Translation

The following document lists all of China's state key laboratories and summarizes their key accomplishments in 2016. An appendix includes contact information for all 254 state key labs and all 7 pilot national laboratories. The document also briefly notes the results of a 2016 evaluation of the 75 biology- and medicine-related state key labs, which gave one lab a failing grade and identified another eight as in need of improvement.

Title
2016 Annual Report on State Key Laboratories
2016 国家重点实验室年度报告

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2016
Annual Report
on State Key Laboratories

Ministry of Science and Technology (MOST) Department of Basic Research

MOST Basic Research Management Center

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Contents

Part I Overview of State Key Laboratories

In 2016, the State Key Laboratories and Pilot National Laboratories continued to play a very important role in in exploring and solving major national needs in the forefront of science. A number of internationally advanced achievements in scientific research and emerged in the construction of talent teams. A group of internationally influential teams have become the cradle of China's scientific and technological (S&T) leaders. The laboratories continue to adhere to an operating mechanism of "openness, mobility, unity, and competition," and carried out various forms of international academic exchanges and cooperation, and the international influence was significantly improved.

The state continued to provide support to state key laboratories and pilot national laboratories, with a special fund of 4.17 billion yuan Renminbi (RMB) for state key laboratories, RMB 200 million for national (key) laboratories, and RMB 200 million for Qingdao Marine National Laboratory (pilot), which provides a strong guarantee for the healthy development of the laboratory.

I. Layout

As of the end of 2016, there were 254 state key laboratories and 7 pilot national laboratories in operation.

1. State Key Laboratories

(1) Area of Research (领域) Distribution

The 254 state key laboratories are distributed in eight scientific research fields, including 44 in the field of earth sciences, accounting for 17.3% of the total number of laboratories; 43 in the field of engineering science, accounting for 16.9% of the total number of laboratories; 40 in the field of biological sciences, accounting for 15.7% of the total number of laboratories; 34 in the medical sciences, accounting for 13.4% of the total number of laboratories; 32 in the information science field, accounting for 12.6% of the total number of laboratories; 25 in the field of chemical sciences, accounting for 9.9% of the total number of laboratories; 21 materials science fields, accounting for 8.3% of the total number of laboratories; and 15 in the field of mathematical science, accounting for 5.9% of the total number of laboratories.

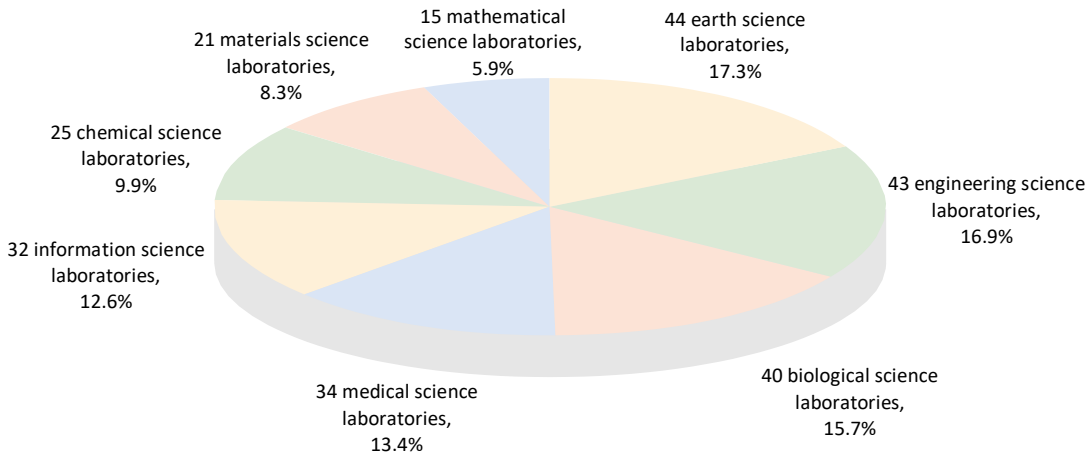


Figure 1 Area of Research Distribution of State Key Laboratories

(2) Departmental Distribution

The state key laboratories are mainly distributed in the Ministry of Education and the Chinese Academy of Sciences, including 131 in the Ministry of Education, accounting for 51.6%; 78 in the Chinese Academy of Sciences, accounting for 30.7%; and 45 in other departments and places, accounting for 17.7%.

Table 1 Departmental Distribution of State Key Laboratories

Department in Charge	Ministry of Education	Ministry of Industry and Information Technology	Ministry of Environmental Protection	Ministry of Water Resources	Ministry of Agriculture	National Health and Family Planning Commission	National Forestry and Grassland Administration	Chinese Academy of Sciences	China Earthquake Administration	China Meteorological Administration	State Oceanic Administration
Quantity	131	8	1	1	6	8	1	78	1	1	1
Department in Charge	Logistic Support Department of the Central Military Commission (CMC)	Training and Administration Department of the CMC	Hebei Science & Technology Department	Shanxi Science & Technology Department	Jiangsu Science & Technology Department	Shandong Science & Technology Department	Hunan Science & Technology Department	Guangdong Science & Technology Department	Guangxi Zhuang Autonomous Region Science & Technology Department	Sichuan Science & Technology Department	Shaanxi Science & Technology Department
Quantity	3	3	1	1	2	1	1	1	1	2	1

Note: For laboratories with two departments in charge (主管部门), statistics only count the first department in charge.

(3) Geographical Distribution

The state key laboratories are located in 25 provinces, autonomous regions, and municipalities across the country, including 79 in Beijing, 32 in Shanghai, 20 in Jiangsu, 18 in Hubei, and 13 in Shaanxi. This distribution basically reflects the geographical strength of China's basic research capabilities.

Table 2 Regional Distribution of State Key Laboratories

Region	Quantity	Region	Quantity	Region	Quantity
Beijing Municipality	79	Tianjin Municipality	6	Shanghai Municipality	32
Chongqing Municipality	5	Hebei Province	1	Shanxi Province	2
Liaoning Province	8	Jilin Province	10	Heilongjiang Province	4
Jiangsu Province	20	Zhejiang Province	9	Anhui Province	1
Fujian Province	4	Shandong Province	3	Henan Province	1
Hubei Province	18	Hunan Province	5	Guangdong Province	11
Guangxi Zhuang Autonomous Region	1	Sichuan Province	9	Yunnan Province	2
Guizhou Province	2	Shaanxi Province	13	Gansu Province	7
Xinjiang Uygur Autonomous Region	1				

Note: For laboratories with multiple supporting units, the statistics only count the location of the first supporting unit.

Figure 2 Geographical Distribution of State Key Laboratories

2. Pilot National Laboratories

The seven pilot national laboratories are divided among two departments and distributed in five provinces and municipalities.

Table 3 Departmental and Geographical Distribution of Pilot National Laboratories

Laboratory Name	Supporting Units	Department in Charge	Region
Beijing National Laboratory for Molecular Sciences (Planned)	Peking University Institute of Chemistry, Chinese Academy of Sciences	Ministry of Education Chinese Academy of Sciences	Beijing Municipality
Beijing National Laboratory for Condensed Matter Physics (Planned)	Institute of Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Beijing Municipality
Hefei National Laboratory for Physical Sciences at the Microscale (Planned)	University of Science and Technology of China	Chinese Academy of Sciences	Anhui Province
Tsinghua National Laboratory for Information Science and Technology (Planned)	Tsinghua University	Ministry of Education	Beijing Municipality
Shenyang National (Joint) Laboratory for	Institute of Metal Research, Chinese	Chinese	Liaoning

Laboratory Name	Supporting Units	Department in Charge	Region
Materials Science	Academy of Sciences	Academy of Sciences	Province
Wuhan National Laboratory for Optoelectronics (Planned)	Huazhong University of Science and Technology and other units	Ministry of Education	Hubei Province
Pilot National Laboratory for Marine Science and Technology (Qingdao)	Ocean University of China Institute of Oceanology, Chinese Academy of Sciences First Institute of Oceanography, State Oceanic Administration Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences Qingdao Institute of Marine Geology		Shandong Province

II. Personnel Structure

In 2016, there were a total of 34,504 staff in state key laboratories and pilot national laboratories, of which 23,567 were fixed personnel (固定人员), accounting for 68.3%, and 10,937 were floating personnel (流动人员), accounting for 31.7%.

1. Fixed Personnel

The research teams of State Key Laboratories and Pilot National Laboratories have grown steadily, and the total number of fixed personnel has increased by 2.0% compared with 2015. The team structure still reflects the characteristics of a structure with young and middle-aged personnel as the backbone and highly educated, highly specialized technical researchers as the primary focus.

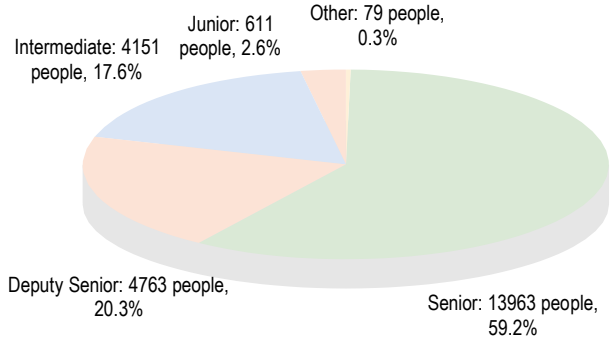


Figure 3 2016 Distribution of Professional Technical Positions of Fixed Laboratory Personnel

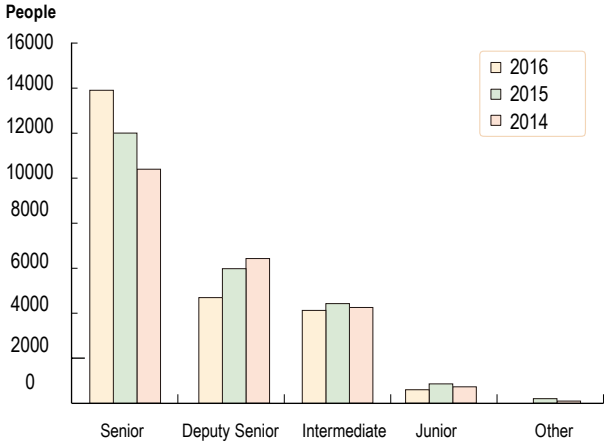


Figure 4 2014-2016 Comparative Distribution of Professional Technical Positions of Fixed Laboratory Personnel

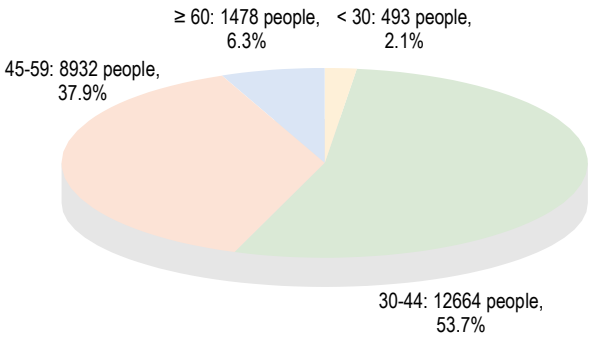


Figure 5 2016 Age Distribution of Fixed Laboratory Personnel

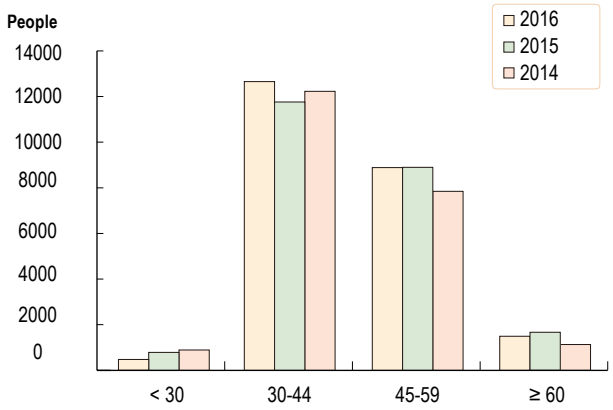


Figure 6 2014-2016 Comparative Age Distribution of Fixed Laboratory Personnel

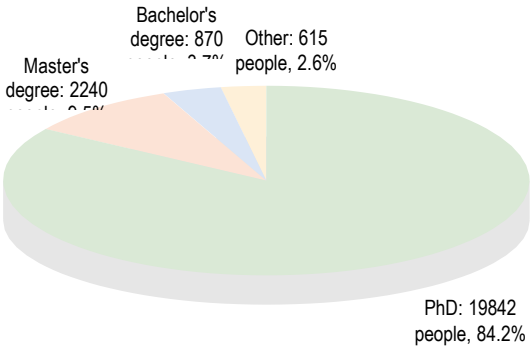


Figure 7 2016 Degree Distribution of Fixed Laboratory Personnel

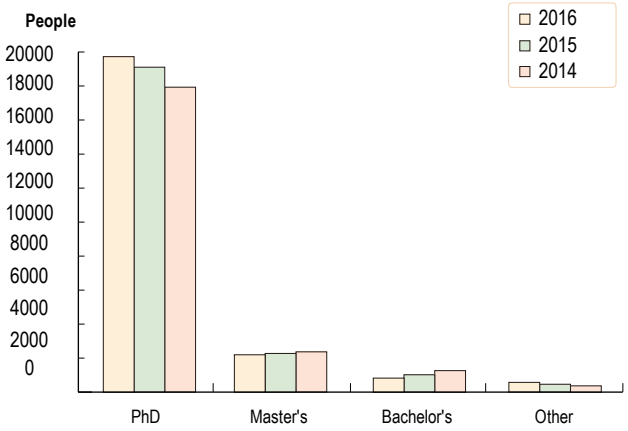


Figure 8 2014-2016 Comparative Degree Distribution of Fixed Laboratory Personnel

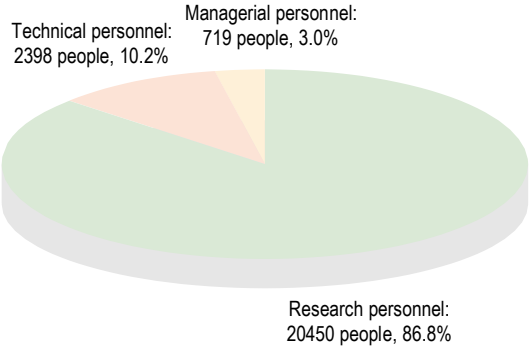


Figure 92016 Fixed Laboratory Personnel Structure

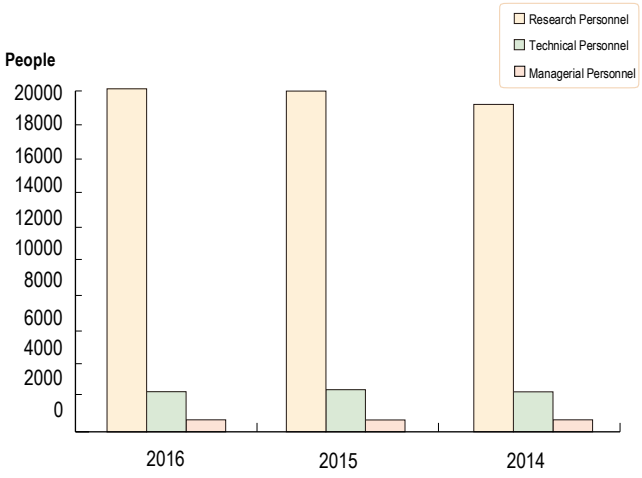


Figure 10 2014-2016 Comparative Fixed Laboratory Personnel Structure

2. Mobile Personnel

In 2016, there were 10,937 mobile personnel working in state key laboratories and pilot national laboratories, of which 9,396 held PhDs, accounting for 85.9%.

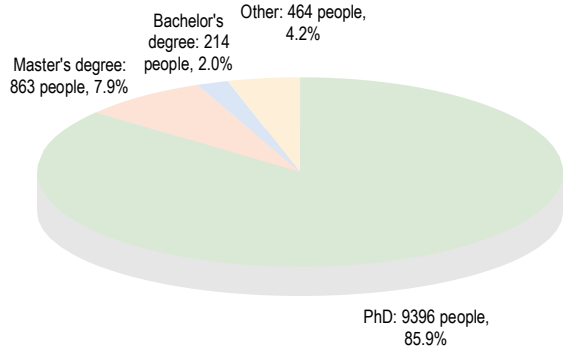


Figure 11 2016 Degree Distribution of Mobile Laboratory Personnel

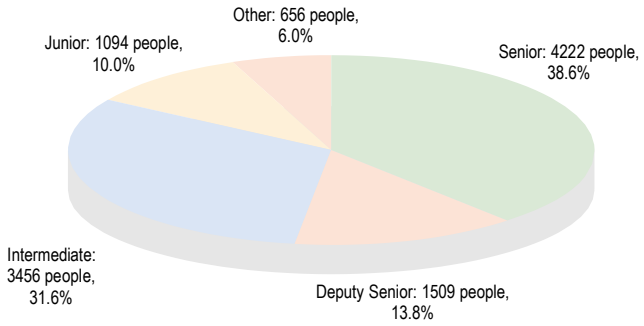


Figure 12 2016 Distribution of Professional Technical Positions of Mobile Laboratory Personnel

III. Fixed Assets

Due to the implementation of special funding for the state key laboratories, the basic construction of state key laboratories and pilot national laboratories has advanced rapidly, forming a research support platform with advanced equipment and an excellent scientific research environment. As of the end of 2016, the total construction area of the laboratories was 3.473 million square meters, and the total number of instruments and devices was 646,601, with a total value of RMB 42.33 billion.

Table 4 Overview of Laboratory Fixed Assets

Year	Construction Area (in 10,000 m²)	Total Devices	Total Device Value
2016	347.3	646601	423.3
2015	336.1	524383	343.2
2014	289.8	473942	299.4

Table 5 Overview of Laboratory Devices Valued at Over RMB 300,000

Category	Total Devices	Total Device Value (RMB 100 million)	Average Research Operating Hours per Instrument D	Average Service Operating Hours per Instrument E	Operating Rate (%)
Value	16506	191.4	1712.8	847.3	142.2

Note: The standard operating time per device is K=1800 hours/year. Research operating time (D) refers to the total time researchers in the laboratory use a certain device per year. Service operating time (E) refers to the total time each device is used by non-laboratory staff in the laboratory each year. Operating rate (%) = (D+E)/K.

Part II Overall Operating Conditions of State Key Laboratories

I. Scientific Research Tasks

In 2016, the state key laboratories and pilot national laboratories hosted and undertook a total of 42,747 research projects of various types, an increase of 6.3% over 2015. The laboratories received RMB 21.37 billion in research funding, an increase of 8.0% over 2015. Among them, there were 22,780 national-level research projects with RMB 13.10 billion in research funding, representing increases of 2.6% and 19.1%, respectively, over the previous year.

Table 6 Composition of Laboratory Research Projects

Category	National Level							Provincial Level	International Collaboration	Horizontal Collaboration
	State Key R&D Program	973 Program	863 Program	Major S&T Special Projects	S&T Support	National Natural Science Foundation of China	Other National-level Projects			
Research Projects	1575	1968	565	535	374	15724	2039	7319	1222	11426
Project Proportion (%)	53.3							17.1	2.9	26.7
Funding (RMB 10,000)	310489	171795	57926	91283	27965	420566	229762	384393	60762	382105
Funding Proportion (%)	61.3							18.0	2.8	17.9

Note: Research projects refer to research projects undertaken by state key laboratories and the pilot national laboratories from January 1 to December 3, 2016 (including the projects established and completed in the current year; research funds are the actual funds made available that year). Among these projects, other national-level projects include major national projects, early-stage special projects of the State Key Basic R&D Program (国家重点基础研究计划), special national major scientific instrument and equipment development projects (国家重大科学仪器设备开发专项), and special national public welfare industry scientific research projects (国家公益性行业科研专项).

II. Scientific Research Output

In 2016, state key laboratories and pilot national laboratories won a total of 110 national awards (including for participation and completion). Among these awards, Academician Zhao Zhongxian of the Beijing National Laboratory of Condensed Matter Physics (planned) won the Highest Science and Technology Award, the “New Mode of Neutrino Oscillation Discovered in the Daya Bay Reactor Neutrino Experiment” completed by the State Key Laboratory of Particle Detection and Electronics won the only first prize of the National Natural Science Awards, and the “Key Technologies and Applications of the Fourth Generation Mobile Communication Systems (TD-LTE)” jointly completed by the State Key Laboratory of Networking and Switching Technology, Tsinghua National Laboratory of Information Science and Technology (planned), and State Key Laboratory of Mobile Communications was awarded the Grand Prize of the National Science and Technology Progress Awards (General Project). These awards also include 26 second prizes at the National Natural Science Awards, accounting for 63.4% of the total awards; 23 second

prizes at the National Technical Invention Awards (General Project), accounting for 48.9% of the total awards; and 5 first prizes at the National Science and Technology Progress Awards (General Project), accounting for 62.5% of the total awards, 2 innovation team awards, accounting for 66.7% of the total awards, and 51 second prizes, accounting for 42.5% of the total awards.

In addition, state key laboratories and pilot national laboratories obtained 11,086 authorized invention patents; published more than 86,400 academic papers in important academic journals and conferences in China and abroad, of which more than 55,100 were indexed by SCI, accounting for 63.7% of the total and 5,984 papers indexed by EI (unique from the papers indexed by SCI), accounting for 6.9%; and published 28 papers in *Science*, and 369 papers in *Nature* and its series of journals.

Table 7 National-Level Awards Won by Laboratories

Category	Highest Science and Technology Awards	National Natural Science Awards		National Technology Invention Awards	National Science and Technology Progress Award			
		First Prize	Second Prize	Second Prize	Grand Prize	First Prize	Innovation Teams	Second Prize
Awards won by laboratories	1	1	26	23	1	5	2	51
Total awards granted nationwide	2	1	41	47	1	8	3	120
Percentage of total awards won (%)	50.0	100	63.4	48.9	100	62.5	66.7	42.5

Table 8 National Natural Science Awards Won by Laboratories

No.	Achievement Code	Achievement Name	Award Level	Award Winners		Laboratory Name
1	Z-102-1-01	A New Mode of Neutrino Oscillation Discovered in Daya Bay Reactor Neutrino Experiment	First Prize	Wang Yifang (1) Heng Yuekun (4)	Cao Jun (2) Li Xiaonan (5)	State Key Laboratory of Particle Detection and Electronics
2	Z-101-2-02	Stability of Hamiltonian System under Resonance	Second Prize	Li Yong (1)		State Key Laboratory of Automotive Simulation and Control
3	Z-102-2-02	Magnetoelectric Generation New Materials and High-Voltage Controlled Quantum Sequence	Second Prize	Jin Changqing (1) Liu Qingqing (3) Yu Richeng (5)	Wang Xiancheng (2) Deng Zheng (4)	Beijing National Laboratory for Condensed Matter Physics (Planned)
4	Z-103-2-01	Research on the Mechanism, Regulation, and Application of Biological Analysis of the Interaction Process of Biomolecules	Second Prize	Li Genxi (2)		State Key Laboratory of Pharmaceutical Biotechnology
5	Z-103-2-02	A New Method of Carbon-Carbon Bond Recombination Construction and Natural Product Synthesis	Second Prize	Tu Yongqiang (1) Zhang Fumin (3)	Fan Chunan (2) Zhang Shuyu (5)	State Key Laboratory of Applied Organic Chemistry
6	Z-103-2-03	Research on Basic Physical and Chemical Problems of Organic Field Effect Transistor	Second Prize	Hu Wenping (1) Dong Huanli (5)	Liu Yunqi (2)	Beijing National Laboratory for Molecular Sciences (Planned)
7	Z-103-2-04	Research on Several New Methods of Efficient Asymmetric Carbon-Carbon Bond Construction	Second Prize	Xu Minghua (2)		State Key Laboratory of New Drug Research

No.	Achievement Code	Achievement Name	Award Level	Award Winners		Laboratory Name
8	Z-103-2-05	Design, Synthesis, and Assembly Strategy of Oxy-Clusters	Second Prize	Yang Guoyu (1)		State Key Laboratory of Structural Chemistry
9	Z-103-2-07	Total Synthesis of Complex Natural Products with Important Biological Activities	Second Prize	Yang Zhen (1)	Chen Jiahua (2)	Beijing National Laboratory for Molecular Sciences (Planned)
10	Z-104-2-01	Linkage Between Asian Monsoon Changes and Global Climate	Second Prize	An Zhisheng (1) Cai Yanjun (3) Shen Ji (5)	Sun Youbin (2) Zhou Weijian (4)	State Key Laboratory of Loess and Quaternary Geology State Key Laboratory of Lake Science and Environment
11	Z-104-2-02	Process and Environmental Causes of the Largest Extinction of Phanerozoic Organisms and Subsequent Biological Recovery	Second Prize	Xie Shucheng (1) Song Haijun (3) Luo Genming (5)	Lai Xulong (2) Sun Yadong (4)	State Key Laboratory of Biogeology and Environmental Geology
12	Z-104-2-05	Formation of Earth's Animal Tree	Second Prize	Zhang Xingliang (1) Liu Jianni (3) Han Jian (5)	Shu Deqian (2) Zhang Zhifei (4)	State Key Laboratory of Continental Dynamics
13	Z-104-2-06	Basic Research on Omics Identification and Prevention and Control of Environmental Health Hazards of High-Risk Pollutants	Second Prize	Zhang Xuxiang (1) Wu Bing (5)	Ren Hongqiang (3)	State Key Laboratory of Pollution Control and Resource Reuse
14	Z-105-2-01	Function and Mechanism of Plant Small RNA	Second Prize	Wang Xiujie (4)		State Key Laboratory of Plant Genomics
15	Z-105-2-02	Genetic and Molecular Biology Basis of Rice Yield Traits	Second Prize	Zhang Qifa (1) He Yuqing (3) Fan Chuchuan (5)	Xing Yongzhong (2) Yu Sibin (4)	State Key Laboratory of Crop Genetic Improvement
16	Z-107-2-01	Research on Theoretical Methods of Image Structure Modeling and Visual Appearance Reconstruction	Second Prize	Gao Xinbo (1) Deng Cheng (3)	Li Xuelong (2) Yuan Yuan (4)	State Key Laboratory of Integrated Services Network State Key Laboratory of Transient Optics and Photonics
17	Z-107-2-05	Carbon-Based Nanoelectronic Devices and Integration	Second Prize	Wang Sheng (4)		State Key Laboratory of Advanced Optical Communication Systems & Networks
18	Z-107-2-06	New Microwave and Millimeter Wave Substrate Integrated Guided Wave Structure and Device	Second Prize	Hong Wei (1) Chen Jixin (5)	Hao Zhangcheng (2)	State Key Laboratory of Millimeter Waves
19	Z-108-2-01	Principles and Construction of Non-Metallic Supernormal Electromagnetic Medium	Second Prize	Zhou Ji (1) Li Bo (3)	Zhao Gan (2)	State Key Laboratory of New Ceramics and Fine Processing State Key Laboratory of Tribology
20	Z-108-2-02	Long-Life High-Temperature Oxidation, and Ablative Coating Protection Mechanism and Application Basis	Second Prize	Li Hejun (1) Li Kezhi (3)	Fu Qiangang (2) Zhang Yulei (5)	State Key Laboratory of Solidification Processing
21	Z-108-2-03	New Physical Effects of Ferrous Smart Materials based on Crystal Defect Regulation	Second Prize	Ren Xiaobing (1) Ding Xiangdong (3) Liu Wenfeng (5)	Zhang Lixue (2) Yang Sen (4)	State Key Laboratory for Mechanical Behavior of Materials State Key Laboratory of Electrical Insulation and Power Equipment
22	Z-108-2-04	Research on the Macro-Preparation of Nanostructure Units and	Second Prize	Yu Shuhong (1) Yao Hongbin (5)	Liang Haiwei (2)	Hefei National Laboratory for Physical Sciences at the

No.	Achievement Code	Achievement Name	Award Level	Award Winners	Laboratory Name
		the Functionalization of Macro-Scale Assemblies			Microscale (Planned)
23	Z-108-2-05	Fluorescence Sensing Metal-Organic Frame Material Structure design and Function Construction	Second Prize	Qian Guodong (1) Cui Yuanjing (2) Wang Zhiyu (5)	State Key Laboratory of Silicon Materials
24	Z-108-2-06	Construction and Synergy Mechanism of High-Performance Composite Electrode Materials for Energy Storage	Second Prize	Huang Yunhui (1) Li Hejun (2) Hu Xianluo (3) Yuan Lixia (4)	State Key Laboratory of Material Processing and Die & Mould Technology Wuhan National Laboratory for Optoelectronics (Planned)
25	Z-109-2-02	Probability Density Evolution Theory of Reliability Design for Engineering Structure Disaster	Second Prize	Li Jie (1) Chen Jianbing (2) Chen Juan (3) Wu Jianying (4)	State Key Laboratory of Civil Engineering Disaster Prevention State Key Laboratory of Subtropical Building Science
26	Z-109-2-04	Basic Research on Ultrafast Laser Micro and Nano Manufacturing Mechanisms, Methods, and Preparation of New Materials	Second Prize	Qu Liangti (2)	State Key Laboratory of Explosion Science and Technology
27	Z-110-2-01	Homotopy Analysis Method and its Application for Solving Strongly Nonlinear Problems in Mechanics	Second Prize	Liao Shijun (1)	State Key Laboratory of Ocean Engineering

Note: After the winner names, the ranking of the winner is in parentheses

Table 9 National Technology Invention Awards Won by Laboratories

No.	Achievement Code	Achievement Name	Award Level	Award Winners	Laboratory Name
1	F-301-2-03	Discovery of Important Genes for Nutritional Quality and Excellence of Maize and Molecular Breeding Applications	Second Prize	Yan Jianbing (2)	State Key Laboratory of Crop Genetic Improvement
2	F-303-2-02	Special Drilling Fluid for Complex Structure Wells and Industrial Application	Second Prize	Jiang Guancheng (1) Pu Xiaolin (3) Gao Deli (4)	State Key Laboratory of Petroleum Resources and Prospecting State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering
3	F-303-2-03	Key Technologies for Cold Drilling and Thermal Recovery of Land Gas Hydrate	Second Prize	Sun Youhong (1) Chen Chen (3)	State Key Laboratory of Superhard Materials
4	F-303-2-05	High-Efficiency Fracturing Acidification Reforming Technology and Applications for Deep and Ultra-Deep Oil and Gas Reservoirs	Second Prize	Zhao Jinzhou (1) Guo Jianchun (2) Li Yongming (3)	State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering
5	F-304-2-02	Diagnosis Technology and Practices for Service Behavior of Complex Hydraulic Concrete Structures	Second Prize	Hu Shaowei (1) Gu Chongshi (2) Su Huaizhi (3)	State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering
6	F-305-2-02	Key Technology Innovation and	Second Prize	Chen Jianfeng (4)	State Key Laboratory of Organic-Inorganic

No.	Achievement Code	Achievement Name	Award Level	Award Winners		Laboratory Name
		Industrialization for Ultra-Micro Manufacturing of Important Fat-Soluble Nutrients				Composite Materials
7	F-306-2-01	New Technology for Polyolefin Fluidized Bed Reactors Based on Acoustic Emission Monitoring	Second Prize	Yang Yongrong (1)	Wang Jingdai (2)	State Key Laboratory of Chemical Engineering
8	F-306-2-03	Creation and Application of New Reactive Dyes with Enhanced Group Functions	Second Prize	Zhang Shufen (1) Lu Rongwen (4)	Tang Bingtao (2) Mao Zhiping (6)	State Key Laboratory of Fine Chemicals State Key Laboratory for Modification of Chemical Fibers and Polymer Materials
9	F-307-2-03	Low-Power High-Performance Soft Magnetic Composite Materials and Key Preparation Technologies	Second Prize	Yan Mi (1)	Wang Xinhua (3)	State Key Laboratory of Silicon Materials
10	F-307-2-04	Key Technology and Engineering Applications of Carbon-Based Film Combining Toughness and Lubrication	Second Prize	Wang Liping (1) Xue Qunji (4) Yan Xingbin (6)	Zhang Junyan (2) Zhang Bin (5)	State Key Laboratory of Solid Lubrication
11	F-307-2-05	New Type of Alloy Material Controlled Non-Equilibrium Solidification Technology and Applications	Second Prize	Fu Hengzhi (4)		State Key Laboratory of Solidification Processing
12	F-30801-2-02	Shock Wave Wind Tunnel Experiment Technology for Reproducing Hypersonic Flight Conditions	Second Prize	Jiang Zonglin (1) Liu Yunfeng (3) Li Jinping (5)	Zhao Wei (2) Wang Chun (4) Yu Hongru (6)	State Key Laboratory of High Temperature Gas Dynamics
13	F-30801-2-03	Local Loading, Precise Plastic Forming, and Integrated Manufacturing Technology for High-Performance Lightweight Components	Second Prize	Yang He (1) Zhan Mei (3) Fan Xiaoguang (5)	Sun Zhichao (2) Li Heng (4)	State Key Laboratory of Solidification Processing
14	F-30801-2-04	Key Technologies and Equipment for Multi-Station Precision Forging Net Formation	Second Prize	Wang Xinyun (1)		State Key Laboratory of Material Processing and Die & Mould Technology
15	F-30801-2-05	Technology for Smart Prosthetics and Their Neural Information Channel Reconstruction	Second Prize	Zhu Xiangyang (1) Xiong Caihua (3) Liu Hong (6)	Jiang Li (2) Sheng Xinjun (5)	State Key Laboratory of Mechanical System and Vibration State Key Laboratory of Robotics and Systems State Key Laboratory of Digital Manufacturing Equipment and Technology
16	F-30802-2-01	Fast Breaking Technology and Applications for Large Capacity Circuit Breakers in DC Distribution Systems	Second Prize	Rong Mingzhe (1) Yang Fei (3)	Wu Yi (2) Wang Xiaohua (5)	State Key Laboratory of Electrical Insulation and Power Equipment
17	F-30802-2-03	Key Technology and Applications of ±800kV UHV DC Transmission Converter Valve	Second Prize	Cui Xiang (4)		State Key Laboratory of Alternate Electrical Power System with Renewable Energy Sources
18	F-30901-2-03	Hybrid Optical Fiber Sensing Technology and its Application in the Field of Engineering Safety Monitoring	Second Prize	Liu Tiegen (1)	Jiang Junfeng (2)	State Key Laboratory of Hydraulic Engineering Simulation and Safety State Key Laboratory of Engines

No.	Achievement Code	Achievement Name	Award Level	Award Winners	Laboratory Name
19	F-30901-2-04	Wide Area Broadband Cooperative Communication Technology and Applications	Second Prize	Lu Jianhua (1) Tao Xiaoming (3)	Tsinghua National Laboratory for Information Science and Technology (Planned)
20	F-30901-2-05	Multi-Interface Light-Thermal Coupling White Light LED Packaging Optimization Technology	Second Prize	Luo Xiaobing (2) Chen Mingxiang (3)	State Key Laboratory of Coal Combustion State Key Laboratory of Digital Manufacturing and Equipment Technology
21	F-30902-2-01	Key Technologies, Systems, and Industrial Applications of Scalable Routing and Switching for Support Service Innovation	Second Prize	Xu Ke (1) Yin Xia (2) Wu Jianping (5) Zhao Youjian (6)	Tsinghua National Laboratory for Information Science and Technology (Planned)
22	F-30902-2-02	Key Technologies and Applications of Urban Travel Information Services Based on Mobile Location Data	Second Prize	Lu Weifeng (1) Zhu Tongyu (2) Du Bowen (3)	State Key Laboratory of Software Development Environment
23	F-30902-2-04	Key Technologies and Applications of Steel Production and Logistics Dispatch	Second Prize	Tang Lixin (1)	State Key Laboratory of Synthetical Automation for Process Industries

Note: After the winner names, the ranking of the winner is in parentheses

Table 10 National Science and Technology Progress Awards Won by Laboratories

No.	Achievement Code	Achievement Name	Award Level	Award Winners	Laboratory Name
1	J-236-0-01	Key Technologies and Applications of Fourth-Generation Mobile Communication Systems (TD-LTE)	Grand Prize	Zhang Ping (5) Wang Dongming (43) Li Xing (35) Xiong Bing (49) Zhou Shidong (41)	State Key Laboratory of Networking and Switching Technology Tsinghua National Laboratory for Information Science and Technology (Planned) State Key Laboratory of Wireless Mobile Communications
2	J-21701-1-01	Major Renovation Project of the Beijing Electron-Positron Collider	First Prize		State Key Laboratory of Particle Detection and Electronics
3	J-234-1-01	Innovative Research and Applications of IgA Nephropathy Integrating Traditional Chinese and Western Medicine Treatment Regimens and Key Diagnosis and Treatment Technologies	First Prize	Chen Xiangmei (1) Cai Guangyan (2) Feng Zhe (9) Sun Xuefeng (10) Xie Yuansheng (13)	State Key Laboratory of Kidney Diseases
4	J-236-1-01	Key Technologies and Applications of DTMB System Internationalization and Industrialization	First Prize	Yang Zhixing (1) Pan Zhangyong (2) Song Jian (3) Wang Jintao (4) Yang Fang (10) Wang Jun (11) Wang Zhaocheng (12) Pen Kewu (13) Zhang Yu (14)	Tsinghua National Laboratory for Information Science and Technology (Planned)
5	J-21702-1-01	Key Technologies and Applications of Dynamic Process Security Defenses for Interconnected Power Grids	First Prize	Wen Jinyu (13)	State Key Laboratory of Advanced Electromagnetic Engineering and Technology
6	J-222-1-01	Key Technologies and Applications of Ecological Water-Saving Irrigation Area Construction	First Prize	Cui Yuanlai (4) Xu Junzeng (7) Mao Zhi (10) Luo Yufeng (14)	State Key Laboratory of Water Resources and Hydropower Engineering Science State Key Laboratory of

No.	Achievement Code	Achievement Name	Award Level	Award Winners		Laboratory Name
						Hydrology-Water Resources and Hydraulic Engineering
7	J-207-1-01	Oncology Research Innovation Team of the Digestive Department of Fourth Military Medical University	Innovation Team Award	Fan Daiming (1) Wu Kaichun (3) Nie Yongzhan (5) Yang Angang (7) Han Guohong (9) Shi Yongquan (11) Liang Qiaoyi (13) Xia Limin (15)	Shen Zuyao (2) Yu Jun (4) Yao Libo (6) Han Hua (8) Guo Xuegang (10) Pan Yanglin (12) Liang Jie (14)	State Key Laboratory of Cancer Biology
8	J-207-1-02	Zhejiang University Clean Energy Utilization Innovation Team	Innovation Team Award	Ni Mingjiang (1) Luo Zhongyang (3) Gao Xiang (5) Zhou Hao (7) Chi Yong (9) Wang Shurong (11) Bo Zheng (13) Cen Kefa (15)	Yan Jianhua (2) Fan Jianren (4) Zhou Junhu (6) Zhou Jinsong (8) Wang Zhihua (10) Huang Qunxing (12) Zhang Yanwei (14)	State Key Laboratory of Clean Energy Utilization
9	J-201-2-01	Breeding Technology and Application of Zhongmiansuo 49 (中棉所49), a New Cotton Variety with Multiple Resistances and Stable Yield	Second Prize	Yan Gentu (1)	Kuang Meng (6)	State Key Laboratory of Cotton Biology
10	J-203-2-01	Innovation and Integrated Application of Prevention and Control Technologies for Major Swine Diseases in China	Second Prize	Jin Meilin (1) He Qigai (3) Fang Liurong (6)	Chen Huanchun (2) Wu Bin (4)	State Key Laboratory of Agricultural Microbiology
11	J-203-2-02	Development and Application of High-Efficiency Vaccines Against Epidemic Strains of Foot-and-Mouth Disease Newly Introduced to China	Second Prize	Zheng Haixue (2) Guo Jianhong (10)	Liu Xiangtao (5)	State Key Laboratory of Veterinary Etiological Biology
12	J-203-2-05	Cultivation and Application of a New Breed of Yellow Feather Broiler Chicken	Second Prize	Wen Jie (1)	Liu Ranran (9)	State Key Laboratory of Animal Nutrition
13	J-204-2-02	Understanding and Combating Glaucoma	Second Prize	Sun Xinghuai (1)		State Key Laboratory of Medical Neurobiology
14	J-204-2-03	*One Hundred Thousand Whys of National Health* (全民健康十万个为什么) book series	Second Prize	Zhong Nanshan (1)		State Key Laboratory of Respiratory Disease
15	J-211-2-01	Key Technology and Industrial Application of Probiotic Fermentation of Fruits and Vegetables	Second Prize	Xie Mingyong (1) Nie Shaoping (3)	Xiong Tao (2) Yin Junyi (6)	State Key Laboratory of Food Science and Technology
16	J-212-2-02	Key Technologies and Industrialization of Ramie Eco-Efficient Textile Processing	Second Prize	Cheng Longdi (1)		State Key Laboratory for Modification of Chemical Fibers and Polymer Materials
17	J-212-2-03	Key Technology and Industrialization of Dry Spinning Polyimide Fiber Preparation	Second Prize	Zhang Qinghua (1)	Chen Dajun (4)	State Key Laboratory for Modification of Chemical Fibers and Polymer Materials
18	J-214-2-02	Cement Kiln High-Efficiency Ecological Solid Waste Co-Processing Technology and Applications	Second Prize	Li Yeqing (1) Xie Junlin (6)	Hu Shuguang (2)	State Key Laboratory of Silicate Materials for Architectures

