and conducted in-depth discussions on further promoting Sino-Finnish and Sino-Dutch collaboration with respective organizations. In June, President YANG Wei led a delegation to Hong Kong, visiting relevant governmental agencies, funding organizations and universities. The visit demonstrated the emphasis NSFC has for collaboration with Hong Kong. In August, President YANG Wei led a delegation to the States, Canada and Cuba, attending the International Congress of Theoretical and Applied Mechanics. In May, Vice-President SHEN Yan led a delegation to New Delhi, India, attending the 5th Global Research Council. He introduced NSFC's practices and experiences in "Funding Interdisciplinary Research" and "Equality and Status of Women in Research". A delegation led by Vice President HE Minghong visited Sri Lanka, attending the Science and Technology for Society Forum Sri Lanka 2016 held in Colombo, and delivered a speech "China's Scientific Management, Plan and Prospect" in the "Science and Technology Innovation for Sustainable Development Goals". Vice President LIU Congqiang led a delegation to UK and Germany in April, attending Sino-UK Bi-annual Conference, Kick-off meeting for Sino-UK International Major Research Plan and also working meetings with DFG. Vice President Liu also led delegations in August to Chile to attend Sino-Chilean Bilateral Workshop on Earthquake Research and paid working visits to Argentina and Peru; and to Sweden, Iceland and Israel for working visits in September, attending 10th ASIA-HORCs in September; to Germany for the 19th Sino-German Joint Committee Meeting in October and attended the IIASA Committee in November. In October, Vice President GAO Wen visited Beckman-institute and Carnegie Mellon University in the States. In March, Vice President Gao Ruiping accompanied Vice Premier LIU Yandong to visit Israel, attending the 2nd Sino-Israeli Joint Committee for Innovation Cooperation, chaired by Vice Premier LIU Yandong and Israel Premier Nethanyahu and also visited Israeli Science

Foundation.

In 2016, a total of 31 delegations from funding agencies and research organizations visited NSFC, including provincial governor Christine St. Pierre and chief scientist Rémi Quirion from Quebec, Canada, President Professor Venki Ramakrishnan from Royal Society, President Jean-Pierre Bourguignon from European Research Council, President Michinari Hamaguchi from Japan Science and Technology Agency, President Sirimali Fernando from National Science Foundation Sri Lanka, etc. Also President Professor HUA Yunsheng from RGC attended the 1st Young Scholar Forum jointly funded by NSFC and RGC.

Secondly, actively conduct investigation and research to strengthen strategic planning.

In order to implement "the Belt and Road Initiative", NSFC organized the Shuangqing Forum entitled "promoting cooperation of countries along the Belt and Road route and creating win-win situations for science, talents and development". The participants hold in-depth discussion on the strategies, manners and methods for developing cooperation with "Belt and Road" countries from a global perspective. After discussions and reaching consensus, the participants offered constructive suggestions on Natural Science Fund and conducting S&T cooperation and promoting S&T diplomacy with "Belt and Road" countries. This bears great significance for guidance for China's S&T cooperation with "Belt and Road" countries, and realization of the win-win objective of "Science-Talent-Development".

NSFC organized the 2nd Session of the Advisory Panel on Cooperation with International Organizations, fully exerting the role of think-tank in NSFC's international cooperation. The participating scholars offered valuable advice and suggestions for future prospects of NSFC's international cooperation, centering on issues such as improving basic research through international cooperation of the National Natural Science Fund, attracting excellent talents from abroad, promoting "Belt and Road" international S&T cooperation, organizing major international S&T cooperative plans and perfecting program management mechanisms.

In order to be better informed about our partners and increase the initiative and performance of NSFC's international cooperation, NSFC conducted the "Country and Region Policy of Natural Science Fund's International Cooperation" project, analyzing the disciplinary level of important areas from major countries, combining the international S&T policy with the reality and preliminarily forming the Research Report on Country and Region Policy of Natural Science Fund's International Cooperation.

Thirdly, complete the review and funding of various international cooperative projects.

Providing the platform and funding for the internationalization of researchers is the primary task of Science Funder's international cooperation. Through years of innovation, summarization and perfection, NSFC has formed a multi-channel, multi-layer funding system.

In 2016, NSFC received a total of 4,772 applications from varied international cooperative programs and approved 1,056 applications for funding with a total funding amount of 897 million yuan. Among them, 251 joint research projects

were selected from 42 rounds of calls for proposals launched between NSFC and its 34 foreign partners, with a total investment of 541 million yuan from NSFC. Besides, NSFC also approved 267 exchange projects selected from 24 calls for proposals jointly launched with 19 foreign partners, as well as 307 bilateral or multilateral workshops selected from 44 calls for proposals with 30 foreign partnering funding agencies or research institutions.

Fourthly, strengthen bilateral collaboration and collaboration with "Belt and Road" region.

On April 7th, under the witness of Premier LI Keqiang and the Democratic Socialist Republic of Sri Lanka President Ratnasiri Wickramanayaka, President YANG Wei and NSF President Sirimali Fernando signed Memorandum of Understanding between NSFC and NSF Sri Lanka on Science and Technology Cooperation. On April 8th, Vice President SHEN Yan and Swiss National Science Foundation's Deputy Director Katharina Fromm signed the Memorandum of Understanding under the witness of President XI Jinping and Swiss President Johann Schneider-Ammann. The agreement shows that NSFC and SNSF will support researchers from China and Switzerland to conduct joint research and other collaborations following the principle of negotiations and mutual interest. By far, NSFC has concluded 86 Memorandum of Understandings or cooperative agreements with partners in 44 countries and regions across the globe.

NSFC strengthens cooperation with S&T powers from America, Europe and Asia. In Northern America, NSFC continues to develop collaboration with the States and Canada, actively seeking mutual interest and gradually lifting the scale and level of cooperation in areas of health and environment. NSFC has developed the successful bilateral cooperation mechanism to multilateral cooperation, signing a cooperative agreement for cohorts research funding program with Canada for the first time under the framework of World Health Organization (WHO). NSFC also conducted cooperation with non-governmental charity organization Bill & Melinda Gates Foundation, attracting financial resources outside governmental funds and broadening the network, raising NSFC's international influence through Melinda Gates Foundation's "Grand Challenge" global program framework.

In Europe, through years of effort, NSFC's collaboration network with European partners has covered major economical and S&T powers, and comprehensively established a Sino-European cooperation and exchange network with extensive cooperation with UK, Germany, France and Russia at the core and selected cooperation with the Netherlands, Sweden, Finland, Denmark, Switzerland, Portugal, Italy and Ireland in advantageous areas. The Bi-Annual Strategic Meeting with RCUK provides strategic guidance for bilateral cooperation with RCUK, elevating the scale, level and performance of the cooperation and effectively enriching the content of international agreements. In collaboration with Germany, both sides have changed the on-going interdisciplinary major international cooperative program and joint research programs in selected areas into jointly funding top-down major international joint research programs and open call in joint research programs, laying a solid

foundation for future in-depth cooperation.