No.	Achievement Code	Achievement Name	Award Level	Award Winners	Laboratory Name
19	J-215-2-01	Key Technology and Applications of High-Efficiency and Low-Consumption Super-Large Blast Furnaces	Second Prize	Zhang Jianliang (3)	State Key Laboratory of Refractory and Metallurgy
20	J-215-2-04	Research and Application of Compound Converting Technology for Electric Arc Furnace Steelmaking	Second Prize	Zhu Rong (1)	State Key Laboratory of Refractory and Metallurgy
21	J-215-2-07	Material Marine Environment Corrosion Evaluation and Protection Technology System Innovation and Major Engineering Applications	Second Prize	Li Xiaogang (1)	State Key Laboratory for Advanced Metals and Materials
22	J-216-2-01	Key Technologies and Applications of Dynamic Design and Manufacturing of Large and Heavy-Duty Mechanical Equipment	Second Prize	Chen Xuedong (1) Luo Xin (4) Li Xiaoqing (10)	State Key Laboratory of Digital Manufacturing Equipment and Technology
23	J-216-2-02	Harmless and Efficient Solder Brazing Technology and Applications	Second Prize	He Peng (2)	State Key Laboratory of Advanced Welding and Joining
24	J-216-2-03	Special Complete Sets of Manufacturing Equipment and Processes for Large-Scale and Complex Structures in the Aerospace Field	Second Prize	Meng Guang (1) Wang Yuhan (2) Long Xinhua (7)	State Key Laboratory of Mechanical System and Vibration
25	J-216-2-04	Research and Application of Key Technology for High-Power Marine Gearbox Transmission and Propulsion Systems	Second Prize	Tong Shuiguang (1)	State Key Laboratory of Fluid Power and Mechatronic Systems
26	J-21702-2-01	Key Technologies and Engineering Applications for the Prevention and Control of Large-Scale Pollution Flashover Accidents in Power Grids	Second Prize	Liang Xidong (2)	State Key Laboratory of Safety Control and Simulation of Power System and Large-Scale Power Generation Equipment
27	J-21702-2-04	Subsynchronous Resonance, and Oscillation Control and Protection Technology, Equipment, and Application of Large Steam Turbine Generator Sets	Second Prize	Xie Xiaorong (3) Bi Tianshu (8)	State Key Laboratory of Safety Control and Simulation of Power System and Large-Scale Power Generation Equipment State Key Laboratory of Alternate Electrical Power System with Renewable Energy Sources
28	J-219-2-01	Multi-Level System Chip Low-Power Design Technology for Integrated System and Power Management	Second Prize	Gu Huaxi (7)	State Key Laboratory of Integrated Services Network
29	J-220-2-01	Key Technology and Industrialization of the New Generation of Stereo Vision	Second Prize	Dai Qionghai (1) Suo Jinli (3)	Tsinghua National Laboratory for Information Science and Technology (Planned)
30	J-220-2-03	High-Safety Complete Set of Special Control Devices and Systems	Second Prize	Wang Wenhai (1) Sun Youxian (3) Cheng Peng (6) Chen Jiming (5)	State Key Laboratory of Industrial Control Technology
31	J-220-2-04	Key Technologies and Applications of Risk Prevention and Control for Online Transaction Payment Systems	Second Prize	Sun Yuzhong (5)	State Key Laboratory of Computer Architecture
32	J-220-2-05	Key Technologies and Application of Low	Second Prize	He Peng (5)	State Key Laboratory of Fluid Power and Mechatronic Systems

No.	Achievement Code	Achievement Name	Award Level	Award Winners		Laboratory Name
		Frequency Fault Diagnosis for Large-Scale Wind Power and Hydroelectric Generating Units				
33	J-221-2-03	Key Technologies and Integrated Demonstration of Large-Scale Underground Space Construction in High-Density Urban Areas	Second Prize	Zhu Hehua (1) Yan Zhiguo (4)	Liu Xinrong (2) Shen Shuilong (7)	State Key Laboratory of Civil Engineering Disaster Prevention State Key Laboratory of Coal Mine Disaster Dynamics and Control State Key Laboratory of Ocean Engineering
34	J-221-2-04	Key Technology and Application of Stability Monitoring and Control of Broken and Weak Surrounding Rock of Deep Tunnels (Roads)	Second Prize	Liu Quansheng (1) Jing Hongwen (5)	Jiao Yuyong (2)	State Key Laboratory of Water Resources and Hydropower Engineering Science State Key Laboratory of Geomechanics and Geotechnical Engineering State Key Laboratory for Geomechanics and Deep Underground Engineering
35	J-222-2-01	Key Technology Research and Practices of High Concrete Dam Structure Safety	Second Prize	Jia Jinsheng (1) Chen Gaixin (4)	Zhang Guoxin (2) Liu Yi (8)	State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin
36	J-222-2-02	Hydraulic Control Theory and Key Technology of Long-Distance Water Delivery Engineering	Second Prize	Liu Zhiping (1) Huang Yuefei (5) Ma Chao (9)	Lian Jijian (2) Chen Wenxue (7) Guo Xinlei (10)	State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin State Key Laboratory of Hydraulic Engineering Simulation and Safety State Key Laboratory of Water Resources and Hydropower Engineering Science
37	J-223-2-03	Technical Innovation and Application of High-Speed Railway Catenary, and Pantograph System Based on Coupling Dynamics	Second Prize	Zhang Weihua (1) Mei Guiming (9)	Zhou Ning (6)	State Key Laboratory of Traction Power
38	J-231-2-01	Research on the Development and Application of Common Technologies for Urban Circular Economy Development	Second Prize	Wen Zongguo (2)		State Key Joint Laboratory of Environmental Simulation and Pollution Control
39	J-231-2-02	Key Technologies and Equipment for the Treatment of Refractory Organic Industrial Wastewater and Toxicity Reduction	Second Prize	Li Aimin (1) Long Chao (8)	Liu Fuqiang (2)	State Key Laboratory of Pollution Control and Resource Reuse
40	J-231-2-04	Research and Business Application of National Environmental Quality Remote Sensing Monitoring System	Second Prize	Chen Liangfu (6)	Jiang Dong (10)	State Key Laboratory of Remote Sensing Science State Key Laboratory of Resources and Environmental Information System
41	J-233-2-02	Research and Application of Multi-Modal Molecular Imaging and Functional Imaging Based on Magnetic Resonance Imaging	Second Prize	Teng Gaojun (1) Zhang Yu (8)	Gu Ning (4)	State Key Laboratory of Bioelectronics
42	J-233-2-03	Innovation, Promotion, and Application of Key Diagnosis and Treatment Technologies for Malignant Hematological Tumors	Second Prize	Xiao Zhijian (4)		State Key Laboratory of Experimental Hematology

No.	Achievement Code	Achievement Name	Award Level	Award Winners		Laboratory Name
43	J-233-2-04	Mechanism and Clinical Prevention and Treatment of Chronic Kidney Disease	Second Prize	Cheng Yongxian (8)		State Key Laboratory of Phytochemistry and Plant Resources in West China
44	J-233-2-06	Innovation and Application of Individualized Treatment Strategies for Colorectal Cancer	Second Prize	Xu Ruihua (1) Xie Dan (6)	Jia Weihua (5) Huang Wenlin (7)	State Key Laboratory of Oncology in South China
45	J-234-2-01	Establishment and Application of an Internationally Oriented Overall Quality Standard System for Chinese Medicine	Second Prize	Ye Min (5)		State Key Laboratory of Natural and Biomimetic Drugs
46	J-235-2-01	Establishment and Application of the Key Technology Systems for Crystal Forms of Chemical Pharmaceuticals	Second Prize	Du Guanhua (1)	Lu Yang (2)	State Key Laboratory of Bioactive Substance and Function of Natural Medicines
47	J-235-2-02	Development and Application of Genetically Engineered Mice and Other Related Disease Models	Second Prize	Gao Xiang (1) Yang Zhongzhou (3) Zhao Jing (7) Zhang Chenyu (10)	Zhu Minsheng (2) Li Chaojun (4) Liu Geng (9)	State Key Laboratory of Pharmaceutical Biotechnology
48	J-235-2-04	Development and Industrialization of Anti-Tumor Drugs from Natural Products with Complex Structures	Second Prize	You Qidong (1)	Guo Qinglong (3)	State Key Laboratory of Natural Medicines
49	J-25101-2-01	Key Techniques and Application of Preventing and Controlling Obstacles in Continuous Cropping of Protected Vegetables	Second Prize	Wang Xiufeng (3)		State Key Laboratory of Crop Biology
50	J-25101-2-02	Establishment and Application of High-Efficiency and Low-Risk Pesticide Technology Systems	Second Prize	Zheng Yongquan (1)	Dong Fengshou (3)	State Key Laboratory for Biology of Plant Diseases and Insect Pests
51	J-25101-2-03	Key Technologies for Improving Low-Yield Paddy Soil in Southern China	Second Prize	Xu Fangsen (6)		State Key Laboratory of Crop Genetic Improvement
52	J-25101-2-05	Regularities of Rice Stripe Leaf Blight and Black-Streak Dwarf Virus Catastrophes and Green Prevention and Control Technology	Second Prize	Wang Xifeng (3) Wu Jianxiang (6)	Zhou Xueping (4)	State Key Laboratory for Biology of Plant Diseases and Insect Pests State Key Laboratory of Rice Biology
53	J-25201-2-01	Key Technology and Applications of National E-Government Collaborative Spatial Decision Service	Second Prize	Zhang Mingbo (9)		State Key Laboratory of Resources and Environmental Information System
54	J-25201-2-03	Key Technologies and Applications of Domestic Land Satellite Quantitative Remote Sensing	Second Prize	Gu Xingfa (1)	Liu Qinhuo (9)	State Key Laboratory of Remote Sensing Science
55	J-25201-2-04	National Geographic Information Public Service Platform (Sky Map) R&D and System Construction	Second Prize	Wu Huayi (2) Song Aihong (7)	Gong Jianya (4)	State Key Laboratory of Information Engineering in Surveying, Mapping, and Remote Sensing

No.	Achievement Code	Achievement Name	Award Level	Award Winners	Laboratory Name
56	J-25202-2-01	Key Theory and Technology of Fully Mechanized Longwall and Caving Mining in Steeply Inclined Thick Coal Seams	Second Prize	Wang Jiachen (1)	State Key Laboratory of Coal Resources and Safe Mining
57	J-25202-2-03	Key Technology System and Engineering Applications of Safe and Efficient Extraction of Coal Seam Gas	Second Prize	Zhou Fubao (1) Gao Feng (3)	State Key Laboratory of Coal Resources and Safe Mining State Key Laboratory for Geomechanics and Deep Underground Engineering
58	J-25302-2-02	Construction and Application of Dental Pulp Disease Prevention and Treatment Technology System	Second Prize	Zhou Xuedong (1) Li Jiyao (2) Huang Dingming (3) Ye Ling (4) Xu Xin (5) Zheng Liwei (6) Cheng Lei (7) Hu Tao (8)	State Key Laboratory of Oral Diseases
59	J-25302-2-03	Establishment and Promotion of Chinese Severe Trauma Treatment Standards	Second Prize	Zhou Jihong (2)	State Key Laboratory of Trauma, Burns, and Combined Injury

Note: After the winner names, the ranking of the winner is in parentheses

Table 11 Acquisition of Authorized Invention Patents, New Drug Certificates, Software Registrations, Monographs, and Formulation of Standards by Laboratories

Year	Authorized Invention Patents	New Drug Certificates	Software Registrations	Monographs	Standards and Specifications
2016	11086	14	208	792	60
2015	8897	11	450	566	57
2014	7619	10	638	782	46

Table 12 Publication of Academic Papers by Laboratories

Category	Important Foreign Publications			Important Domestic Publications			Proceedings	
	Indexed by SCI	Indexed by EI	Other Journals	Indexed by SCI	Indexed by EI	Other Journals	International Conferences	Domestic Conferences
Quantity	53333	2517	897	1765	3467	6407	10336	7721

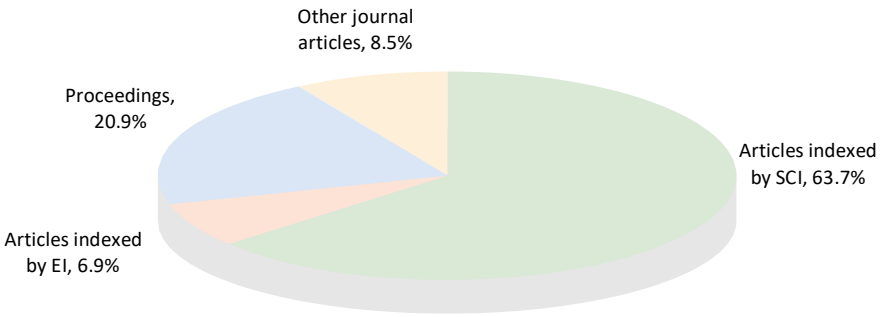


Table 13 Proportion of Academic Paper Types Published by Laboratories

III. Academic Exchange and Open Sharing

In recent years, state key laboratories and pilot national laboratories have carried out various forms of domestic and foreign academic exchanges and cooperation. In 2016, state key laboratories and pilot national laboratories undertook a total of 1,222 international cooperation projects and received research funding of approximately RMB 610 million. They held 462 global academic conferences and 561 national academic conferences; gave a total of 6,828 lectures at these academic conferences; invited 8,355 foreign experts to give lectures in China and received 3,791 invitations to give lectures abroad; and a total of 37,827 people (人次) participated in domestic and foreign academic conferences, including 13,651 people who participated in foreign academic conferences.

The State Key Laboratory of Resources and Environmental Information System successfully hosted the 17th International Symposium on Spatial Data Handling (SDH2016) from August 18 to 20, 2016. The theme of the symposium was "Challenges Facing Big Data," and it was divided into 6 topics and 53 academic reports. The content involved spatial big data storage, query, visual expression, and knowledge discovery, geoscientific calculations, spatiotemporal models, and data quality issues in crowdsourced environments, spatial data analysis methods, and the geoscience applications of spatial data. It attracted more than 120 representatives from 12 countries and regions including the United States and the United Kingdom, who discussed new developments, new directions, and new trends in the field of spatial data processing. This symposium provided an international perspective on laboratory development and provided a development direction and theoretical basis for spatial data processing. The International Symposium on Spatial Data Handling is an international conference jointly initiated by the Geographic Information Science (IGU-GIScience) Committee and the Geographic System Modeling (IGU-CMGS) Committee under the International Geographical Union (IGU). It is one of the first and most representative international conferences in the field of geographic information systems.

From May 23 to 27, 2016, the State Key Laboratory of Transient Optics and Photonics, together with Xi'an Institute of Optics and Fine Mechanics of the Chinese Academy of Sciences and the Shanghai Institute of Optics and Fine Mechanics of the Chinese Academy of Sciences hosted the 17th International Symposium on Laser Precision Microfabrication, which was held in a grand manner in the ancient city of Xi'an. More than 330 experts and scholars and 20 professional manufacturers from 17 countries and regions including the United States, Germany, Britain, Japan, and France attended the symposium. The International Symposium on Laser Precision Microfabrication has been

successfully held in Japan, Singapore, Germany, the United States, Austria, and other countries. It has become a thematic international conference with extensive influence and a high level in the field of laser precision processing. The successful holding of this conference in China provided a wide range of academic exchange platforms for domestic and foreign peers and will also play a positive role in promoting the development of the laser micro and nano processing field in China.

Sponsored by the State Key Laboratory of Stem Cell and Reproductive Biology and co-organized by the School of Medicine of the University of Chinese Academy of Sciences (中国科学院大学医学院), "The 4th SKLRB Symposium on Reproductive Biology" was held in a grand manner at the International Conference Center of the University of Chinese Academy of Sciences from October 26 to 29, 2016. The symposium invited 30 scientists and clinical experts from the United States, United Kingdom, Canada, Spain, Australia, Japan, and China to give keynote speeches. More than 300 scholars in the field of reproductive biology participated in the symposium. The symposium established 6 themes, and the participants discussed and exchanged views concerning the frontiers of reproductive biology. Different from previous conferences, 18 graduate students from various Chinese research institutes shared their latest research results and had a casual and enthusiastic dialogue with well-known scientists. This conference has a positive effect on enhancing the international influence of scientific workers in the field of reproductive biology in China and promoting domestic research on reproductive biology. It is of great significance for the guidance of the country's S&T planning in related fields in the new era. SKLRB Symposium on Reproductive Biology was founded in 2010. Held every two years, it has become an important conference for international peers in the field of reproductive biology for communication and looking forward to the future. It provides a broad academic exchange platform for Chinese basic and clinical research in reproductive biology, the promotion of the treatment of reproductive diseases, and the maintenance of the reproductive health of the people.

The 2016 International Conference on Science and Technology of Synthetic Metals (ICSM2016) sponsored by the State Key Laboratory of Luminescent Materials and Devices was held from June 26 to July 1, 2016 in Guangzhou Baiyun International Convention Center. A total of 1,430 experts, scholars, and S&T personnel from 35 countries and regions were invited to this conference, and foreign participants accounted for about 40%. The conference closely focused on the theme of "Organic Optoelectronic Functional Materials and Devices - The Rising Star of Energy Information Science" (有机光电功能材料与器件-能源信息科学的明日之星) and established 12 topics, basically covering all research hotspots of organic functional materials. The conference received about 1,000 papers, including 12 conference reports, 143 invited reports, 153 oral reports, and 668 posters. This conference provided a platform for Chinese and foreign experts and scholars to exchange and display their latest academic achievements and ideas. It has a

profound impact on the development of organic information materials and nano-optoelectronic devices in China and has played an important role in promoting the development of organic energy and information materials and optoelectronic devices in China. From November 18 to 20, the laboratory also hosted "Faraday Discussions (FD) - Aggregation Induced Emission (AIE)," attracting about 100 scientific research workers from 9 countries and regions to participate. The holding of this forum promoted in-depth exchanges between experts in the field, effectively promoted the development of the laboratory in this field, and enhanced the influence of the laboratory.

The State Key Laboratory of Solid State Microstructures, with the School of Modern Engineering and Applied Science of Nanjing University, Collaborative Innovation Center of Advanced Microstructures of Nanjing University, and Nanjing University Quantum Material Microstructure Research Center (南京大学量子材料微结构研究中心), jointly hosted "The 23rd International Workshop on Oxide Electronics (WOE)," which was successfully held in Nanjing from October 12 to 14, 2016. Nearly 200 experts and scholars from more than 20 countries and regions were invited to the workshop. The participating scholars discussed the latest progress and development trends in the field of oxide electronics. The content covered nine directions including polarized vortex and polarized metals, ferroelectrics and their functions, artificially designed multiferroic materials, superconductivity in two-dimensional systems, and oxide materials. The "International Workshop on Oxide Electronics" conference series has been held in the United States, Europe, Japan, South Korea, and other Asian countries. It has become the most influential international conference in the field of oxide electronics and has a high academic level. This conference provides a good exchange platform for Chinese and foreign peers in this discipline and will also play a positive role in promoting the development of oxide electronics in China.

The State Key Laboratory of Physical Chemistry of Solid Surfaces carried out extensive cooperation and exchanges in 2016. In 2016, the laboratory was approved to build a new university discipline innovation and intelligence introduction program, "Nano Surface Interface and Cluster Chemistry Innovation and Intelligence Introduction Base in Energy Materials Chemistry" (能源材料化学中纳米表界面和团簇化学创新引智基地). The laboratory has renewed a friendly cooperation agreement with the Institute for Catalysis of Hokkaido University and established the "Nano Biocatalytic Electrochemistry International Joint Laboratory (LIA NanoBioCatEchem)" with the French National Centre for Scientific Research, the École Normale Supérieure, the University of Rennes 1, and Wuhan University. In 2016, 63 experts including Nobel Prize winner Eric Betzig were invited to come to the laboratory for academic exchanges. The laboratory established the second international advisory committee, which includes 13 well-known experts from the United States, Germany, France, Finland, Israel, and Japan, to provide an international perspective for the development of the laboratory. In addition, the laboratory hosted the "Beijing

Forum 2016: Chemical Reactions under External Field Control - International Symposium on Nanoplasmonic Optics and Nanospectroscopy" (北京论坛2016：外场调控下的化学反应——纳米等离激元光学和纳米光谱国际研讨会), the "16th International Conference on Catalysis (16th ICC) Satellite Symposium: International Symposium on Catalytic Activation and Selective Conversion of Energy-Related Molecules," the "PCOSS-ICAT Joint International Symposium on Catalysis Science for Using Nano-Porous Materials for Sustainable Energy Development," "Surface Chemical Reaction and Catalytic Kinetic Process International Symposium" (表面化学反应与催化动力学过程国际研讨会), and other international academic conferences.

The Qingdao Pilot National Laboratory for Marine Science and Technology actively built an international exchange network to lay the foundation for international cooperation. In August 2016, the laboratory formally joined the Partnership for Observation of the Global Ocean (POGO). This organization is an important global maritime organization, with 38 member institutions. It plays an important role in promoting the exchange and cooperation of global marine scientific research institutions, coordinating the observational information of marine disciplines in different regions, achieving the exchange and sharing of multidisciplinary observational information, and supporting marine observation and research in developing countries. In 2016, there were 43 international cooperation projects under research, including the Northwest Pacific Ocean Circulation and Climate Experiment Project of the Functional Laboratory of Ocean Dynamics Process and Climate. The Centre for Southern Hemisphere Oceans Research, established in cooperation with the Australian Commonwealth Scientific and Industrial Research Organisation, the University of New South Wales, and the University of Tasmania, has strongly promoted the development of Chinese ocean and climate science and provided a platform for China to participate in the development of marine resources in the Southern Hemisphere. The first open studio (开放工作室), the open studio for seabed cable observation, was launched to efficiently gather global innovation resources, quickly improve innovation capabilities, and carry out research and development on deep-sea observation network construction technology. In 2016, 17 sessions of the Aoshan Forum were held, with a total of 258 reports and more than two thousand domestic and foreign experts participating in the seminar. The laboratory hosted the CLIVAR (Climate Variability and Predictability Research Program) 2016 Open Science Conference to discuss the formulation of a CLIVAR scientific program for the next 10 years and promote global ocean climate change research. The laboratory initiated and hosted the Global Ocean Summit 2016. The holding of this summit greatly improved the laboratory's position in the international marine science and education community, presented an open and collaborative international image, and is known as the "G20 Summit" in the marine science and education field.

The State Key Laboratory of New Drug Research has actively carried out high-level and high-grade academic exchanges through large-scale academic seminars. In 2016, the laboratory held the "Belt and Road" International Symposium on Science and Technology Innovation Sub-forum 3 (Disease and Health) (科技创新国际研讨会分论坛3 (疾病与健康)), CSIRO-CAS Health Medicine Forum (CSIRO-CAS健康医学论坛), the 3rd SIMM-AZ High-level Symposium on New Drug Creation (第三届SIMM-AZ新药创制高层学术研讨会), Sino-Swiss Science and Technology Cooperation Seminar, and other conferences. More than 60 professors and scholars from over 10 countries along the "Belt and Road" route, including Australia, Greece, Hungary, Serbia, and Ethiopia, were invited to visit the laboratory in order to promote international exchanges and collaboration on the theme of new drug research and development. The laboratory strengthened academic cooperation with Chinese and foreign research institutions, such as the

Beijing Institute of Genomics of the Chinese Academy of Sciences, Harvard Medical School, University of Chicago, University of Chinese Academy of Sciences, and China Pharmaceutical University. Related research results were published as 52 papers in international academic journals such as *Cancer Cell, Adv. Mater., Nat. Commun., and PNAS*. The fixed members of the laboratory gave 34 reports by special invitation at international conferences, discussed pharmaceutical progress and trends with their pharmaceutical peers, covering drug innovation, new drug development in the era of precision medicine, and other topics, and enhanced the laboratory's domestic and foreign influence.

The 11th ACM Asia Conference on Computer and Communications Security, AsiaCCS hosted by the State Key Laboratory of Integrated Services Network was held at the Xi'an Qujiang International Conference Center from May 30 to June 3, 2016. The content covered theories and practices related to the fields of information and computer and communication security, such as software security, cloud security, password authentication and security, attribute-based encryption, outsourced computing, system security, mobile security, security protocols, web and network security, malware and attacks, and privacy protection. The conference attracted more than 260 experts, scholars, and related persons from China and abroad. The conference received more than 350 submitted papers, accepted 81 papers, and published the conference proceedings. This conference enhanced the laboratory's international influence in the field of information, computer, and communication security, provided a platform for exchanges between Chinese and foreign scholars, and promoted the development of this field.

In June 2016, the Tsinghua National Laboratory of Information Science and Technology (planned), together with the National Engineering Laboratory For DTV (Beijing) and Design Institute of the State Administration of Radio, Film, and Television, launched the China DTMB standard trial network project and network construction survey in the Greater Islamabad area of Pakistan. With the assistance of Pakistan, China and Pakistan jointly inspected six sites, MURREE, KALA SHAH KAKU, SAKESAR, CHERAT, THANDIANI, and KHEWRA, and conducted in-depth investigations on overdue coverage, population coverage, site environment, and local requirements. With the joint efforts of technicians from both sides, a preliminary design plan was formed. The Islamabad area test network mainly covers Islamabad and its surrounding areas, benefiting a population of approximately 14.5 million. The test network includes 3 main transmitting stations and 2 auxiliary transmitting stations. It is designed to transmit no less than 20 high-definition and standard-definition digital TV programs and will also transmit some Chinese TV programs. Construction will start on the network in 2017, and it will be put into operation in 2018. As the first drafter of the DTMB international standard, the laboratory has always been committed to the internationalization, industrialization, and technological evolution of the standard. 13 countries and regions have applied the standard and 15 related international standards have been formulated.

The State Key Laboratory of Organometallic Chemistry attaches great importance to cooperative research with relevant research institutions in China and abroad. The laboratory actively organizes and participates in major international research projects. It presided over 3 international cooperation projects of the National Natural Science Foundation of China in 2016 (Partners: Technion - Israel Institute of Technology, The Chinese University of Hong Kong, The University of North Carolina at Chapel Hill, and the University of Campinas in Brazil) and 1 Shanghai International Cooperation Project (Partner: Ruđer Bošković Institute of Croatia). The laboratory published 10 collaborative research papers as the first author. In addition, the laboratory has also actively conducted joint research with 15 Chinese and foreign companies including Luxi Chemical Group Co., Ltd., China Petroleum & Chemical Corporation, Bayer HealthCare Company Ltd., and Daicel Chiral Technologies (Shanghai) Co., Ltd. In 2016, the laboratory undertook 18 enterprise cooperation projects, with contract research funding of RMB 14.79 million.

The implementation of the laboratory's unclassified topics (开放课题) has attracted a large number of Chinese and foreign talents to carry out high-level basic research and applied basic research in the laboratory, leading and driving the development of related disciplines in China and enhancing the influence of the laboratory. In 2016, the laboratory set up a total of 5,759 unclassified topics with funding of RMB 460 million.

The State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering published 67 papers in 2016 with funding from open projects. Among them is the project "Application Research on the Application of Assimilation Technology in Land-Atmosphere Coupling Real-Time Flood Forecasting" (同化技术在陆气耦合实时洪水预报中的应用研究) undertaken by Professor Liu Jia from the China Institute of Water Resources and Hydropower Research. Through data assimilation, the rainfall forecast accuracy of the WRF model was effectively improved, a land-atmosphere coupled flood forecasting system with two-way correction of rainfall and runoff was constructed, a two-dimensional index system for evaluating and forecasting rainfall was proposed, and typical application research was successfully carried out in the Daqing River Basin. In July 2016, the laboratory released the 2016 Application Instructions and Regulations of Open Research Fund (2016 开放研究基金管理办法及申请指南) and set up key projects (重点项目) and general projects (面上项目). The key projects invite high-level Chinese and foreign talents in this field to come to the laboratory for collaborative research, focusing on the key research content of the laboratory, in order to obtain high-level research results. The general projects provide funding to outstanding young and middle-aged talents in the form of free declarations (自由申报形式). A total of 38 project applications from 31 Chinese and foreign universities and research institutes were received. After review, 3 key projects and 15 general projects were approved and granted funding of RMB 1.65 million.

The State Key Laboratory of Low-Dimensional Quantum Physics actively leverages its scientific research platform advantages in terms of academic and equipment facilities to promote basic research, applied basic research, and academic exchanges in the field of low-dimensional quantum physics. In 2016, the laboratory selected 15 open projects for funding, with a funding amount of RMB 2.07 million. A total of 37 academic papers were published on the unclassified topics that were completed in 2016, including in *Adv. Mater., Appl. Phys. Lett., and P R*. There were 2 reports given by special invitation in China and abroad; 18 domestic and foreign group reports, 3 monographs published, and 7 patent applications. Associate Professor Wang Xina of Hubei University undertook the "Interfacial Band Regulation and Photolysis Water Performance

of Cobalt Oxide Composite Nanoarrays" project, which developed applications of dual-functional Ni1-xFex layered double hydroxides (LDHs) in full water splitting. In the photoelectrolysis water battery, the introduction of a promoter can not only effectively protect the photoelectrode from photochemical corrosion and light passivation, but also promote the kinetics of hydrogen evolution or oxygen evolution reaction (HER or OER), reduce the over-potential of HER or OER, and improve the solar-to-hydrogen (STH) conversion efficiency.

The State Key Laboratory for Diagnosis and Treatment of Infectious Diseases established 11 unclassified topics around its research direction in 2016, with funding of RMB 2.02 million. The laboratory formulated the *Regulations on the Management of Open Funds* (开放基金管理条例) to ensure that open funds can be used in a reasonable, legal, and effective way. The laboratory arranged for special personnel to supervise the implementation of various topics and regularly collect topic progress reports. Relying on the open fund, 6 SCI papers were published in 2016, and some topics made important progress. Among them, for the application of large clinical samples, a cheap, highly reproducible, fast, and high-throughput proteomics pretreatment process based on ordinary 96T microplates and the low-speed acetone precipitation method was developed, which can pre-treat 96 samples within 2 hours. For the first time, research on the correlation between urine microecology and host metabolic diseases, such as diabetes, in the Chinese population was completed, and the potential role of urine flora in the progression of diabetes was analyzed.

In addition, through the establishment of unclassified topics, the laboratories have increased the utilization rate of advanced laboratory equipment, achieved resource sharing, promoted the formation and development of emerging and interdisciplinary academic subjects, and played a positive role in the cultivation of high-level S&T talents.

Table 13 Large Academic Conferences Held by Laboratories

Category	Global	Regional	Bilateral	National
No. of Conferences	462	103	101	561
Proportion (%)	37.7	8.4	8.2	45.7

Table 14 Participation of Laboratory Personnel in Academic Exchanges

Category	Invited Lecturer		Dispatched Lecturer		Conference Participant	
	Chinese	International	Chinese	International	Chinese	International
No. of People (人次)	8025	8355	9745	3791	24176	13651

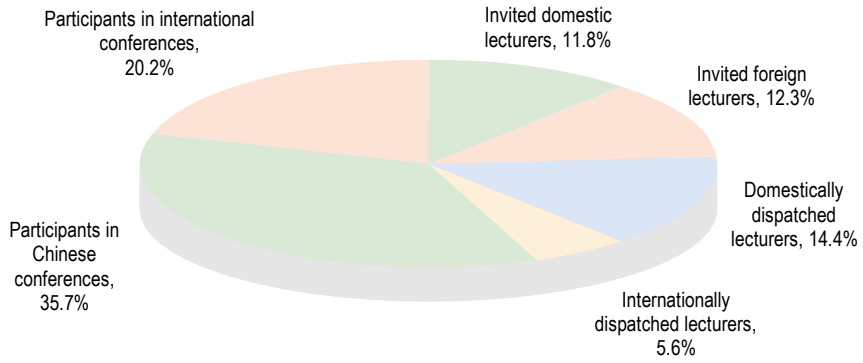


Table 14 Proportion of Academic Exchange Types Held by Laboratories in 2016

IV. Public Opening

In 2016, each laboratory actively carried out public opening (公众开放) activities. The laboratories made full use of their own scientific research, talent, and resource advantages and have done a lot of work in disseminating scientific knowledge, popularizing science, and improving citizens' scientific literacy, achieving gratifying results. In 2016, the laboratories organized 40,727 public opening activities of various formats, such as visits, summer camps, popular science lectures, and student practice. The objects of opening up were mainly ordinary citizens and college students, accounting for 39.8% and 25.5% of the total number of visitors, respectively.

On May 19, 2016, the State Key Laboratory of Molecular Biology successfully held a Public Science Day event at the National Center for Protein Science (Shanghai). The event attracted nearly a hundred teachers and students from the Second Affiliated Middle School of East China Normal University and Shanghai Zhuyuan Middle School. The teachers and students concentrated on watching the popular science videos “Seeing the Protein” and “The Magic Little Egg” and gained a preliminary understanding and understanding of protein science research. Researcher Huang Jing from the Center for Protein Science gave a popular science report on “Decoding the Mysteries of Life - RNA Discovery Journey,” providing a detailed introduction to the discovery of RNase and an analysis of its structure, the cutting-edge technology CRISPR/cas9, and other milestones. Later, under the leadership of popular science promoters, the students visited the five lines and six stations for protein structure and dynamic analysis of the Shanghai Synchrotron Radiation Facility. Through zero-distance “close contact” with the state-level large scientific installation, the students showed great interest in the “weapon of the country” (“国之利器”). They actively asked questions and interacted with S&T personnel and volunteers. Everyone expressed that they had completed an enriching “protein science journey.”

The State Key Laboratory of Ocean Engineering successfully held the “Go Deep Blue” (走向深蓝) summer camp in July 2016. More than 400 students from 145 key high schools in 18 provinces across the country signed up. After 6 days and 5 nights of learning and exchange

experiences, the students felt the strong academic atmosphere of the laboratory, listened to lectures by ship and marine experts, learned to make ship models, visited the China Maritime Museum, gained an in-depth understanding of the laboratory's ship and marine scientific research strength, the development of national marine S&T, and the history of China's maritime development, and felt the infinite charm of the "Spire of the Science Pyramid" (科学金字塔塔尖). In addition, the laboratory actively cooperated with the Shanghai Society of Naval Architects and Marine Engineers in launching the National Science Popularization Day with the theme of "Innovative Dreams: S&T Leading the Future" (创新放飞梦想，科技引领未来); carried out the "Roadshow Exhibition of Shipbuilding and Marine Engineering Knowledge Exhibition Boards" (船舶与海洋工程知识展板巡回展览), benefiting more than 2,000 primary and secondary school students and teachers; and held the "Ship and Marine Engineering College Student Essay Competition" (船舶与海洋工程大学生论文比赛), where the instructed students won 3 first prizes, 2 second prizes, and 2 third prizes in the 31st Shanghai Youth Innovation Competition. The laboratory organized the publication of *English-Chinese Dictionary of Ship and Ocean Engineering Technology* (英汉船舶及海洋工程技术大词典) and *Impressions of Dredging Equipment in China and Abroad* (印象国内外疏浚装备) and participated in the compilation of *Understanding Marine Development Equipment and Engineering Ships* (认识海洋开发装备和工程船) and other popular science books. These activities provided the residents of the city with the opportunity to experience the scientific research work environment at close range and played a role in disseminating scientific knowledge and cultivating future scientists.

The State Key Laboratory of Molecular Reaction Dynamics aims to improve the scientific quality of the whole people, stimulate the enthusiasm of the general public for S&T innovation, and create a good atmosphere throughout society of loving science, advocating science, and paying attention to scientific undertakings. From May 13th to 14th, about 6,000 students from universities, secondary, and primary schools and visitors from the general public participated in the 17th "Public Science Day" series of activities. The laboratory held popular science lectures such as "Fantastic Science Experiments" (奇妙的科学实验), "Magic Laser" (神奇的激光), "Scanning Tunneling Microscope: Atoms and Molecules in Your Eyes" (扫描隧道显微镜——你我眼中的原子分子), "Ion Velocity Imaging: A Real-time Portrait of the Molecular World" (离子速度成像——分子世界的实时写真), and "Femtosecond Spectroscopy and Crossed Molecular Beams: Tracking Molecular Footprints" (飞秒光谱与

交叉分子束——追踪分子的足迹), fully demonstrating the laboratory's internationally leading scientific equipment and scientific research results. The opening-up activities fully demonstrated to the public the important role of S&T in leading economic and social development, creating a happy life for the people, and enhancing the country's comprehensive strength. They demonstrated the innovative ideas, solid work practices, and world-leading scientific research results of the laboratory's scientific researchers.

The State Key Laboratory of Fire Science has established a popular science interpretation group with teachers as the main participants and formed a science education mechanism that combines popular science activities, such as S&T Activity Week, Disaster Prevention and Mitigation Day, and 119 Fire Prevention Publicity Day, with daily opening-up activities. The combination of “base opening” and “college student science interpretation groups going to the community and classroom” is adopted to continuously expand the scope of popular science education. The laboratory organized undergraduates of the class of 2016 to conduct fire safety evacuation drills, school-wide student apartment fire evacuation drills, college student safety committee training, and other activities, which vigorously popularized fire safety knowledge and fire-fighting skills and enhanced public fire safety awareness. These activities received 15,000 visitors throughout the year, including more than 7,000 visitors during the Science and Technology Week in May. The National Popular Science Education Base established by the laboratory instructed science groups of university students to go to communities, primary and secondary schools, and special education schools to carry out propaganda on popular science, which left a deep impression on the broad audience and stimulated students’ deep interest in fire science.

Table 15 Overview of Laboratories’ Public Opening-Up Formats

Opening-Up Format	Visits	S&T Summer Camps	Popular Science Lectures	Student Practice	Other Activities
No. of Activities	30931	1734	2725	3892	1445
Proportion (%)	75.9	4.3	6.7	9.6	3.5

Table 16 Overview of Laboratories’ Public Opening-Up Objects

Opening-Up Object	University Students	Secondary School Students	Primary School Students	Other Members of Public
No. of People	93804	67947	59424	146138
Proportion (%)	25.5	18.5	16.2	39.8

Part III Team Construction at State Key Laboratories

The state key laboratories and pilot national laboratories have attracted, condensed, and cultivated a group of outstanding S&T talents, created a group of leading figures at the frontier of science, and established a high-quality research team with a reasonable age and knowledge structure.

I. Basic Situation

As of the end of 2016, state key laboratories and pilot national laboratories had a total of 383 academicians of the Chinese Academy of Sciences and 203 academicians of the Chinese Academy of Engineering, accounting for 51.8% and 25.0% of the total number of academicians respectively. The laboratories had 1,513 winners of support from the National Science Fund for Distinguished Young Scholars, accounting for 43.4% of the total, and 241 grants from the Science Fund for Creative Research Groups, accounting for 54.4% of the total.