In Asia, NSFC comprehensively stabilizes and deepens bilateral cooperation with Israel, Japan, South Korea and Singapore, deepens bilateral cooperation with Israeli Science Foundation and broadens the funding scale. Both governments pay high attention to Sino-Israeli cooperation. As a result, the 2nd Sino-Israeli Joint Committee for Innovation Cooperation was organized, with Vice Premier LIU Yandong and Israeli Foreign Minister as the chairpersons and President YANG Wei as the Committee Member. The cooperative mechanism between China, Japan and Korea has matured and the A3 Plan, jointly initiated by three organizations, has become a significant 3-country joint funding scheme.

NSFC strengthens the cooperative network and substantial cooperation with "Belt and Road" countries and international organizations. While strategic cooperation with America, Europe and Asia is strengthened, NSFC further broadens the cooperative network with "Belt and Road" countries. Under the witness of Premiers from China and Sri Lanka, President YANG Wei and Natural Science Foundation Sri Lanka President signed the Memorandum of Understanding. NSFC also initiated the collaboration for joint research program with Pakistan and made breakthrough with Singapore, funding joint research projects from "Data Science" and "Emerging Infectious Diseases", as a result of the 2016 Cooperative Agreement. NSFC continues to launch program with National Research Council of Thailand, Thailand Research Foundation and also funded for the first time with International Centre for Integrated Mountain Development, promoting border cooperation through regional scientific collaboration.

Fifthly, actively participate in multilateral, regional, global cooperation, undertake corresponding responsibilities and obligations.

In 2016, under the framework of Administrative Arrangement between NSFC and the Directorate-General for Research of the European Commission to implement Coordinated Calls, NSFC and DG-RTD reached consensus in launching joint research programs in "Biotechnology" from 2018 to 2020. ERA-net's Joint Programming Initiative Urban Europe is a high-level cooperation platform jointly built by European funding agencies. Through negotiations, NSFC plans to participate in this platform and co-fund multilateral programs for Chinese and European researchers, meeting the global challenges.

NSFC actively deepens collaboration with international organizations, makes use of the international organization's platform to conduct multilateral cooperation and raises China's right of speech and influence. NSFC participated in Belmont Forum and the multilateral joint funding mechanism. In 2016, NSFC completed the evaluation and funding for programs in areas of mountain science and climate service. NSFC deepened and broadened collaboration with the Consultative Group for International Agricultural Research (CGIAR), and participated in 11 cooperative centers, successfully implementing the joint research program funding scheme. NSFC continues to strengthen collaboration with IIASA. A delegation led by Vice President LIU Congqiang attended IIASA Committee Meeting, and participated in the decision making process. Academician FU Bojie and ZHANG Linxiu have been appointed as the new IIASA

Scholar Consulting Committee member and Evaluation Committee member. NSFC continued collaboration with CERN in in-depth research, joined as the funder for BRICS S&T Scheme and for the first time jointly launched programs with foundations from BRICS.

In participating multilateral, regional and global cooperation, President YANG Wei chaired the 14th A-HORCs held in Hangzhou. President YANG Wei, JST President and NRF President held discussions on each organization's future five-year plans. In May 2016, Vice President SHEN Yan led a delegation to attend the 5th GRC meeting held in India, introducing NSFC's practices and experiences in "Interdisciplinary Funding" and "Equality for Women in Research". Vice President LIU Congqiang attended the 10th ASIAHORCs. Participants exchanged views on "Organization Strategy and Function of Research Development and Innovation".

Sixthly, continue to improve and broaden talent funding mechanism.

In 2016, for the Research Fund for International Young Scientists, NSFC received 240 submissions, an increase by 27.7% over that of 188 in 2015. After peer review, 108 were approved with a total funding of 2,768 million yuan for direct costs. Besides, 10 renewed applications were received, out of which 9 were approved with a total funding of 2.32 million yuan for direct costs.

Breakthroughs have been achieved in joint programs for high-level and international talent programs with UK and ERC. Based on Memorandum of Understanding on UK-China Research and Innovation Partnership Program (Newton Fund) between the Royal Society and the Academy of Medical Sciences and the National Natural Science Foundation of China, awardees have been selected among grant-holders of National Science Fund for Distinguished Young Scholars and Excellent Young Scientists. Funds are provided for them to conduct long-term stable cooperation with first class research teams in UK. This has raised the influence of National Science Fund for Distinguished Young Scholars and Excellent Young Scientists holders, bearing significance for promoting the long-lasting cooperation between young Chinese and UK researchers. In 2016, NSFC completed the second round of Sino-UK talent funding for 15 projects, with a total of 6,283 million yuan. In September 2016, NSFC and the Royal Society launched the call for 2017, receiving 68 proposals.

In 2016, NSFC and European Research Council successfully launched a call for talent program. Chinese researchers funded by NSFC are funded to join the first-class European research teams. A total number of 11 proposals were funded, with funding of 330,000 yuan.

Seventhly, serve the overall national situation and steadily promote cooperation with Hong Kong, Macao and Taiwan regions.

Mechanism for collaborating with Hong Kong is ever improving. Young Scholar Forum is jointly funded by NSFC and RGC, building up the platform for communication and exchanges and encouraging young scholars from mainland and Hong Kong to reach common understanding through research. Both organizations successfully held the first Young Scholar forum, which President YANG Wei and RGC President HUA Yunsheng attended and delivered speeches. In June, President YANG Wei visited relevant governmental agencies, funding organizations and universities, demonstrating the emphasis NSFC has for collaboration with Hong Kong. Through years of communication and negations on collaborative mechanism, NSFC and the Science and Technology Development Fund of Macao signed a Memorandum of Understanding, covering joint research programs, workshops, personal mobility and lead-agency evaluation methods, etc., which is a great breakthrough in collaboration with Macao. In order to further improve the initiative and goal-orientation for scholar exchange across the strait, through consideration and preliminary research, in 2016 Office of Hong Kong, Macau and Taiwan Affairs implemented the soft task of Situation Analysis of Science & Technology Policy and Disciplinary Development in Taiwan region.

Eighthly, promote the Sino-German Center for the Promotion of Science.

The Sino-German Center for the Promotion of Science is an important platform for Sino-German cooperation. In 2016, following the basic principle of mutual respect, mutual benefit and equal cooperation and following the requirements and decisions by the joint committee, the Center completed all the funding task and other work. The center received 98 applications, out of which 15 research projects, 36 academic meetings, 2 short-term seminars, 6 short-term visits and 2 collaborative research groups were funded. The Center continued to select and send distinguished doctors to the Lindau Meeting of Nobel Laureates. According to decisions by the two organizations, the management of joint research program is transferred from the Center to NSFC's European Affair Division. Since July 1st, the Center will no longer accept submissions for joint research programs. After the approval from the Center Committee, the Center will start the Sino-German mobility program and the actual funding mechanism is under discussion. The Center also successfully organized the 19th Joint Committee with DFG in Hamburg, Germany.

International Cooperation Events

January

Jan. 6 Vice President LIU Congqiang met with Professor Okimura Kazuki, former President of the Japan Science and Technology Agency, who was awarded the Award for International Scientific and Technological Cooperation in 2015.

Jan. 7 Vice President LIU Congqiang met with the Hong Kong S&T delegation headed by Professor Charles Wang-wai Ng, Associate Vice President of the Hong Kong University of Science and Technology.

Jan. 11 President YANG Wei met with a delegation led by Professor Richard H. Brodhead, President of Duke University.

Jan.25 Vice President LIU Congqiang met with Professor Mark Bailey, Director of Centre for Ecology and Hydrology of UK (CEH), Professor Alan Jenkins, Deputy Director of CEH, Ms. Grace Lang, Director of RCUK China and Mr. Glen Noble, Deputy Director of RCUK China.

Jan. 29 Vice President SHEN Yan met with a delegation led by Dr. Steven Buchsbaum, Deputy Director of Discovery & Translational Sciences of Bill & Melinda Gates Foundation.

Vice President SHEN Yan meets with Deputy Director of Discovery & Translational Sciences of Bill & Melinda Gates Foundation.

February

Feb. 25 Vice President LIU Congqiang met with a delegation led by Dr. Johanna Kowol-Santen, Deputy Head of Scientific Affairs of German Science Foundation.

Feb. 25 Vice President LIU Congqiang met with Mr. Nimal Dharmasiri Hettiarachchi, Secretary of the Ministry of Urban Development, Water Supply & Drainage of Sri Lanka and Professor Sirimali Fernando, President of the National Science Foundation of Sri Lanka.

Vice President LIU Congqiang meets with the Sri Lanka S&T delegation.

Feb. 26 President YANG Wei hosted a lunch for a delegation led by Mr. Vincent Chan, Managing Director and Head of China Macro Research for Credit Suisse.

March

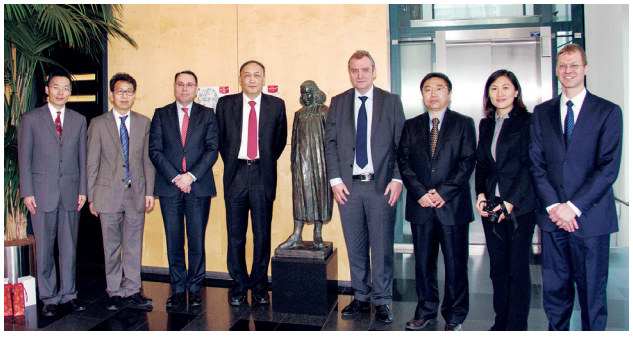
Mar. 3 Vice President LIU Congqiang chaired a symposium on China-Thailand cooperation program of watershed sustainable development in the context of the "Future Earth" Program.

Mar. 13 An NSFC delegation led by Vice President LIU Congqiang paid a visit to Sri Lanka.

Mar. 17 President YANG Wei led a delegation and visited Finland and the Netherlands. President YANG Wei met with Ms. Sanni Grahn-Laasonen,

Finnish Minister of Education and Culture, and Professor Heikki Mannila, President of Academy of Finland. He also attended the International Workshop with the theme of "Removing Barriers: A Global Implementation Plan for Open Access Scholarly Publishing" organized by Netherlands Organization for Scientific Research as the representative of Asian science funding agencies. President Yang also met with Mr. Sander Dekker, State Secretary for Education, Culture and Science and Professor Jos Engelen, President of Netherlands Organization for Scientific Research.

President YANG Wei meets with Ms. Sanni Grahn-Laasonen, Finnish Minister of Education and Culture.



President YANG Wei visits the Netherlands Organization for Scientific Research.

Mar. 21 Vice President LIU Congqiang met with Ms. Christine St. Pierre, Minister of International Relations and La Francophonie of Quebec, and Dr. Rémi Quirion, Chief Scientist of Quebec and President of Research Foundation of Quebec.

Vice President LIU Congqiang meets with Minister of International Relations and La Francophonie of Quebec.

Mar. 23 Vice President LIU Congqiang met with a delegation led by Professor Pavel Kabat, Director General of International Institute for Applied Systems Analysis.

Mar. 25 A Shuangqing Forum with the theme of "promoting cooperation of countries along the Belt and Road route and creating win-win situations for science, talents and development" was held in Guangzhou. Vice President LIU Congqiang attended the meeting and made a presentation.

Mar. 27 Vice President GAO Ruiping attended the 2nd Meeting of China-Israel Joint Committee on Innovation Cooperation and visited the Israel Science Foundation.

Vice President GAO Ruiping attends the 2nd Meeting of China-Israel Joint Committee on Innovation Cooperation.

Mar. 30 President YANG Wei met with a delegation led by Dr. Christina Hull Paxson, President of Brown University.

President YANG Wei meets with President of Brown University.

Mar. 30 The Bilateral Workshop on NSFC-ICIMOD Strategic Cooperation was held in Chengdu. Vice President LIU Congqiang and Dr. David Molden, Director General of the International Centre for Integrated Mountain Development (ICIMOD), attended the meeting.

Bilateral Workshop on NSFC-ICIMOD Strategic Cooperation is held in Chengdu.

April

Apr. 11 Vice President LIU Congqiang met with a delegation of S&T administrators led by Professor CHEN Yugao from Taiwan, China.

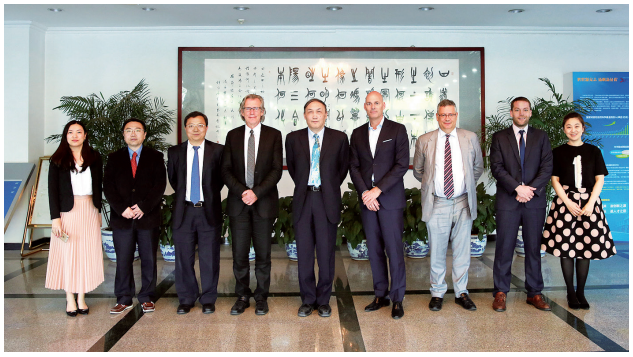
Vice President LIU Congqiang meets with guests from Taiwan, China.

Apr. 13 Vice President LIU Congqiang led a delegation and visited Germany and the United Kingdom. In Germany, Vice President LIU Congqiang met with Ms. Dorothee Dzwonnek, Secretary General of German Research Foundation, and Professor Michael Famulok, Vice President of German Research Foundation. In the UK, he co-chaired the 2nd NSFC-RCUK Biennial Meeting with Professor Jane Elliot, Economic and Social Research Council Chief Executive and Research Councils UK International Champion. He also attended the kick-off meeting of projects funded in the framework of NSFC-NERC major international cooperative research plan "using Critical Zone Science to understand sustaining the ecosystem service of soil and water".