The state key laboratories and pilot national laboratories play an important role in promoting the development of academic disciplines. Relying on the laboratories, there are a total of 2,120 doctoral degree authorization points (授权点) and master's degree authorization points. In 2016, there were a total of 102,555 doctoral and master's students studying at and enrolled in the laboratories, and a total of 27,967 doctoral and master's students graduated.

Table 17 Laboratory Talent Team Construction

Category	Chinese Academy of Sciences Academicians	Chinese Academy of Engineering Academicians	Recipients of National Fund for Distinguished Young Scholars Support	Science Fund for Creative Research Groups
No. of Laboratory Staff	383	203	1513	241
Total People Nationwide	739	812	3486	443
Nationwide Proportion (%)	51.8	25.0	43.4	54.4

Table 18 Laboratory Degree Point Construction and Talent Training

Category	Degree Points	Studying and Enrolled Students This Year	Graduates This Year
Master's	1139	59084	18897
PhD	981	43471	9070

II. Winner of the 2016 National Highest Science and Technology Award

Academician Zhao Zhongxian of Beijing National Laboratory for Condensed Matter Physics (planned) won the 2016 National Highest Science and Technology Award. Zhao Zhongxian, male, was born in Xinmin, Liaoning in 1941 and worked in the Institute of Physics of the Chinese Academy of Sciences after graduating from the University of Science and Technology of China in 1964. He has served as the business leader of the National Defense Research Group (国防课题组) and director of the National Laboratory for Superconductivity (超导国家重点实验室). He is

currently a researcher at the Institute of Physics of the Chinese Academy of Sciences and a fixed staff member of the Beijing National Laboratory for Condensed Matter Physics (planned). He was made an academician of the Chinese Academy of Sciences in 1991. For more than 50 years, except for participating in national defense tasks for a few years, he has been engaged in superconductivity research and is one of the founders of high-temperature superconductivity research in China.

The critical temperature of superconductors is very low, affecting their widespread application. It has been a long-term dream of scientists to find high-temperature superconductors in the temperature region of liquid nitrogen or even room temperature. In the over 100-year history of superconductivity research, there have been two major breakthroughs in high-temperature superconductivity, and Zhao Zhongxian and his collaborators have made both important achievements: The independent discovery of high-temperature superconductors in the liquid nitrogen temperature zone and the discovery of a series of iron-based high-temperature superconductors above 50K and setting a record of 55K.

Zhao Zhongxian was one of the first few scholars in the world to realize the significance of Bednorz and Müller's "possibly up to 35K superconductivity in Ba-La-Cu-O" (which later won them the Nobel Prize.) This work resonates with the idea that "structural instability can lead to high critical temperatures", which he has advocated for many years. In February 1987, Zhao Zhongxian and his collaborators independently discovered high-temperature superconductors in the liquid nitrogen temperature zone and, in a world-first, announced its elemental composition as Ba-Y-Cu-O, which promoted an international boom in high-temperature superconductivity research. In 1987, he won the Third-World Academy of Science (TWAS) physics award. This was the first time that a Chinese scientist had won this award. In 1989, he won the first prize (ranked first) of the National Natural Science Award for the "Discovery of Oxide Superconductivity in the Temperature Zone of Liquid Nitrogen."

Zhao Zhongxian

Zhao Zhongxian's second major contribution was the discovery of a series of iron-based high-temperature superconductors above 50K and setting a record of 55K. With long-term persistence and accumulation, Zhao Zhongxian gradually developed a new idea for the exploration of new high-temperature superconductors, that is, it is possible to realize high-temperature superconductivity in a layered tetragonal system with multiple cooperative phenomena. In 2008, a group in Japan reported that LaFeAsO has a superconductivity of 26K. Zhao Zhongxian combined this discovery with his own academic ideas and realized that a new breakthrough might be born in it. Based on the research on the LaFeAs(O, F) pressure effect, Zhao Zhongxian proposed a synthesis scheme for light rare earth element substitution and high temperature and high pressure and took the lead in increasing the critical temperature of iron-based superconductors from 26K to 52K, which significantly exceeded the 40K McMillan limit. Soon, most of the series of iron-based superconductors above 50K were synthesized, setting the highest critical temperature record for bulk iron-based superconductors at 55K. In 2013, Zhao Zhongxian won first prize at the National Natural Science Awards for "the discovery of iron-based high-temperature superconductors above 40K and the study of several basic physical properties." In 2015, he won the Matthias Award, an important international superconductivity award.

Zhao Zhongxian has persevered in high-temperature superconductivity research for 40 years. He focuses on cultivating talent and actively creates a good environment for young people. He is the main advocate, promoter, and practitioner of high-temperature superconductivity research in China, and he has made important contributions that have allowed high-temperature superconductivity research to take root in China, making the country one of the international leaders.

III. Laboratories Receiving Funding from the Innovative Research Group (创新研究群体) and the National Science Fund for Distinguished Young Scholars (国家杰出青年科学基金资助) and Those Selected as Key Field Innovation Teams (重点领域创新团队) and Young and Middle-Aged S&T Innovation Talent Leaders (中青年科技创新领军人才名单)

In 2016, 20 national key laboratories and pilot national laboratories were funded by the National Natural Science Foundation of China's Science Fund for Creative Research Groups (创新研究群体科学基金), accounting for 52.6% of the total that year. 26 teams were selected as innovation teams in key fields by the Ministry of Science and Technology (MOST), accounting for 38.8% of the total that year, reflecting the remarkable achievements in laboratory team building. 95 people were funded by the National Science Fund for Distinguished Young Scholars of the National Natural Science Foundation of China, accounting for 47.5% of the total that year, and 137 young and middle-aged S&T innovation talent leaders were selected by MOST, accounting for 43.6% of the total that year.

Table 19: List of New Laboratory Grants from the National Natural Science Foundation of China's Science Fund for Creative Research Groups

No.	Academic Leader	Name	Laboratory Name	Unit
1	Cao Wuchun	Discovery and Traceability of Natural Epidemic Diseases	State Key Laboratory of Pathogen and Biosecurity Microorganisms	Academy of Military Medical Sciences of the People's Liberation Army (PLA) Academy of Military Science
2	Deng Xingwang	Study on the Molecular Mechanism of the Integration of Environmental and Endogenous Signals to Regulate Plant Cell Elongation	State Key Laboratory of Protein and Plant Gene Research	Peking University
3	Feng Xiating	Safety Analysis Prediction and Control of Major Rock Engineering	State Key Laboratory of Geomechanics and Geotechnical Engineering	Wuhan Institute of Rock and Soil Mechanics, Chinese Academy of Sciences
4	Gao Ziyou	Urban Traffic Management Theory and Methods	State Key Laboratory of Rail Traffic Control and Safety	Beijing Jiaotong University
5	Gong Qiyong	Medical Imaging	State Key Laboratory of Biotherapy	Sichuan University
6	Han Xu	Automobile Collision Safety Analysis and Optimization Design	State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body	Hunan University
7	Li Fuguang	Cotton Germplasm Innovation and High-Yield Molecular Breeding	State Key Laboratory of Cotton Biology	Institute of Cotton Research, Chinese Academy of Agricultural Sciences

No.	Academic Leader	Name	Laboratory Name	Unit
8	Liu Changsheng	Inorganic Nanobiomaterials	State Key Laboratory of Bioreactor Engineering	East China University of Science and Technology
9	Liu Xiaolong	Tumor Immunology	State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
10	Qin Boqiang	Lake Environment Changes and Their Ecosystem Responses	State Key Laboratory of Lake Science and Environment	Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences
11	Su Hongye	Complex Petrochemical Process Modeling and Optimization Control Theory, Technologies, and Applications	State Key Laboratory of Industrial Control Technology	Zhejiang University
12	Yan Jianhua	Thermal Conversion Mechanism and Clean Utilization of Complex Component Solid Fuel	State Key Laboratory of Clean Energy Utilization	Zhejiang University
13	Yang Guanghong	Fault Diagnosis and Fault Tolerance Control	State Key Laboratory of Synthetical Automation for Process Industries	Northeastern University
14	Yao Xuebiao	Dynamic Assembly and Regulation of Centromeres	Hefei National Laboratory for Physical Sciences at the Microscale (Planned)	University of Science and Technology of China
15	Yu Jihong	Porous Functional Materials	State Key Laboratory of Inorganic Synthesis and Preparative Chemistry	Jilin University
16	Yu Biao	Chemical Biology of Natural Products	State Key Laboratory of Bioorganic and Natural Product Chemistry	Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences
17	Zeng Dajun	Big Data-Driven Safety Informatics	State Key Laboratory of Management and Control for Complex Systems	Institute of Automation, Chinese Academy of Sciences
18	Zeng Heping	Molecular Precision Spectroscopy and Precision Measurement	State Key Laboratory of Precision Spectroscopy	East China Normal University
19	Zhang Xingliang	Early Life Evolution	State Key Laboratory of Continental Dynamics	Northwest University
20	Zhou Qi	Stem Cells and Regenerative Medicine	State Key Laboratory of Stem Cell and Reproductive Biology	Institute of Zoology, Chinese Academy of Sciences

Table 20 Laboratory Teams Newly Selected as Innovation Teams in Key Fields by MOST

No.	Academic Leader	Team Name	Laboratory Name	Unit
1	Chen Hongbing	Food Allergy Innovation Team	State Key Laboratory of Food Science and Technology	Nanchang University
2	Chu Chengcai	Molecular Design of Efficient Resource Rice Utilization Innovation Team	State Key Laboratory of Plant Genomics	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences
3	Dai Songyuan	Research on the Basis and Application of New Thin Film Solar Cells	State Key Laboratory of Alternate Electrical Power System with Renewable Energy Sources	North China Electric Power University
4	Feng Yujie	Targeted Transformation of Water Pollutants and Resource, and Energy Recovery Innovation Team	State Key Laboratory of Urban Water Resources and Environment	Harbin Institute of Technology
5	Gao Liang	High-Speed Railway Line Engineering Service Innovation Team	State Key Laboratory of Rail Traffic Control and Safety	Beijing Jiaotong University

No.	Academic Leader	Team Name	Laboratory Name	Unit
6	Han Yanchun	Polymer Material Structure and Performance Innovation Team	State Key Laboratory of Polymer Physics and Chemistry	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences
7	He Gaohong	New Efficient Process Coupling Strengthening Innovation Team	State Key Laboratory of Fine Chemicals	Dalian University of Technology
8	Jiang Bin	High-Performance Magnesium Alloy Materials and Application Innovation Team	State Key Laboratory of Mechanical Transmission	Chongqing University
9	Jin Yongdong	Life and Health Analytical Chemistry and Technology Innovation Team	State Key Laboratory of Electroanalytical Chemistry	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences
10	Ju Yang	Deep Coal Mining Dynamic Disaster Mechanisms and Prevention Innovation Team	State Key Laboratory of Coal Resources and Safe Mining	China University of Mining and Technology
11	Li Chaolun	Deep-Sea Extreme Environment and Life Process Research and Innovation Team	Qingdao Pilot National Laboratory for Marine Science and Technology	Institute of Oceanology, Chinese Academy of Sciences
12	Li Yaping	New Anticancer Drug Delivery System Innovation Team	State Key Laboratory of New Drug Research	Shanghai Institute of Materia Medica, Chinese Academy of Sciences
13	Liu Zhimin	Green Conversion and Utilization of Renewable Carbon Resources Innovation Team	Beijing National Laboratory for Molecular Sciences (Planned)	Institute of Chemistry, Chinese Academy of Sciences
14	Luo Zhenge	Neurodevelopment and Regeneration Research Innovation Team	State Key Laboratory of Neuroscience	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
15	Ma Dongge	Organic Polymer Display and Lighting Materials and Device Innovation Team	State Key Laboratory of Luminescent Materials and Devices	South China University of Technology
16	Shen Wenjie	Nanocatalysis Basic Research Innovation Team	State Key Laboratory of Catalysis	Dalian Institute of Chemical Physics, Chinese Academy of Sciences
17	Song Jian	Broadband Multimedia Transmission Technology Innovation Team	Tsinghua National Laboratory for Information Science and Technology (Planned)	Tsinghua University
18	Wu Guangning	Rail Transit Traction Power Supply Safety Assurance Technology Innovation Team	State Key Laboratory of Traction Power	Southwest Jiaotong University
19	Ye Gongyin	Pest Parasitic Wasp Resource Mining and Application Research Innovation Team	State Key Laboratory of Rice Biology	Zhejiang University
20	Yuan Xiaoming	Renewable Energy Grid Integration and Consumption	State Key Laboratory of Advanced Electromagnetic Engineering and Technology	Huazhong University of Science and Technology
21	Zhang Donghui	Molecular Reaction Dynamics Research Team	State Key Laboratory of Molecular Reaction Dynamics	Dalian Institute of Chemical Physics, Chinese Academy of Sciences
22	Zhao Liang	Continental Convergence Boundary Deep Dynamics Innovation Team	State Key Laboratory of Lithospheric Evolution	Institute of Geology and Geophysics, Chinese Academy of Sciences
23	Zhao Shimin	Mechanism and Intervention Strategy Innovation Team for Major Birth Defects Caused by Malnutrition	State Key Laboratory of Genetic Engineering	Fudan University

No.	Academic Leader	Team Name	Laboratory Name	Unit
24	Zheng Gang	Major Civil Engineering Safety and Disaster Prevention Innovation Team	State Key Laboratory of Hydraulic Engineering Simulation and Safety	Tianjin University
25	Zhou Demin	Research on Biomimetic Drugs Based on Chemical Modification of Endogenous Substances	State Key Laboratory of Natural and Biomimetic Drugs	Peking University
26	Zhou Xingjiang	Copper-Based and Iron-Based High-Temperature Superconducting Mechanism Research Team	Beijing National Laboratory for Condensed Matter Physics (Planned)	Institute of Physics, Chinese Academy of Sciences

Table 21: List of Laboratory Staff Newly Sponsored by the National Science Fund for Distinguished Young Scientists

No.	Name	Laboratory Name	Unit
1	Cao Dapeng	State Key Laboratory of Organic-Inorganic Composite Materials	Beijing University of Chemical Technology
2	Chen Yan	State Key Laboratory for Surface Physics	Fudan University
3	Chen Yue	State Key Laboratory of Medicinal Chemical Biology	Nankai University
4	Chen Hongsheng	State Key Laboratory of Modern Optical Instrumentation	Zhejiang University
5	Chen Jiubin	State Key Laboratory of Environmental Geochemistry	Institute of Geochemistry, Chinese Academy of Sciences
6	Qiu Zilong	State Key Laboratory of Neuroscience	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
7	Deng Youjin	Hefei National Laboratory for Physical Sciences at the Microscale (Planned)	University of Science and Technology of China
8	Fu Pingqing	State Key Laboratory of Atmospheric Boundary Layer Physics and Atmospheric Chemistry	Institute of Atmospheric Physics, Chinese Academy of Sciences
9	Han Yongming	State Key Laboratory of Loess and Quaternary Geology	Institute of Earth Environment, Chinese Academy of Sciences
10	Hou Jian	State Key Laboratory of Heavy Oil Processing	China University of Petroleum (Huadong)
11	Huang Yuan	State Key Laboratory of Biotherapy	Sichuan University
12	Huang Guanghua	State Key Laboratory of Mycology	Institute of Microbiology, Chinese Academy of Sciences
13	Huang Xiaolong	State Key Laboratory of Isotope Geochemistry	Guangzhou Institute of Geochemistry, Chinese Academy of Sciences
14	Huang Yihua	State Key Laboratory of Biomacromolecules	Institute of Biophysics, Chinese Academy of Sciences
15	Huang Zhiming	State Key Laboratory of Infrared Physics	Shanghai Institute of Technical Physics, Chinese Academy of Sciences
16	Jin Shi	State Key Laboratory of Wireless Mobile Communications	Southeast University
17	Lei Xiaoguang	Beijing National Laboratory for Molecular Sciences (Planned)	Peking University
18	Li Guohui	State Key Laboratory of Molecular Reaction Dynamics	Dalian Institute of Chemical Physics, Chinese Academy of Sciences
19	Li Hanying	State Key Laboratory of Silicon Materials	Zhejiang University
20	Li Kenli	State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body	Hunan University
21	Liu Chang	Shenyang National (Joint) Laboratory for Materials Science	Institute of Metal Research, Chinese Academy of Sciences
22	Liu Gang	State Key Laboratory for Mechanical Behavior of Materials	Xi'an Jiaotong University
23	Liu Jun	State Key Laboratory of Polymer Physics and Chemistry	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences
24	Liu Yong	State Key Laboratory for Powder Metallurgy	Central South University

No.	Name	Laboratory Name	Unit
25	Liu Guanghui	State Key Laboratory of Biomacromolecules	Institute of Biophysics, Chinese Academy of Sciences
26	Liu Hongzhong	State Key Laboratory for Manufacturing Systems Engineering	Xi'an Jiaotong University
27	Liu Jianguo	State Key Laboratory of Integrated Optoelectronics	Institute of Semiconductors, Chinese Academy of Sciences
28	Liu Jianxiang	State Key Laboratory of Genetic Engineering	Fudan University
29	Liu Naian	State Key Laboratory of Fire Science	University of Science and Technology of China
30	Lu Minghui	State Key Laboratory of Solid State Microstructures	Nanjing University
31	Lu Xinpei	State Key Laboratory of Advanced Electromagnetic Engineering and Technology	Huazhong University of Science and Technology
32	Lu Yiyu	State Key Laboratory of Coal Mine Disaster Dynamics and Control	Chongqing University
33	Luan Tiangang	State Key Laboratory of Biocontrol	Sun Yat-sen University
34	Luo Cheng	State Key Laboratory of New Drug Research	Shanghai Institute of Materia Medica, Chinese Academy of Sciences
35	Luo Jie	State Key Laboratory of Crop Genetic Improvement	Huazhong Agricultural University
36	Luo Xisheng	State Key Laboratory of Fire Science	University of Science and Technology of China
37	Luo Xiaobing	State Key Laboratory of Coal Combustion	Huazhong University of Science and Technology
38	Luo Zhenghong	State Key Laboratory of Metal Matrix Composites	Shanghai Jiao Tong University
39	Lu Haidong	State Key Laboratory of Cognitive Neuroscience and Learning	Beijing Normal University
40	Lu Jiancheng	State Key Laboratory of Hydraulics and Mountain River Engineering	Sichuan University
41	Mao Tonglin	State Key Laboratory of Plant Physiology and Biochemistry	China Agricultural University
42	Miao Feng	State Key Laboratory of Solid State Microstructures	Nanjing University
43	Nie Zongxiu	Beijing National Laboratory for Molecular Sciences (Planned)	Institute of Chemistry, Chinese Academy of Sciences
44	Niu Junfeng	State Key Joint Laboratory of Environmental Simulation and Pollution Control	Beijing Normal University
45	Peng Chengzhi	Hefei National Laboratory for Physical Sciences at the Microscale (Planned)	University of Science and Technology of China
46	Peng Fangyu	State Key Laboratory of Digital Manufacturing Equipment and Technology	Huazhong University of Science and Technology
47	Peng Haiping	State Key Laboratory of Particle Detection and Electronics	University of Science and Technology of China
48	Qin Feng	State Key Laboratory of Plant Physiology and Biochemistry	China Agricultural University
49	Shen Yang	State Key Laboratory of New Ceramics and Fine Processing	Tsinghua University
50	Shen Guozhen	State Key Laboratory of Superlattices and Microstructures	Institute of Semiconductors, Chinese Academy of Sciences
51	Shi Ming	State Key Laboratory of Oncology in South China	Sun Yat-sen University
52	Shi Xun	State Key Laboratory of High Performance Ceramics and Ultrastructure	Shanghai Institute of Ceramics, Chinese Academy of Sciences
53	Song Lingyang	State Key Laboratory of Advanced Optical Communication Systems & Networks	Peking University
54	Song Yufei	State Key Laboratory of Chemical Resource Engineering	Beijing University of Chemical Technology
55	Su Shijian	State Key Laboratory of Luminescent Materials and Devices	South China University of Technology
56	Tang Ruikang	State Key Laboratory of Silicon Materials	Zhejiang University
57	Tian Shanxi	Hefei National Laboratory for Physical Sciences at the Microscale (Planned)	University of Science and Technology of China
58	Wang Bo	State Key Laboratory of Explosion Science and Technology	Beijing Institute of Technology

No.	Name	Laboratory Name	Unit
59	Wang Wei	State Key Laboratory of Multiphase Complex Systems	Institute of Process Engineering, Chinese Academy of Sciences
60	Wang Huiyuan	State Key Laboratory of Automotive Simulation and Control	Jilin University
61	Wang Jianhua	State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin	China Institute of Water Resources and Hydropower Research
62	Wang Jianqiang	State Key Laboratory of Automotive Safety and Energy	Tsinghua University
63	Wang Shouguo	State Key Laboratory for Advanced Metals and Materials	University of Science and Technology Beijing
64	Wang Shuxiao	State Key Joint Laboratory of Environmental Simulation and Pollution Control	Tsinghua University
65	Wang Yawei	State Key Laboratory of Environmental Chemistry and Ecotoxicology	Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences
66	Wu Fei	State Key Laboratory of Computer-Aided Design & Computer Graphics	Zhejiang University
67	Wu Chengyin	State Key Laboratory for Artificial Microstructures and Mesoscopic Physics	Peking University
68	Wu Yuanbao	State Key Laboratory of Geological Processes and Mineral Resources	China University of Geosciences (Wuhan)
69	Wu Zhenlong	State Key Laboratory of Animal Nutrition	China Agricultural University
70	Xie Tao	State Key Laboratory of Chemical Engineering	Zhejiang University
71	Xu Kun	State Key Laboratory of Information Photonics and Optical Communications	Beijing University of Posts and Telecommunications
72	Xu Xiao	State Key Laboratory for Diagnosis and Treatment of Infectious Diseases	Zhejiang University
73	Xu Huailiang	State Key Laboratory of Integrated Optoelectronics	Jilin University
74	Xu Mingwei	Tsinghua National Laboratory for Information Science and Technology (Planned)	Tsinghua University
75	Xu Qi	State Key Laboratory of Medical Molecular Biology	Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences
76	Xue Qiang	State Key Laboratory of Geomechanics and Geotechnical Engineering	Wuhan Institute of Rock and Soil Mechanics, Chinese Academy of Sciences
77	Yi Tinghua	State Key Laboratory of Coastal and Offshore Engineering	Dalian University of Technology
78	Yu Wei	State Key Laboratory of Metal Matrix Composites	Shanghai Jiao Tong University
79	Zeng Yi	State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
80	Zhan Mei	State Key Laboratory of Solidification Processing	Northwestern Polytechnical University
81	Zhan Naijun	State Key Laboratory of Computer Science	Institute of Software, Chinese Academy of Sciences
82	Zhang Feng	State Key Laboratory of Genetic Engineering	Fudan University
83	Zhang Lei	State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
84	Zhang Yan	State Key Laboratory of Crop Biology	Shandong Agricultural University
85	Zhang Jianming	State Key Laboratory of Hydraulics and Mountain River Engineering	Sichuan University
86	Zhang Wenming	State Key Laboratory of Mechanical System and Vibration	Shanghai Jiao Tong University
87	Zhang Yalei	State Key Laboratory of Pollution Control and Resource Reuse	Tongji University
88	Zhang Yongjun	State Key Laboratory of Medicinal Chemical Biology	Nankai University
89	Zhang	State Key Laboratory of Cognitive Neuroscience and	Beijing Normal University

No.	Name	Laboratory Name	Unit
	Zhanjun	Learning	
90	Zhang Zhihong	Wuhan National Laboratory for Optoelectronics (Planned)	Huazhong University of Science and Technology
91	Zhou Bin	State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
92	Zhou Xin	State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics	Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences
93	Zhou Dawang	State Key Laboratory of Cellular Stress Biology	Xiamen University
94	Zhu Chaodong	State Key Laboratory of Integrated Management of Pest Insects and Rodents	Institute of Zoology, Chinese Academy of Sciences
95	Zhu Shoufei	State Key Laboratory of Elemento-Organic Chemistry	Nankai University

Table 22 Laboratory Personnel Newly Selected as Young and Middle-Aged S&T Innovation Talent Leaders by MOST

No.	Name	Laboratory Name	Unit
1	Ai Bo	State Key Laboratory of Rail Traffic Control and Safety	Beijing Jiaotong University
2	Ai Qinghui	Qingdao Pilot National Laboratory for Marine Science and Technology	Ocean University of China
3	Bai Bofeng	State Key Laboratory of Multiphase Flow in Power Engineering	Xi'an Jiaotong University
4	Chen Bin	State Key Laboratory of Multiphase Flow in Power Engineering	Xi'an Jiaotong University
5	Chen Gang	State Key Laboratory of Computer-Aided Design & Computer Graphics	Zhejiang University
6	Chen Shu	Beijing National Laboratory for Condensed Matter Physics (Planned)	Institute of Physics, Chinese Academy of Sciences
7	Chen Jiubin	State Key Laboratory of Environmental Geochemistry	Institute of Geochemistry, Chinese Academy of Sciences
8	Chen Lingling	State Key Laboratory of Molecular Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
9	Chen Lingling	State Key Laboratory of Crop Genetic Improvement	Huazhong Agricultural University
10	Chen Xiaofeng	State Key Laboratory of Integrated Services Network	Xidian University
11	Chen Xingqiu	Shenyang National (Joint) Laboratory for Materials Science	Institute of Metal Research, Chinese Academy of Sciences
12	Cui Zhaoxia	Qingdao Pilot National Laboratory for Marine Science and Technology	Institute of Oceanology, Chinese Academy of Sciences
13	Dai Yuhong	State Key Laboratory of Scientific and Engineering Computing	Academy of Mathematics and Systems Science, Chinese Academy of Sciences
14	Deng Weiqiao	State Key Laboratory of Molecular Reaction Dynamics	Dalian Institute of Chemical Physics, Chinese Academy of Sciences
15	Dong Shikui	State Key Joint Laboratory of Environmental Simulation and Pollution Control	Beijing Normal University
16	Du Yan	State Key Laboratory of Tropical Marine Environment	South China Sea Institute of Oceanology, Chinese Academy of Sciences
17	Duan Haibin	State Key Laboratory of Virtual Reality Technology and Systems	Beijing University of Aeronautics and Astronautics (Beihang University)
18	Fan Jiangli	State Key Laboratory of Fine Chemicals	Dalian University of Technology
19	Fan Tongxiang	State Key Laboratory of Metal Matrix Composites	Shanghai Jiao Tong University
20	Feng Yujun	State Key Laboratory of Polymer Materials Engineering	Sichuan University

No.	Name	Laboratory Name	Unit
21	Fu Qiangang	State Key Laboratory of Solidification Processing	Northwestern Polytechnical University
22	Fu Xuefeng	Beijing National Laboratory for Molecular Sciences (Planned)	Peking University
23	Fu Yao	Hefei National Laboratory for Physical Sciences at the Microscale (Planned)	University of Science and Technology of China
24	Gao Li	State Key Laboratory for Biology of Plant Diseases and Insect Pests	Institute of Plant Protection, Chinese Academy of Agricultural Sciences
25	Guo Kai	State Key Laboratory of Materials-Oriented Chemical Engineering	Nanjing Tech University
26	Guo Huichen	State Key Laboratory of Veterinary Etiological Biology	Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences
27	Guo Jiandong	Beijing National Laboratory for Condensed Matter Physics (Planned)	Institute of Physics, Chinese Academy of Sciences
28	Guo Yuguo	Beijing National Laboratory for Molecular Sciences (Planned)	Institute of Chemistry, Chinese Academy of Sciences
29	Han Qinghua	State Key Laboratory of Hydraulic Engineering Simulation and Safety	Tianjin University
30	He Peng	State Key Laboratory of Advanced Welding and Joining	Harbin Institute of Technology
31	He Ningjia	State Key Laboratory of Silkworm Genomic Biology	Southwest University
32	Hou Jianhui	Beijing National Laboratory for Molecular Sciences (Planned)	Institute of Chemistry, Chinese Academy of Sciences
33	Hu Longhua	State Key Laboratory of Fire Science	University of Science and Technology of China
34	Hu Xiaoyong	State Key Laboratory for Artificial Microstructures and Mesoscopic Physics	Peking University
35	Hu Xiumian	State Key Laboratory for Mineral Deposits Research	Nanjing University
36	Huang Gang	State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics	Institute of Atmospheric Physics, Chinese Academy of Sciences
37	Huang Xun	State Key Laboratory of Molecular Developmental Biology	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences
38	Huang Yuan	State Key Laboratory of Biotherapy	Sichuan University
39	Huang Shengxiong	State Key Laboratory of Phytochemistry and Plant Resources in West China	Kunming Institute of Botany, Chinese Academy of Sciences
40	Huang Yihua	State Key Laboratory of Biomacromolecules	Institute of Biophysics, Chinese Academy of Sciences
41	Huang Zhongwei	State Key Laboratory of Petroleum Resources and Prospecting	China University of Petroleum (Beijing)
42	Ji Baohua	State Key Laboratory of Explosion Science and Technology	Beijing Institute of Technology
43	Ji Hongbin	State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
44	Jiang Jianhui	State Key Laboratory of Chemo, and Biosensing and Chemometrics	Hunan University
45	Jiao Ning	State Key Laboratory of Natural and Biomimetic Drugs	Peking University
46	Jing Chuanyong	State Key Laboratory of Environmental Chemistry and Ecotoxicology	Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences
47	Li Shenghong	State Key Laboratory of Phytochemistry and Plant Resources in West China	Kunming Institute of Botany, Chinese Academy of Sciences
48	Li Feng	Shenyang National (Joint) Laboratory for Materials Science	Institute of Metal Research, Chinese Academy of Sciences
49	Li Gang	State Key Laboratory of Coastal and Offshore Engineering	Dalian University of Technology
50	Li Chengjun	State Key Laboratory of Veterinary Biotechnology	Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences
51	Li Chengyu	State Key Laboratory of Neuroscience	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
52	Li Jianqiu	State Key Laboratory of Automotive Safety and Energy	Tsinghua University
53	Li Kenli	State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body	Hunan University

No.	Name	Laboratory Name	Unit
54	Li Yunhai	State Key Laboratory of Plant Cell and Chromosome Engineering	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences
55	Liang Jie	State Key Laboratory of Cancer Biology	Fourth Military Medical University of Chinese People's Liberation Army
56	Liu Bing	State Key Laboratory of Proteomics	Academy of Military Medical Sciences of the PLA Academy of Military Science
57	Liu Gang	Shenyang National (Joint) Laboratory for Materials Science	Institute of Metal Research, Chinese Academy of Sciences
58	Liu Yong	State Key Laboratory for Powder Metallurgy	Central South University
59	Liu Jiahong	State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin	China Institute of Water Resources and Hydropower Research
60	Liu Liming	State Key Laboratory of Food Science and Technology	Jiangnan University
61	Liu Sijin	State Key Laboratory of Environmental Chemistry and Ecotoxicology	Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences
62	Liu Yuanhong	State Key Laboratory of Organometallic Chemistry	Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences
63	Liu Liwang	State Key Laboratory of Crop Genetics and Germplasm Enhancement	Nanjing Agricultural University
64	Luo Cheng	State Key Laboratory of New Drug Research	Shanghai Institute of Materia Medica, Chinese Academy of Sciences
65	Luo Jie	State Key Laboratory of Crop Genetic Improvement	Huazhong Agricultural University
66	Luo Junhua	State Key Laboratory of Structural Chemistry	Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences
67	Luo Sanzhong	Beijing National Laboratory for Molecular Sciences (Planned)	Institute of Chemistry, Chinese Academy of Sciences
68	Luo Zhenghong	State Key Laboratory of Metal Matrix Composites	Shanghai Jiao Tong University
69	Ma Xucun	State Key Laboratory of Low-Dimensional Quantum Physics	Tsinghua University
70	Pan Anlian	State Key Laboratory of Chemo, and Biosensing and Chemometrics	Hunan University
71	Pan Xiulian	State Key Laboratory of Catalysis	Dalian Institute of Chemical Physics, Chinese Academy of Sciences
72	Peng Guiqing	State Key Laboratory of Agricultural Microbiology	Huazhong Agricultural University
73	Peng Huisheng	State Key Laboratory of Molecular Engineering of Polymers	Fudan University
74	Peng Zhike	State Key Laboratory of Mechanical System and Vibration	Shanghai Jiao Tong University
75	Qian Linmao	State Key Laboratory of Traction Power	Southwest Jiaotong University
76	Qin Yong	State Key Laboratory of Rail Traffic Control and Safety	Beijing Jiaotong University
77	Qin Botao	State Key Laboratory of Coal Resources and Safe Mining	China University of Mining and Technology
78	Su Sen	State Key Laboratory of Networking and Switching Technology	Beijing University of Posts and Telecommunications
79	Sun Youbin	State Key Laboratory of Loess and Quaternary Geology	Institute of Earth Environment, Chinese Academy of Sciences
80	Tang Ruikang	State Key Laboratory of Silicon Materials	Zhejiang University
81	Wang Jianhua	State Key Laboratory of Pattern Recognition	Institute of Automation, Chinese Academy of Sciences
82	Tian Ming	State Key Laboratory of Organic-Inorganic Composite Materials	Beijing University of Chemical Technology
83	Tian Zhixi	State Key Laboratory of Plant Cell and Chromosome Engineering	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences
84	Wang Jiadao	State Key Laboratory of Tribology	Tsinghua University
85	Wang Bo	State Key Laboratory of Explosion Science and Technology	Beijing Institute of Technology

No.	Name	Laboratory Name	Unit
86	Wang Zhi	State Key Laboratory of Automotive Safety and Energy	Tsinghua University
87	Wang Fazhou	State Key Laboratory of Silicate Materials for Architectures	Wuhan University of Technology
88	Wang Hongbin	State Key Laboratory of Biocontrol	Sun Yat-sen University
89	Wang Jiawei	State Key Laboratory of Plant Molecular Genetics	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
90	Wang Kaiyun	State Key Laboratory of Traction Power	Southwest Jiaotong University
91	Wang Xinping	State Key Laboratory of Modern Coordination Chemistry	Nanjing University
92	Wang Xinqiang	State Key Laboratory for Artificial Microstructures and Mesoscopic Physics	Peking University
93	Wang Zhouping	State Key Laboratory of Food Science and Technology	Jiangnan University
94	Wei Min	State Key Laboratory of Chemical Resource Engineering	Beijing University of Chemical Technology
95	Wei Yujie	State Key Laboratory of Nonlinear Mechanics	Institute of Mechanics, Chinese Academy of Sciences
96	Wu Di	State Key Laboratory of Solid State Microstructures	Nanjing University
97	Wu Ligang	State Key Laboratory of Robotics and Systems	Harbin Institute of Technology
98	Wu Mingbo	State Key Laboratory of Heavy Oil Processing	China University of Petroleum (Huadong)
99	Wu Yuanbao	State Key Laboratory of Geological Processes and Mineral Resources	China University of Geosciences (Wuhan)
100	Wu Zhenlong	State Key Laboratory of Animal Nutrition	China Agricultural University
101	Xia Xinghui	State Key Joint Laboratory of Environmental Simulation and Pollution Control	Beijing Normal University
102	Xiong Lihua	State Key Laboratory of Water Resources and Hydropower Engineering Science	Wuhan University
103	Xiong Youcai	State Key Laboratory of Grassland Agro-Ecosystems	Lanzhou University
104	Xiong Yujie	Hefei National Laboratory for Physical Sciences at the Microscale (Planned)	University of Science and Technology of China
105	Xu Kun	State Key Laboratory of Information Photonics and Optical Communications	Beijing University of Posts and Telecommunications
106	Xu Yanhui	State Key Laboratory of Genetic Engineering	Fudan University
107	Xue Qiang	State Key Laboratory of Geomechanics and Geotechnical Engineering	Wuhan Institute of Rock and Soil Mechanics, Chinese Academy of Sciences
108	Yang Xu	State Key Laboratory of Electrical Insulation and Power Equipment	Xi'an Jiaotong University
109	Yang Shouye	State Key Laboratory of Marine Geology	Tongji University
110	Ye Naihao	Qingdao Pilot National Laboratory for Marine Science and Technology	Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences
111	Yin Xiaowei	State Key Laboratory of Solidification Processing	Northwestern Polytechnical University
112	Yin Meizhen	State Key Laboratory of Chemical Resource Engineering	Beijing University of Chemical Technology
113	Yu Xiang	State Key Laboratory of Neuroscience	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
114	Yu Yanlei	State Key Laboratory of Molecular Engineering of Polymers	Fudan University
115	Yuan Quan	State Key Laboratory of Oral Diseases	Sichuan University
116	Zeng Peng	State Key Laboratory of Robotics	Shenyang Institute of Automation, Chinese Academy of Sciences
117	Zeng Rong	State Key Laboratory of Safety Control and Simulation of Power System and Large-Scale Power Generation Equipment	Tsinghua University

No.	Name	Laboratory Name	Unit
118	Zeng Yi	State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
119	Zhan Mei	State Key Laboratory of Solidification Processing	Northwestern Polytechnical University
120	Zhang Jian	Shenyang National (Joint) Laboratory for Materials Science	Institute of Metal Research, Chinese Academy of Sciences
121	Zhang Yan	State Key Laboratory of Crop Biology	Shandong Agricultural University
122	Zhang Yao	State Key Laboratory of Marine Environmental Science	Xiamen University
123	Zhang Haoli	State Key Laboratory of Applied Organic Chemistry	Lanzhou University
124	Zhang Wenke	State Key Laboratory of Supramolecular Structure and Materials	Jilin University
125	Zhang Xinbo	State Key Laboratory of Rare Earth Resource Utilization	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences
126	Zhang Yuanbo	State Key Laboratory for Surface Physics	Fudan University
127	Zhang Yunlin	State Key Laboratory of Lake Science and Environment	Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences
128	Zhang Zhifei	State Key Laboratory of Continental Dynamics	Northwest University
129	Zhao Yao	State Key Laboratory of Medical Neurobiology	Fudan University
130	Zhao Yun	State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences
131	Zhao Weilai	State Key Laboratory of Medical Genomics	Shanghai Jiao Tong University
132	Zheng Jinhai	State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering	Hohai University
133	Zhou Feng	State Key Laboratory of Solid Lubrication	Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences
134	Zhou Lei	State Key Laboratory for Surface Physics	Fudan University
135	Zhou Dawang	State Key Laboratory of Cellular Stress Biology	Xiamen University
136	Zhou Shuyun	State Key Laboratory of Low-Dimensional Quantum Physics	Tsinghua University
137	Zhu Xiaohua	State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering	Southwest Petroleum University

Part IV State Key Laboratory Evaluation Report

In 2016, MOST commissioned the China Biotechnology Development Center (中国生物技术发展中心) to conduct an independent evaluation of a total of 75 state key laboratories in the fields of biology and medicine in conjunction with the China Union of Life Science Societies. Based on the submitted evaluation results and the State Key Laboratory Evaluation Rules and as approved by MOST, the evaluation results are as follows.