Vice President LIU Congqiang visits German Research Foundation.

The 2nd NSFC-RCUK Biennial Meeting is held in London.

Apr. 21 President YANG Wei met with a delegation led by Mr. David Mccune, Deputy Executive Chairman of the SAGE Publications Inc.



President YANG Wei meets with Deputy Executive Chairman of the SAGE Publications Inc.

May

May 6 Vice President LIU Congqiang attended the 2016 China-Japan University Fair & Forum held in Beijing. He also attended the ceremony celebrating the 10th anniversary of the China Research and Communication Center of Japan Science and Technology Agency (JST) and the 5th anniversary of JST Beijing Representative Office.

May 13 Vice President HE Minghong met with a delegation of Durham University, including Vice Chancellor Stuart Corbridge, Dean of Business School Rob Dixon, Dr. Michael Guo, Reader of Institute for China Development and Research, and Mr. Bruno van Dyk, Director of the International Office.

Vice President HE Minghong meets with Professor. Stuart Corbridge, Vice Chancellor of Durham University.

May 25–27 Vice President SHEN Yan attended the 5th Global Research Council Meeting held in New Delhi, India.

May 30 President YANG Wei met with Professor Richard Zare, member of National Academy of Sciences of the United States.

May 30 Vice President LIU Congqiang met with Ms. Irene Giner-Reichl, Austrian Ambassador to China.

Vice President LIU Congqiang meets with Ms. Irene Giner-Reichl, Austrian Ambassador to China.

June

Jun. 20 The 20th Meeting of China-Korea Joint Committee for Basic Scientific Research and the

China-Korea Science Cooperation Forum was held in Xi'an. Vice President HE Minghong and Mr. Min K. Chung, President of National Research Foundation of Korea attended the meeting.

The 20th Meeting of China-Korea Joint Committee for Basic Scientific Research is held in Xi'an.

Jun. 20 Vice President GAO Ruiping attended the symposium between NSFC and International Eurasian Academy of Sciences.

Jun. 23 Vice President LIU Congqiang met with Professor Jean-Pierre Bourguignon, President of European Research Council.

Jun. 24 Vice President HE Minghong met with Chinese PhD students selected to attend the 66th Lindau Nobel Laureate Meeting and awarded them commemorative certificates.

July

Jul. 8 Vice President LIU Congqiang met with Dr. Enriqueta Barrera, Program Director of Geobiology and Geochemistry of National Science Foundation of the United States.

Jul. 17 Vice President GAO Wen attended the Sino-American Education and Research Meeting held in the United States and visited the National Science Foundation of the United States.

Jul. 22 Vice President HE Minghong met with a delegation led by Ms. Reed Elfenbein, Vice President of John Wiley & Sons Inc.

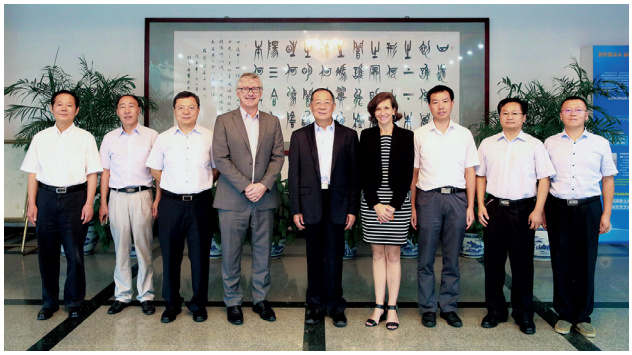
Jul. 28 Vice President HE Minghong met with a delegation led by Professor Stephen Flint, Associate Vice-President of University of Manchester.

August

Aug. 15 Vice President HE Minghong met with a delegation led by Professor Essam Khamis, Vice Minister of Higher Education and Scientific Research of Egypt.

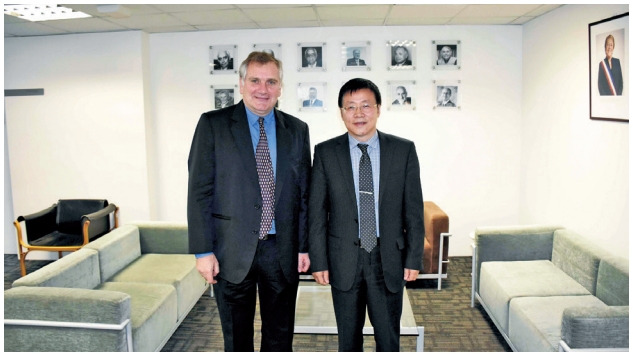
Vice President HE Minghong meets with Vice Minister of Higher Education and Scientific Research of Egypt.

Aug. 17 Vice President SHEN Yan met with a delegation led by Dr. Matthew Morell, Director General of the International Rice Research Institute.



Vice President SHEN Yan meets with Director General of the International Rice Research Institute.

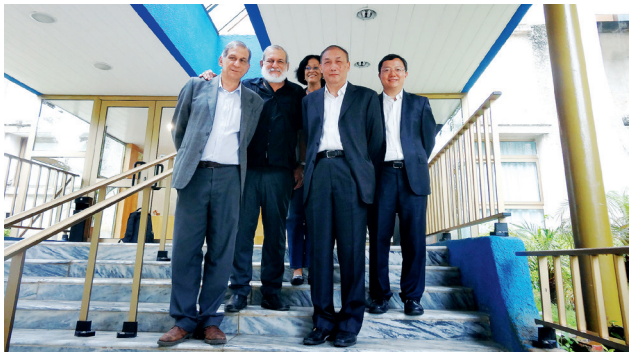
Aug. 21 Vice President LIU Congqiang paid a visit to Argentina, Chile and Peru. In Argentina, he visited the National Commission on Science and Technology. In Chile, Vice President LIU Congqiang attended the China-Chile Workshop on Earthquake and Hazard Management jointly held by NSFC and Chile National Commission on Science and Technology. He also visited Chile National Commission on Science and Technology and Chile National Center for Disaster Prevention and Emergency Management. In Peru, Vice President LIU Congqiang visited the National Commission for Science, Technology and Innovation.



Vice President LIU Congqiang visits Chile National Commission on Science and Technology.

Aug. 22 President YANG Wei paid a visit to the United States, Canada and Cuba. In the US, President YANG Wei met with Ms. Cherry Murray, Director of the Department of Energy's Office of Science and Dr. Rush Holt, Chief Executive Officer of the American Association for the Advancement of Science. In Canada, he attended the 24th International Congress of Theoretical and Applied Mechanics and met with Dr. Rémi Quirion, Chief Scientist of Quebec and President of Research Foundation of Quebec, and Dr. Alain Beaudet, President of Canadian Institutes of Health Research. In Cuba, he met with Mr. Jose Fidel Santana Nuñez, Vice Minister of Science, Technology and Environment. He also visited Cuban Environmental Protection Agency and Cuba Neuroscience Centre and met with Chinese Ambassador to Cuba.