Table 23 Results of the Evaluation of State Key Laboratories in the Field of Biology and Medicine in 2016

Laboratory Name	Supporting Units	Department in Charge
Outstanding Laboratories (20 laboratories)		
State Key Laboratory for Diagnosis and Treatment of Infectious Diseases	Zhejiang University	Ministry of Education
State Key Laboratory of Proteomics	Academy of Military Medical Sciences of the PLA Academy of Military Science	Logistic Support Department of the CMC
State Key Laboratory of Molecular Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Stem Cell and Reproductive Biology	Institute of Zoology, Chinese Academy of Sciences	National Health and Family Planning Commission
State Key Laboratory of Respiratory Disease	Guangzhou Medical University	Guangdong Science & Technology Department
State Key Laboratory of Membrane Biology	Institute of Zoology, Chinese Academy of Sciences Tsinghua University Peking University	Chinese Academy of Sciences
State Key Laboratory of Neuroscience	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Kidney Diseases	301 Hospital of People's Liberation Army (PLA) General Hospital	Logistic Support Department of the CMC
State Key Laboratory of Biomacromolecules	Institute of Biophysics, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Bioreactor Engineering	East China University of Science and Technology	Ministry of Education
State Key Laboratory of Biotherapy	Sichuan University	Ministry of Education
State Key Laboratory of Veterinary Biotechnology	Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences	Ministry of Agriculture
State Key Laboratory of Rice Biology	China National Rice Research Institute, Zhejiang University	Ministry of Agriculture
State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of New Drug Research	Shanghai Institute of Materia Medica, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Medical Genomics	Shanghai Jiao Tong University	Ministry of Education
State Key Laboratory of Medical Immunology	Second Military Medical University of Chinese People's Liberation Army	Training and Administration Department of the CMC
State Key Laboratory of Hybrid Rice	Hunan Hybrid Rice Research Center, Wuhan University	Hunan Science & Technology Department Ministry of Education
State Key Laboratory of Crop Genetic Improvement	Huazhong Agricultural University	Ministry of Education
State Key Laboratory of Crop Genetics and Germplasm Enhancement	Nanjing Agricultural University	Ministry of Education
Good Laboratories (46 laboratories)		
State Key Laboratory of Virology	Wuhan University Wuhan Institute of Virology, Chinese Academy of Sciences	Ministry of Education
State Key Laboratory of Pathogen and Biosecurity Microorganisms	Academy of Military Medical Sciences of the PLA Academy of Military Science	Logistic Support Department of the CMC
State Key Laboratory of Grassland Agro-	Lanzhou University	Ministry of Education

Laboratory Name	Supporting Units	Department in Charge
Ecosystems		
State Key Laboratory for Infectious Disease Prevention and Control	Chinese Center for Disease Control and Prevention	National Health and Family Planning Commission
State Key Laboratory of Trauma, Burns, and Combined Injury	Third Military Medical University of Chinese People's Liberation Army	Training and Administration Department of the CMC
State Key Laboratory of Freshwater Ecology and Biotechnology	Institute of Hydrobiology, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Protein and Plant Gene Research	Peking University	Ministry of Education
State Key Laboratory of Animal Nutrition	Beijing Institute of Animal Science and Veterinary Medicine, Chinese Academy of Agricultural Sciences, China Agricultural University	Ministry of Agriculture
State Key Laboratory of Molecular Developmental Biology	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Molecular Oncology	Cancer Institute, Cancer Hospital, Chinese Academy of Medical Sciences	National Health and Family Planning Commission
State Key Laboratory of Crop Stress Biology for Arid Areas	Northwest A&F University	Ministry of Education
State Key Laboratory of Oncology in South China	Sun Yat-sen University	Ministry of Education
State Key Laboratory of Veterinary Etiological Biology	Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences	Ministry of Agriculture
State Key Laboratory of Oral Diseases	Sichuan University	Ministry of Education
State Key Laboratory of Cotton Biology	Institute of Cotton Research, Chinese Academy of Agricultural Sciences, Henan University	Ministry of Agriculture Henan Science & Technology Department
State Key Laboratory of Brain & Cognitive Sciences	Institute of Biophysics, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Integrated Management of Pest Insects and Rodents	Institute of Zoology, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Agrobiotechnology	China Agricultural University	Ministry of Education
State Key Laboratory of Agricultural Microbiology	Huazhong Agricultural University	Ministry of Education
State Key Laboratory of Biochemical Engineering	Institute of Process Engineering, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Reproductive Medicine	Nanjing Medical University	Jiangsu Science & Technology Department
State Key Laboratory of Food Science and Technology	Jiangnan University Nanchang University	Ministry of Education
State Key Laboratory of Bioactive Substance and Function of Natural Medicines	Institute of Materia Medica, Chinese Academy of Medical Sciences	National Health and Family Planning Commission
State Key Laboratory of Natural Medicines	China Pharmaceutical University	Ministry of Education
State Key Laboratory of Natural and Biomimetic Drugs	Peking University	Ministry of Education
State Key Laboratory of Microbial Metabolism	Shanghai Jiao Tong University	Ministry of Education
State Key Laboratory of Systematic and Evolutionary Botany	Institute of Botany, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Cellular Stress Biology	Xiamen University	Ministry of Education
State Key Laboratory of Cardiovascular Disease	Fuwai Cardiovascular Hospital, Chinese Academy of Medical Sciences	National Health and Family Planning Commission
State Key Laboratory for Conservation and Utilization of Subtropical Agro-Bioresources	Guangxi University South China Agricultural University	Guangxi Zhuang Autonomous Region Science & Technology Department Guangdong Province Science & Technology Department
State Key Laboratory of Ophthalmology	Sun Yat-sen University	Ministry of Education
State Key Laboratory of Medicinal Chemical Biology	Nankai University	Ministry of Education

Laboratory Name	Supporting Units	Department in Charge
State Key Laboratory of Medical Molecular Biology	Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences	National Health and Family Planning Commission
State Key Laboratory of Medical Neurobiology	Fudan University	Ministry of Education
State Key Laboratory of Pharmaceutical Biotechnology	Nanjing University	Ministry of Education
State Key Laboratory of Genetic Engineering	Fudan University	Ministry of Education
State Key Laboratory of Genetic Resources and Evolution	Kunming Institute of Zoology, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Biocontrol	Sun Yat-sen University	Ministry of Education
State Key Laboratory for Biology of Plant Diseases and Insect Pests	Institute of Plant Protection, Chinese Academy of Agricultural Sciences	Ministry of Agriculture
State Key Laboratory of Plant Molecular Genetics	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Phytochemistry and Plant Resources in West China	Kunming Institute of Botany, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Plant Genomics	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences Institute of Microbiology, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Plant Physiology and Biochemistry	China Agricultural University Zhejiang University	Ministry of Education
State Key Laboratory of Plant Cell and Chromosome Engineering	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Cancer Biology	Fourth Military Medical University of Chinese People's Liberation Army	Training and Administration Department of the CMC
State Key Laboratory of Crop Biology	Shandong Agricultural University	Shandong Science & Technology Department
Laboratories in Need of Improvement (8 laboratories)		
State Key Laboratory of Oncogenes and Related Genes	Shanghai Cancer Institute	National Health and Family Planning Commission
State Key Laboratory of Silkworm Genomic Biology	Southwest University	Ministry of Education
State Key Laboratory of Tree Genetics and Breeding	Chinese Academy of Forestry Northeast Forestry University	National Forestry and Grassland Administration Ministry of Education
State Key Laboratory of Cognitive Neuroscience and Learning	Beijing Normal University	Ministry of Education
State Key Laboratory of Experimental Hematology	Institute of Hematology, Hospital of Hematology, Chinese Academy of Medical Sciences	National Health and Family Planning Commission
State Key Laboratory of Microbial Technology	Shandong University	Ministry of Education
State Key Laboratory of Microbial Resources	Institute of Microbiology, Chinese Academy of Sciences	Chinese Academy of Sciences
State Key Laboratory of Mycology	Institute of Microbiology, Chinese Academy of Sciences	Chinese Academy of Sciences
Laboratories That Failed Evaluation (1 laboratory)		
State Key Laboratory of Medical Genetics	Central South University	Ministry of Education

Part V Selection of Important Achievements of the State Key Laboratories

In 2016, important progress was made in the research work of state key laboratories and pilot national laboratories. Some of the achievements have attracted widespread attention in China and abroad. The following are some of the outstanding achievements obtained by the laboratories this year.

1. A New Mode of Neutrino Oscillation Discovered in Daya Bay Reactor Neutrino Experiment
2. Stability of Hamiltonian System under Resonance
3. Magnetoelectric Generation New Materials and High-Voltage Controlled Quantum Sequence
4. A New Method of Carbon-Carbon Bond Recombination Construction and Natural Product Synthesis
5. Research on Basic Physical and Chemical Problems of Organic Field Effect Transistor
6. Design, Synthesis, and Assembly Strategy of Oxy-Clusters
7. Total Synthesis of Complex Natural Products with Important Biological Activities
8. Linkage Between Asian Monsoon Changes and Global Climate
9. Process and Environmental Causes of the Largest Extinction of Phanerozoic Organisms and Subsequent Biological Recovery
10. Formation of Earth Animal Tree
11. Basic Research on Omics Identification and Prevention and Control of Environmental Health Hazards of High-Risk Pollutants
12. Genetic and Molecular Biology Basis of Rice Yield Traits
13. Research on Theoretical Methods of Image Structure Modeling and Visual Appearance Reconstruction
14. New Microwave and Millimeter Wave Substrate Integrated Guided Wave Structure and Device
15. Principles and Construction of Non-Metallic Supernormal Electromagnetic Medium
16. Long-Life High-Temperature Oxidation, and Ablative Coating Protection Mechanism and Application Basis
17. New Physical Effects of Ferrous Smart Materials based on Crystal Defect Regulation
18. Research on the Macro-Preparation of Nanostructure Units and the Functionalization of Macro-Scale Assemblies
19. Fluorescence Sensing Metal-Organic Frame Material Structure Design and Function Construction
20. Construction and Synergy Mechanism of High-Performance Composite Electrode Materials for Energy Storage
21. Probability Density Evolution Theory of Reliability Design for Engineering Structure Disaster
22. Homotopy Analysis Method and its Application for Solving Strongly Nonlinear Problems in Mechanics
23. Special Drilling Fluid for Complex Structure Wells and Industrial Application
24. Key Technologies for Cold Drilling and Thermal Recovery of Land Gas Hydrate
25. High-Efficiency Fracturing Acidification Reforming Technology and Applications for Deep and Ultra-Deep Oil and Gas Reservoirs

26. Diagnosis Technology and Practices for Service Behavior of Complex Hydraulic Concrete Structures

27. New Technology for Polyolefin Fluidized Bed Reactors Based on Acoustic Emission Monitoring

28. Creation and Application of New Reactive Dyes with Enhanced Group Functions

29. Low-Power High-Performance Soft Magnetic Composite Materials and Key Preparation Technologies

30. Key Technology and Engineering Applications of Carbon-Based Film Combining Toughness and Lubrication

31. Shock Wave Wind Tunnel Experiment Technology for Reproducing Hypersonic Flight Conditions

32. Local Loading, Precise Plastic Forming, and Integrated Manufacturing Technology for High-Performance Lightweight Components

33. Key Technologies and Equipment for Multi-Station Precision Forging Net Formation

34. Technology for Smart Prosthetics and Their Neural Information Channel Reconstruction

35. Fast Breaking Technology and Applications for Large Capacity Circuit Breakers in DC Distribution Systems

36. Hybrid Optical Fiber Sensing Technology and its Application in the Field of Engineering Safety Monitoring

37. Wide Area Broadband Cooperative Communication Technology and Applications

38. Key Technologies, Systems, and Industrial Applications of Scalable Routing and Switching for Support Service Innovation

39. Key Technologies and Applications of Urban Travel Information Services Based on Mobile Location Data

40. Key Technologies and Applications of Steel Production and Logistics Dispatch

41. Major Renovation Project of the Beijing Electron-Positron Collider

42. Innovative Research and Applications of IgA Nephropathy Integrating Traditional Chinese and Western Medicine Treatment Regimens and Key Diagnosis and Treatment Technologies

43. Key Technologies and Applications of DTMB System Internationalization and Industrialization

44. Technology to Transform Influenza Virus into Replication-Defective Live Vaccines

45. Lighting the Way to Zeolite Molecular Sieve Synthesis

46. The World's First Non-Human Primate Model of Autism

47. Plant Male and Female Ligand Recognition Mechanism

48. Fractional Spinon Excitation in $YbMgGaO_4$, a Candidate Liquid Material for Triangular Lattice Quantum Spin

A New Mode of Neutrino Oscillation Discovered in Daya Bay Reactor Neutrino Experiment

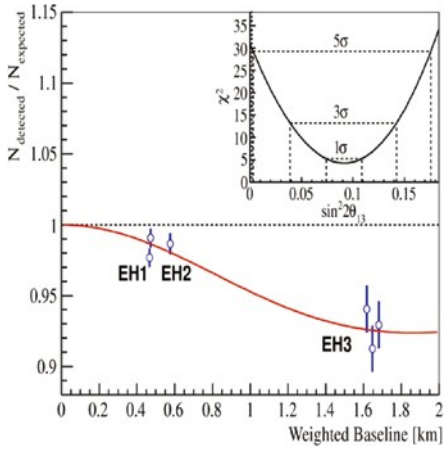
State Key Laboratory of Particle Detection and Electronics

(Institute of High Energy Physics, Chinese Academy of Sciences, University of Science and Technology of China)

The neutrino mixing angle θ_{13} is one of the six basic parameters of neutrino oscillation, and its magnitude is related to the future development direction of neutrino physics research. It is also related to the "mystery of the disappearance of antimatter" in the universe and a hot spot in international neutrino research. As the main unit, the State Key Laboratory of Particle Detection and Electronics has long participated in the research work of the Daya Bay Reactor neutrino experiment. The research is mainly to find a new neutrino oscillation mode by detecting neutrinos from the reactor and accurately measure the θ_{13} parameter that describes the oscillation. The main innovation achievements include:

Top view of the remote experimental hall, 3 neutrino detectors are placed in the water Cherenkov detector pool and the resistive plate detectors are visible at the far end

1. A complete experiment scheme and detector design were proposed. There are a series of original innovations in the design, and the design precision exceeds previous experiments by more than one order of magnitude and provides the highest precision among similar experiments worldwide. For the first time, the idea of multi-module measurement was proposed. For the first time, new solutions and new technologies, such as concentric cylindrical detectors, movable detectors, reflectors, and new gadolinium-doped liquid scintillators, were proposed.



The ratio of the number of neutrinos measured by the 6 neutrino detectors in the 3 laboratories to the expected number of neutrinos

2. The experiment obtained high-quality data and made a series of innovations in data analysis methods. Finally, with a confidence of 5.2 times the standard deviation, it was the first to discover a new neutrino oscillation and accurately measure its oscillation amplitude of $\sin^2 2\theta_{13}$.

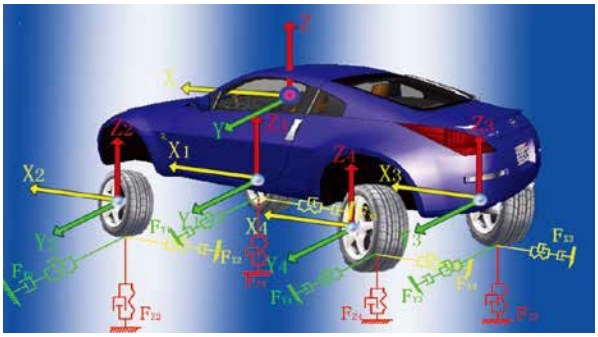
This achievement has been widely recognized by the international scientific community. It was selected as one of the top ten scientific breakthroughs in 2012 by the magazine *Science*, won the 2014 American Physical Society's highest award in particle physics, the Panofsky Prize, and the 2016 Breakthrough Prize in Fundamental Physics. The high-precision θ_{13} measurement is of great significance for the determination of neutrino quality level

and CP phase angle. It has a major impact on research on neutrino theory, precision testing of the Standard Model, the Grand Unified Theory of particle physics, astrophysics, cosmology, and the search and identification of new physics (新物理). It is of great scientific significance. It won first prize at the 2016 National Natural Science Awards.

Stability of Hamiltonian System under Resonance

State Key Laboratory of Automotive Simulation and Control (Jilin University)

The simulation and control of automobile dynamic stability is a recognized problem in the field of international automobile engineering. How to carry out stability analysis on the human-vehicle-environment closed-loop dynamics system has long lacked support from basic scientific theory and effective solutions. Since its establishment, the State Key Laboratory of Automotive Simulation and Control has been conducting basic research on applications involving high-precision modeling of vehicle dynamics, system stability analysis, and multi-variable precision control. In recent years, the State Key Laboratory of Automobile Simulation and Control has focused on the inherent characteristics of automobile dynamics and the mathematical and mechanical problems in the study of its stability, conducted innovative interdisciplinary research on stability theory for resonance Hamiltonian systems, multi-scale Hamiltonian systems, and generalized Hamiltonian systems, and proposed a Hamiltonian dynamics stability analysis method for the multi-directional movement of lateral and vertical vehicle movement. The main innovative achievements include:



Hamilton dynamics of a vehicle under three-way yaw, roll, and pitch rotation

1. Established the KAM theory of general resonance conditions, which solves an important guess about the basic dynamics of general resonance conditions.

2. Established the KAM theory of generalized Hamiltonian system and its effective stability theory, revealed the rupture mechanism of resonant tori under small perturbations, and obtained the results of the invariant tori of multi-scale Hamiltonian systems.

3. Established a six-degree-of-freedom Hamiltonian dynamics theory analysis model for automobiles, which provides a scientific and systematic solution for accurately analyzing vehicle dynamics stability under road disturbances.

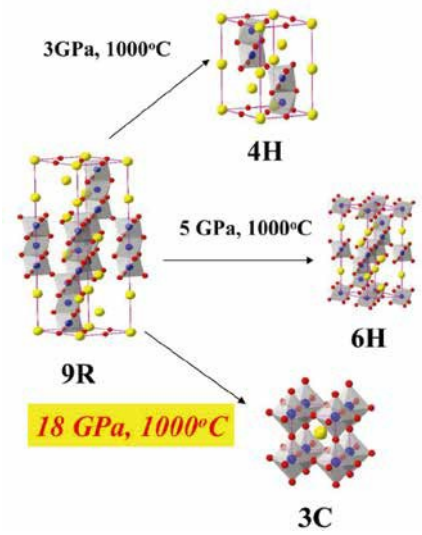
The above research achievements have been highly praised by the international academic community. Research achievements such as the generalized Hamiltonian system KAM theory and effective stability analysis theory are considered to be some of the most important developments in international related academic theories in the past ten years. The research won second prize at the 2016 National Natural Science Award.

Magnetoelectric Generation New Materials and High-Voltage Controlled Quantum Sequence

Beijing National Laboratory for Condensed Matter Physics (Planned) (Institute of Physics, Chinese Academy of Sciences)

Emergent materials present extremely rich quantum characteristics and major application prospects due to their multi-body interaction of spin and charge with orbits. Designing new materials with simple structural components and revealing and opening up new ways to regulate quantum order are major frontiers and scientific problems in promoting a leap in the research on magnetoelectric generation materials. The State Key Laboratory for Condensed Matter Physics in Beijing (planned) has long been engaged in research aimed at discovering new materials for magnetoelectric generation and high-voltage regulation of quantum sequences. It focuses on three types of typical magnetoelectric interactions: Ferromagnetism, antiferromagnetism, and strong spin-orbit coupling and has systemically carried out in-depth original research on systems, making breakthrough progress. The main achievements include:

1. Discovered and named the "111" system, one of the main iron-based superconducting systems: The "111" system is a major expansion of iron-based superconductivity. Professor Hosono, who discovered iron-based superconductivity, lists "111" as one of the three main iron-arsenic superconducting systems. In June 2008, the "111" system became the first iron-based superconducting system independently discovered by Chinese scientists, which has played an important role in promoting research on iron-based superconductivity. It has been the subject of extensive and in-depth research from 302 research units in 37 countries and regions.



The magnetic element of BaRuO3 changes with synthesis pressure

2. Discovered a series of ferromagnetic evolution materials and novel quantum sequences: Discovered a dilute magnetic semiconductor based on the separation of the spin and charge doping mechanism of LiZnAs, which broke through the bottleneck of spin and charge doping binding that has long restricted dilute magnetic semiconductors and opened up research on a new class of dilute magnetic semiconductors; discovered the $BaRuO_3$ new cruise magnet, revealing the key regulation of the chemical bond strength on this kind of exotic ferromagnetic order, overturning the previous mainstream theoretical predictions, and revising the international understanding of the discovery of Ru cruise magnetism (Ru巡游磁性) developed over half a century.

Multifunctional test platform for low temperature and strong magnetic field of the in-situ high voltage measurement system

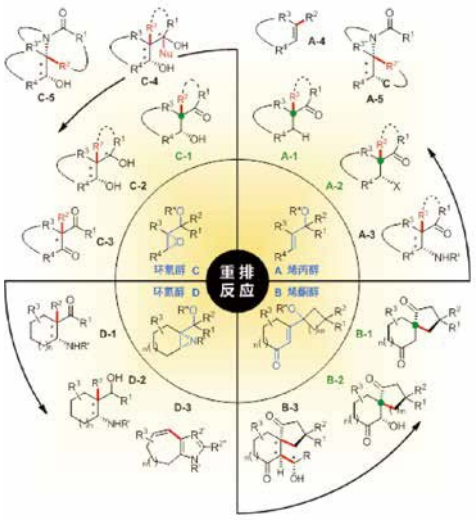
3. Revealed a new phenomenon of pressure-induced strong spin-orbit coupling quantum sequence evolution, discovered the pressure-induced macroscopic quantum condensation of topological compounds, and achieved the pure physical regulation of topological quantum sequences.

The above research results have won high praise from the international academic community, leading and promoting the development of basic research and applied basic research in iron-based superconductors and new ferromagnetic sequence evolution materials. The research won second prize at the 2016 National Natural Science Awards.

A New Method of Carbon-Carbon Bond Recombination Construction and Natural Product Synthesis

State Key Laboratory of Applied Organic Chemistry (Lanzhou University)

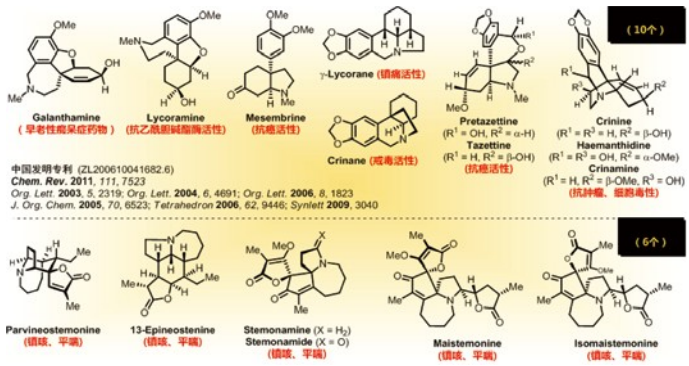
Carbon-carbon bonds are the most basic structural units that constitute a large number of organic substances with various structures and different functions. The achievement of "selectivity and efficiency" in the construction of carbon-carbon bonds of molecules with complex structures and dense functional groups is an important and cutting-edge field of research in organic chemistry. It is also one of the most challenging scientific problems. The State Key Laboratory of Applied Organic Chemistry has long been engaged in "selectivity and efficiency" in the construction of carbon-carbon bonds. It has systematically developed a series of original new methods and strategies for carbon-carbon bond construction and has made breakthrough progress. The main achievements include:



Representative reactions

1. Innovated and expanded the semi-pinacol rearrangement and its tandem reactions involving the formation of carbon-carbon bonds: For the first time, the laboratory designed and systematically developed a new type of highly stereoselective half-pinacol rearrangement and cascade reaction of sixteen epoxy alcohols, cyclonitrogen alcohols, allyl alcohols, and enone alcohols. They innovated and enriched the efficient and diversified construction of carbon-carbon bonds in "multi-stereocenters, multi-functional groups, and multi-ring structural units," especially providing new methods and adding new content for the enantioselective construction of chiral quaternary carbon centers.

2. Discovered and developed oxygen-containing carbon-hydrogen bond functionalization reactions involving the formation of carbon-carbon bonds: For the first time, the laboratory designed, discovered, and developed the carbon-hydrogen bond functionalization reactions of four alcohols and two ether compounds; revealed the new reaction



Representative molecules

properties of sp^3 carbon-hydrogen bonds in active alcohols and inert ether molecules in ruthenium, rhodium, palladium, iron metal catalytic systems, and organic catalytic systems; opened up a new way for the direct and diverse construction of carbon-carbon bonds in the molecular system of alcohol and ether; and enriched the research content of alcohol and ether compounds in modern organic synthetic chemistry.

3. Established and realized a new strategy for the synthesis of natural products involving carbon-carbon bond formation methods: Based on the above series of studies involving new methods of carbon-carbon bond construction, the laboratory developed new and efficient synthetic strategies for a series of natural products with important biological activities and completed the chemical synthesis of 26 natural products with important biological activities, providing basic and scientific support for the development of new synthetic strategies for related drug molecules and practical industrial synthesis.

The above research results have received extensive attention and high praise from colleagues in China and abroad. The research won second prize at the 2016 National Natural Science Awards.

Research on Basic Physical and Chemical Problems of Organic Field Effect Transistor

Beijing National Laboratory for Molecular Sciences (Planned) (Peking University, Institute of Chemistry of the Chinese Academy of Sciences)

Molecular electronics is a new cutting-edge interdisciplinary science, which receives intense attention from IUPAC and the American Chemical Society and is listed as a key support direction by the EU. The Beijing National Laboratory of Molecular Sciences (planned) has long been committed to research on the basic physical and chemical problems of organic field-effect transistors in molecular electronics. It has made a series of innovative achievements in high-performance organic field-effect materials, the relationship between material condensed state structures and performance, and field-effect devices, which have solved some basic physical and chemical problems faced by organic field-effect transistors, forming international characteristics. The main scientific achievements include:

Field effect material

1. From the viewpoint of structure and energy,

through the regulation of energy levels and molecular accumulation, the laboratory developed a series of organic field effect materials with good stability, high mobility, and excellent comprehensive performance and proposed design and synthesis strategies for organic field effect materials.

2. In view of the unclear relationship between the condensed state structure and performance of molecular materials, the intrinsic performance is difficult to reveal. For this problem, the laboratory invented a series of unique organic micro and nano crystals and preparation methods for field-effect transistors, using organic micro and nano crystals to efficiently reveal the relationship between the condensed state structure and properties of materials, guide the rational design and synthesis of molecules, and promote the application of their devices.

Organic field effect transistor integrated module and circuit

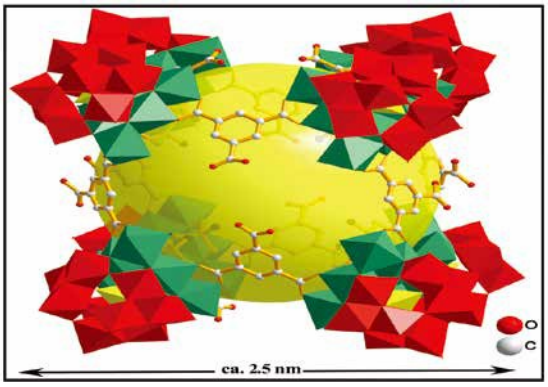
3. Starting from key physical parameters such as the energy level, microstructure, and interface, the laboratory continually optimized devices through methods such as material control assembly and interface optimization and achieved the construction of high-performance organic field effect transistors and new functional devices, which strongly promoted the development of organic field effect transistors.

The above research results provide new strategies for the design and synthesis of field-effect molecular materials, new methods for the physical properties of field-effect materials, and new ideas for the construction of high-performance organic field-effect transistors and new functional devices. It has played a leading role in the development of this field internationally and laid a solid scientific foundation for the application of organic field effect transistors and the research of organic circuits. The research won second prize at the 2016 National Natural Science Awards.

Design, Synthesis, and Assembly Strategy of Oxy-Clusters

State Key Laboratory of Structural Chemistry (Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences)

Oxygen clusters are metal and nonmetal-oxygen clusters formed by the combination of metal or nonmetal and oxygen. This is an important frontier in chemistry and materials science. Carrying out the research on "the design, synthesis, and assembly strategies of oxy-cluster compounds" has important scientific significance for the synthesis of specific functional materials. The State Key Laboratory of Structural Chemistry focuses on the basic scientific problem of the design, synthesis, and assembly of oxy-cluster compounds. It has proposed corresponding synthesis strategies in the fields of transition metal-oxygen clusters, rare earth-oxygen clusters, and main group metal-oxygen clusters. These strategies play a guiding role in the design and synthesis of catalytic and magnetic materials. The main scientific findings are as follows:



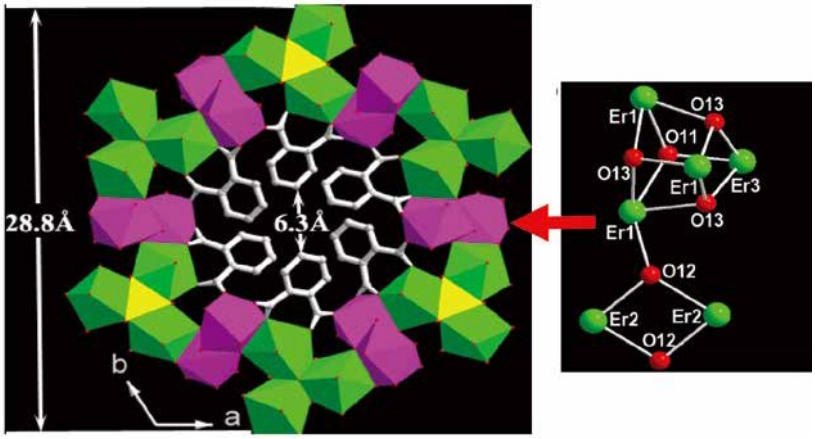
Cluster-Organic Polyhedron and Cages

1. In the field of transition metal oxygen clusters, the laboratory established a hydrothermal synthesis method for vacant substitution of metal oxygen clusters; proposed the ideas of vacancy site orientation, guided assembly, and synergy between peripheral substitution and axial substitution and the concept of cluster organic frameworks; broadened the scope of synthesis methods and structure directing agents for substituted metal oxygen clusters; and successfully achieved and the second on-site substitution reaction on vanadium oxide clusters.

2. In the field of rare-earth oxygen clusters, the laboratory synthesized a series of rare-earth organic spiral tubes with the purposeful selection of multifunctional organic ligands and proposed the idea of ligand-induced clustering and collaborative coordination, and constructed a series of cluster organic frameworks.

3. In the field of main group metal oxygen clusters, the laboratory synthesized microporous indium germanate and super-macroporous nickel germanate for the first time and discovered metal bonds in the presence of water and oxygen. They proposed a strategy to synthesize the organic framework of rare earth germanium oxygen clusters through self-polymerization and induced clustering.

The above research results have received high praise from colleagues in China and abroad. The research won second prize at the 2016 National Natural Science Awards.

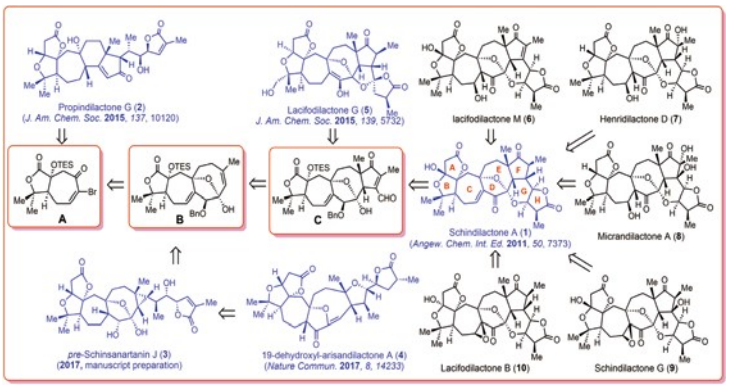


36-core rare earth-oxygen wheel cluster organic framework

Total Synthesis of Complex Natural Products with Important Biological Activities

Beijing National Laboratory for Molecular Sciences (Planned) (Peking University, Institute of Chemistry of the Chinese Academy of Sciences)

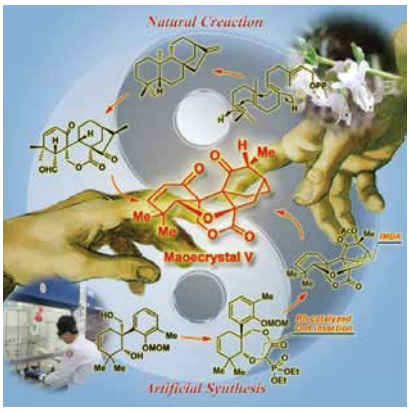
Natural products are one of the important sources for discovering new drugs or leading structures. The total synthesis of natural products not only can break through the limitations of natural resources, but can also provide analogs of natural products for the study of structure-activity relationships and mechanisms of action, thereby increasing the possibility of natural products being transformed into drugs. The Beijing National Laboratory for Molecular Sciences (planned) is oriented toward new drug research and development. It has developed simple and efficient new organic synthesis methods and new reactions; opened up new routes for asymmetric synthesis that are efficient, environmentally friendly, highly selective, and oriented toward structural diversity; accomplished a series of original work; and made breakthrough progress. The main achievements include:



Integrated synthesis strategy of Schisandra nortriterpenoids natural products

1. Opened up an efficient, simple, three-dimensional controllable, and flexible synthetic route, with a series of transition metals participating in the series reaction as the key step, and completed the first total synthesis of several Schisandra nortriterpenoids, which laid the foundation

for research on the creation of drugs from this family of compounds.



The first total synthesis of the complex natural product Maoecrystal V

2. Made groundbreaking use of rhodium-catalyzed oxygen-hydrogen insertion reactions to overcome the problem of carbon-oxygen ether bond construction and completed the first total synthesis of Maoecrystal V, a natural product of diterpenoids, in 16 steps. The research work was reported in the journal *Nature*.

3. Developed a gold-catalyzed tandem cyclization reaction, implemented a one-step synthesis method for building the core skeleton of Antrocin, and completed the first total synthesis of Antrocin. International patents have been obtained for its synthesis method, and the method has been authorized in China, the United States, Europe, and Japan. Preclinical research on this molecule is currently being carried out. The above research results have won high praise from the international academic community, leading and promoting the development of basic research and applied basic research on the total synthesis of active natural products. The research won second prize at the 2016 National Natural Science Awards.

Linkage Between Asian Monsoon Changes and Global Climate

State Key Laboratory of Loess and Quaternary Geology (Institute of Earth Environment, Chinese Academy of Sciences)

State Key Laboratory of Lake Science and Environment (Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences)

As a key link connecting high-middle-low latitude climates and sea-land-atmosphere interaction, the Asian monsoon is an important part of the global climate system. It plays an important role in the transmission of water vapor and heat between the northern and southern hemispheres. It is closely related to the changes in the ecological environment and human survival in densely populated Asian regions and has distinct regional characteristics and important global significance. The State Key Laboratory of Loess and Quaternary Geology and the State Key Laboratory of Lakes Science and Environment conducted comprehensive research on different geological and biological records and multiple climatic and environmental proxy indicators and integrated high-quality representative climate and environmental evolution sequences in Asia to conduct a series of original work on changes in the Asian monsoon and their connection with the global climate, achieving breakthrough progress. The main achievements include:

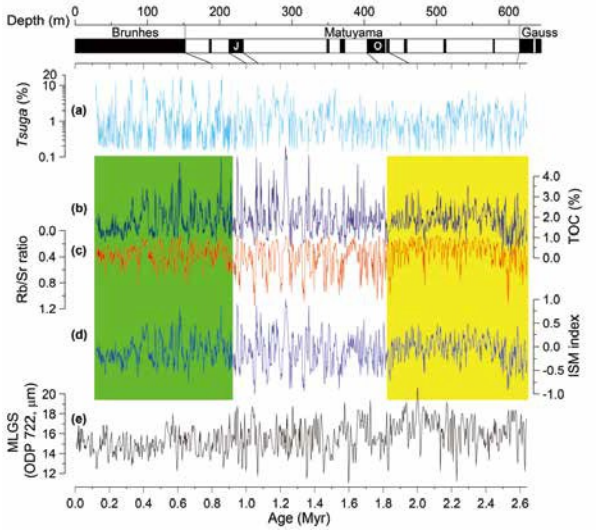
1. The laboratories studied the changing characteristics of the Asian monsoon on scales of glacial-interglacial to precession, revealed the influence of solar radiation and the trans-equator pressure gradient caused by changes in northern hemisphere ice volume and Antarctic temperature on the evolution of the Indian monsoon, and proposed a new dynamic theory of Indian summer

monsoon changes during the glacial-interglacial period.

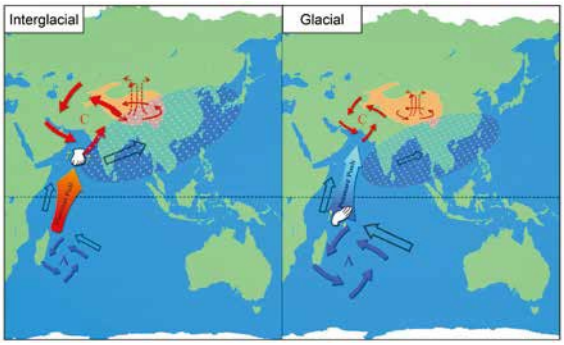
2. Through a combination of geological evidence and numerical simulations, the laboratories clarified the influence of the Atlantic meridional circulation and Antarctic temperature on abrupt Asian monsoon events, propose the interaction model of monsoon-westerly climate during the glacial-interglacial period, and revealed the important role of westerly circulation and the East Asian monsoon in linking high-middle-low latitude climate changes.

3. Through the comprehensive integration of geological records of different environmental units, the laboratories revealed the temporal and spatial characteristics and influencing factors of Holocene Asian monsoon climate changes and identified the links between them and the north-south movement of the tropical convergence zone, cold events in high northern latitudes, and changes in solar activity.

The above research results have won high praise from the international academic community. From the perspective of earth system science, the study of ancient Asian monsoons has been expanded to the integrated study of multi-scale and multi-dynamic factors along with regional and global integration, greatly promoting the development of past global change science related to monsoons. The research won second prize at the 2016 National Natural Science Awards.



In the 2.60 Ma Indian summer monsoon recorded in the 666-meter Heqing core, left picture, during the Interglacial period, the amount of ice in the northern hemisphere decreased and the Indian low pressure strengthens; the Antarctic temperature increases and

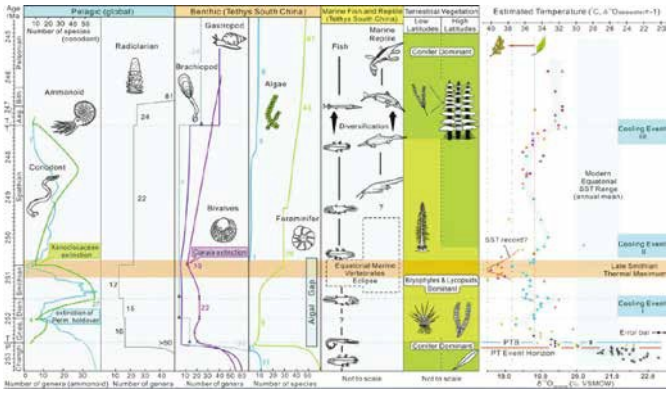


the Mascarene high pressure weakens; the Indian low pressure "thermal traction" strengthens the summer monsoon; in the right picture, during the Glacial period, the amount of ice in the northern hemisphere increased and the India low pressure weakened; the amount of ice in the Antarctic increased, and the "pressure push" of the strengthened Mascarene high caused the Indian summer monsoon to strengthen earlier.

Process and Environmental Causes of the Largest Extinction of Phanerozoic Organisms and Subsequent Biological Recovery

State Key Laboratory of Biogeology and Environmental Geology (China University of Geosciences (Wuhan))

At the turn of the Paleozoic and Mesozoic, the largest biological extinction event of the Phanerozoic occurred. The marine environment showed extreme deterioration, and the biological recovery process was abnormally complicated. The State Key Laboratory of Biogeology and Environmental Geology has long been engaged in the study of biological and environmental events in the mass extinction-recovery period at the turn of the Paleo-Mesozoic. It quantitatively determined changes in a number of environmental indicators during the geological mutation period, revealed the process of extinction, survival, and recovery of organisms at different trophic levels in the marine ecosystem, conducted a series of original work, and achieved breakthrough progress. The main achievements include:



The relationship between the biological evolution process of the Early Triassic and paleo sea temperatures

1. Using the methods of conodont biostratigraphy and cycle stratigraphy, a high-resolution stratigraphic framework from the Late Permian to the Middle Triassic in South China was established, providing a time scale to reveal the co-evolution process of organisms and the environment in this period of major geological upheaval.

2. Based on a large amount of biological fossil data, the laboratory proposed two episodes in the mass extinction of organisms at the turn of the Permian and Triassic. The first episode severely damaged plankton and shallow-water benthic organisms, and the second episode completely destroyed the Paleozoic marine ecosystem structure. The laboratory discovered that the recovery of micro-organisms such as foraminifera began in the Smithian period 1 million years after the mass extinction, which was significantly faster than the traditional thinking that the recovery time for macro-organisms was 5 million years.

3. Using multiple micro-area, in-situ analysis techniques and isotope geochemical methods, the laboratory constructed high-precision paleo-sea temperature and paleo-oxygen phase curves from the end of the Late Permian to the early Middle Triassic. The laboratory proposed that high temperatures, the ocean hypoxia they triggered, and other factors of the earth

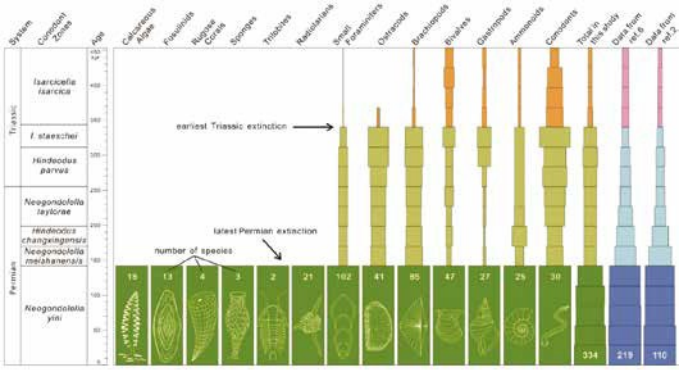


Diagram of the extinction patterns of different types of marine life at the turn of the Permian-Triassic

itself are some of the main factors controlling the extinction and subsequent biological recovery at the turn of the Paleo-Mesozoic, as well as the cause of the miniaturization and migration of animals to high latitudes.

The above research results provide direct evidence for the internal cause of the end-Permian mass extinction, reveal the co-evolution process of organisms and the environment at the turn of the Paleozoic and Mesozoic, and provide a scientific reference for exploring contemporary human adaptation and transformation of the deteriorating global environment. The results were twice positively reviewed by special issues of the journal *Science* (2011, 2012). They are leading and promoting the development of basic research on biological environmental events in major geological historical periods and won second prize at the 2016 National Natural Science Awards.

Formation of Earth Animal Tree

State Key Laboratory of Continental Dynamics (Northwest University)

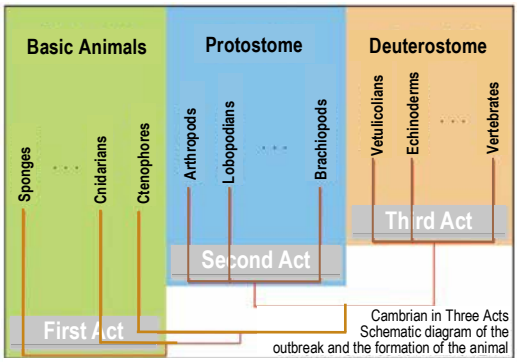
Darwin's theory of evolution, with the idea of "Tree of Life" showing the ancestor of all living things, changed the human view of nature and the world. In this field, the formation of the origin of the animal tree and the difficult problem for this century of its internal connection with the Cambrian outbreak are eye-catching issues. The existing animal family tree is composed of three major branches and 38 categories. How was the animal tree formed in the early evolutionary stage? What is the internal relationship between the formation of the three branches and the Cambrian explosion? In order to solve these two core scientific questions, the State Key Laboratory of Continental Dynamics has long been committed to the study of Chengjiang fauna and other related Early Cambrian fauna.

The distant ancestor of arthropods-Diania cactiformis

Through a series of important scientific discoveries, fundamental breakthroughs have been made in the origin and formation of the three major branches of the animal tree and the essential properties of the Cambrian explosion. The main achievements include:

1. The laboratory revealed the origin and evolution of the key categories of the three major animal sub-kingdoms (basic animals [基础动物], Protostome, and Deuterostome): Discovered the early Cambrian Wende creature Stromatoveris (the ancestor of the comb jellies) and the earliest sea anemone fossils and constructed the early basic animal family evolution relationship, demonstrating the continuity of animal evolution between the Cambrian and Precambrian; discovered the phyllopod Diania cactiformis providing fossil evidence for revealing the evolution from phyllopods to arthropods; systematically studied the classification and evolution of the Naraoia arthropods of the Cambrian period; proposed a new plan for the origin of arthropod double bifurcated appendages and an arthropod ancestor model; found fossil evidence

of the soft body tissues and organs of the Cambrian brachiopods and proposed their adaptive evolution strategies for surficial life on muddy substrate; revealed the diversity of Priapulida in the Cambrian and found the earliest fossil record of the scavenging life of Priapulida; and discovered the most primitive Archaea of the phylum Echinoderm.



Three-Act Cambrian Outbreak and Animal Tree Formation

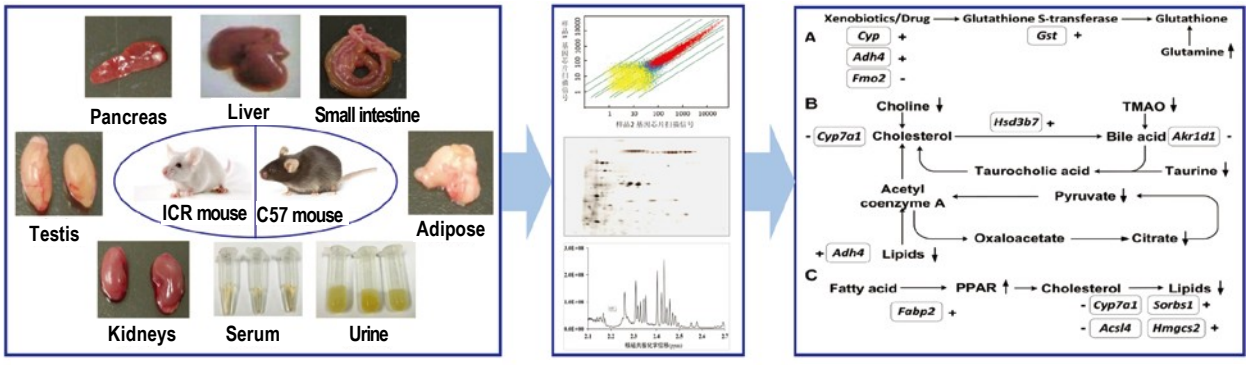
2. In terms of theoretical innovation, the laboratory proposed a new hypothesis that "the three-act Cambrian explosion constructed the three the animal subkingdoms in sequence" and revealed the evolutionary process of the animal kingdom from double germ layer to tertiary germ layer, to oral anal inversion, and continuous improvement of metabolism over 40 million years, reflecting the continuity and stages of animal evolution during the Cambrian outbreak.

The relevant results have been cited many times by *Nature* and *Science*, and have been selected twice as one of the top ten S&T advances by Chinese universities. They have been selected for inclusion in textbooks and professional books in China and abroad. This achievement broke through the boundary in human understanding between the origin of animal phyla and the Cambrian explosion. The research breadth and depth represent the highest level of attainment in the field on a global scale. The research won second prize at the 2016 National Natural Science Awards.

Basic research on omics identification and prevention and control of environmental health hazards of high-risk pollutants

State Key Laboratory of Pollution Control and Resource Reuse
(Tongji University, Nanjing University)

High-risk pollutants (HRPs) have many types, strong toxicity, and complex toxic mechanisms. Very low concentrations can cause serious harm to population and ecological health. They are listed by the United Nations Environment Programme as an environmental problem that



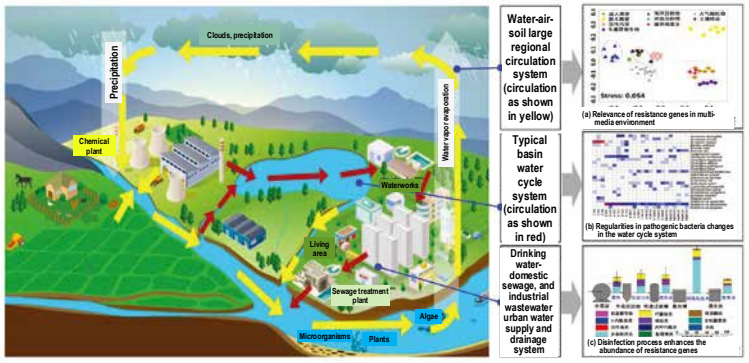
(a) Experimental model animal-mouse (b) Omics results (c) RNA- Protein and Metabolite regulatory network

Pattern recognition of self-regulatory network of toxic molecules of chemical HRPs

urgently requires global cooperation. HRPs health hazards and prevention and control have become the frontiers and hotspots of research in the international environmental field. Through 17 years of continuous and systematic research, the State Key Laboratory of Pollution Control and Resource Reuse has created research methods such as high-sensitivity and high-throughput HRP identification and molecular pathway toxicity analysis. The laboratory has revealed the bionomics mechanisms of the environmental behavior and health hazards of HRPs, which laid a theoretical and methodological basis for the comprehensive prevention and control of HRP health hazards. The main achievements include:

1. The laboratory created a new method for pattern recognition of the self-regulating network of toxic molecules of chemical HRPs, a new method for molecular linking screening for structure-effect toxicity classification, and a new method for high-throughput screening of biological HRPs and metagenomics, breaking through the difficulties of integration technology for massive HRPs and their toxicity information fragments. They analyzed the compound toxic effects of chemical HRPs in complex environmental media and performed full-spectrum screening of biological HRPs.

2. The laboratory revealed the network self-regulation mechanism of RNA transcription and protein translation, and biological small molecule metabolism by which chemical HRPs cause induced lipid metabolism, energy metabolism disorders, and other hazards; systemically explained the toxic molecular mechanism of typical HRPs, clarified the association characteristics of environmental pathogenic bacteria (factors), resistant bacteria (genes) and other biological HRPs with microbial communities; and revealed the molecular ecology mechanism of the horizontal transfer of environmental resistance genes.



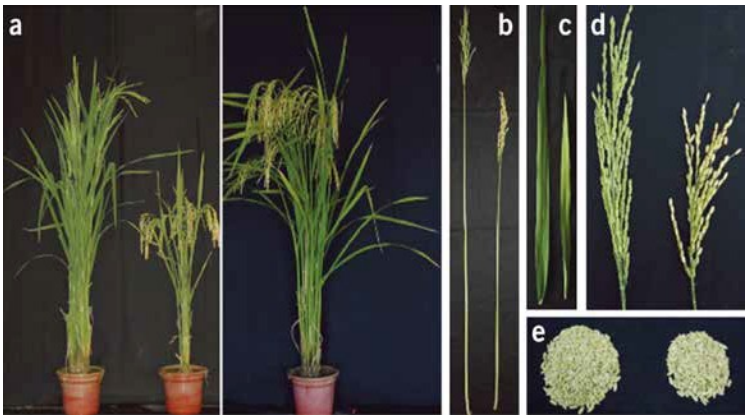
Source and sink characteristics of HRPs in multi-scale and multi-media environments

3. The laboratory systematically studied the temporal and spatial distribution and source-sink laws of HRPs in the water, soil, and atmosphere of Lake Tai and the Yangtze River; identified key chemical and biological HRPs such as polycyclic aromatic hydrocarbons, heavy metals, pathogenic bacteria (factors), and drug-resistant genes; and revealed the spatial heterogeneity of HRP health hazards in the water environment. They systematically studied the dynamic changes of HRP health hazards in the process of urban water supply and drainage; discovered the potential health risks arising from the water treatment process; and invented new technologies for the reduction and prevention and control of health risks from HRPs.

The above research results have won praise from well-known international experts in the same field and have improved the international influence of the environmental toxicology academic discipline in China. The research won second prize at the 2016 National Natural Science Awards.

Genetic and Molecular Biology Basis of Rice Yield Traits

State Key Laboratory of Crop Genetic Improvement (Huazhong Agricultural University)



The pleiotropic gene GHd7 controls rice yield

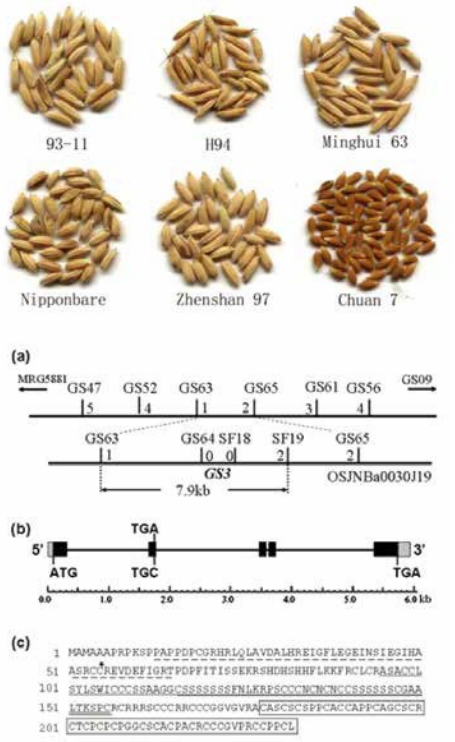
Rice is the most important food crop in China, and high yields and high quality have always been among the main goals of rice genetic research and breeding. The State Key Laboratory of Crop Genetic Improvement focuses on the genetic and molecular basis of rice yield. They carried out the identification and excavation of yield traits, the isolation and cloning of key genes for yield traits, and systematic research on molecular genetic mechanisms. They achieved a series of breakthrough results, laying an important theoretical and practical foundation for rice genetic improvement. The main achievements include:

1. The laboratory discovered and located 104 QTLs for yield traits, analyzed their genetic effects and modes of action, enriched the theory of quantitative genetics.

2. The laboratory cloned the major QTL GS3, which regulates rice grain shape, providing an example for the cloning and utilization of major genes for quantitative traits in rice.

3. The laboratory cloned the minor QTL GS5, which positively regulates rice grain width, revealing the molecular mechanism of its regulation.

4. By cloning the pleiotropic gene Ghd7, which controls rice yield, the laboratory found that the different alleles of this gene are closely related to the regional adaptability of rice varieties.



The major gene GS3 controls rice grain shape

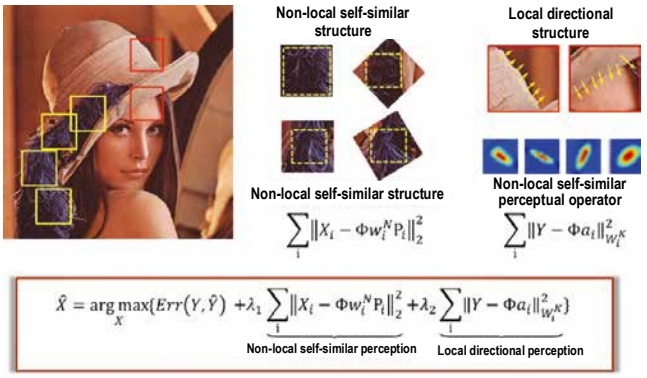
The above research results have won high praise from the international academic community. The cloned genes have been applied by many breeding units at home and abroad, and new varieties have been cultivated. The research won second prize at the 2016 National Natural Science Awards.

Research on Theoretical Methods of Image Structure Modeling and Visual Appearance Reconstruction

State Key Laboratory of Integrated Services Network (Xidian University)

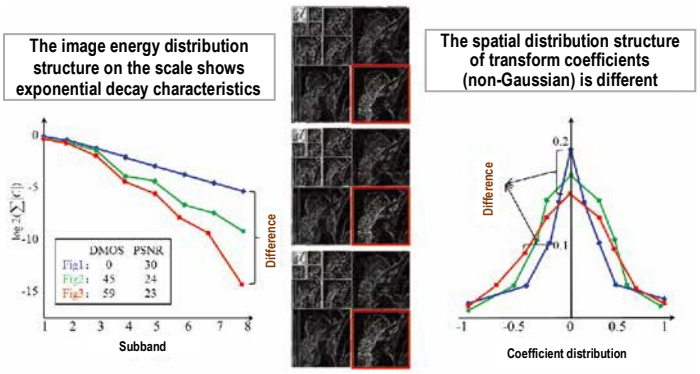
State Key Laboratory of Transient Optics and Photonics (Xi'an Institute of Optics and Fine Mechanics, Chinese Academy of Sciences)

Image structure modeling means to extract more discriminative structural information by constructing an image feature representation model, while visual appearance reconstruction is a process of reconstructing image content using the structural elements of visual perception. Both are common basic problems in the field of image processing and computer vision, and they are also very active research directions. The State Key Laboratory of Integrated Service Network and the State Key Laboratory of Transient Optics and Photonics have long been engaged in basic theoretical research in the field of computer vision. They have established a visual computing framework based on the fusion of information-physical-cognitive space and proposed a new method of image structure modeling, a new model of visual appearance reconstruction, and new criteria for visual quality evaluation, which have enriched the theory of visual computing. The main achievements include:



Visual performance reconstruction model for image local-non-local structure perception

1. The laboratories revealed the consistency of image structure in space-time and scale changes. Based on this, they established an integrated high-order tensor representation model combining the global-local structures of the images, which solves the problem of large covariance matrix decomposition caused by small sample problems. They proposed an alternate projection algorithm for compact tensor quantum space optimization, proved the convergence, and obtained a more compact high-order tensor representation.



Internal law between the statistical distribution of structure and the quality of visual perception

2. The laboratories discovered the same direction excitation relationship between the saliency of image structure and visual perception sensitivity and constructed an apparent reconstruction model of image local-non-local structure perception to ensure the clarity and integrity of the reconstructed image. They proposed a fast optimization algorithm for apparent reconstruction based on multi-dictionary joint learning, which constructs and simplifies the multiple mapping relationship between

the original space and the reconstructed space and reduces the computational complexity.

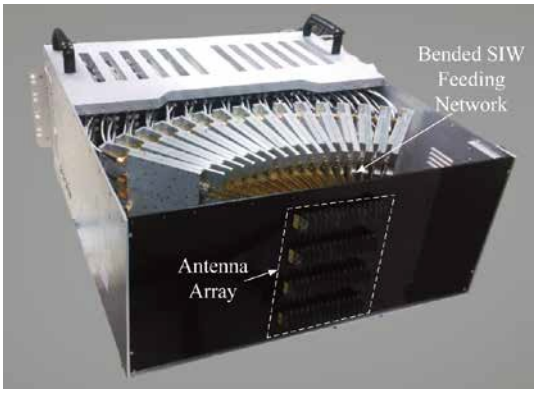
3. The laboratories explored the internal laws between the statistical distribution of image structure and visual perception, breaking through the theoretical bottleneck that made it difficult to describe quality changes using structural statistical characteristics. They constructed a visual perception fusion filtering model for image structure changes, enhancing the perception of image quality changes. The laboratories proposed an objective evaluation criterion for image quality consistent with human visual perception and established an iterative optimization framework for visual appearance reconstruction.

The above research results have won high praise from the international academic community, leading and promoting the development of basic research on image structure modeling and visual appearance reconstruction. The research won second prize at the 2016 National Natural Science Awards.

New Microwave and Millimeter Wave Substrate Integrated Guided Wave Structure and Device

State Key Laboratory of Millimeter Waves (Southeast University)

Substrate integrated guided-wave structures and devices have extremely low electromagnetic leakage and mutual interference, and their quality factors and power capacity are much higher than the corresponding traditional planar transmission lines and devices. They have a significant effect on improving the performance of wireless systems, such as wireless communications, radar, and radio astronomy, and are one of the research branches in the field of microwave and millimeter waves in recent years that has received the most attention. The State Key Laboratory of Millimeter Waves has carried out long-term and in-depth research around this direction. They systemically revealed the basic working mechanism of such structures and devices; developed corresponding design methods, invented a series of new high-performance microwave and millimeter wave devices, and innovatively proposed new planar guided wave structures, such as half-mode substrate integrated waveguides, and new structures for series of passive devices. The laboratory conducted a series of original work and made important progress. The main achievements include:

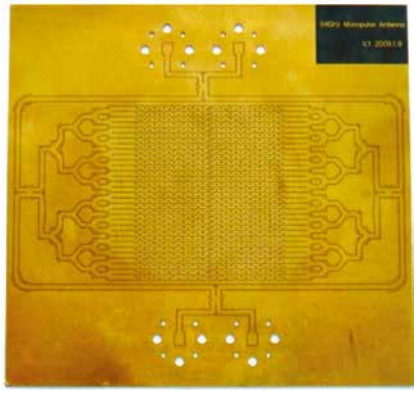


Millimeter wave multi-beam array based on substrate-integrated guided wave technology
(Used for 5th-generation mobile communication massive MIMO system)

1. The laboratory was the first in the world to propose and develop the frequency domain finite difference and straight-line method full-wave analysis model suitable for the integrated guided wave-like structures the periodic substrates, revealed its transmission mechanism, and constructed closed-form design formulas on this basis. This set of formulas has been widely used by Chinese and foreign scholars in the design of substrate-

integrated guided wave-like structure components.

2. The laboratory proposed and named new guided wave structures such as half-mode substrate integrated waveguides, systematically studied their guided wave characteristics, loss mechanisms, and mode conversion mechanisms, constructed a design formula, and developed a series of new high-performance microwave and millimeter wave devices on this basis.



94 GHz substrate-integrated monopulse antenna

3. The laboratory proposed a variety of substrate-integrated waveguide passive new structures, deeply studied their resonance characteristics, coupling characteristics, and loss mechanisms, and developed a series of new high-performance devices and single-substrate integrated systems on this basis.

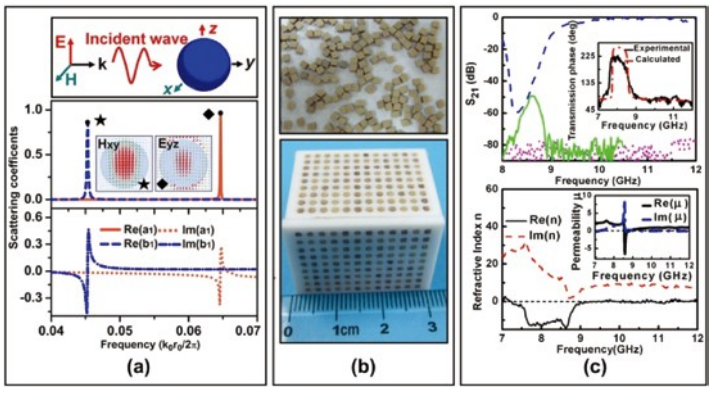
4. The laboratory clarified the radiation mechanism of the substrate-integrated waveguide antenna, established the corresponding analysis model and design method on this basis, and proposed and implemented a series of novel and unique high-performance substrate-integrated antennas and arrays.

The above research results promoted the "substrate integrated guided wave technology" to become a new branch in the international microwave and millimeter wave discipline and won high praise from the international academic community. The research won second prize at the 2016 National Natural Science Awards.

Principles and Construction of Non-Metallic Supernormal Electromagnetic Medium

State Key Laboratory of New Ceramics and Fine Processing (Tsinghua University)
State Key Laboratory of Tribology (Tsinghua University)

Super-normal electromagnetic media have peculiar electromagnetic properties that are very different from conventional materials, overturning several rules described in traditional electromagnetic theory. They are expected to trigger major technological changes in information technology and other fields. The State Key Laboratory of New Ceramics and Fine Processing and the State Key Laboratory of Tribology have long been engaged in the research of non-metal-based supernormal electromagnetic media. Leveraging the abundant

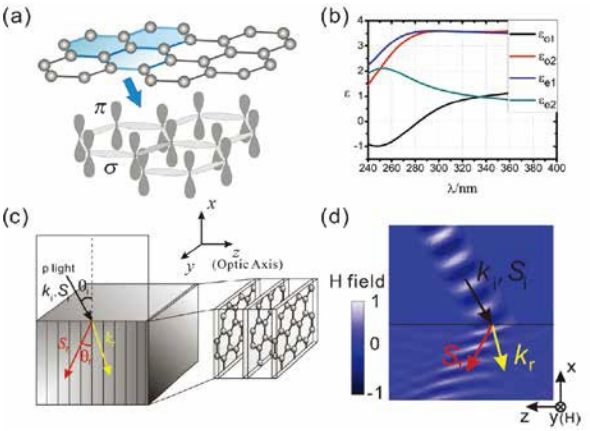


Metamaterial based on sub-wavelength ceramic resonance units

electromagnetic polarization mechanisms of non-metallic materials, the laboratories initially created a principle framework and construction strategy for non-metal-based supernormal media. They developed a new super-normal dielectric system with low electromagnetic loss, simple artificial structure, and easy control and guided device application. The main achievements include:

1. The laboratories constructed a principle of supernormal electromagnetic response based on non-metallic materials and their structures. The laboratories proposed design principles for ceramic metamaterials based on dielectric Mie resonance and discovered the supernormal electromagnetic response caused by the structure of inorganic crystalline materials. The laboratories opened up a new route to construct super-normal electromagnetic media other than metal meta-materials and achieved the low loss, simplified structure, and isotropy of super-normal media.

2. The laboratories proposed a regulation mechanism for non-metal-based supernormal electromagnetic media. Utilizing the sensitivity of non-metallic functional materials to the external field and through the construction of artificial atoms or dielectric backgrounds, the laboratories developed a universal metamaterial control method. This breaks through the difficult problem of the adjustability of supernormal electromagnetic responses and has been hailed as a "powerful, reliable, and feasible supernormal media control technology" by international peers.



Natural layered hyperbolic material and its negative refraction phenomenon

3. The laboratories established a bottom-up optical frequency non-metal based supernormal medium preparation strategy. Using self-assembled colloidal crystals, anodic aluminum oxide (AAO), and biological templates, the laboratories developed a construction method for non-metal-based metamaterials based on soft chemical processes, which frees the preparation of optical frequency supernormal media from the constraints of micromachining technology.

The above results established the theoretical and experimental basis for non-metal-based supernormal media and led the development of supernormal media. The research won second prize at the 2016 National Natural Science Awards.

Long-Life High-Temperature Oxidation, and Ablative Coating Protection Mechanism and Application Basis

State Key Laboratory of Solidification Processing (Northwestern Polytechnical University)

Targeting the application bottleneck of C/C composite materials that are easy to oxidize at high temperature and have insufficient ablation resistance under extreme environments, the State

Key Laboratory of Solidification Processing has carried out in-depth research on the protection mechanisms and application bases of high-temperature oxidation or ablation coatings and achieved a series of original results. The main achievements are as follows:

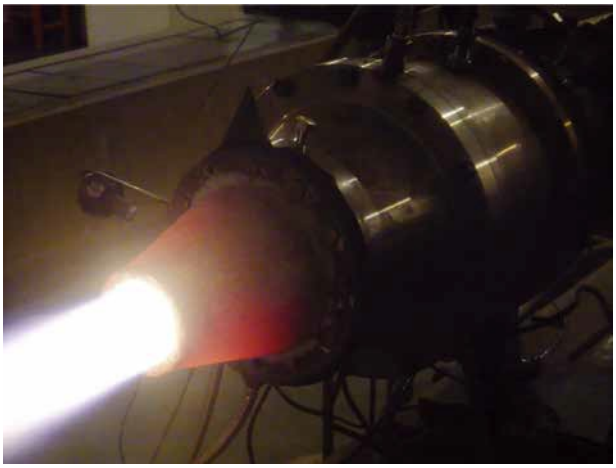
1. The laboratory discovered the mechanisms of nanowire deformation, interface fracture debonding, and node occlusion toughening in coatings and opened up a new direction for nanowire-toughened ceramic coatings.

2. The laboratory discovered that the structure of the inlaid coating and the pinning buffer interface layer can alleviate the thermal expansion coefficient mismatch and induce crack deflection and solved the problem of compatibility between the coating and the substrate interface.

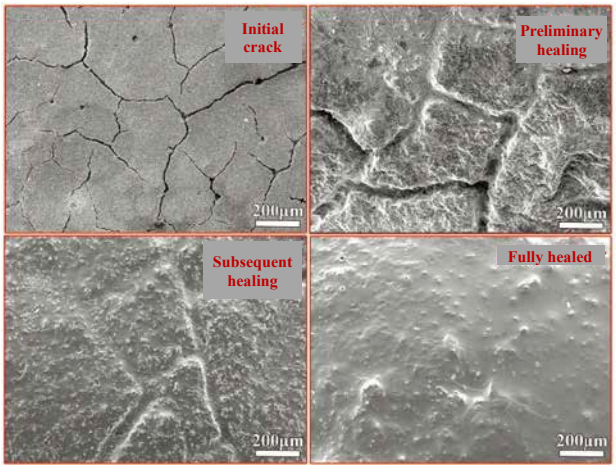
3. The laboratory proposed a new idea for the synergistic design of boride modification and gradient transition coating structure and revealed the oxidation expansion effect of boride and the self-healing mechanism of the glass phase flow.

4. The laboratory clarified the high-texture pyrolytic carbon coating and ultra-high temperature ceramic film synergistic anti-ablation mechanism, established an ablation failure model, and developed an anti-ablation method of matrix modification and coating combination.

Based on the above results, related high-temperature oxidation or ablation coating technologies and methods have been developed, which have been successfully applied in key components in aerospace weaponry and other fields and solved a variety of defense application problems in extremely harsh environments, producing significant social benefits. The research won second prize at the 2016 National Natural Science Awards.



1600°C gas wind tunnel coating scouring environment



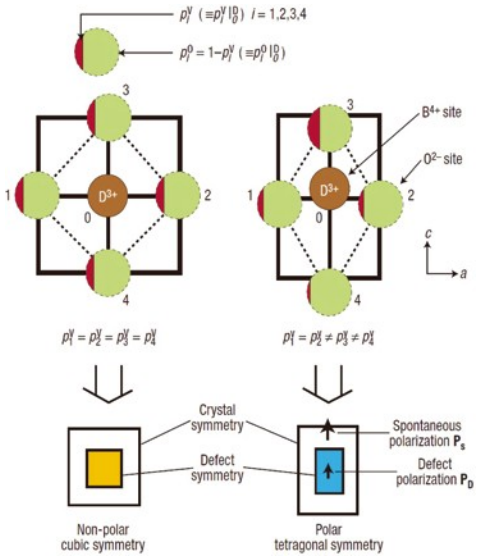
Self-healing coating system oxidation self-healing process SEM photo

New Physical Effects of Ferrous Smart Materials based on Crystal Defect Regulation

State Key Laboratory for Mechanical Behavior of Materials (Xi'an Jiaotong University)

State Key Laboratory of Electrical Insulation and Power Equipment (Xi'an Jiaotong University)

Ferrous smart materials mainly include shape memory alloys, ferroelectric and ferromagnetic materials that respond to external fields such as temperature, force, electricity, and magnetism. They are some of the core materials required in important fields such as high technology and national defense. The State Key Laboratory for Mechanical Behavior of Materials and the State Key Laboratory of Electrical Insulation for Power Equipment have long been engaged in this research focus and basic problems in this field. They discovered several new physical principles and new effects that utilize crystal defects to regulate performance, greatly improving the performance of this type of material. The main achievements include:



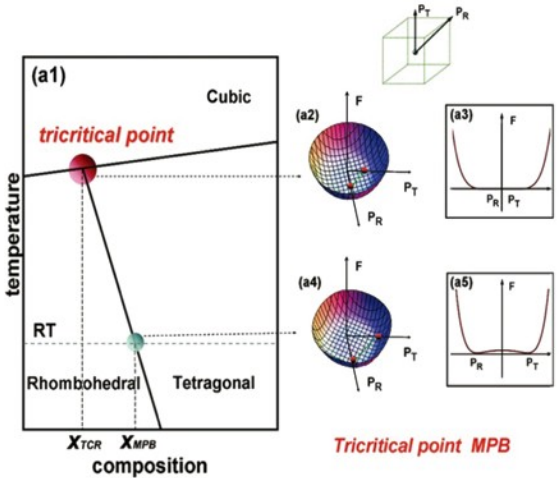
The principle of short-range order symmetry of crystal point defects in ferroelectric materials

1. The laboratories proposed the principle of short-range order symmetry of point defects that regulates the properties of ferroelectric materials through the distribution of crystal point defects, discovered a huge recoverable electrostrain effect in ferroelectric materials that is 40 times that of traditional electrostrain, and provided a new idea for greatly improving the electrostrain performance of ferroelectric materials.

2. The laboratories proposed a three-phase point quasi-homotype phase boundary theory that regulates the performance of ferrous smart materials by the concentration of crystal point defects. In lead-free piezoelectric materials, the laboratories found a large piezoelectric effect with a piezoelectric coefficient exceeding that of the king of piezoelectric ceramics—lead zirconate titanate, and found a giant magnetostrictive effect in ferromagnetic materials.

3. The laboratories discovered the domain structure transformation and reversible twin deformation effect produced by adjusting the order parameters of ferrous smart materials through crystal surface defects (surface and interface). The laboratories proposed a new concept of "nanospring" and discovered a zero hysteresis superelastic deformation of up to 30% in metal nanowires.

The above research results have been highly praised by international authoritative scholars and colleagues in the field and provide a theoretical basis and new ideas for greatly improving the performance of ferrous smart materials. The research won second prize at the 2016 National Natural Science Awards.

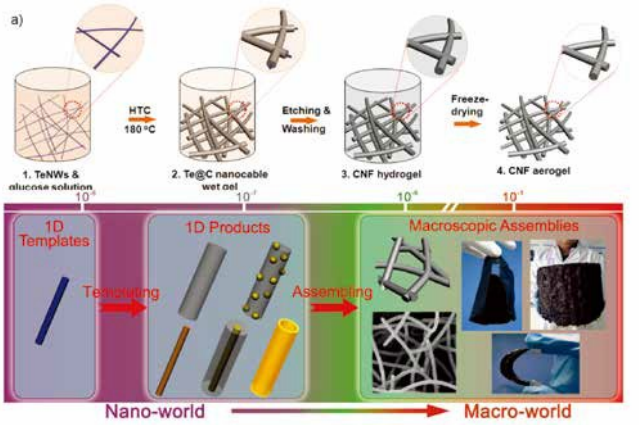


Three-phase point quasi-homotype phase boundary theory of ferrous smart materials based on crystal point defect concentration

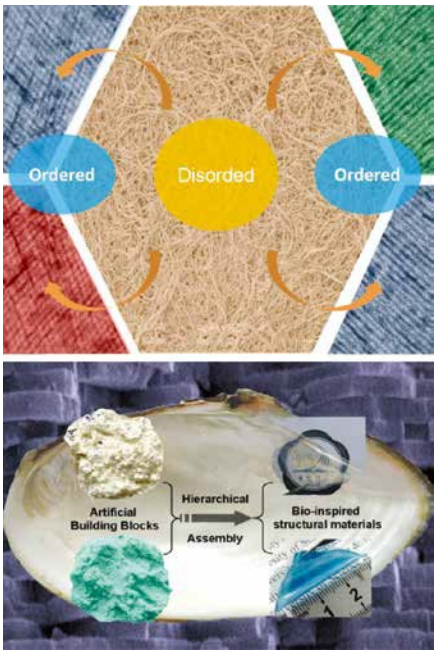
Research on the Macro-Preparation of Nanostructure Units and the Functionalization of Macro-Scale Assemblies

Hefei National Laboratory for Physical Sciences at the Microscale (Planned) (University of Science and Technology of China, Chinese Academy of Sciences)

Macroscopic assembly material systems constructed by nanostructure units have become a new object of research in the field of nanomaterials. Its rich scientific significance has injected new research vitality and provided strategic opportunities for nanomaterials science research. The Hefei National Laboratory for Physical Sciences at the Microscale (Planned) focuses on the key scientific issues in the macro-preparation technology of nano-structure units and the functionalization of assemblies that need to be resolved in the field of nanotechnology. They were the first in the world to conduct in-depth research on the controllable macro-preparation of nano-structure units and the functionalization of macro-scale assemblies. The main achievements include:



Macro-preparation of carbon nanofiber sheet by the ultra-fine nanowire template method



Preparation, composition, and assembly preparation of nanostructure units of different dimensions

1. Established and developed a new method for the macro-preparation of nanostructure units. Taking self-developed and macro-preparable tellurium nanowires with uniform high aspect ratio as a guiding template, the laboratory established a new technology for the mass preparation of carbon nanofibers by hydrothermal carbonization and successfully prepared a series of high aspect ratio functional nanowires with important application prospects in the field of energy conversion.

2. The laboratory implemented the preparation, composition, and assembly preparation of nanostructure units of different dimensions. The laboratory established new methods for the preparation of bracelet-shaped nickel-cobalt alloy nanorings, gold-coated cobalt eggshell structure nanospheres, and chain-like assembly structures, new magnetic graphene and ferric oxides, and magnetic three-dimensional graphene and ferric oxide composite gels. They used the electrospinning method to realize the composite assembly of functional nanomaterials and polymers.

3. The laboratory established a new method for the interface controllable assembly of nanostructure units and the preparation of macro-scale assemblies. The laboratory developed a method for assembling

disordered nanowires into large-area ordered nanowire films at the air and water interface. They developed methods such as layer-by-layer assembly and solvent evaporation induction to prepare high-strength and transparent organic and inorganic composite functional films and transparent layered composite film materials with mother-of-pearl structures.

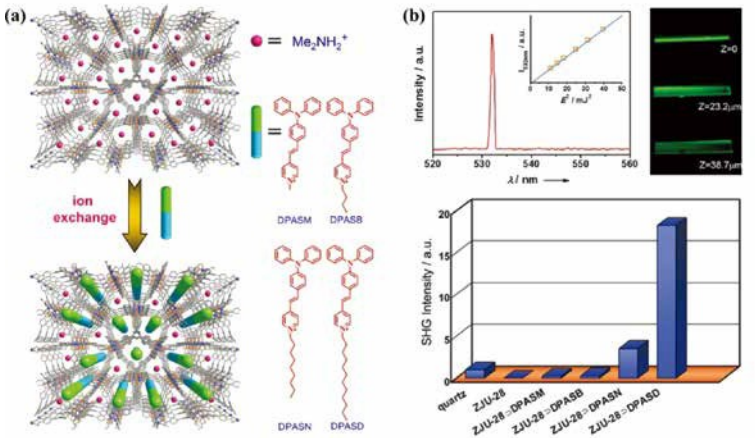
The above research results in the controllable macro-preparation of nanostructure units and the functionalization of macro-scale assemblies stand at the international leading level and have made important contributions to China's international presence in this field. The research won second prize at the 2016 National Natural Science Awards.

Fluorescence Sensing Metal-Organic Frame Material Structure Design and Function Construction

State Key Laboratory of Silicon Materials (Zhejiang University)

With the development of China's society and economy, the problems of environmental pollution and ecological destruction have become increasingly serious, and the need to establish a modern real-time environmental monitoring and emergency system has become urgent. Fluorescence sensing methods have the advantages of real-time online monitoring. However, current fluorescent sensing materials generally have fatal limitations, such as weak resolution, low sensitivity, and poor selectivity and stability, which greatly restrict their applications. In response to these problems, the State Key Laboratory of Silicon Materials was the first to propose the use of the unique ordered microporous structure, large specific surface area, and abundant active sites and luminescent centers of light-emitting metal-organic framework materials. They proposed innovative ideas for the high-sensitivity, high-selectivity, and high-resolution fluorescence sensing and detection of ions, small molecules, and temperature in the biological and environmental fields. The main achievements include:

1. The laboratory discovered the mechanism of interaction between the uncoordinated active sites in the luminescent metal-organic framework material and exogenous ions and organic molecules and its dependence on the luminescence response. Based on this, they achieved high-

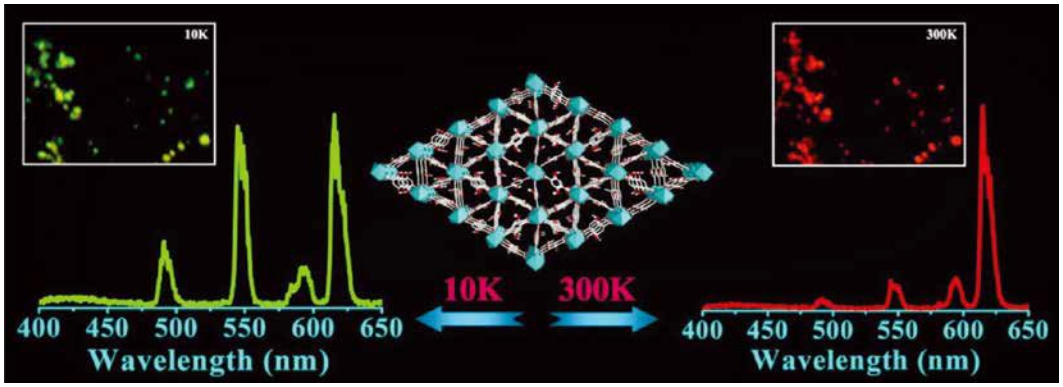


Ordered assembly of organic dye molecules in the pores of metal-organic framework materials and its nonlinear optical frequency doubling effect

selectivity and high-resolution fluorescence detection of anions, metal ions, and small organic molecules by the framework material.