President YANG Wei visits American Association for the Advancement of Science.



President YANG Wei visits Cuba Neuroscience Centre.

September

Sep. 1 President YANG Wei met with a delegation led by Dr. Paul Hardaker, Chief Executive for the Institute of Physics.

Sep. 6 Vice President LIU Congqiang hosted a dinner for the delegation of the Centre for Ecology and Hydrology of UK.

Sep. 6 Vice President HE Minghong visited Sri Lanka and attended the 2016 Forum on Society

and Science and Technology of Sri Lanka.

Sep. 8 Vice President LIU Congqiang paid a visit to Sweden, Iceland and Israel. In Sweden, he met with Dr. Sven Stafstroem, Director General of Swedish Research Council, and Dr. Andreas Goethenberg, Executive Director of Swedish Foundation for International Cooperation in Research and Higher Education. In Iceland, he met with Dr. Hallgrimur Joenasson, Director General of the Icelandic Centre for Research, and Ms. Hellen Gunnarsdóttir, Director of Department of Education and Science of Iceland Ministry of Education, Science and Culture. He also visited the University of Iceland and Reykjavik University. In Israel, He met with Professor Benjamin Geiger, President of Israel Science Foundation, and visited the Hebrew University.

Sep. 21 Vice President LIU Congqiang paid a visit to the Philippines. He attended the 10th Asian Heads of Research Councils General Meeting and visited the International Rice Research Institute.

Sep. 30 Vice President GAO Wen visited the United States to learn about the progress of researches on image processing and artificial intelligence. He visited the University of Illinois Urbana-Champaign, Beckman Institute for Advanced Science and Technology and Carnegie Mellon University.

October

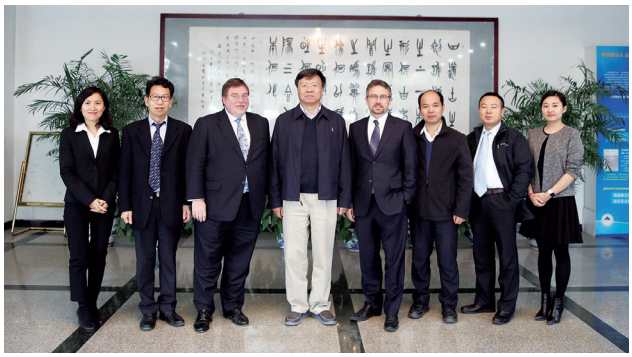
Oct. 10 Vice President LIU Congqiang and Vice President HE Minghong visited Germany and attended the 19th Joint Committee Meeting of the Sino-German Center for Research Promotion. The meeting discussed and approved the Work Report of 2015, the Financial Report, Audit Report, Management Letter of Auditor, feedback to the Management Letter and the budget of 2017. The meeting also made the funding decision of Sino-German cooperation and exchange projects recommended by the Sino-German Center for Research Promotion.

Oct. 30 Vice President LIU Congqiang attended the panel review meeting of NSFC-ICIMOD cooperation program of 2016 held in Beijing.

November

Nov. 5 Vice President LIU Congqiang visited Austria and attended the 89th Meeting of the IIASA Council.

Nov. 9 Vice President GAO Wen met with a delegation led by Mr. Michael Mabe, Chief Executive Officer of International Association STM Publishers.



Vice President GAO Wen met with Mr. Michael Mabe, Chief Executive Officer of International Association STM Publishers.

Nov. 10 The 14th Meeting of Heads of Research Councils in Asia was held in Hangzhou. President YANG Wei, President Yuichiro Anzai of the Japan Society for the Promotion of Science, and President Moo Je Cho of National Research Foundation of Korea attended the meeting. The theme of the meeting was "strategic planning of the funding policies for the next five years". President YANG Wei chaired the meeting.

President YANG Wei attends the 14th Meeting of Heads of Research Councils in Asia.