2. The laboratory proposed the design idea of mixed metal-organic framework materials with dual luminous centers, established a new principle for proportional self-calibration fluorescence temperature sensors, solved the scientific problem where the traditional detection method based on single fluorescence intensity was vulnerable to external interference, and significantly improved the accuracy and sensitivity of detection.

3. The laboratory proposed the design idea of structure-function coordination of light-emitting framework materials, achieved the structure and function prediction, controllable preparation, and directional assembly of light-emitting framework materials, and obtained light-emitting metal-organic framework materials with excellent luminescence performance, stability, and dispersion.



Self-calibrated fluorescence sensing and imaging of temperature with dual rare earth-organic framework materials

The above results have been published in authoritative international journals such as *J. Am. Chem. Soc.*, *Angew. Chem. Int. Ed.*, *Adv. Mater.*, and *Chem. Rev.*, and have attracted widespread attention and follow-up research in the international academic community. The research won second prize at the 2016 National Natural Science Awards.

Construction and Synergy Mechanism of High-Performance Composite Electrode Materials for Energy Storage

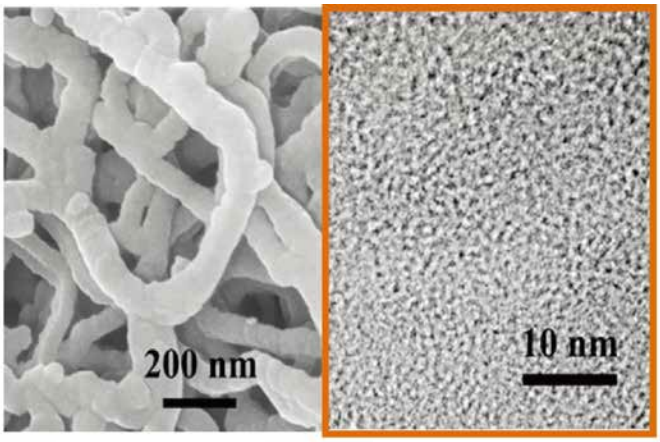
State Key Laboratory of Material Processing and Die & Mould Technology (Huazhong University of Science and Technology)

Wuhan National Laboratory for Optoelectronics (Planned) (Huazhong University of Science and Technology)

Efficient energy storage is a key technology for electric vehicles and smart grids. Lithium-ion batteries and supercapacitors are the two mainstream electrochemical energy storage devices. Researchers face huge challenges in finding ways to further improve their energy density, power

density, cycle life, and safety performance. The State Key Laboratory of Material Processing and Die & Mould Technology and Wuhan National Laboratory of Optoelectronics (planned) address key scientific issues such as the ion and electron conduction mechanism in composite electrode materials, the evolution of material structures, and the surface energy storage mechanism. They conducted in-depth and systematic research and achieved the following innovative results:

1. The laboratory found an energy storage synergistic enhancement effect of composite electrode materials coated with electrochemically active materials and proposed a new idea for constructing composite materials through the matching of redox potential and energy band structure.

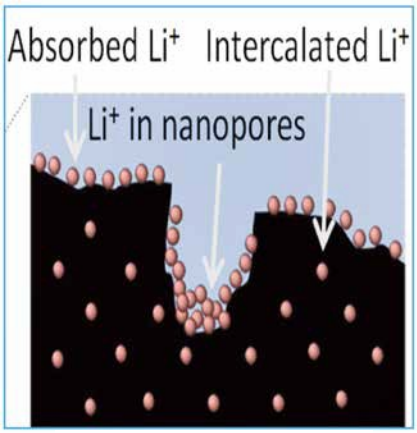


Nanofibers Microporous structure

2. The laboratory found that metal oxides can form composite nano-clusters with adaptive volume changes after electrochemical reconstruction and proposed a "conformal strong coupling" mechanism to construct negative electrode materials for lithium-ion batteries in order to avoid performance deterioration caused by volume expansion during charging and discharging.

3. The laboratory found that nitrogen doping can greatly increase the lithium storage capacity of microporous carbon, proposed a "lithium-ion reservoir" energy storage model in which nitrogen active sites and boundary surfaces are synergistic, and constructed a series of high-activity graded porous hard carbon materials.

Based on the above research results, a series of high-performance composite electrode materials have been designed and synthesized, which have been industrialized and received applications in related companies. They are suitable for lithium ion batteries and supercapacitors, and show significantly improved electrochemical performance. The research won second prize at the 2016 National Natural Science Awards.



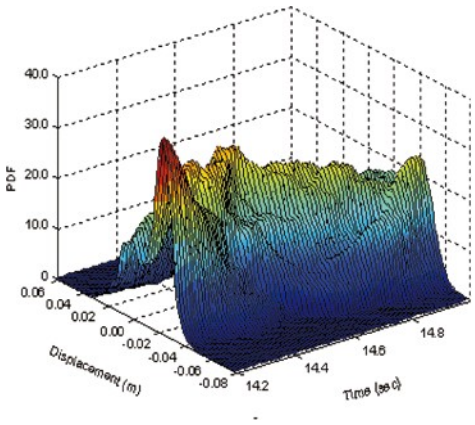
Lithium ion reservoir

Probability Density Evolution Theory of Reliability Design for Engineering Structure Disaster

State Key Laboratory of Civil Engineering Disaster Prevention (Tongji University)

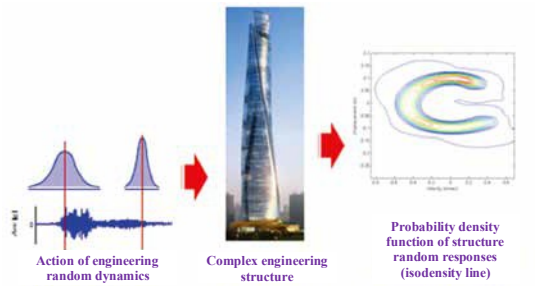
State Key Laboratory of Subtropical Building Science (South China University of Technology)

China is one of the countries most affected by severe natural disasters such as earthquakes and wind disasters in the world. The safety of major engineering projects under the impact of disasters is the cornerstone of ensuring the safety of people's lives and property and the healthy economic and social development. The disaster-resistant reliability design of engineering structures is the basis for ensuring the safety of major engineering projects. After more than 20 years of hard work, the State Key Laboratory of Civil Engineering Disaster Prevention and the State Key Laboratory of Subtropical Building Science have discovered laws of random propagation in engineering systems and established a probability density evolution theory for engineering random systems (工程随机系统). The main achievements include:



Probability density function of structure random responses

1. For engineering random systems, the laboratories established a generalized probability density evolution equation, which provides a scientific basis for understanding and studying the physical nature and evolution laws of random systems.



Basic idea of the probability density evolution theory for the reliability design of engineering structures

2. Based on the probability density evolution theory, the laboratories established a unified analysis method for structural disaster resistance reliability.

3. The laboratories have made important scientific discoveries and a series of research progress in dynamic action and random source identification, concrete random damage constitutive model, and other areas, providing key theoretical support for dynamic catastrophe analysis and disaster-resistant reliability design for major engineering structures.

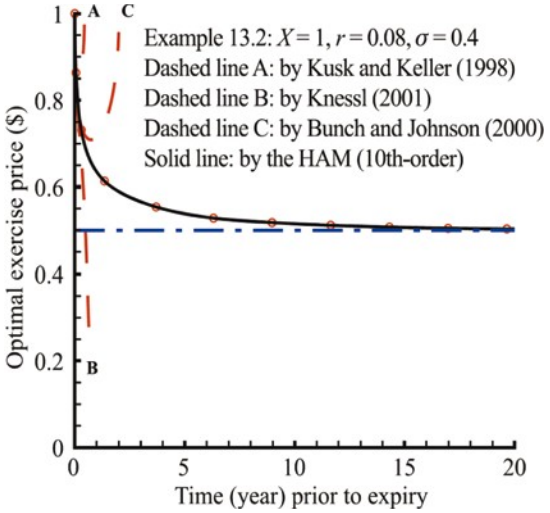
The research results have received high praise from famous scholars in China and abroad. The results were not only applied in civil engineering, but also substantively applied in many other fields such as mechanical engineering, aerospace engineering, marine engineering, and ship engineering by Chinese and foreign research institutions. The research and won second prize at the 2016 National Natural Science Awards.

Homotopy Analysis Method and its Application for Solving Strongly Nonlinear Problems in Mechanics

State Key Laboratory of Ocean Engineering (Shanghai Jiao Tong University)

There are a large number of nonlinear problems in science and engineering, and nonlinear science is an important part of basic science. However, perturbation theory relies on small physical parameters, and traditional analytical approximation methods usually cannot guarantee the validity of analytical approximation solutions for strongly nonlinear problems. Traditional analytical approximation methods including perturbation methods have a hard time giving effective analytical approximation solutions for all physical parameter values. Traditional analytical approximation methods are essentially only suitable for weakly nonlinear problems, which seriously hinders the in-depth understanding of many nonlinear problems in mechanics. Therefore, it is of great theoretical significance to propose analytical approximation methods that are effective, widely applicable, and capable of solving strongly nonlinear problems. This is also a difficult problem that has plagued the field of mechanics for a long time. The State Key Laboratory of Ocean Engineering innovatively proposed the "homotopy analysis method," which fundamentally overcomes the above limitations of traditional analytical approximation methods. The main achievements include:

1. The laboratory originally applied the homotopy concept of topology theory to the analytical approximation solution of nonlinear differential equations and proposed a new general method for solving analytical approximation solutions of nonlinear equations, whose validity does not depend on small physical parameters—the "homotopy analysis method." After more than 20 years of continuous improvement, the laboratory has formed a complete theoretical system.



The homotopy analysis method used to solve the American option equation, the convergence range of its approximate solution is nearly 100x that of the traditional method

2. The laboratory took the lead in proposing the concepts of "generalized homotopy" and "convergence control" and introduced "convergence control parameters." They proposed a way to ensure the convergence of the analytic series solution so that the "homotopic analysis method" is suitable for strongly nonlinear equations and fundamentally overcame the limitations of traditional analytical approximation methods.

3. The application of the "homotopy analysis method" to solve many nonlinear problems, not only can better solve some classical mechanics problems and obtain solutions that converge in a larger physical parameter interval, but can also obtain some brand-new solutions that are missed by other methods.

The above research results have been widely used by Chinese and foreign researchers and won high praise from the international academic community. The "homotopy analysis method"

fundamentally overcomes the limitations of traditional analytical approximation methods and opens up a new way to obtain analytical approximation solutions of strongly nonlinear problems in mechanics. It has had a driving and far-reaching influence on the development of nonlinear mechanics. The research won second prize at the 2016 National Natural Science Awards.

Special Drilling Fluid for Complex Structure Wells and Industrial Application

State Key Laboratory of Petroleum Resources and Prospecting
(China University of Petroleum (Beijing))

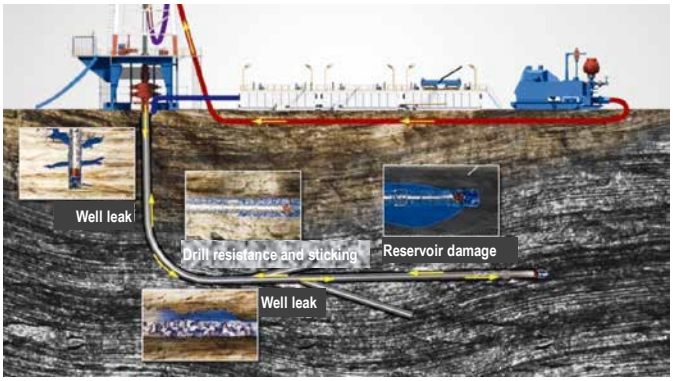
State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering
(Southwest Petroleum University and Chengdu University of Technology)

Fishbone wells, three-dimensional barrier wells, and other complex structure wells are internationally recognized advanced well types and main technological development directions for the efficient development of low-permeability, unconventional, and marine complex oil and gas fields in the 21st century. After ten years of continuous research, the State Key Laboratory of Petroleum Resources and Prospecting and the State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering invented special drilling fluids for complex wells with completely independent intellectual property rights and formed a batch of core patents and corporate standards, which have been verified and applied on site. They have achieved outstanding results in improving the drilling success rate of wells with complex structures, protecting oil and gas reservoirs, increasing oil and gas production, and reducing costs. The main achievements include:

1. The laboratories invented new bionic drilling fluid materials and a new bionic drilling fluid system. The laboratories revealed the mechanism by which the adhesion protein secreted by mussels that strongly cements them to rocks can effectively stabilize the well wall and the high-lubrication mucus secreted by earthworms can reduce friction. They invented a new material to enhance the cohesion between rock particles and collapse prevention and a new material to enhance metal and rock bonding and lubrication. Based on the two bionic materials, the laboratories created a new bionic drilling fluid system, which increases the rate of rock compressive strength to 99.8% higher than that of advanced U.S. technology, reduces the rate of well collapse accidents by 82.6%, and increases the drilling speed by 27.7%. The friction and torque reduction rates are 12.3% and 35.4% greater than the respective internationally advanced indicators.

2. The laboratories invented a new method for the evaluation of pressure-bearing plugging of core stress changes and new high-friction leak-proof plugging materials. The laboratories revealed the mechanisms of the adhesion, slippage, and pressure transfer of the plugging material to the fracture face of the formation; guided the establishment of a new plugging evaluation method based on core pressure, fracture, fracture reopening, and fracture extension pressure measurement; and invented new modified epoxy polyester leakage plugging material with strong adhesion and high friction, increasing pressure by 8MPa, 10MPa, 5MPa, 4MPa and reducing leakage accidents by 80.6% compared with advanced foreign technology.

3. The laboratories invented new methods and new materials for protecting oil and gas reservoirs with amphiphilic (双疏) and filming. The laboratories created a new theory of amphiphilicity and film protection of oil and gas layers and established new methods and new materials for amphiphilicity and filming of oil and gas layers in complex structure wells. Compared with the previous complex structure wells, this increases average daily output by more than 1.6 times, and the damage evaluation method has been incorporated into textbooks in U.S. universities.



Four major drilling fluid technical problems solved

The above research results constitute an organic whole for special drilling fluids for complex wells, which have played an important role in promoting the technological progress of the industry and the upgrading main drilling technology. The research won second prize at the 2016 National Technical Invention Awards.

Key Technologies for Cold Drilling and Thermal Recovery of Land Gas Hydrate

State Key Laboratory of Superhard Materials (Jilin University)

With the continuous growth of energy demand and the increasing shortage of conventional fuels, natural gas hydrate, as an unconventional energy source, has attracted widespread attention worldwide due to its huge reserves. The State Key Laboratory of Superhard Materials, the Institute for Exploration Technology of the Chinese Academy of Geological Sciences (中国地质科学院勘探技术研究所), the Oil and Gas Resource Survey Center of the China Geological Survey, and other units have jointly carried out technical research. After 14 years, they have successfully developed an internationally pioneering key technology for hydrate cold drilling and thermal mining (冷钻热采) to which China has independent intellectual property rights. The main achievements include:

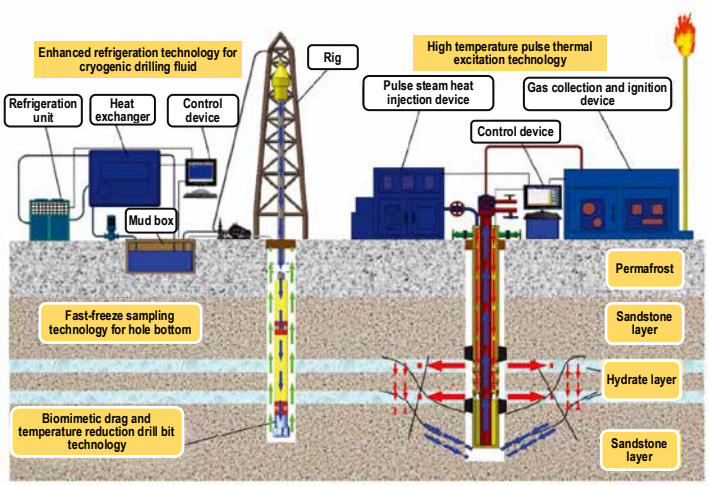
1. Low-temperature drilling fluid enhanced refrigeration technology: The laboratory solved the technical problem of hydrate formation borehole wall collapse caused by the positive deviation effect of the drilling fluid temperature field and satisfied the sampling requirements of hydrate low-temperature drilling.

2. Fast-freeze sampling technology at the hole bottom: Through the process of drilling hydrate samples, freezing samples at the bottom of the hole, and quickly extracting frozen samples, the laboratory solved the technical problems of high-fidelity sampling of hydrates.

3. Biomimetic drag and heat reduction drill bit technology: The laboratory solved the technical problems of the slow drilling speed of traditional drill bits and the decomposition of

hydrate samples caused by friction and heat generation of the drill bit.

4. High temperature pulse thermal excitation technology: The laboratory solved the technical problems of low-grade thin-bed hydrate mining and successfully implemented the trial mining of natural gas hydrate on land. Using this technology, the first physical sample of natural gas hydrate from a land area in China was successfully drilled in the Muli Basin of Qinghai at an altitude of 4000m. In the China permafrost natural gas hydrate trial extraction No. 1 well project (中国冻土天然气水合物试采一号井工程), natural gas was successfully extracted and the trial extraction of hydrates in permafrost regions in China was achieved for the first time.



Key technologies and process of cold drilling and thermal mining of natural gas hydrate on land

The above research results not only provide experience for the drilling and mining of hydrates in the seas of China, but also provide technical reserves for ensuring the security of my China's future energy strategy, taking human development and hydrate utilization another solid step forward. The research won the second prize at the 2016 National Technology Invention Awards.

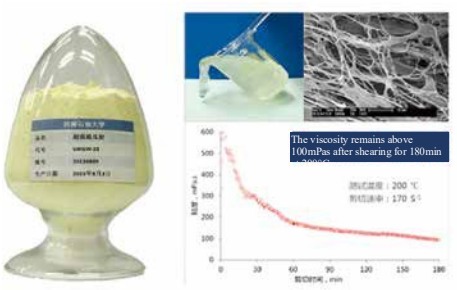
High-efficiency Fracturing Acidification Reforming Technology and Applications for Deep and Ultra-Deep Oil and Gas Reservoirs

State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering
(Southwest Petroleum University and Chengdu University of Technology)

The fracture acidizing of oil and gas reservoirs is the key core technology for the exploration and development of deep and ultra-deep oil and gas resources. However, restricted by worldwide problems such as high and ultra-high temperature, high and ultra-high pressure, high and ultra-high closing pressure, and large filtration loss due to the development of fractured-cavity wormholes, the fracturing acidizing improvement technology cannot yet meet the needs of the country. The State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering has been researching this field for nearly 10 years. It has successfully invented a high-efficiency fracturing acidizing technology for deep and ultra-deep oil and gas reservoirs, achieving a major technological leap with the upgrade from a depth of 4000m to a depth of 7500m. The main achievements include:

1. The laboratory broke through the 160℃ temperature resistance limit of guar gum fracturing fluid in China and abroad, proposed innovative high-temperature modification and composite cross-linking technical ideas for guar collagen powder, successfully invented the

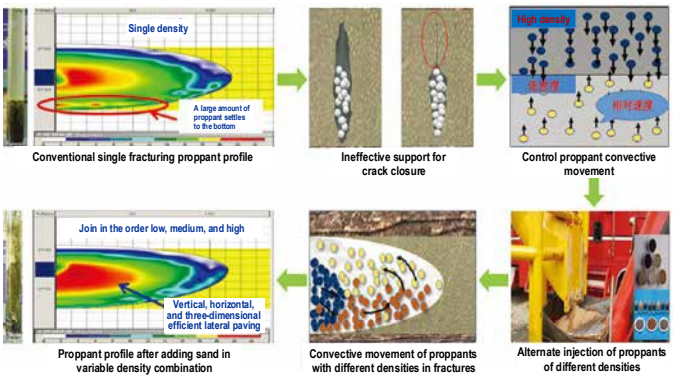
world's first 180-200℃ guar gum fracturing fluid system with an ultra-high temperature modified etherified guar gum thickener and boron-zirconium composite crosslinking agent as its core, and created a successful precedent for guar gum fracturing in a 184.6℃ high-temperature reservoir.



180-200°C ultra-high temperature guar gum fracturing fluid system

2. The laboratory broke through the domestic and foreign technical bottleneck of only adopting weight reduction and drag reduction to reduce the limitation of construction pressure. In a world-first, the laboratory invented a method for predicting acid damage reduction of rupture pressure (酸损伤降低破裂压力预测方法) and pioneered the network fracture acid damage process (网络裂缝酸损伤工艺), reducing the rupture pressure by up to 20MPa. The fracturing capacity of similar technologies in China and abroad has been increased from 95MPa high pressure to 137MPa ultra-high pressure, setting a record construction pressure of 130MPa.

3. The laboratory broke through the domestic and foreign technical limitations that only allowed for qualitative descriptions of proppant embedding and reflux, the adding of a single density of sand, and improvement of the efficiency of lateral paving. They invented a method and device for testing the embedding depth for the first time, proposed, for the first time, a method to improve the vertical proppant placement efficiency, and creatively invented a method for effective proppant placement in large thick reservoirs. They created the first proppant high-efficiency paving fracturing technology integrating concentrated perforation, variable density combined sanding, and embedding and backflow control and set a record for the largest sanding scale in single vertical well single-layer fracturing.



High-efficiency proppant placement fracturing technology

4. The laboratory broke through the technical limitations by which fractured-vuggy reservoirs with acid fracturing would form acid-eroded wormholes, which intensify filtration loss and prevent communication with fractured-vuggy reservoirs in far wells. For the first time, the proposed technical ideas for alternate processes such as the injection of slippery water, powdered ceramics to reduce filtration, and acid liquid cracking and etching. They invented an innovative composite acid fracturing method using an alternation of powder ceramic fracturing and acid fracturing. They created the first large-scale deep penetration composite acid fracturing technology for high-temperature and ultra-deep wells (maximum depth of 7500m).

The application of the above results and technology increased production by the equivalent of 18.53 million tons of oil and gas. The research won second prize at the 2016 National Technology Invention Awards.

Diagnosis Technology and Practices for Service Behavior of Complex Hydraulic Concrete Structures

State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering

(Hohai University and Nanjing Hydraulic Research Institute)

China is the country with the largest number of reservoirs in the world. There are 98,000 reservoirs of various types, which play an irreplaceable role in ensuring national water security. The many complex hydraulic concrete structures that have been built in China or are under construction are playing a huge role in economic development while also providing social benefits. Whether they can operate safely has a direct effect on social stability. For a long time, the State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering has been carrying out integrated R&D work on the "design-construction-operation" for the integration of new technologies for the diagnosis of hydraulic concrete structures through their service lives. They revealed the evolution mechanisms of structure behavior throughout the service life and achieved the scientific diagnosis of behavior changes of complex hydraulic concrete structures throughout their service lives, which is of great significance to the assurance of engineering safety. The main achievements include:

Prototype diagnosis test of complex hydraulic concrete PCCP service behavior

1. The laboratory developed a core performance testing device for complex hydraulic concrete during the forming period and proposed a rapid assessment technology for pouring quality control parameters.

2. The laboratory broke through the bottleneck in damage and fracture mechanics in the applications of complex hydraulic concrete engineering, developed a precise simulation device and system for the mechanical behavior of complex hydraulic concrete after formation, invented end-to-end refined testing technology for damage and fracture after formation, and solved the difficult problem of the difficulty of determining the initiation point.

Integrated platform for online diagnosis of complex hydraulic concrete structure behavior

3. The laboratory established a composite force analysis theory of complex hydraulic concrete prestressed composite structures, developed a composite force damage assessment technology used during the service period of the structure, and proposed processes and methods for repairing structural infirmities.

4. The laboratory invented a series of full service life service behavior monitoring devices for complex hydraulic concrete structures and a diagnostic method for abnormal behavior changes (性态转异) and developed an integrated platform for structural service process safety assessment.

The above research results are of great significance for improving the construction quality of complex hydraulic concrete structures, ensuring their safety in service, and promoting the development of the hydraulic structural engineering discipline. The research won second prize at the 2016 National Technical Invention Awards.

New Technology for Polyolefin Fluidized Bed Reactors Based on Acoustic Emission Monitoring

State Key Laboratory of Chemical Engineering

(Tsinghua University, Tianjin University, East China University of Science and Technology, and Zhejiang University)

Polyolefin is an important basic material for the construction of the national economy. The production capacity of polyolefin in mainland China exceeds 25 million tons per year. The paper products it replaces are equivalent to cutting down half of Zhejiang's forest area every year. As an agricultural mulch, it can effectively expand the arable land area of China by an equivalent of 100 million mu (approx. 164737 acres). A large number of polyolefins are produced by fluidized bed technology, but the global economic loss caused by unstable equipment is huge every year. Implosion prevention, caking prevention, and static prevention have become the three major internationally recognized industry problems. The State Key Laboratory of Chemical Engineering has long been engaged in the R&D and engineering application of olefin polymerization reactors. They have made innovative use of fluidized bed acoustic emission information for the design or improvement of olefin polymerization reactors, conducted a series of original work, and made breakthrough progress. The main achievements include:

Fluidized bed acoustic emission detection system

1. The laboratory invented fluidized bed acoustic emission information technology and created a new platform for the development of olefin polymerization reactor technology. By measuring and analyzing the acoustic emission signal generated by particle friction and collision on the wall of the fluidized bed, the laboratory invented a new measurement technology for solid particle information of the fluidized bed reactor, which solved the problem of early warning of reactor explosions.

2. The laboratory invented a new technology for fluidized bed olefin polymerization reactor structure amplification. Through acoustic emission detection, polymerization kinetics, fluid

mechanics, and other basic research, the laboratory obtained new laws of reactor amplification from non-condensing heat transfer control to condensing reaction control. They invented new structures such as a fluidized bed inlet necking structure, a new type deflector, an anti-deposition distribution plate, and a catalyst injector, achieved the efficient and stable operation of the reactor, and successfully applied these results to the design of the first Chinese-made 300,000 ton/year polyethylene fluidized bed reactor.

300,000 ton/year gas phase polyethylene plant

3. The laboratory invented a new operation process for fluidized bed olefin polymerization reactors. Through the online monitoring of acoustic emission, the laboratory achieved online flushing and self-repair of the distribution plate and heat exchanger, which nearly doubled the continuous operation time of the reactor and reduced energy consumption by 24%.

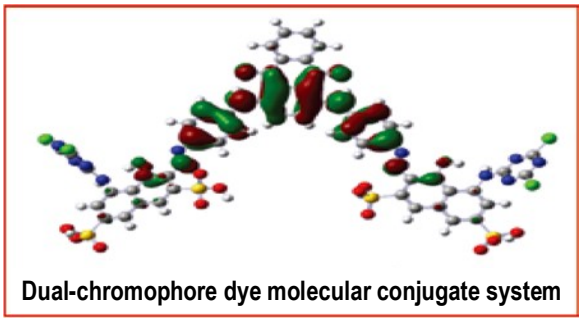
The above research results have won high praise from the international academic community and have been successfully applied to the design or improvement of a total of 15 large polyethylene and polypropylene plants, significantly improving the long-term operational reliability of the plants, reducing catalyst consumption, and bringing core technical indicators to the internationally leading level. The research won second prize at the 2016 National Technology Invention Awards.

Creation and Application of New Reactive Dyes with Enhanced Group Functions

State Key Laboratory of Fine Chemicals (Dalian University of Technology)
State Key Laboratory for Modification of Chemical Fibers and Polymer Materials
(Donghua University)

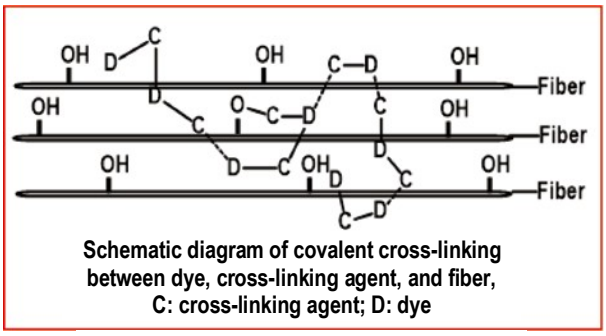
China is the world's largest producer of dyes, accounting for more than 70% of the world's total dye production. The development of new dyes plays a vital role in enhancing China’s competitiveness in the textile market. The State Key Laboratory of Fine Chemicals and the State Key Laboratory for Modification of Chemical Fibers and Polymer Materials have long been committed to the innovation of dye structure and research on new technologies for improving the quality of dye products. They have put forward innovative ideas for group function enhancement, established a new reactive dye system, and made breakthrough progress. The main achievements include:

1. In the single-chromophore azo structure, the laboratories designed a hydrophobic auxochrome group to improve the adsorption capacity of the dye on the fiber and create a new type of reactive dye with a high fixation rate. The laboratories created 1 red and 1 yellow new reactive dyes with single-chromophore monoazos and comprehensive dyeing performance better than that of dyes with similar structures. They created 2 blue and 1 black new reactive dyes with single-chromophore bisazos, whose fixation rate is higher than 90%, so dyed fiber has excellent overall fastness performance.



Dual-chromophore dye molecular conjugate system

2. In the dual-chromophore azo structure, the linking group is endowed with reactivity or color development capabilities to create a new type of dual-chromophore reactive dye with a high fixation rate. The laboratories created 5 new reactive dyes of orange-red, red, purple, green, and blue with high exhaustion rates and high reactivity. The fixation rate is higher than 90%, so the dyed fiber has excellent overall fastness performance.



Covalent cross-linking between dye, cross-linking agent, and fiber

3. The laboratories created multi-chromophore azo macromolecular cross-linking dyes so that macromolecules and polychromophores form supramolecular adsorption capacity with respect to fibers and the linking group connecting the macromolecule and the chromophore has the ability to react with the fiber. They created four macromolecular cross-linking dyes with yellow, red, blue, and black fixing rates close to 100% and excellent fiber fastness. 100% fixation dyes can satisfy the dye fixation rate needs of the new clean coloring technology—fiber digital printing.

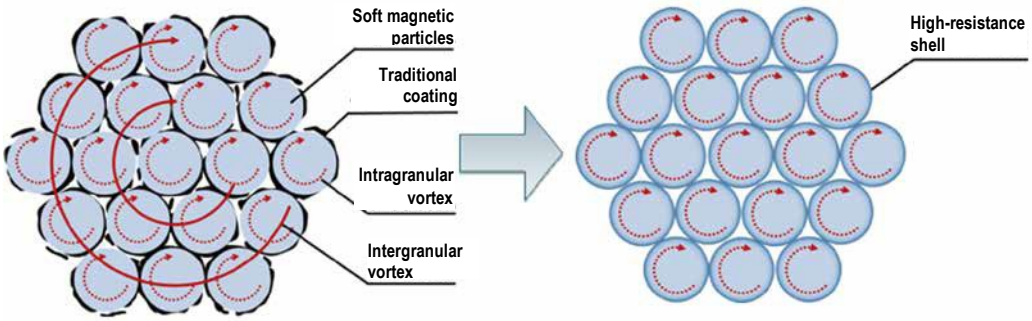
The 14 new reactive dyes created by the laboratories have obtained strong economic benefits in enterprise production and application and play a guiding and demonstrative effect with respect to the technological progress of acid dyes and direct dyes with similar molecular structures, production technology, and dyeing methods. They are of great significance to the improvement of the technological level of China's dye industry and have significant social benefits. The research won second prize at the 2016 National Technology Invention Awards.

Low-Power High-Performance Soft Magnetic Composite Materials and Key Preparation Technologies

State Key Laboratory of Silicon Materials (Zhejiang University)

Soft magnetic composite materials are magnetic composite materials prepared by powdering, insulation treatment, bonding, pressing, and heat treatment of soft magnetic metals. They are widely used in important fields such as energy, information, transportation, and national defense. With the development of power electronic equipment in the direction of high frequency, high power density, energy saving, and electromagnetic compatibility, the requirements for soft magnetic composite materials are constantly increasing. The State Key Laboratory of Silicon Materials has carried out long-term cooperative research with related companies. They originally proposed the technical ideas of multi-soft magnetic phase core-shell structure composite materials; built a new series of high-performance soft magnetic alloy systems; and innovated and integrated core production technology, achieving large-scale production and wide application. The main achievements include:

1. The laboratory invented original multi-soft magnetic phase core-shell structure composite materials. The laboratory proposed a new idea for the generation of a high-resistivity soft magnetic shell layer on the soft magnetic powder matrix in situ to prepare a multi-soft magnetic phase core-shell structure composite material and reduce eddy current loss. They invented a core-shell structure material composed of a Fe-based soft magnetic alloy matrix and Fe_4N/Fe_3O_4, Fe_3O_4, and other high-resistivity soft magnetic shell layers.



Traditional insulation coating　　Multi-soft magnetic phase core-shell structure

2. The laboratory invented a series of new high-performance soft magnetic alloys. The laboratory innovatively designed Fe-Si-Me, Fe-Ni-Me (Me is Mo, Ni, Al, Co) new crystalline soft magnetic alloys, and amorphous-nanocrystalline Fe-Cu-Nb-Ti-Si-B and Fe-Ni-Al -Si-B new soft magnetic alloys. They have mastered the laws and mechanisms of the action of the composition formula on the alloy phase structure, microstructure, and magnetic properties and prepared high-performance soft magnetic composite products with different characteristics,

Products related to soft magnetic composites

such as high magnetic flux density and high DC superposition.

3. The laboratory innovated and integrated core production and application technologies. The laboratory invented a new type of high-temperature-resistant adhesive and organic-inorganic composite bonding technology, innovated and improved the magnetic powder preparation technology for different alloys and completed system integration of related inventions and key technologies, and established a complete set of production processes for soft magnetic composite materials related to low power consumption and high performance soft magnetic composite materials.

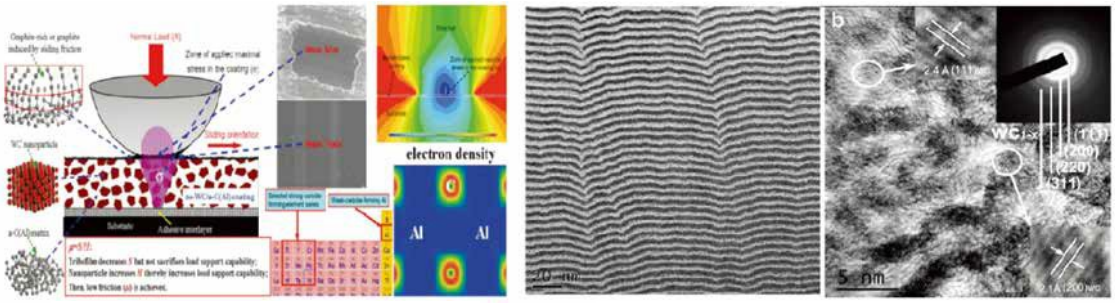
The above innovations and achievements have been fully applied in cooperative enterprises and have made important contributions to the fields of new energy vehicles, high-speed railways, computers, and national defense. The research won second prize at the 2016 National Technology Invention Awards.

Key Technology and Engineering Applications of Carbon-Based Film Combining Toughness and Lubrication

State Key Laboratory of Solid Lubrication (Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences)

Carbon-based film integrating toughness and lubrication is an important guarantee of the high reliability and long service life of the power and transmission systems of mechanical equipment. It is urgently needed in the fields of important bearing and gear parts, energy-saving and emission-reducing automobile engines, and aerospace components. The State Key Laboratory of Solid Lubrication has long been engaged in research on the friction and wear behavior of the material-surface interface. At present, they have systematically developed a series of carbon-based thin film materials that integrate toughness and lubrication and have made major innovations and breakthroughs in carbon-based film design, key technologies, and engineering applications. The main achievements include:

1. The laboratory invented multi-scale coupling strengthening and toughening design and preparation technology for carbon-based thin films, overcame the common problems of low bonding strength, high brittleness, and environmental sensitivity of diamond-like carbon films, and achieved the preparation of carbon-based film materials with high hardness and toughness and low friction on metal surfaces, such as light alloys.



Theoretical simulation calculation　　Fine structure regulation

2. The laboratory invented multi-interface toughness design and preparation technology for ultra-thick carbon-based films, developed a high-density plasma in-situ injection and co-deposition system on the inner wall of the pipeline, and successfully solved the technical problems of ultra-low internal stress, ultra-thickness of the diamond-like film, and deposition on the inner wall of the pipeline.

3. The laboratory invented a self-compensation environment adaptability design and composite preparation technology for the carbon-based thin film lubrication component characteristics synergy and friction interface and solved the problem of the accelerated failure of diamond-like carbon films in humid environments, corrosive media, special atmospheres, high vacuum, and other environments.

4. The laboratory invented super-elastic, high-toughness hydrogen-containing fullerene carbon film preparation technology and key equipment and overcame the problem of low-temperature deposition for this type of carbon-based film (<120°C). In a world-first, they prepared a hydrogen-containing fullerene carbon film with both ultra-low friction (<0.01) and super-elastic recovery (>85%) characteristics.

Equipment manufacturing applications

High-tech defense applications

The above research results have formed a core patent group covering key technologies in this field and have won high praise from the international academic community. The research results have been successfully applied to national defense, major national projects, and well-known Chinese enterprises, successfully solving the technical problem of the integration of toughness and lubrication for core moving parts. The research won second prize at the 2016 National Technology Invention Awards.

Shock Wave Wind Tunnel Experiment Technology for Reproducing Hypersonic Flight Conditions

State Key Laboratory of High Temperature Gas Dynamics
(Institute of Mechanics, Chinese Academy of Sciences)

Aerospace hypersonic flight has become an inevitable research and development trend in the international aerospace field and will have a revolutionary impact on the development of human society, the transformation of the international strategic layout, and the upgrading of the aerospace industry. After 60 years, the State Key Laboratory of High Temperature Gas Dynamics has proposed a systematic detonation-driven shock wave wind tunnel theory, invented a complete system of recurring wind tunnel experimental technology, and successfully developed the world's first super-large shock wind tunnel that replicates hypersonic flight conditions. The main achievements include:

The world's first integrated experiment on a powered aircraft in reproduced hypersonic flight conditions

1. The laboratory established the world's first high-power detonation drive technology, integrating reverse detonation coupling detonation, thick film deep groove critical diaphragm formation, and gradual energy amplification direct detonation technology. They achieved the substitution of chemical energy for the mechanical energy drive mode.

2. The laboratory established long experiment time shock wave wind tunnel technology, integrating detonation-driven shock wave wind tunnel suture operation, vacuum system startup shock wave reflection interference control, and shock wave and boundary layer interference test gas pollution suppression technology. They achieved an increase in the high enthalpy shock wind tunnel experiment time by an order of magnitude.