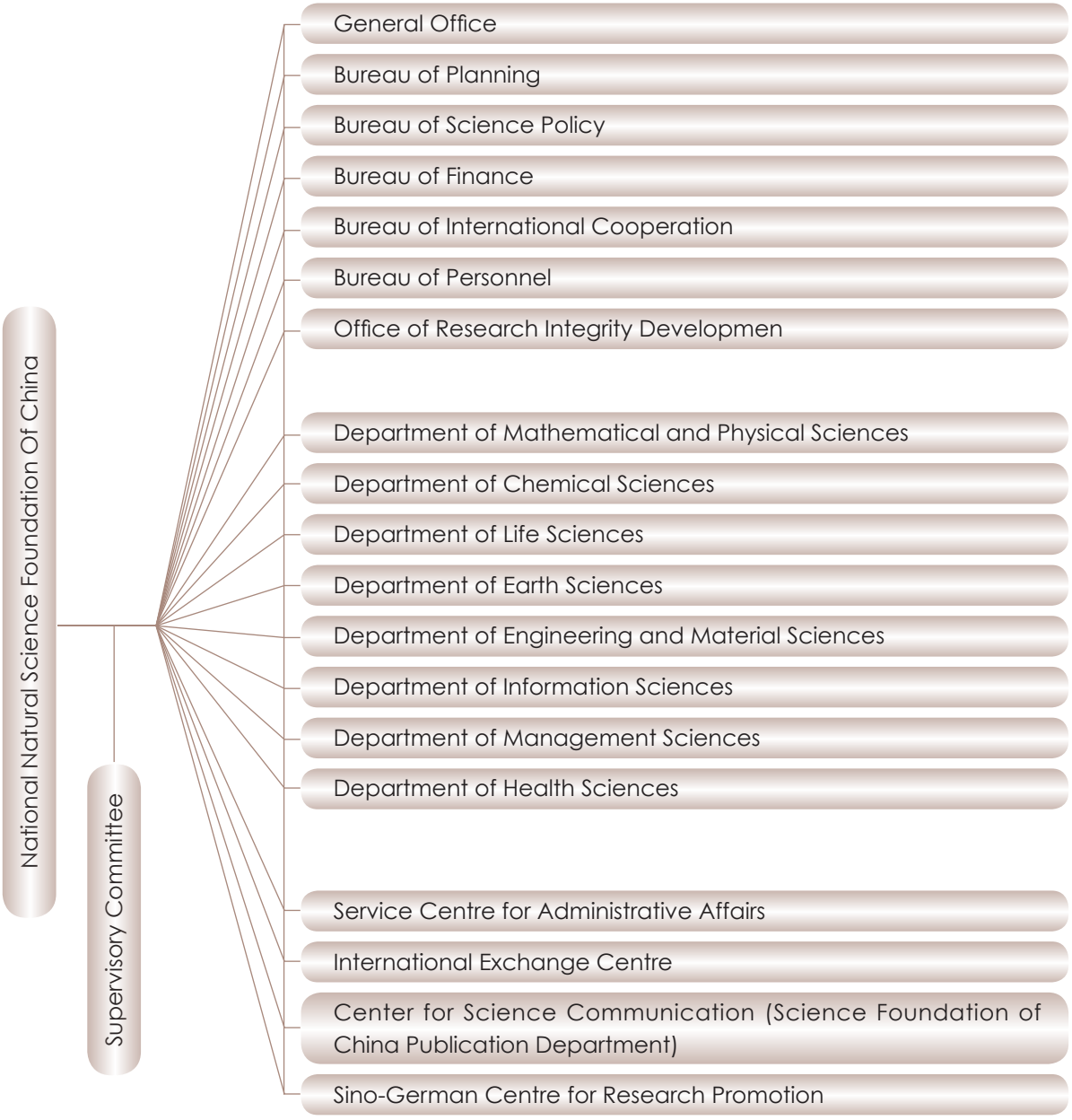
December

Dec. 7 Vice President HE Minghong met with a delegation led by Ms. Reed Elfenbein, Vice President of John Wiley & Sons Inc.

Part 8

Organizational Structure and Personnel of NSFC

1. Organizational Structure



2. NSFC Staff

Full time staff

The staff quota of NSFC is 226. By December 31, 2016, NSFC has 209 full time staff, with 141 males and 68 females and 197 with professional and technical titles. The average age is 46.

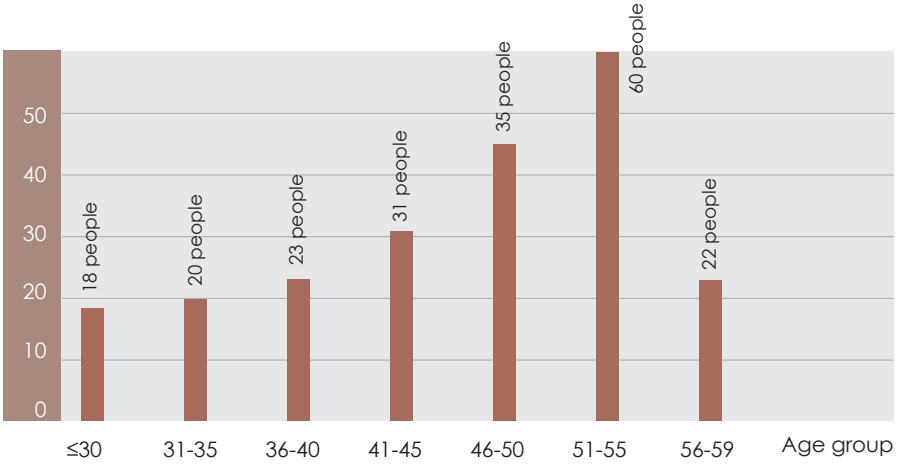


Figure 8.1 **Age Distribution of NSFC Staff** Total (209 people)

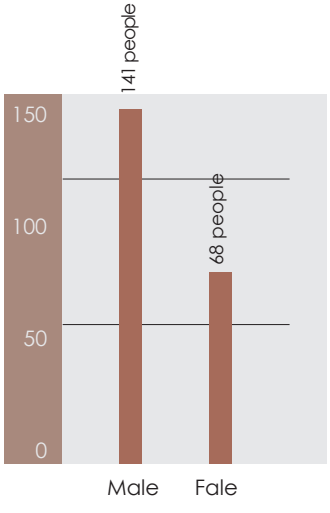


Figure 8.2 **Gender Distribution of NSFC Staff** Total (209 people)

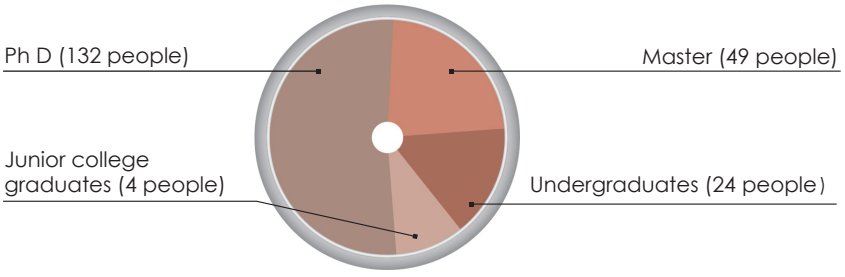


Figure 8.3 **Academic Degree of NSFC Staff** Total (209 people)

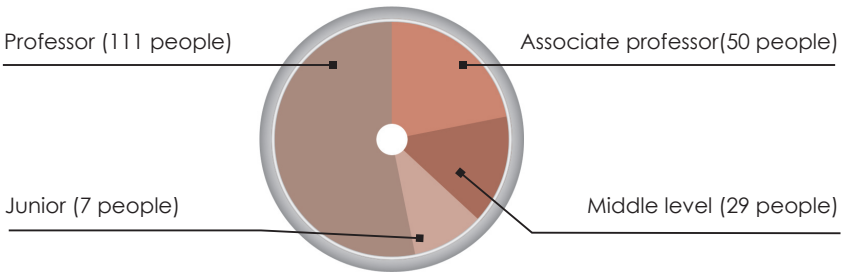


Figure 8.4 **Professional Title of NSFC Staff** Total (197 people)

Rotational Program Directors in NSFC

By December 31, 2016, there are 77 Rotational Program Directors on duty, and all of them have a PhD degree. Among the Rotational Program Directors, 51 are males and 26 females; 28 are professors or research fellows, and 49 are associate professors.

3. Leaders of NSFC's Bureaus, Departments and Subordinate Unit

Leaders of NSFC's Bureaus and Departments

Table 8-1 (by December 31, 2016)

Unit	Leaders
General Office	HAN Yu, FENG Wenan, LI Jianjun (Director of Information Center),
Bureau of Planning	WANG Changrui, WANG Qidong, WEN Mingzhang
Bureau of Science Policy	ZHENG Yonghe
Bureau of Finance	ZHENG Zhongwen, XING Hairu (F)
Bureau of International Cooperation	FENG Feng, LU Rongkai, ZOU Liyao
Bureau of Personnel	ZHOU Yanze, TANG Longhua, ZHANG Xiaohua (F)
Office of Research Integrity Development	ZHU Weitong (F)
Department of Mathematical and Physical Sciences	XIE Sishen (concurrently), MENG Qingguo, DONG Guoxuan
Department of Chemical Sciences	ZHANG Xi (concurrently), CHEN Yongjun, YANG Junlin
Department of Life Sciences	LI Peng (F, concurrently), DU Shengming, FENG Xuelian (F)
Department of Earth Sciences	FU Bojie (concurrently), CHAI Yucheng, GUO Jinyi
Department of Engineering and Material Sciences	WANG Guangqian (concurrently), LI Ming, CHE Chengwei
Department of Information Sciences	CHAI Tianyou (concurrently), QIN Yuwen, ZHANG Zhaotian, HE Jie
Department of Management Sciences	WU Qidi (F, concurrently), LI Yijun
Department of Health Sciences	WANG Hongyang (F, concurrently), DONG Erdan, SUN Ruijuan (F), XU Yanying (F)