3. The laboratory established high-precision measurement technology for recurring wind tunnels, integrating the design of a high-frequency response and large-range force measurement system, the adaptive separation of the balance interference signal wave system, and high-precision thermocouple technology. The high-enthalpy shock wave wind tunnel force measurement accuracy was increased by an order of magnitude, and the thermal measurement accuracy was doubled.

The American Academy of Aeronautics and Astronautics awarded Jiang Zonglin the Ground Testing Award, the first time the award has been given to an Asian scholar in the 41 years since the award was established. China's hypersonic ground testing technology has been highly praised by international peers.

The above research results have achieved the leap from "simulation" to "reproduction" in the state of wind tunnel experiments. They represent the internationally leading level of hypersonic wind tunnels and have been highly praised by Chinese and foreign peers, such as the American Institute of Aeronautics and Astronautics and the Chinese Aerodynamics Association. The results have been applied to major and special tests in two major national projects and multiple space missions and have played an irreplaceable role in breakthroughs in special key technologies, the development of new models, and the recognition of aerodynamic laws. They have produced significant social benefits in promoting the development of hypersonic technology and avoiding flight test risks. The research won second prize at the 2016 National Technology Invention Awards.

Local Loading, Precise Plastic Forming, and Integrated Manufacturing Technology for High-Performance Lightweight Components

State Key Laboratory of Solidification Processing (Northwestern Polytechnical University)

The State Key Laboratory of Solidification Processing has worked for 16 years on the technical challenges of improving the forming limit and forming quality of high-performance lightweight components in the aerospace and other fields in China. They proposed an innovative idea based on the active control of local loading and the use of uneven deformation to explore the potential of material deformation and turn "harm" into "benefit." In the fields of point, line, surface, and body partial load uneven deformation coordination theory, active regulation principles, mold equipment, and process specifications, the laboratory has carried out systematic and innovative research and achieved comprehensive breakthroughs, forming a technical system for the active control of local loading and use of uneven deformation to achieve precise plastic forming. The main achievements include:

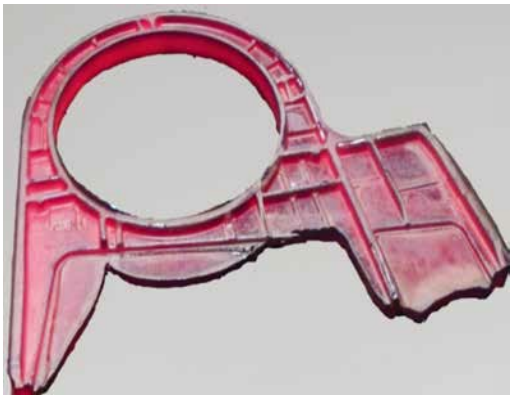
1. Based on the uneven deformation characteristics of multi-constraint or matching local thermal field control body loading tension and compression zones, the laboratory invented numerical control bending forming technology for large-diameter thin-walled tubes of difficult-to-deform materials. They have broken through the internationally recognized engineering forming limit for elbow pipes, enabling Chinese-made aircraft to realize the application of titanium alloy elbow pipes in hydraulic pipelines for the first time, greatly increasing the maximum working pressure.

Point and line local loading precision plastic forming technology

2. The laboratory invented technology for surface local loading isothermal forming to control multi-zone time-varying uneven deformation. They achieved the labor-saving formative integration of titanium alloy high-performance frame parts, more than doubling the forming capacity of small-tonnage equipment.

3. The laboratory invented in-plane precise bending technology for the active uneven line loading compression strip and solved the problem where in-plane bending was extremely susceptible to stability loss, wrinkling, and twisting, increasing the bending limit by more than 3x.

4. Using point-loading coupled blanks to directionally control the uneven deformation during compression-tension-compression, the laboratory has broken through the bottleneck due to the susceptibility of large thin-walled special-shaped parts to cracking and wrinkling and the difficulty in filling and molding.



Accurate plastic forming components with local loading of faces and bodies

The above research results have formed a complete set of technology, mold equipment, and technical systems. Nine companies, such as the Chengdu Aircraft Industry Group and the Fourth Research Institute of China Aerospace Science and Technology Corporation, have applied the results in aerospace and other fields, achieving large-scale and high-end manufacturing of four types of key high-performance lightweight components: Large-diameter thin-walled elbow fittings of difficult-to-deform materials, titanium alloy integral bulkheads, in-plane bending parts, and large thin-walled special-shaped parts. The research won second prize at the 2016 National Technology Invention Awards.

Key Technologies and Equipment for Multi-Station Precision Forging Net Formation

State Key Laboratory of Material Processing and Die & Mould Technology (Huazhong University of Science and Technology)

Multi-work station precision forging net forming (精锻净成形) is an advanced manufacturing technology for the mass production of high-precision and high-performance forgings, which has the advantages of high efficiency, material savings, and energy savings. Countries such as Europe and the United States use it as a cutting-edge technology in the manufacturing industry to implement monopoly control. China has not achieved breakthroughs in related technologies, which severely restricts the innovation and development of key parts in the automotive and military industries.

After more than ten years of joint research and development, the State Key Laboratory of Material Processing and Die & Mould Technology constructed coordinated motion equations for the precision forging equipment slider, ejector mechanism, and manipulator and developed a series of auxiliary devices for forging positioning, clamping, and testing. They established the first Chinese automated multi-work station precision forging net forming production line with independent intellectual property rights. The main achievements are as follows:

Multi-work station press commissioning site

1. Coordinated distribution of metal deformation and directional flow control technology: The laboratory revealed the influence mechanism of the metal hardening

gradient on multi-step flow deformation and invented a coordinated allocation method for the number of stations and deformation. They created a model of the relationship between the position of the split surface and the size of the connecting skin and invented the directional flow control technology for split surface-resistance compounds. This significantly improved the metal filling capacity of each part and achieved net forming of the key dimensions of forgings.

2. Mold design method to minimize stress and long-life mold structures: The laboratory clarified the influence of multiple factors on the mold stress distribution and proposed design methods such as non-uniform prestress, low stress profile, and compact structures. They invented a stepped non-uniform interference prestressed mold and invented an integrated mold base cylinder with adjustable speed ratio, which significantly reduces the peak stress of the mold and greatly improves the service life of the mold.

3. High rigidity anti-eccentric load structure and control technology and multi-work station precision forging equipment: The laboratory created a frame pre-tightening model that couples eccentric load and elastic deformation of the whole body and invented a high-rigidity wide-table body with a built-in slider with multiple cylinders. They established a multi-constraint model based on flat-curved surfaces and invented a precision guiding structure with high resistance to unbalanced loads. They revealed the influence of dynamic eccentric loads on the displacement of the main cylinder, invented high-precision two-stage synchronous control technology, and developed multi-station precision forging equipment.

Multi-station precision forging mold

The above research results have led the technological progress of China's precision forging industry and greatly improved its international competitiveness. The research won second prize at the 2016 National Technical Invention Awards.

Technology for Smart Prosthetics and Their Neural Information Channel Reconstruction

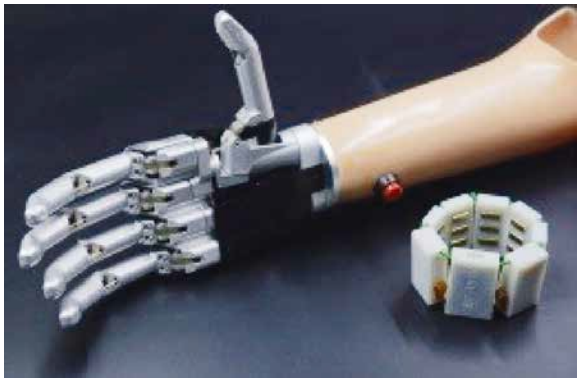
State Key Laboratory of Mechanical System and Vibration (Shanghai Jiao Tong University)

State Key Laboratory of Robotics and Systems (Harbin Institute of Technology)

State Key Laboratory of Digital Manufacturing Equipment and Technology (Huazhong University of Science and Technology)

The reconstruction of diseased motor function has been a dream of mankind since ancient times. The world's first prosthetic association has a history of hundreds of years since its establishment. Until the 1940s, a prosthesis was just a "mechanical device fixed on the human body," and the user could only control its operation in a similar way to manipulating a machine. The State Key Laboratory of Mechanical Systems and Vibration, the State Key Laboratory of

Robotics and Systems, and the State Key Laboratory of Digital Manufacturing Equipment and Technology focus on the technical requirements of the Chinese prosthetics industry and the scientific goal of "recreating human functions." They conduct research on "neural access and control of alternative motor function devices" and have made breakthroughs in a series of key technologies in the design of integrated operation and perception prosthetics and neural information channel reconstruction. The main achievements are as follows:



Prosthetic hand and EMG armband

1. Dexterous prosthetic mechanisms integrating operation and perception: The laboratories invented an under-actuated prosthetic mechanism and array-type tactile sensing system based on the muscle group coordination model and made breakthroughs in the integrated design and manufacturing technology of dexterous mechanism and sensing systems. They developed a simulation and evaluation system for under-actuated prosthetic operation based on "soft collaboration."

2. Neural information channel reconstruction technology for artificial limbs: The laboratories invented an integrated measurement system for residual limb electromyography and near-infrared spectroscopy, proposed a time-frequency-spatial combined filtering method for the identification of residual limb electromyographic signals, a "near-zero" retraining method for feature templates, and a combined electromyographic and near-infrared spectrum decoding method, and developed a high transmission rate and adaptive vitality interface.

3. Closed-loop interactive training paradigm of the vitality interface: The laboratories invented a closed-loop interactive training paradigm for the vitality interface based on electrical stimulation feedback and the feature enhancement technology of residual limb electromyographic signals based on external stimulation assistance, which reduced the multimodal operation training cycle of the dexterous prosthesis from 7 to 10 days to less than 24 hours.

Subject wearing a prosthetic hand

The above research results have achieved time and technology synchronization with first-generation dexterous prosthetic products abroad, broke the technology monopoly of the United States and Europe and the unaffordable product price monopoly facing the disabled, and provided technical assurance for the "reconstruction of limb motor function" for more amputees in China. The results have won high praise from the international academic community, and the research won second prize at the 2016 National Technical Invention Awards.

Fast Breaking Technology and Applications for Large Capacity Circuit Breakers in DC Distribution Systems

State Key Laboratory of Electrical Insulation and Power Equipment (Xi'an Jiaotong University)

DC power distribution systems have become an inevitable choice for the integrated power technology of naval ships. It has been difficult to make breakthroughs in the rapid breaking technology of the large-capacity DC circuit breakers of core equipment, which has become a major bottleneck restricting the development of this field. The State Key Laboratory of Electrical Insulation for Power Equipment has been engaged in the research of power switchgear for a long time. They have solved the technical problems of large-capacity DC breaking and achieved a breakthrough in large-capacity DC fast breaking technology, meeting major national needs. The main innovation achievements include:

1. The laboratory established a DC arc control method combining self-energy air blowing and self-energy magnetic blowing and invented a new arc extinguishing chamber structure with circulating air flow channels and arc excitation units, solving the problem of DC circuit breaker high current arc control.

2. The laboratory established a new method of combining the high-speed tripping and opening processes of DC circuit breakers and invented a quick-acting mechanism driven by the combination of tripping energy and variable torque electric repulsion, solving the problem that made it difficult to increase the opening speed of the circuit breaker.

3. The laboratory established a new method for quickly dissipating energy by air-driven liquid metal arc discharge and invented a new device, which solved the problem of the large circuit breaker volume and arcing distance caused by solely relying on the arc extinguishing chamber to dissipate electromagnetic energy.

Large-capacity DC circuit breaker

DC test loop

4. The laboratory developed a large-capacity DC circuit breaker digital design system and performance test platform and developed 11 military-use DC circuit breakers and 6 civilian-use DC circuit breakers, which are used in naval vessels, rail transit, and other fields.

The above research results have passed the type test of the test station of the authoritative international testing organization IPH, and the breaking capacity achieved the highest metrics in

the world in the field of power distribution. For the first time, these results solved the global problem of large-capacity DC breaking for power distribution, and contributed to establishing China in an internationally leading position in the field of integrated ship power technology. The research won second prize at the 2016 National Technology Invention Awards.

Hybrid Optical Fiber Sensing Technology and its Application in the Field of Engineering Safety Monitoring

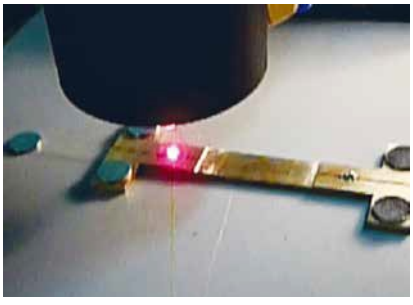
State Key Laboratory of Hydraulic Engineering Simulation and Safety (Tianjin University)

State Key Laboratory of Engines (Tianjin University)

Optical fiber sensing technology is an efficient, stable, and adaptable new sensing technology that can meet various application environments and engineering needs in electric power, petrochemical, aerospace, civil engineering, and other fields. It provides a reliable monitoring guarantee for the safety of major engineering projects. The State Key Laboratory of Hydraulic Engineering Simulation and Safety and the State Key Laboratory of Engines have carried out in-depth research on optical fiber sensing technology under extreme conditions, strain, temperature, acoustic vibration, and other multi-parameter hybrid optical fiber sensing conditions. They conducted a series of original work and made breakthrough progress. The main achievements include:

Vacuum thermal test

1. The laboratories invented high-precision, high-stability hybrid optical fiber sensing demodulation technology to complete the multi-parameter hybrid high-precision measurement of strain, temperature, sound, and vibration in extreme aerospace environments, integrating and miniaturizing multi-parameter measurement. The laboratories solved the technical problems of the single demodulation method, long-term operation drift, and slow response speed in traditional signal demodulation.



Packaging research

2. The laboratories developed high-reliability optical fiber multi-sensor packaging technology for harsh environments, providing new testing techniques for the field of aerospace vacuum thermal testing. They solved the problems of cross-sensitivity, adhesive aging failure, and low sensing sensitivity in sensor packaging.

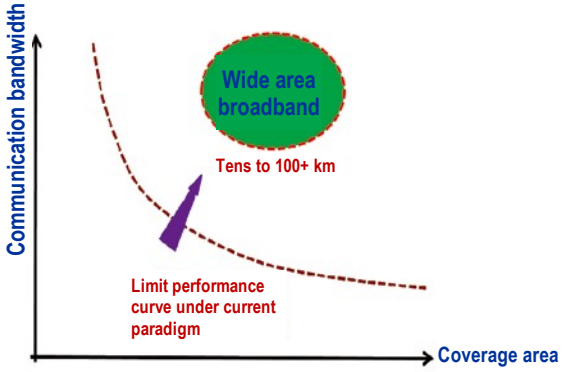
3. The laboratories made breakthroughs in multi-band aliasing optical fiber multi-gas sensing technology and hybrid optical fiber sensing networking fusion technology. This can meet the various application environments and engineering needs in electric power, petrochemical, aerospace, civil engineering, and other fields and provides a reliable monitoring guarantee for the safety assurance of major engineering projects.

The above research results have won high praise from the international academic community. They promoted the development of basic research and applied basic research in the field of optical fiber sensing and lead the forefront of technical exploration in the field of optical fiber sensor safety monitoring. The research won second prize at the 2016 National Technology Invention Awards.

Wide Area Broadband Cooperative Communication Technology and Applications

Tsinghua National Laboratory for Information Science and Technology (Planned) (Tsinghua University)

Broadband wireless communication is the cutting-edge of high-tech and new technology in China and abroad. In this field, wide-area broadband mobile communication with a radius of tens of kilometers to more than 100 kilometers are in urgent need in the informatization construction of shipping, coastal defense, public security, transportation, logistics, national defense, and other fields. The Tsinghua National Laboratory for Information Science and Technology (planned), targeting the theoretical and technical problems faced by large-scale and long-distance broadband coverage, systematically conducts innovative research in fields such as communication system architecture, signal processing, and heterogeneous network integration. They formed a wide-area broadband collaborative communication technology system, invented a wide-area broadband wireless communication system architecture and implementation technology based on time, space and frequency multi-domain coordination, and achieved important applications. The main achievements include:



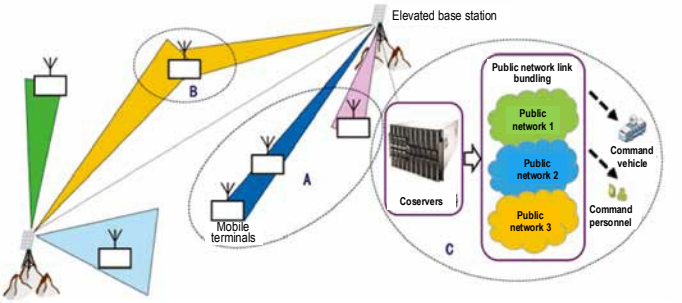
Theoretical and technical difficulties

1. In order to adapt to complex interference environments with large-span changes, the laboratory proposed a large-span multiple access resource control method, which can significantly increase the system capacity.

2. In order to achieve seamless switchover between multiple stations in a large-scale changing environment, the laboratory proposed co-frequency dynamic coverage cooperative communication technology, which can effectively ensure the real-time performance of broadband signal processing and reduce the complexity of equipment implementation.

3. In order to achieve the efficient integration of broadband wireless private networks and heterogeneous public networks, the laboratory proposed a heterogeneous multi-network integration service and protocol method, which improve the resource utilization rate of multi-link bundling and ensure the real-time nature and continuity of cross-network broadband information services.

The above research results have formed a wide-area broadband collaborative communication technology system that includes 20 invention patents. It effectively solves the theoretical basic problems of the efficient utilization of resources under large-span transmission and the integration of multiple heterogeneous networks. The wide-area broadband collaborative communication system developed by the laboratory is superior to similar technologies in China and abroad. It solves the problems that have long plagued broadband communications in marine areas and lays an important technical foundation for the construction of multi-field broadband wireless networks. The results have been applied to the informatization construction in public security, transportation, and other fields, achieved good economic and social benefits. The research won second prize at the 2016 National Technology Invention Awards.



A typical application scenario of wide-area broadband collaborative communication

Key Technologies, Systems, and Industrial Applications of Scalable Routing and Switching for Support Service Innovation

Tsinghua National Laboratory for Information Science and Technology (Planned)
(Tsinghua University)

Routing and switching systems are the hubs of Internet data transmission and a strategic commanding height in the field of network communications. For a long time, the core technology in this field has been monopolized by foreign manufacturers, which has severely restricted the development of China's network communication industry. The Tsinghua National Laboratory for Information Science and Technology (planned), Huawei, and ZTE have jointly tackled key problems, proposed a new technical route for the collaborative expansion of functions and structures, and achieved a series of innovative results. The main achievements include:

1. The laboratory proposed a core technical method to solve the problem of structural scalability in routing and switching equipment, invented a coprocessor that supports efficient cascading of routing and switching equipment, and designed a lightweight communication mechanism between nodes and a data migration method for complex structures.

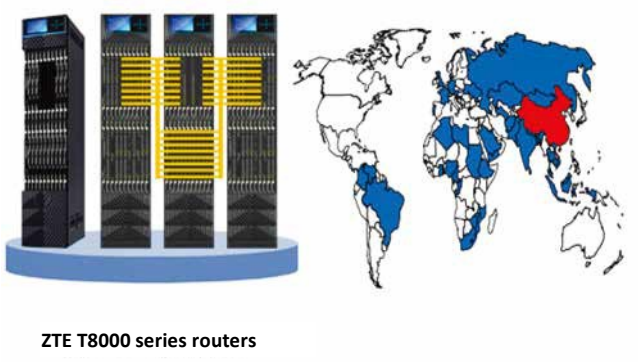
2. The laboratory proposed and achieved a software reconfigurable operating platform in core routing and switching equipment for the first time, invented a flexible assembly mechanism for functional modules and a dynamic component allocation method under the expandable structure, and solved the technical problem of flexible functional reconstruction in large-scale cluster systems.

3. The laboratory proposed a multi-technology association and cooperation mechanism to

improve routing reliability in routing switching equipment, designed a cross-layer fault detection and rapid self-healing mechanism, invented routing jitter suppression methods and network topology reconstruction methods, and solved the technical problem where routing failures in large-scale networks were difficult to quickly recover from. This can quickly realize 100% fault self-healing of the two connected networks and reduces routing table storage costs to 1/8 of the original solution.

4. The laboratory invented a component generation method based on metacomponents and an automated execution method for gray box testing, developed an open routing exchange integrated development environment, provided a unified and open platform for different network equipment manufacturers and third-party organizations, and promoted the establishment of an open network equipment R&D system involving multiple parties.

The above research results have been applied to a variety of routing and switching products of mainstream domestic enterprises. The core source code and all design documents of the project have been disclosed to the public in an open-source format. The research won second prize at the 2016 National Technology Invention Awards.



ZTE series routers are widely used in 56 countries

Awards for Huawei S12700 series switch products

Date	Sponsor	Award
Jun 2014	Interop Tokyo	Special Award for Enterprise Networking
Jan 2014	Zhongguancun Online	2013 Outstanding Product Award
Jan 2014	CCIDnet	2013 Innovative Product Award
Dec 2013	Computerworld	2013 Excellent Product Award

Huawei S12700 series switches

Key Technologies and Applications of Urban Travel Information Services Based on Mobile Location Data

State Key Laboratory of Software Development Environment (Beijing University of Aeronautics and Astronautics)

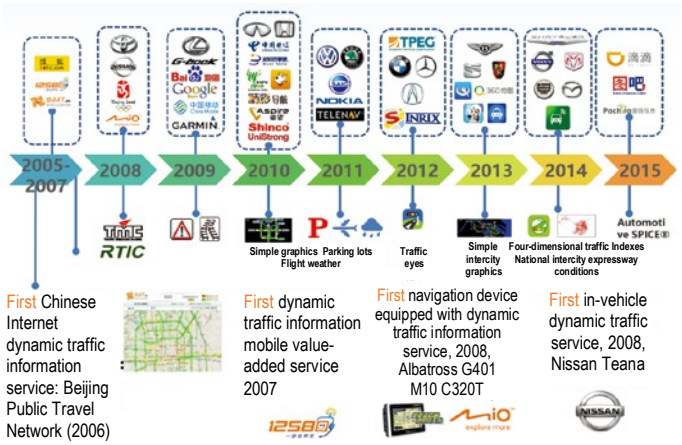
Providing the public with timely, accurate, and comprehensive traffic travel information services is an important means for modern cities to alleviate road congestion, improve travel efficiency, and reduce energy consumption. The State Key Laboratory of Software Development Environment has long been engaged in the research and application of basic theories and key technologies of smart transportation based on big data. They proposed the innovative idea of using mobile location data as a new data source, developed the world's first travel information service system based on mobile data, and created and led China's transportation information service industry. The main achievements include:

National coverage range

1. The laboratory invented an accurate calculation method for traffic information of complex urban road networks in a noisy and small-sample data environment. In view of the problems of long sampling intervals, large deviations, confused patterns, and limited sample sizes in mobile location data, the laboratory proposed, for the first time, a series of original algorithms such as layered abstract road network modeling and traffic status identification. This solved the problem of real-time and accurate calculation of traffic information based on noisy and small-sample data.

2. The laboratory invented a multi-source traffic data fusion method based on temporal and spatial correlation characteristics. In response to the lack of traffic information caused by the randomness of mobile location data, the laboratory proposed a road traffic state spatiotemporal correlation model and feature extraction method, invented a traffic information fusion, filling, and prediction algorithm based on the multi-dimensional confidence evaluation of data, and solved the problem of obtaining continuous, complete, and stable traffic information using massive amounts of spatiotemporal-related data.

3. The laboratory invented traffic information expression and service generation technology driven by scenario characteristics. The laboratory invented road network dynamic coding and adaptive expression methods for traffic information, proposed traffic information service construction technology driven by scenario characteristics, and formulated national standards, laying the foundation for industrial development.



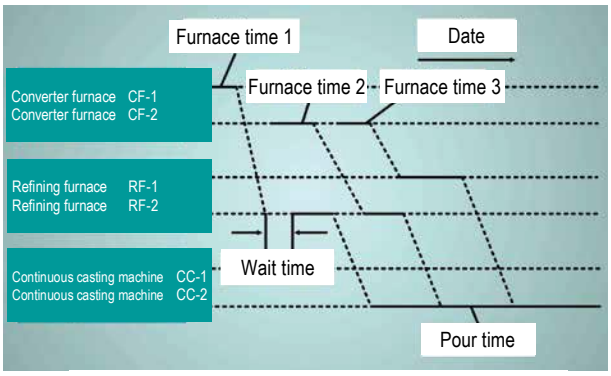
Research and application milestones

The research results currently support the real-time computation of data from tens of millions of vehicles and the dynamic update of information release services, covering 316 cities, major highways, and national highways across the country. It is the pre-installed road condition service provider for Toyota, BMW, SAIC, and other major car manufacturers in China and abroad. The results provide real-time traffic and travel information for users of Internet maps, such as Baidu and Tencent, and have become the technical basis for mobile travel service applications in the Internet era. They provide important decision-making data support for government urban governance (政府城市治理). The research won second prize at the 2016 National Technology Invention Awards.

Key Technologies and Applications of Steel Production and Logistics Dispatch

State Key Laboratory of Synthetical Automation for Process Industries (Northeastern University)

Steel production and logistics scheduling have become key technical problems requiring urgent solutions that have long plagued the iron and steel industry. The State Key Laboratory of Synthetical Automation for Process Industries has conducted systematic and in-depth research on the theory and methods of steel production and logistics scheduling as well as their technology and industrial applications. They have established an intelligent optimization scheduling theory and method for steelmaking-continuous casting, hot rolling, cold rolling, and steel logistics, which has been successfully applied to many large domestic steel companies and achieved obvious application results. The main achievements include:



Steelmaking-continuous casting production scheduling technology

1. Targeting the problems of low utilization rate of large-scale steelmaking-continuous casting equipment, high tundish change costs, and high-temperature molten steel energy loss, the laboratory proposed a theory and method for steelmaking-continuous casting production batch planning and intelligent optimization scheduling, effectively improving the utilization rate of steelmaking-continuous casting equipment.

2. Targeting the problems of the low utilization rate of hot-rolled slab and high cost of roll wear, the laboratory proposed a theory and method for hot-rolled slab matching and intelligent optimal scheduling, which achieved the purposes of improving the utilization rate of slab and reducing product inventory.

3. Targeting the problems of the low production capacity and high costs due to frequent production switching of large cold rolling mills, the laboratory proposed a theory and method for intelligent optimal scheduling of cold rolling production lines, which improves the production capacity of mills and reduces the number of switches.

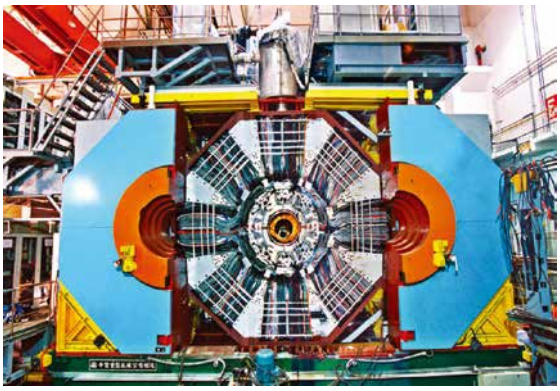
The above research results have won high praise from colleagues in the international academic community and have been successfully applied in many large domestic steel companies. They have played an important role in improving enterprise production efficiency, logistics efficiency, product quality, mining capacity, energy saving, and consumption reduction and reducing production and logistics costs. The research won second prize at the 2016 National Technology Invention Awards.

Major Renovation Project of the Beijing Electron-Positron Collider

State Key Laboratory of Particle Detection and Electronics

(Institute of High Energy Physics, Chinese Academy of Sciences, University of Science and Technology of China)

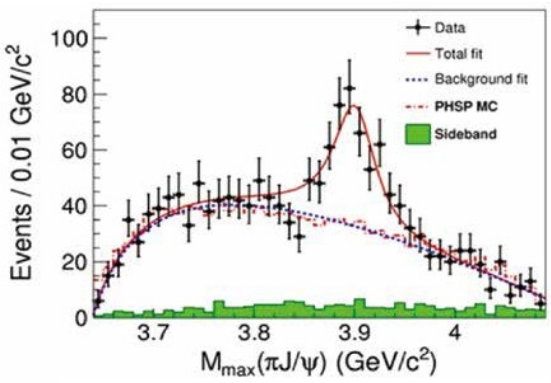
The Beijing Electron-Positron Collider (BEPC) is China's first high-energy accelerator and has achieved many important results in the field of charm physics. In order to develop China's internationally leading advantage in the research of charm physics, the Beijing Positron Collider Major Renovation Project (BEPC Ⅱ) was launched and implemented. The State Key Laboratory of Particle Detection and Electronics undertook the development task of the Beijing Spectrometer BES III. The main S&T innovation achievements include:



Beijing Spectrometer BES III

1. The laboratory broke through the difficulties in the design and construction of the double-loop collider and overcame a series of core key technologies. As a result, the overall performance of BEPC Ⅱ is the international leader in the charm energy zone, and the brightness is more than 12 times that of CESRc.

2. By adopting innovative designs and developing advanced technology, the overall performance of BES III has reached the highest international level: The laboratory adopted the first international solution and successfully developed a large high-precision drift chamber on its own; in a world-first, the calorimeter adopts the innovative crystal rear suspension (晶体后吊挂) solution; and the laboratory designed and developed the largest single superconducting magnet in China and achieved a series breakthroughs in key technologies for detectors.



A new resonance structure Zc (3900) found in a BES III experiment

3. The laboratory adopted effective measures and innovative technology to achieve the efficient operation and two-in-one functionality of BEPC Ⅱ, making it the world's leading high-energy physics experimental device in the charm physics energy zone.

4. The Beijing Spectrometer BES III International Cooperation Group established around me (以我为主建立, probably means "our laboratory"), used BEPC Ⅱ to carry out high-energy physics experimental research and achieved a number of major physics results in light hadron spectrum research and charmonium decay. In 2013, the BES III experiment discovered the charged charmonium Zc (3900). Then, Zc (4020) and

Zc (4025) were discovered, indicating that this is a tetraquark particle family. This quark "quartet" opened up a new vision of the material world.

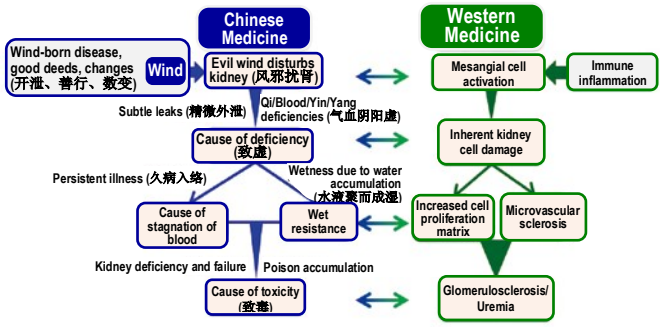
The BEPC Ⅱ is a successful example of China's large-scale scientific engineering construction. It has been highly praised by the international high-energy physics community and marks a major milestone in the development of high-energy physics in China. The successful construction of BEPC Ⅱ developed China's international leading position in charm physics research and laid the foundation for major physical achievements. This achievement won first prize at the 2016 National Science and Technology Progress Awards.

Innovative Research and Applications of IgA Nephropathy Integrating Traditional Chinese and Western Medicine Treatment Regimens and Key Diagnosis and Treatment Technologies

State Key Laboratory of Kidney Diseases (People's Liberation Army General Hospital)

There are 120 million patients with chronic kidney disease in China, and IgA nephropathy is the most common and the first cause of uremia. As IgA nephropathy is protracted and difficult to heal, it places a heavy burden on individuals, families, and society. The State Key Laboratory of Kidney Diseases brought together excellent teams for the research on IgA nephropathy integrating traditional Chinese and Western medicine. This research lasted for more than 20 years. Targeting the key scientific problems in the diagnosis and treatment of IgA nephropathy, the advantages of integrated traditional Chinese and Western medicine have been used to achieve breakthrough results in the progress mechanism of IgA nephropathy, traditional Chinese medicine syndrome differentiation, clinical diagnosis and treatment, and new drug development. The main achievements include:

1. From the perspective of integrated traditional Chinese and Western medicine, the laboratory revealed a new mechanism for the progression of



New theory of integrated traditional Chinese and Western medicine for IgA nephropathy " evil wind disturbs kidney, causes deficiency, blood stagnation, and toxicity"

Leads the formulation of multiple guidelines and standards

IgA nephropathy. It is the first to put forward the innovative theory integrating traditional Chinese and Western medicine that "evil wind disturbs kidney, causes deficiency, blood stagnation, and toxicity" ("风邪扰肾、致虚、致瘀、致毒") and systematically revealed the biological mechanisms and scientific connotations.

2. The laboratory established the world's first IgA nephropathy clinical biological information resource database integrating traditional Chinese and Western medicine. The laboratory created a syndrome differentiation (辩证) evaluation system that combines traditional Chinese medicine, Western medicine, and the biomarkers of IgA nephropathy.

3. The laboratory established a new protocol for the treatment of IgA nephropathy with integrated traditional Chinese and Western medicine, which is superior to the international general treatment protocol.

4. The laboratory carried out internationally registered evidence-based medical research and confirmed that the herbal medicine muskmallow (黄葵) is better than the drugs recommended in the guidelines. This promoted its industrialization.

5. The laboratory took the lead in formulating guidelines, standards, and pathways such as the "*Practical Guidelines for Western Medicine Diagnosis of IgA Nephropathy and TCM Syndrome Differentiation and Typing*," which were recommended by the National Health and Family Planning Commission and the State Administration of Traditional Chinese Medicine to be applied by 3A-level hospitals across the country, benefiting a wide range of patients.

The above research results have contributed to the prevention and treatment of kidney disease with integrated traditional Chinese and Western medicine and provided examples for the research of integrated traditional Chinese and Western medicine in related disciplines. The research won first prize at the 2016 National Science and Technology Progress Awards.

Key Technologies and Applications of DTMB System Internationalization and Industrialization

Tsinghua National Laboratory for Information Science and Technology (Planned) (Tsinghua University)

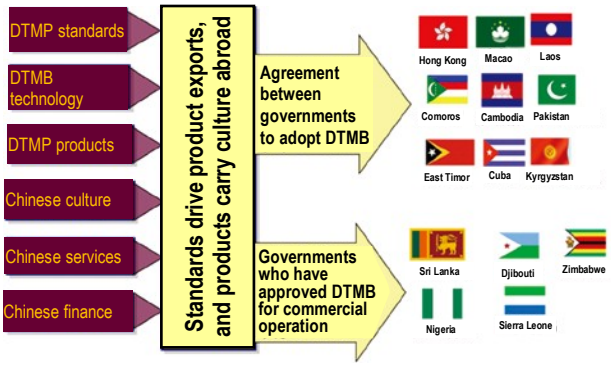
In digital terrestrial TV systems, the TV transmitting station covers a radius of tens of kilometers, and the multiple paths of electric wave propagation create a complicated digital terrestrial TV transmission environment. Tsinghua National Laboratory of Information Science and Technology (planned) has continued to research key problems for more than ten years. After program editing and source coding, it performs channel coding and decoding, modulation and demodulation, transmission and reception, and other ground transmission technology

President Xi Jinping and the Pakistani Prime Minister jointly unveiled a strategic flagship project of the Belt and Road Initiative

processing on digital TV signals, successfully solving the core technical problems of digital TV transmission efficiency and reliability. In response to the major needs of China's digital TV industry in going abroad and targeting areas from key technological breakthroughs, standard formulation, industrialization, and production chain construction to promotion and application at home and abroad, the laboratory has created a Chinese digital terrestrial TV broadcasting transmission system and achieved leapfrog development to stand at the forefront of the world. The main achievements include:

1. The laboratory invented a patented QC-LDPC error correction coding technology and successfully developed a low-complexity DTMB multi-rate error correction codec with a receiving threshold significantly better than similar international standards.

2. The laboratory invented an overall structure for individual receivers with multi-domain signal coordination and multicarrier fusion, which broke through the key technical bottlenecks of digital TV reception such as system synchronization and single receiver multicarrier compatibility. They completed the construction of the DTMB system production chain and formed large-scale applications in China and abroad.



Internationalization of DTMB standards and systems

3. The laboratory innovative technologies such as equivalent constellation extension mapping and time-domain parallel sampling rate conversion to support the multi-bandwidth options and multi-service functions necessary for DTMB internationalization. They made a historic breakthrough in upgrading China's mandatory national standards for digital TV to international standards.

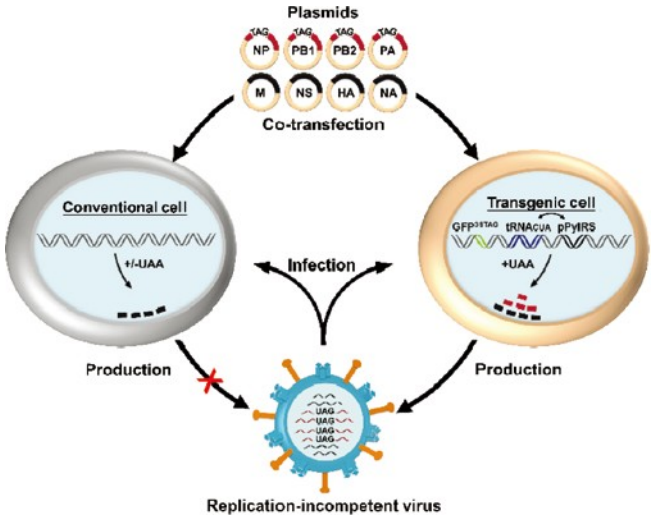
The above research results have laid the foundation of theory, key technology, and intellectual property rights for the establishment of China's independent digital terrestrial TV broadcasting transmission system. This opened the history of the overseas application of China's mandatory standards in the digital TV field and promoted the technological progress of the industry and the leapfrog development of academic disciplines. It has been of great significance to the sustainable development of digital TV in China and driven the export of complete sets of industrial technology, products, services, and cultural products, generating significant economic and social benefits. The research won first prize at the 2016 National Science and Technology Progress Awards.

Technology to Transform Influenza Virus into Replication-Defective Live Vaccines

State Key Laboratory of Natural and Biomimetic Drugs (Peking University)

Deadly infectious diseases such as influenza, AIDS, SARS, and Ebola hemorrhagic fever are

always endangering human health and social stability. The “black hand” (黑手) behind the scenes is a variety of viruses with diverse structures, complex functions, and rapid mutations. Vaccines are an effective means to prevent viral infections. However, the use of a live virus with complete structure and complete infectivity as a vaccine is regarded as a clinical contraindication, because live viruses use host cells to replicate in large numbers and spread quickly. Therefore, the various viral vaccines currently in clinical use generally adopt structural modification and processing. Unfortunately, these clinical vaccines have poor immunogenicity and safety due to virus inactivation, or are not universally used due to complex preparation processes, or suffer from immune escape failure due to virus mutations.



Technical principle of viruses with PTC

The State Key Laboratory of Natural and Biomimetic Drugs addressed the key scientific problem where it is difficult to use a fully infectious live virus as a vaccine by proposing a virus vaccine preparation technology that is completely different from the traditional attenuation or inactivation processing method. The core technology of this research only mutates one triplet of the genetic code genome of a live virus into a premature termination codon (PTC), which converts the lethal virus into a preventive vaccine, and then mutates more than three triplet codes as a PTC to transform the virus from a preventive vaccine to a therapeutic drug. The efficacy of the drug increases as the number of PTCs increases. This technology enables not only invalidates the virus's self-replication mechanism while retaining its complete structure and full infectivity, but also exerts its immunogenicity to make the host cell immune.

The advantage of this invention lies in its simplicity and versatility. For almost any virus, researchers can quickly isolate this unknown virus strain from the infected person and only need to select a codon in the genetic sequence of the virus and transform it into a virus strain containing a PTC. The new virus can be promoted as a vaccine, creating new killers for deadly viruses including SARS and Ebola. This is conducive to the R&D biological and chemical weapon prevention, ensuring national defense security.