Leaders of NSFC's Subordinate Unit

Table 8-2 (by December 31, 2016)

Unit	Director general	Deputy director general
Service Centre for Administrative Affairs	ZHANG Xiangping (F), YANG Tao, SHI Xinghe, YUAN Youxin	
International Exchange Centre	SHI Xinghe (concurrently)	
Center for Science Communication	HAN Zhiyong	
Sino-German Centre for Research Promotion	LU Rongkai (concurrently), CHEN Lesheng	

Part 9

Research Integrity and Auditing

The research integrity and auditing work of NSFC in 2016 was fully implemented in accordance with the spirit of the 18th CPC National Congress and all of its Plenary Sessions as well as an important series of Remarks of CPC General-Secretary Xi. Under the leadership of the NSFC CPC Leading Group and guided by the strategy of innovation-driven development, with the strategic orientation of three focuses, we firmly carried out the deployment for research integrity development laid down by the 4th Plenary Session of the 7th NSFC General Assembly. The supervision and management mechanism was improved, the research integrity governing capability was enhanced, the regulation on the Project Funds Management was implemented, and the supervision and management of project funds was deepened.

Safeguarding research integrity and jointly promoting the development of National Research Integrity System.

First, strengthening supervision and restriction and gradually normalizing the mechanism of active surveillance.

(1) We continued the practice of sending supervision team to review meetings. In 2016 we have sent 34 teams including 67 persons to 231 review panels. The supervision team supervised review behavior, organized evaluation of expert commitment and review creditability, listened to the advice of panelists, and received complaint reports. In recent years, in accordance with the expert creditability survey, we took corresponding measures to intensify the reviewers' consciousness of self-discipline and practice has proved that the mechanism of sending supervision team to review meetings had guaranteed the creditability of the national science fund review system.

(2) Through active surveillance means including application similarity inspection supported by efficient control measures, regular duplicate applications have decreased obviously and research misconduct have been taken under control efficiently. In 2016, we investigated 34 cases of highly similar applications and 24 persons and one home institution have been punished.

Second, strengthening guidance and education on academic self-discipline and intensifying the role of warning.

We conducted various forms of research integrity lectures and trainings to intensify the integrity consciousness of home institutions, researchers and peer reviewers. On December 12, NSFC held the briefing conference on Safeguarding Scientific Ethics and Combating Research Misconduct during which 8 typical cases and 61 research misconduct disposal decisions were released to the public. The briefing

On December 12, 2016, the NSFC briefing conference on Safeguarding Scientific Ethics and Combating Research Misconduct was held in Beijing

conference has intensified the warning effect, promoted academic ethics, helped to create a sound academic environment, and caused preferable social echoes. We have given full play to the scientific community and boosted the development of the national research integrity system.

Third, strictly punishing research misconducts and actively responding to the essay withdrawal scandal.

(1) In 2016, we received 203 complaint reports and self-investigation cases, concluded 75 cases and punished 91 related people. In the meantime, we revoked 33 funded projects, cancelled the eligibility of 70 applicants for national science fund from 1 to 7 years, and passed a notice of criticism or provide conversation reminder to 3 home institutions. (2) We strictly investigated the withdrawal of essays from BMC, Springer, Elsevier and Nature. Among the 117 essays withdrew, we conducted thorough investigation into 28 of them funded by national science fund, and punished 52 related people and one home institution.

Fourth, advancing the information-based management of research misconduct investigation and treatment.

We strengthened the development of information-based system of research misconduct treatment, established and improved the information-based management system of complaint reports, interconnected the treatment decision of the research integrity cases with the Internet-based Science Information System, and promoted the establishment of a sound mechanism on the management of the credit file of home institutions.

The 9th Plenary Session of the 4th Supervisory Committee was held in Beijing on September 12, 2016

Implementing the guidelines of serving the research community by combining decentralization and regulation, and increasing the study on funding supervision and auditing.

First, summarizing the random auditing results of projects funded by NSFC in Hubei and Ningxia in 2015.

We implemented the guidelines and general requirement of the National Science, Technology and Innovation Congress on the decentralization, regulation and service regarding research funding expenses. In accordance with the Regulation of National Natural Science Fund and the Regulation on the Management of NSFC Project Funding Expenses, we strengthened the supervision of project funding expenses through random auditing. We further stressed on the main responsibility of home institutions and project leaders in funds management and use. We required that home institutions should establish and improve the system and mechanism for funds management and use, strengthen the systematic standardization, and intensify institutional execution.

Second, strengthening the study on the random auditing of the project funding expenses.

We systematically sorted out and analyzed relevant data, conducted preliminary research into regulations on the supervision of project funding expenses, and further improved the regulation system of supervision and auditing of project funding expenses.

Part 10

Other Work of NSFC

Shuangqing Forum

Shuangqing Forum is a high-level strategic and academic exchange platform sponsored by NSFC to create favorable academic environment, promote interdisciplinary integration, develop innovation culture, and serve the development of basic research. Based on science fund management, Shuangqing Forum mainly concentrates on highly cross-disciplinary frontier scientific issues, major basic scientific issues related to the demand of the national strategy, and major management and policy issues in improving the science funding system.

In line with the principle of letting a hundred flowers blossom and a hundred schools of thought contend, Shuangqing Forum strives to create a sound environment for the pursuit of truth and fair competition, advance constructive academic critics and ensure that participants can fully enjoy the exchange of thoughts and ideas. Compared with general academic workshops, the Forum has four features: (1) Interdisciplinary contents. Each forum is jointly organized by more than two departments and the topic of each forum is multidisciplinary. (2) Effective results. The results are highly relevant, because the themes of the forums are closely related to the national natural science fund and its management. (3) Innovative organizing forms. The fundamental task of the forum is to explore new ways for academic exchange so as to inspire innovative ideas. (4) Standardization. The forums have clear positioning and standard organizing procedures.

In 2016, Shuangqing Forum sponsored 21 sessions (from the 153rd to 173rd session). The total number of participants reached 879, among which over 80 participants were members of Chinese Academy of Sciences and Chinese Academy of Engineering. NSFC's science departments were responsible for 18 sessions, and administration bureaus held three sessions. The themes of 9 sessions were related to frontier basic scientific issues, which were: The Forensic Medicine Research on Human Injury; The Light Field Multidimensional Control Physics; The Silk Road and Energy Resources-Study on Tethys Earth Power System; The Dynamic Modification of Biological Macromolecules and Chemical Intervention; Alzheimer's disease: Opportunities and Challenges of the Century; The Design, Preparation and Novelty Performance of Functional Element in Superstructure Materials; The Frontier and Cross-Cognitive Neuroscience; The Fundamental study of Computed Imaging; The Theory of Warm Disease and Infection/Infectious Diseases. There were 9 sessions focusing on deep-level scientific issues addressing the demand of the national development strategy, which were: Mathematical Techniques for Medical Image Analysis and Processing that Support Precision Medical Care; The Basic Theory and Key Technology of Intelligent Manufacturing System for Raw Material Industry; The Data-driven Pension Service Resource Organization and Management Mechanism Innovation; The Basic Scientific Issues Related to Key Aerodynamic Thermodynamics of High-speed Rotating Compression System; Major Theoretical and Practical issues of Accounting, Auditing and Corporate Finance; The Scientific Basis of Green process and engineering; The New Generation Integrated Energy Power System; The Mechanics Opportunities and Challenges for High Efficiency Mining of Shale Oil and Gas; The Fertility and

Reproductive Health. The themes of 3 sessions were related to major policy and management issues in the development and improvement of science funding system, which were: Promoting One Belt and One Road Cooperation and Creating Win-Win Relationship between Science-Talent-Development; The Demand-oriented Fundamental Research Funding System and Mechanism; Serving Science: Interdisciplinary Discussion

Shuangqing Forum not only provided a platform for the exchange and cooperation among researchers from different disciplines, promoted the exchange of academic ideas and the expansion of academic vision, but also helped the fund managers to learn about the frontier scientific issues and carry out strategy research, thus enriching the dialogue mechanism between managers and scientists. The forum focuses on the consensus reached between the scientific community and all sectors of society, and the results generated from the forums are fully reflected in the national natural science funding and management. For example, the topics discussed in 77th session, The Microorganism-driven Mechanism of Important Earth Elements of Typical Habitat, 102nd session, The Key Scientific Problems in the Study of Aging Transformation Medicine, 146th session, Robot of future: outlook and scientific challenges and 154th session, The Light Field Multidimensional Control Physics were key scientific issues related to the Major Research Plan in 2016; the topics of 123th session The Innovation of Major Equipment Manufacturing Management in Emerging Information Technology Environment, 108th session The Study on the Frontier Study of Efficient Delivery System in Biological Macromolecules and 132nd session The Multidisciplinary Approach of Big Data Analysis and Processing were listed as priority areas in the funding direction of Major Project; and the outcomes of some sessions were listed in NSFC's relevant sections of Guide to Programs of 2017. In the meantime, various academic overview articles based on the discussions of forums were published in journals including *China Science Fund* and *Discipline Policy Dynamics*. *China Science Fund* published 8 overview articles.

Topics of Shuangqing Forum in 2016

The 153rd Session: The Forensic Medicine Research on Human Injury (Department of Health Sciences, Department of Information Sciences, Bureau of Policy)

The 154th Session: The Light Field Multidimensional Control Physics (Departments of Mathematical and Physical Sciences, Information Sciences, Chemical Sciences, Engineering and Materials Sciences, and Bureau of Policy)

The 155th Session: Promoting One Belt and One Road Cooperation and Creating Win-win Relationship between Science-Talent-Development (Bureau of International Cooperation, Departments of Management Sciences, Earth Sciences, and Bureau of Policy)

The 156th Session: Mathematical Techniques for Medical Image Analysis and Processing that Support Precision Medical Care (Departments of Mathematical and Physical Sciences, Information Sciences, Health Sciences, and Bureau of Policy)

The 157th Session: The Basic Theory and Key Technology of Intelligent Manufacturing System for Raw Material Industry (Departments of Information Sciences, Engineering and Materials Sciences, Chemical Sciences, Management Sciences, and Bureau of Policy)

The 158th Session: The Silk Road and Energy Resources-Study on Tethys Earth Power System (Departments of Earth Sciences, Engineering and Materials Sciences, and Bureau of Policy)

The 159th Session: The Data-driven Pension Service Resource Organization and Management Mechanism Innovation (Departments of Management Sciences, Information Sciences, Health Sciences, and Bureau of Policy)

The 160th Session: The Basic Scientific Issues Related to Key Aerodynamic Thermodynamics of High-speed Rotating Compression System (Departments of Engineering and Materials Sciences, Mathematical and Physical Sciences, Information Sciences, and Bureau of Policy)

The 161st Session: Major Theoretical and Practical issues of Accounting, Auditing and Corporate Finance (Departments of Management Sciences, Mathematical and Physical Sciences, Information Sciences, and Bureau of Policy)

The 162nd Session: The Demand-oriented Fundamental Research Funding System and Mechanism (Bureau of Policy, Departments of Mathematical and Physical Sciences, Information Sciences, and Management Sciences)

The 163rd Session: The Scientific Basis of Green process and engineering (Departments of Chemical Sciences, Engineering and Materials Sciences, and Bureau of Policy)

The 164th Session: The Dynamic Modification of Biological Macromolecules and Chemical Intervention (Department of Chemical Sciences, Life Sciences, Health Sciences, and Bureau of Policy)

The 165th Session: Alzheimer's disease: Opportunities and Challenges of the Century (Departments of

Health Sciences, Life Sciences, and Bureau of Policy)

The 166th Session: Serving Science: Interdisciplinary Discussion (Departments of Information Sciences, Management Sciences, and Bureau of Policy)

The 167th Session: The New Generation Integrated Energy Power System (Departments of Engineering and Materials Sciences, Information Sciences, Management Sciences, and Bureau of Policy)

The 168th Session: The Mechanics Opportunities and Challenges for High Efficiency Mining of Shale Oil and Gas (Departments of Mathematical and Physical Sciences, Engineering and Materials Sciences, Earth Sciences, and Bureau of Policy)

The 169th Session: The Design, Preparation and Novelty Performance of Functional Element in Superstructure Materials (Departments of Engineering and Materials Sciences, Mathematical and Physical Sciences, Information Sciences, and Bureau of Policy)

The 170th Session: The Fertility and Reproductive Health (Departments of Health Sciences, Information Sciences, Chemical Sciences, Life Sciences, and Bureau of Policy)

The 171st Session: The Frontier and Cross-Cognitive Neuroscience (Departments of Life Sciences, Information Sciences, and Bureau of Policy)

The 172nd Session: The Fundamental study of Computed Imaging (Departments of Information Sciences, Health Sciences, and Bureau of Policy)

The 173rd Session: The Theory of Warm Disease and Infection/Infectious Diseases (Department of Health Sciences, and Bureau of Policy)