The research results were published in the 2016 edition of *Science* [354 (6316) 1170–1173].

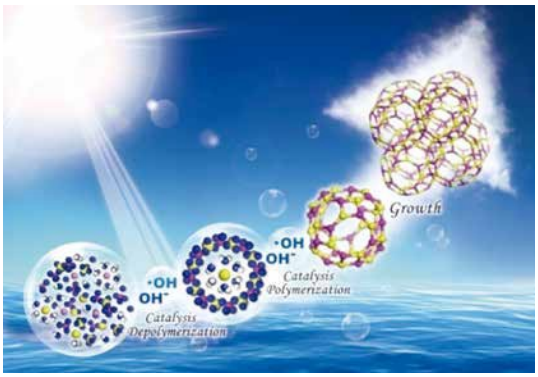
Lighting the Way to Zeolite Molecular Sieve Synthesis

State Key Laboratory of Inorganic Synthesis and Preparative Chemistry (Jilin University)

Molecular sieves are materials that can sieve molecules and have been widely used in important fields, such as petroleum refining, petrochemicals, fine chemicals, and daily use

chemicals, that are closely related to energy and the environment.

Since people used the hydrothermal method to artificially synthesize zeolite molecular sieves in 1940, research on its formation mechanism has attracted much attention. Because the synthesis system of zeolite molecular sieves is extremely complex, so far, people have not had a clear understanding of its crystallization mechanism. In the basic synthesis system of zeolite molecular sieves, hydroxide (OH-) is generally considered to catalyze the breaking of Si, Al-O-Si, and Al bonds to achieve the depolymerization of aluminosilicate gels. At the same time, it can also catalyze the formation of Si, Al-O-Si, and Al bonds, so that the aluminosilicate anion species re-polymerize around the hydrated cations to form microporous crystals with specific regular pores.



Free radicals accelerate the crystallization of molecular sieve porous materials

Researchers at the State Key Laboratory of Inorganic Synthesis and Preparative Chemistry have discovered that hydroxyl radicals still exist in the hydrothermal synthesis system of zeolite molecular sieves, which can significantly accelerate the crystallization of zeolite molecular sieves. Through research, they found that the use of ultraviolet radiation can significantly accelerate the crystallization of zeolite molecular sieves. Combining spin capture technology and using electron paramagnetic resonance spectroscopy (EPR) technology, they discovered for the first time that hydroxyl radicals (OH) exist in the hydrothermal synthesis system of zeolite molecular sieves. The additional introduction of hydroxyl radicals into the hydrothermal synthesis system of the zeolite molecular sieve through ultraviolet irradiation or Fenton reaction can significantly accelerate the nucleation of the zeolite molecular sieve, thereby accelerating its crystallization process.

This research is an important breakthrough in the research on the formation mechanism of inorganic microporous crystals. This discovery gave people a new understanding of the formation mechanism of zeolite molecular sieves. People can use various physical or chemical means to introduce free radicals into the synthesis system of zeolite molecular sieves to accelerate the crystallization process or reduce the amount of alkali. This opens up a new path for the high-efficiency, energy-saving, and green synthesis of zeolite molecular sieve materials for important industrial needs.

The research results were published in the 2016 edition of *Science* [351 (6278) 1188–1191].

The World's First Non-Human Primate Model of Autism

State Key Laboratory of Neuroscience (Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences)

Autism is a type of developmental neuropsychiatric disease that occurs mostly in adolescents. Patients often exhibit social disorders, repetitive stereotyped behaviors, anxiety and depression,

and other behavioral and emotional abnormalities. There is currently no effective drug treatment. In recent years, countries around the world have found that the prevalence of autism is increasing year by year, which has aroused widespread concern from all sectors of society.

First-generation F0 transgenic cynomolgus monkey

Among the many genes related to autism, the methyl CpG binding protein 2 (MECP2) gene has attracted widespread attention from researchers due to its uniqueness. When the chromosome segment containing the MECP2 gene is doubled in copy number, it will cause MECP2 doubling syndrome, and the patient will show severe symptoms of autism. In order to construct a transgenic monkey model carrying human MECP2 in non-human primates, the State Key Laboratory of Neuroscience and the Suzhou Non-Human Primate Facility adopted a transgenic method based on lentivirus infection and obtained cynomolgus monkeys that specifically overexpress human MECP2 in the nervous system. Through deep sequencing analysis, they found that the foreign human MECP2 gene was effectively inserted into the genome of the cynomolgus monkey.

Second-generation F1 transgenic cynomolgus monkeys

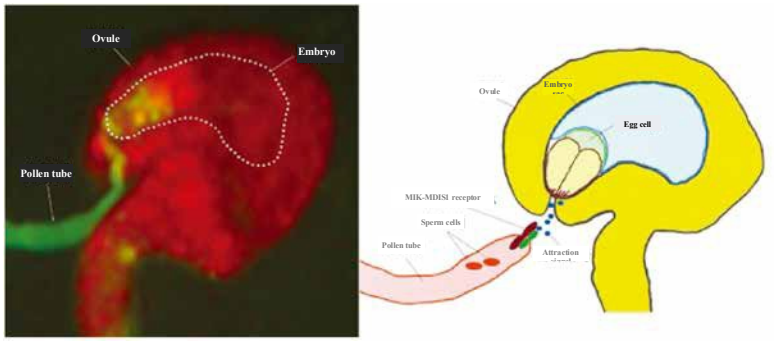
By comparison with the wild-type control group, they found that the MECP2 transgenic cynomolgus monkeys exhibited slow bodyweight development and abnormal fatty acid metabolism. In action course tracking, the genetically modified group spends significantly more time on repetitive courses of action than the control group. In social-related behavioral experiments, the social time of transgenic monkeys was significantly lower than that of the control group. The research team successfully obtained second-generation transgenic monkeys (F1) carrying the human MECP2 gene. Paired socialization time analysis of the offspring of transgenic cynomolgus monkeys also showed that the social time of the transgenic monkeys was significantly reduced compared with the control group.

This research work established the MECP2 transgenic cynomolgus monkey as a non-human primate model of MECP2 doubling syndrome. This lays a solid foundation for the more in-depth study of autism pathology and the exploration of therapeutic intervention methods. This research work was selected as a “Top Ten Advances in Chinese Science in 2016” (2016年度中国科学十大进展) by MOST and a “Top Ten Advances in China's Life Sciences in 2016” by the China Association for Science and Technology. The research results were published in the 2016 edition of *Nature* [530 (7588) 98–102].

Plant Male and Female Ligand Recognition Mechanism

State Key Laboratory of Molecular Developmental Biology (Institute of Genetics and Developmental Biology, Chinese Academy of Sciences)

Fertilization requires the combination of sperm and egg cells. Whether the sperm can be delivered to the egg in time is the key to fertilization. In angiosperms, sperm is passed through the pollen tube, but how does the pollen tube transfer the sperm to the egg? This has been a main concern of plant reproductive biology for decades, and it is also one of the technical bottlenecks of hybrid breeding. The State Key Laboratory of Molecular Developmental Biology isolated, for the first time, a receptor protein complex that recognizes female attraction signals in pollen tubes and revealed the molecular mechanism of signal recognition and activation.



MIK-MDIS1 receptor complex recognizes the embryo sac attraction signal LURE, which mediates pollen tube guidance to blastula

Distant hybrid breeding means that humans use different species, genera, or hybridization between species with more distant relationships to produce distant hybrids, thereby breaking the isolation between plant species and genera and obtaining new crop varieties. For a long time, hybrid breeding has been the main technology by which mankind has improved the yield and quality of crops. However, there are widespread obstacles to hybridization caused by reproductive isolation in distant hybridization, which often lead to incompatibility of hybridization, failure of crop cross-breeding, or low efficiency. One of the main causes of hybridization disorder is the effective recognition of male and female gametophytes.

Because it does not have the swimming ability of animal sperm, the embryo sac in angiosperms will secrete signal molecules to guide the directional growth of the pollen tube. The pollen tube transports the sperm cells to the embryo sac and then combines with the egg cells wrapped in the embryo sac. In the model plant Arabidopsis thaliana, through reverse genetics, the researchers screened two membrane surface receptor protein kinases (MIK and MDIS1) in the pollen tube, which are involved in the response of the pollen tube to embryo sac signaling molecules. The results of a series of biochemical and cell biology experiments showed that the two receptor protein kinases jointly receive signals from the embryo sac and initiate the directed growth of pollen tubes. More importantly, one of the signal receptors was introduced into another plant, Capsella rubella, through genetic modification, and hybridization experiments were performed with Arabidopsis thaliana. The pollen tubes of transgenic Capsella rubella have greatly improved efficiency in identifying Arabidopsis embryo sacs.

This research is a major breakthrough in the field of plant reproduction. Through genetic engineering methods, a method of using key reproductive genes to break reproductive isolation has been established, which provides an important theoretical basis for overcoming hybrid

incompatibility in hybrid breeding.

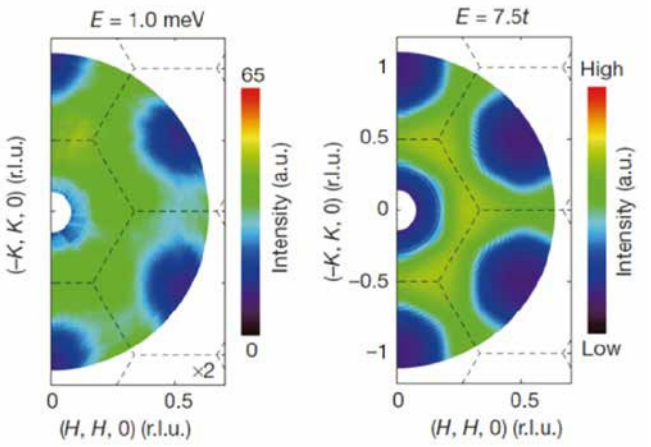
The research results were published in the 2016 edition of *Nature* [531 (7593): 241- 244].

Fractional Spinon Excitation in $YbMgGaO_4$, a Candidate Liquid Material for Triangular Lattice Quantum Spin

State Key Laboratory for Surface Physics (Fudan University)

Quantum spin liquid refers to a new state of matter that has a strong spin correlation in the system, but does not appear magnetically ordered to absolute zero. This state of matter cannot be understood by Landau's phase transition theory and is mostly described by concepts such as topological order and canonical structure. In theory, this state will produce a series of strange physical phenomena, including fractional spinon excitation. At the same time, quantum spin liquids also have potential applications in high-temperature superconducting mechanisms and quantum computing, so they have attracted widespread attention. However, recognized experimental evidence for the existence of quantum spin liquids is still lacking, hindering people from conducting in-depth research on quantum spin liquids.

The State Key Laboratory for Surface Physics performed detailed neutron scattering measurements on the newly discovered quantum spin liquid candidate material $YbMgGaO_4$. The study found that the magnetic excitation of the sample is not a sharp spin-wave (magnon) excitation, but a continuum covering a large area of the Brillouin zone. This kind of continuum generally exists within the entire magnetic excitation bandwidth and is mainly concentrated at the boundaries of the Brillouin zone. The signal is suppressed near the center of the Brillouin zone, thus forming the upper edge of a V-shape on the dispersion spectrum. This continuum is a typical feature of spinon excitation, which is caused by deconfined spinon pairs excited by neutrons. Further theoretical calculations show that this continuum is consistent with the calculated results of the particle-hole excitation spectrum near the spinon Fermi surface, indicating that $YbMgGaO_4$ is likely to be a spinon Fermi surface quantum spin liquid. For the first time, this research observed a complete spinon excitation spectrum in a two-dimensional triangular lattice system, which provides strong experimental evidence for the realization of quantum spin liquids.



Spinon excitation in $YbMgGaO_4$

The research results were published in the 2016 edition of *Nature* [540 (7634) 559-562].

Additional Materials

Additional Materials

Contact Information for State Key Laboratories

Chemistry Field

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Materials-Oriented Chemical Engineering	Nanjing Tech University	Jiangsu Science & Technology Department	Xu Nanping	Zhong Shenglai	025-83172262
State Key Laboratory of Supramolecular Structure and Materials	Jilin University	Ministry of Education	Sun Junqi	Qiu Lingying	0431-85168476
State Key Laboratory of Catalysis	Dalian Institute of Chemical Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Shen Wenjie	Mao Jia	0411-84379307
State Key Laboratory of Electroanalytical Chemistry	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Lu Lehui	Li Fei	0431-85262060
State Key Laboratory of Multiphase Complex Systems	Institute of Process Engineering, Chinese Academy of Sciences	Chinese Academy of Sciences	Ge Wei	Bai Xue	010-82544806
State Key Laboratory of Molecular Reaction Dynamics	Dalian Institute of Chemical Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhang Donghui	Cheng Lina	0411-84379702
State Key Laboratory of Polymer Physics and Chemistry	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Yang Xiaoniu	Song Yuhong	0431-85262125
State Key Laboratory of Applied Organic Chemistry	Lanzhou University	Ministry of Education	Wang Wei	Tian Qiuping	0931-8912500
State Key Laboratory of Physical Chemistry of Solid Surfaces	Xiamen University	Ministry of Education	Wang Ye	Wang Min	0592-2182432
State Key Laboratory of Chemical Resource Engineering	Beijing University of Chemical Technology	Ministry of Education	He Jing	Song Jing	010-64425385
State Key Laboratory of Chemical Engineering	Tsinghua University Tianjin University East China University of Science and Technology Zhejiang University	Ministry of Education	Luo Guangsheng	Qin Wei	010-62782748
State Key Laboratory of Chemo, and Biosensing and Chemometrics	Hunan University	Ministry of Education	Tan Weihong	Pang Xinyu	0731-88821848
State Key Laboratory of Structural Chemistry	Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences	Chinese Academy of Sciences	Guo Guocong	Chen Yubiao	0591-63173196
State Key Laboratory of Organometallic Chemistry	Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Tang Yong	Zhang Yanxia	021-54925155
State Key Laboratory of Fine Chemicals	Dalian University of Technology	Ministry of Education	Peng Xiaojun	Dai Yanqiu	0411-84986292
State Key Laboratory of Molecular Engineering of Polymers	Fudan University	Ministry of Education	Ding Jiandong	Lu Wenqi	021-65643412
State Key Laboratory of Coal Conversion	Shanxi Institute of Coal Chemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Fan Weibin	Yang Li	0351-4134410
State Key Laboratory of Analytical Chemistry for Life Sciences	Nanjing University	Ministry of Education	Ju Huangxian	Zhang Zhijie	025-83686106
State Key Laboratory of Bioorganic and Natural Product Chemistry	Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Yu Biao	Deng Ping	021-54925125

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory for Oxo Synthesis and Selective Oxidation	Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Xia Chungu	Niu Jianzhong	0931-4968126
State Key Laboratory of Inorganic Synthesis and Preparative Chemistry	Jilin University	Ministry of Education	Li Guangshe	Gao Lu	0431-85168603
State Key Laboratory of Rare Earth Resource Utilization	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Xue Dongfeng	Liu Yingxin	0431-85262035
State Key Laboratory of Modern Coordination Chemistry	Nanjing University	Ministry of Education	Zuo Jinglin	Chen Yao	025-83594569
State Key Laboratory of Elemento-Organic Chemistry	Nankai University	Ministry of Education	Cui Chunming	Li Zhichun	022-23503691
State Key Laboratory of Heavy Oil Processing	China University of Petroleum (Beijing) China University of Petroleum (Huadong)	Ministry of Education	Gao Jinsen	Dong Zhiyong	010-89733070

Mathematics Field

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Superlattices and Microstructures	Institute of Semiconductors, Chinese Academy of Sciences	Chinese Academy of Sciences	Li Shushen	Guo Chunying	010-82304287
State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics	Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences	Chinese Academy of Sciences	Deng Feng	Bi Yijiong	027-87198842
State Key Laboratory of Low-Dimensional Quantum Physics	Tsinghua University	Ministry of Education	Wang Yayu	Zhou Dan	010-62795188
State Key Laboratory of Nonlinear Mechanics	Institute of Mechanics, Chinese Academy of Sciences	Chinese Academy of Sciences	Wei Yujie	Shen Nan	010-82543935
State Key Laboratory of High Temperature Gas Dynamics	Institute of Mechanics, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhang Xinyu	Me Jie	010-82543973
State Key Laboratory of Solid State Microstructures	Nanjing University	Ministry of Education	Chen Yanfeng	Zhang Wenjun	025-83592756
State Key Laboratory of Particle Detection and Electronics	Institute of High Energy Physics, Chinese Academy of Sciences University of Science and Technology of China	Chinese Academy of Sciences	An Qi	Chen Mali	010-88236046
State Key Laboratory of Nuclear Physics and Technology	Peking University	Ministry of Education	Ye Yanlin	Wu Jing	010-62751870
State Key Laboratory of Precision Spectroscopy	East China Normal University	Ministry of Education	Wu Jian	Zheng Lijuan	021-62232453
State Key Laboratory of Scientific and Engineering Computing	Academy of Mathematics and Systems Science, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhang Linbo	Ding Rujuan	010-82541031
State Key Laboratory of High Field Laser Physics	Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences	Chinese Academy of Sciences	Leng Yuxin	Tang Yan	021-69918443
State Key Laboratory for Artificial Microstructures and Mesoscopic Physics	Peking University	Ministry of Education	Liu Yunquan	Liu Xizhen	010-62752540
State Key Laboratory of Acoustics	Institute of Acoustics, Chinese Academy of Sciences	Chinese Academy of Sciences	Wang Haibin	He Li	010-82547821
State Key Laboratory for Turbulence and Complex System	Peking University	Ministry of Education	Chen Shiyi	Wang Xinxin	010-62757426
State Key Laboratory for Surface Physics	Fudan University	Ministry of Education	Feng Donglai	Wei Jia	021-65643180

Earth Science Field

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Cryospheric Sciences	Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences	Chinese Academy of Sciences	Kang Shichang	Du Wentao	0931-49671121
State Key Laboratory of Information Engineering in Surveying, Mapping, and Remote Sensing	Wuhan University	Ministry of Education	Chen Ruizhi	Wan Aiping	027-68778969
State Key Laboratory of Urban and Regional Ecology	Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences	Chen Liding	Han Bing	010-62941033
State Key Laboratory of Urban Water Resources and Environment	Harbin Institute of Technology	Ministry of Industry and Information Technology	Ren Nanqi	Zhang Yuqiu	0451-86283787
State Key Laboratory of Geodesy and Earth's Dynamics	Institute of Geodesy and Geophysics, Chinese Academy of Sciences	Chinese Academy of Sciences	Ni Sidao	Yang Hui	027-86783841
State Key Laboratory of Continental Dynamics	Northwest University	Shaanxi Science & Technology Department	Dong Yunpeng	Tian Xinhong	029-88303628
State Key Laboratory of Atmospheric Boundary Layer Physics and Atmospheric Chemistry	Institute of Atmospheric Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Wang Zifa	Xie Fuying	010-82085512
State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics	Institute of Atmospheric Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Xiao Ziniu	Pan Jing	010-82995265
State Key Laboratory of Earth Surface Processes and Resource Ecology	Beijing Normal University	Ministry of Education	Xiao Cunde	Liu Zhe	010-58805461
State Key Laboratory of Earthquake Dynamics	Institute of Geology, China Earthquake Administration	China Earthquake Administration	Zhang Peizhen	Hu Xiaoyan	010-62009427
State Key Laboratory of Geological Processes and Mineral Resources	China University of Geosciences (Wuhan) China University of Geosciences (Beijing)	Ministry of Education	Cheng Qiuming	Zhao Laishi	027-67884974
State Key Laboratory of Geohazard Prevention and Geoenvironment Protection	Chengdu University of Technology	Sichuan Science & Technology Department	Huang Runqiu	Feng Wenkai	028-84073537
State Key Laboratory of Frozen Soil Engineering	Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences	Chinese Academy of Sciences	Wu Qingbai	Li Guoyu	0931-4967290
State Key Laboratory of Marine Geology	Tongji University	Ministry of Education	Yang Shouye	Zhang Jin	021-65985090
State Key Laboratory of Estuarine and Coastal Research	East China Normal University	Ministry of Education	Gao Shu	Wang Lu	021-62232887
State Key Laboratory of Lake Science and Environment	Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences	Chinese Academy of Sciences	Shen Ji	Guo Ya	025-86882189
State Key Laboratory of Environmental Geochemistry	Institute of Geochemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Wang Shijie	Xu Dan	0851-85891334
State Key Laboratory of Environmental Chemistry and Ecotoxicology	Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences	Jiang Guibin	Wu Jingjing	010-62849339
State Key Laboratory of Environmental Criteria and Risk Assessment	Chinese Research Academy of Environmental Sciences	Ministry of Environmental Protection	Wu Fengchang	Zhao Yujie	010-84931804
State Key Joint Laboratory of Environmental Simulation and Pollution Control	Tsinghua University Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences Peking University Beijing Normal University	Ministry of Education	Huang Xia	Li Ruirui	010-62785684

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Desert and Oasis Ecology	Xinjiang Ecology And Geography Institute, Chinese Academy of Sciences	Chinese Academy of Sciences	Chen Yaning	Pan Tingting	0991-7823174
State Key Laboratory of Soil Erosion and Dryland Farming on Loess Plateau	Research Center of Soil and Water Conservation and Ecological Environment, Chinese Academy of Sciences and Ministry of Education	Chinese Academy of Sciences	Liu Baoyuan	Huang Shaohua	029-87012884
State Key Laboratory of Loess and Quaternary Geology	Institute of Earth Environment, Chinese Academy of Sciences	Chinese Academy of Sciences	Jin Zhangdong	Lei Ying	029-62336287
State Key Laboratory of Marine Environmental Science	Xiamen University	Ministry of Education	Dai Minhan	Lin Mengmei	0592-2187538
State Key Laboratory of Space Weather	Center for Space Science and Applied Research, Chinese Academy of Sciences	Chinese Academy of Sciences	Wang Chi	Fu Ying	010-62582648
State Key Laboratory of Ore Deposit Geochemistry	Institute of Geochemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Hu Ruizhong	Chen Hongwei	0851-5891664
State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin	China Institute of Water Resources and Hydropower Research	Ministry of Water Resources	Wang Hao	Cui Yihao	010-68781657
State Key Laboratory of Coal Resources and Safe Mining	China University of Mining and Technology (Beijing), China University of Mining and Technology	Ministry of Education	Peng Suping	Zhou Qiang	010-62331854
State Key Laboratory for Mineral Deposits Research	Nanjing University	Ministry of Education	Wang Rucheng	Wang Xiaolei	025-89680896
State Key Laboratory of Tropical Marine Environment	South China Sea Institute of Oceanology, Chinese Academy of Sciences	Chinese Academy of Sciences	Shi Ping	Wang Liying	020-89235313
State Key Laboratory of Biogeology and Environmental Geology	China University of Geosciences (Wuhan)	Ministry of Education	Tong Jinnan	Hu Jun	027-67883452
State Key Laboratory of Isotope Geochemistry	Guangzhou Institute of Geochemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Xu Yigang	Luo Zhenyu	020-85290401
State Key Laboratory of Soil and Sustainable Agriculture	Nanjing Institute of Soil Science, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhang Ganlin	Dang Qi□ Jia Nan	025-86881028
State Key Laboratory of Satellite Ocean Environment Dynamics	Second Institute of Oceanography, State Oceanic Administration	State Oceanic Administration	Chai Fei	Chen Xiaoyan	0571-81963106
State Key Laboratory of Pollution Control and Resource Reuse	Tongji University Nanjing University	Ministry of Education	Zhang Weixian	Chen Hao	021-65982684-8010
State Key Laboratory of Palaeobiology and Stratigraphy	Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences	Chinese Academy of Sciences	Yuan Xunlai	Dong Baoqing	025-83282140
State Key Laboratory of Lithospheric Evolution	Institute of Geology and Geophysics, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhu Rixiang	Ye Peng	010-82998240
State Key Laboratory of Remote Sensing Science	Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences Beijing Normal University	Chinese Academy of Sciences	Shi Jiancheng	Li Dandan	010-64848730
State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering	Southwest Petroleum University Chengdu University of Technology	Sichuan Science & Technology Department	Zhou Shouwei	Guo Xiao & Lu Zhengyuan	028-83032071
State Key Laboratory of Petroleum Resources and Prospecting	China University of Petroleum (Beijing)	Ministry of Education	Jia Chengzao	Weng Qingping	010-89733952
State Key Laboratory of Organic Geochemistry	Guangzhou Institute of Geochemistry, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhang Gan	Han Linlin	020-85290150
State Key Laboratory of Severe Weather	Chinese Academy of Meteorological Sciences	China Meteorological Administration	Liang Xudong	Zhao Yan	010-68406768
State Key Laboratory of Vegetation and Environmental Change	Institute of Botany, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhang Wenhao	Mao Zhihong	010-62836978

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Resources and Environmental Information System	Institute of Geographic Sciences and Natural Resources, Chinese Academy of Sciences	Chinese Academy of Sciences	Su Fenzhen	Yin Qian	010-64889055

Biology Field

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Virology	Wuhan University Wuhan Institute of Virology, Chinese Academy of Sciences	Ministry of Education	Wu Jianguo	Liu Fang	027-68754592
State Key Laboratory of Grassland Agro-Ecosystems	Lanzhou University	Ministry of Education	Nan Zhibiao	Chen Xianjiang & Fan Chengyong & Zhao Zhigang	0931-8910944
State Key Laboratory of Freshwater Ecology and Biotechnology	Institute of Hydrobiology, Chinese Academy of Sciences	Chinese Academy of Sciences	Nie Pin	Liu Li	027-68780549
State Key Laboratory of Protein and Plant Gene Research	Peking University	Ministry of Education	Zhu Yuxian	Wang Li	010-62751848
State Key Laboratory of Animal Nutrition	Institute of Animal Husbandry, Chinese Academy of Agricultural Sciences China Agricultural University	Ministry of Agriculture	Wang Jiaqi	Zhang Hongfu	010-62818910
State Key Laboratory of Molecular Developmental Biology	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences	Chinese Academy of Sciences	Yang Weicai	Liu Rui	010-64806637
State Key Laboratory of Molecular Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences	Li Lin	Xu Mingmin	021-54921364
State Key Laboratory of Crop Stress Biology for Arid Areas	Northwest A&F University	Ministry of Education	Kang Zhensheng	Hu Yingang	029-87080062
State Key Laboratory of Silkworm Genomic Biology	Southwest University	Ministry of Education	Xia Qingyou	Chang Huaipu	023-68251716
State Key Laboratory of Veterinary Etiological Biology	Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences	Ministry of Agriculture	Yin Hong	Guo Jianhong	0931-8342166
State Key Laboratory of Tree Genetics and Breeding	Chinese Academy of Forestry Northeast Forestry University	National Forestry and Grassland Administration Ministry of Education	Lu Mengzhu	Wang Junhui	010-62888539
State Key Laboratory of Cotton Biology	Institute of Cotton Research, Chinese Academy of Agricultural Sciences, Henan University	Ministry of Agriculture Henan Science & Technology Department	Li Fuguang	Wang Caixiang	0372-2525358
State Key Laboratory of Integrated Management of Pest Insects and Rodents	Institute of Zoology, Chinese Academy of Sciences	Chinese Academy of Sciences	Ge Feng	Ren Shanshan	010-64807068
State Key Laboratory of Agrobiotechnology	China Agricultural University	Ministry of Education	He Qun (agent)	Zhang Fan	010-62733332
State Key Laboratory of Agricultural Microbiology	Huazhong Agricultural University	Ministry of Education	Chen Huanchun	Xu Rong	027-87280670
State Key Laboratory of Neuroscience	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhou Jiawei	Wang Aiqin	021-54921738

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Biomacromolecules	Institute of Biophysics, Chinese Academy of Sciences	Chinese Academy of Sciences	Xu Ruiming	Li Jia	010-64889882
State Key Laboratory of Bioreactor Engineering	East China University of Science and Technology	Ministry of Education	Xu Jianhe	Liu Xuqin	021-64252250
State Key Laboratory of Membrane Biology	Institute of Zoology, Chinese Academy of Sciences Tsinghua University Peking University	Chinese Academy of Sciences	Wang Shiqiang	Hou Guoli	010-64807313
State Key Laboratory of Food Science and Technology	Jiangnan University Nanchang University	Ministry of Education	Jin Zhengyu	Xu Jing & You Feng	0510-85329291
State Key Laboratory of Veterinary Biotechnology	Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences	Ministry of Agriculture	Wang Xiaomei	Zhang Yanhe	0451-51997166
State Key Laboratory of Rice Biology	China National Rice Research Institute, Zhejiang University	Ministry of Agriculture	Qian Qian	Yan Honglan	0571-63370389
State Key Laboratory of Microbial Metabolism	Shanghai Jiao Tong University	Ministry of Education	Deng Zixin	Yu Qing	021-34204051
State Key Laboratory of Microbial Technology	Shandong University	Ministry of Education	Zhang Youming	Zhang Lingli	0531-88364429
State Key Laboratory of Microbial Resources	Institute of Microbiology, Chinese Academy of Sciences	Chinese Academy of Sciences	Dong Xiuzhu	Zhang Min	010-64807430
State Key Laboratory of Systematic and Evolutionary Botany	Institute of Botany, Chinese Academy of Sciences	Chinese Academy of Sciences	Wang Xiaoquan	Li Yannan	010-62836086
State Key Laboratory for Conservation and Utilization of Subtropical Agro-Bioresources	Guangxi University South China Agricultural University	Guangxi Zhuang Autonomous Region Science & Technology Department Guangdong Science & Technology Department	Chen Baoshan	Huang Jing	0771-3237873
State Key Laboratory of Genetic Engineering	Fudan University	Ministry of Education	Ma Hong	Wang Ying	021-51630515
State Key Laboratory of Genetic Resources and Evolution	Kunming Institute of Zoology, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhang Yaping	Tang Jia	0871-65199125
State Key Laboratory of Biocontrol	Sun Yat-sen University	Ministry of Education	Qu Lianghu	Liu Lingyan	020-84115665
State Key Laboratory of Hybrid Rice	Hunan Hybrid Rice Research Center, Wuhan University	Hunan Science & Technology Department Ministry of Education	Fu Xiqin	Hu Meixia	0731-89733467
State Key Laboratory of Mycology	Institute of Microbiology, Chinese Academy of Sciences	Chinese Academy of Sciences	Liu Xingzhong	Qi Sha	010-64807515
State Key Laboratory for Biology of Plant Diseases and Insect Pests	Institute of Plant Protection, Chinese Academy of Agricultural Sciences	Ministry of Agriculture	Zhou Xueping	Chen Dongli	010-62815921
State Key Laboratory of Plant Molecular Genetics	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences	Xue Hongwei	Chen Hui	021-54924286
State Key Laboratory of Plant Genomics	Institute of Genetics and Developmental Biology, Chinese Academy of Sciences Institute of Microbiology, Chinese Academy of Sciences	Chinese Academy of Sciences	Zuo Jianru	Shi Jiao	010-64806711
State Key Laboratory of Plant Physiology and Biochemistry	China Agricultural University Zhejiang University	Ministry of Education	Wu Weihua	Liu Caifei	010-62733475
State Key Laboratory of Plant Cell and Chromosome Engineering	Institute of Genetics and Developmental Biology, Chinese	Chinese Academy of Sciences	Fu Xiangdong	Zhang Bairu	010-64806537

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
	Academy of Sciences				
State Key Laboratory of Crop Biology	Shandong Agricultural University	Shandong Science & Technology Department	Zhang Xiansheng	Liu Binbin	0538-8249767
State Key Laboratory of Crop Genetic Improvement	Huazhong Agricultural University	Ministry of Education	Zhang Qifa	Zhang Meidong	027-87282104
State Key Laboratory of Crop Genetics and Germplasm Enhancement	Nanjing Agricultural University	Ministry of Education	Ding Yanfeng	Zhang Fang	025-84395201

Information Field

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Transducer Technology	Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences Institute of Electronics, Chinese Academy of Sciences	Chinese Academy of Sciences	Li Xinxin	Liu Hainan	021-62511070-5463
State Key Laboratory of Electronic Thin Films and Integrated Devices	University of Electronic Science and Technology of China	Ministry of Education	Li Yanrong	Yan Yichao	028-83202502
State Key Laboratory of Luminescence and Application	Changchun Institute of Optics, Fine Mechanics, and Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Shen Dezhen	Ma Yuejia	0431-86176315
State Key Laboratory of Management and Control for Complex Systems	Institute of Automation, Chinese Academy of Sciences	Chinese Academy of Sciences	Wang Feiyue	Yan Yan	010-82544528
State Key Laboratory of Industrial Control Technology	Zhejiang University	Ministry of Education	Su Hongye	Pan Huiru	0571-87951804
State Key Laboratory of Millimeter Waves	Southeast University	Ministry of Education	Hong Wei	Zheng Kaipeng	025-83794225
State Key Laboratory of Infrared Physics	Shanghai Institute of Technical Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Chen Xiaoshuang	Han Li	021-25051396
State Key Laboratory of Robotics	Shenyang Institute of Automation, Chinese Academy of Sciences	Chinese Academy of Sciences	Yu Haibin	Zhang Chan	024-23970130
State Key Laboratory of Integrated Optoelectronics	Jilin University Institute of Semiconductors, Chinese Academy of Sciences	Ministry of Education	Huang Yongzhen	Zhang Jinglin	0431-85168269
State Key Laboratory of Computer-aided Design & Computer Graphics	Zhejiang University	Ministry of Education	Zhou Kun	Xie Lei	0571-88206681-406
State Key Laboratory of Computer Science	Institute of Software, Chinese Academy of Sciences	Chinese Academy of Sciences	Shen Yidong	Zhang Li	010-62661616
State Key Laboratory for Novel Software Technology	Nanjing University	Ministry of Education	Lu Jian	Xu Xuan	025-89683467
State Key Laboratory of Computer Architecture	Panasonic Corporation of China	Chinese Academy of Sciences	Sun Ninghui	Dong Hui	010-62600600
State Key Laboratory of Precision Measurements Technology and Instruments	Tianjin University Tsinghua University	Ministry of Education	Hu Xiaotang	Qu Xinghua	022-27406643
State Key Laboratory of Quantum Optics and Quantum Optics Devices	Shanxi University	Shanxi Science & Technology Department	Zhang Jing	Gao Xing	0351-7018917
State Key Laboratory of Synthetical Automation for Process Industries	Northeastern University	Ministry of Education	Chai Tianyou	Li Xing	024-83687794-807
State Key Laboratory of Pattern Recognition	Institute of Automation, Chinese Academy of Sciences	Chinese Academy of Sciences	Liu Chenglin	Zhao Wei	010-82544593

State Key Laboratory of Advanced Optical Communication Systems & Networks	Shanghai Jiao Tong University Peking University	Ministry of Education	He Zuyuan	Zhang Ying & Li Li	021-34204597
State Key Laboratory of Software Engineering	Wuhan University	Ministry of Education	Xu Baowen	Wu Minquan	027-68775519
State Key Laboratory of Software Development Environment	Beijing University of Aeronautics and Astronautics (Beihang University)	Ministry of Industry and Information Technology	Li Wei	Luo Jie	010-82338422
State Key Laboratory of Bioelectronics	Southeast University	Ministry of Education	Lu Zuhong	Qin Huiling	025-83792245
State Key Laboratory of Transient Optics and Photonics	Xi'an Institute of Optics and Fine Mechanics, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhao Wei	Wang Yishan & Li Ping & Yao Baoli	029-88887603
State Key Laboratory of Networking and Switching Technology	Beijing University of Posts and Telecommunications	Ministry of Education	Zhang Ping	Zhang Yongping	010-62283412
State Key Laboratory of Optical Technologies on Nano-Fabrication and Micro-Engineering	Institute of Optics and Electronics, Chinese Academy of Sciences	Chinese Academy of Sciences	Luo Xiangang	Pan Sijie	028-85100203
State Key Laboratory of Modern Optical Instrumentation	Zhejiang University	Ministry of Education	Qiu Min	Zheng Wenhua	0571-87951432
State Key Laboratory of Information Security	Institute of Information Engineering, Chinese Academy of Sciences	Chinese Academy of Sciences	Lin Dongdai	Liu Feng	010-82546591
State Key Laboratory of Information Photonics and Optical Communications	Beijing University of Posts and Telecommunications	Ministry of Education	Ren Xiaomin	Huang Shanguo	010-61198106
State Key Laboratory of Virtual Reality Technology and Systems	Beijing University of Aeronautics and Astronautics (Beihang University)	Ministry of Industry and Information Technology	Zhao Qinping	Jiang Han	010-82338861
State Key Laboratory of Wireless Mobile Communications	Southeast University	Ministry of Education	You Xiaohu	Fu Weibin	025-83795611
State Key Laboratory of Applied Optics	Changchun Institute of Optics, Fine Mechanics, and Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Cao Jianlin	Liu Yan	0431-86176199
State Key Laboratory of Application Specific Integrated Circuit (ASIC) and System	Fudan University	Ministry of Education	Yan Xiaolang	Xu Wei	021-51355279
State Key Laboratory of Integrated Services Network	Xidian University	Ministry of Education	Gao Xinbo	Yu Jian	029-88202524

Materials Field

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Advanced Technology for Materials Synthesis and Processing	Wuhan University of Technology	Ministry of Education	Zhang Qingjie	Zhou Lihua	027-87651837-8304
State Key Laboratory of Superhard Materials	Jilin University	Ministry of Education	Liu Bingbing	Xu Dan	0431-85168881
State Key Laboratory of Luminescent Materials and Devices	South China University of Technology	Ministry of Education	Ma Yuguang	Liao Yanfei	020-22237016
State Key Laboratory for Powder Metallurgy	Central South University	Ministry of Education	Zhou Kechao	Chen Chao	0731-88836460
State Key Laboratory of Polymer Materials Engineering	Sichuan University	Ministry of Education	Li Guangxian	Fan Minmin	028-85405132
State Key Laboratory of High Performance Ceramics and Ultrastructure	Shanghai Institute of Ceramics, Chinese Academy of Sciences	Chinese Academy of Sciences	Chen Lidong	Zheng Shan	021-52412608

State Key Laboratory of Solid Lubrication	Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Liu Weimin	Hu Haiyuan	0931-4968079
State Key Laboratory of Optoelectronic Materials and Technology	Sun Yat-sen University	Ministry of Education	Yu Siyuan	Zheng Xiangzhi	020-84112292
State Key Laboratory of Silicon Materials	Zhejiang University	Ministry of Education	Yang Deren	Wang Lei	0571-87952124
State Key Laboratory of Silicate Materials for Architectures	Wuhan University of Technology	Ministry of Education	Wang Fazhou	Xiao Haiyan	027-87651856
State Key Laboratory for Mechanical Behavior of Materials	Xi'an Jiaotong University	Ministry of Education	Sun Jun	Li Jie	029-82668610
State Key Laboratory of Metal Matrix Composites	Shanghai Jiao Tong University	Ministry of Education	Zhang Di	Wang Honghua	021-54748860
State Key Laboratory of Crystal Materials	Shandong University	Ministry of Education	Tao Xutang	Jiang Wanli	0531-88364550
State Key Laboratory of Solidification Processing	Northwestern Polytechnical University	Ministry of Industry and Information Technology	Huang Weidong	Li Xiaoli	029-88492374
State Key Laboratory for Modification of Chemical Fibers and Polymer Materials	Donghua University	Ministry of Education	Zhu Meifang	Chen Liyun	021-67792851
State Key Laboratory for Advanced Metals and Materials	University of Science and Technology Beijing	Ministry of Education	Lu Zhaoping	Zhang Laiqi	010-62334925
State Key Laboratory of New Ceramics and Fine Processing	Tsinghua University	Ministry of Education	Pan Wei	Zhang Yuduo	010-62772556
State Key Laboratory of Functional Materials for Informatics	Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences	Chinese Academy of Sciences	Song Zhitang	Cao Jiannan	021-62511070-8302
State Key Laboratory of Metastable Materials Science & Technology	Yanshan University	Hebei Science & Technology Department	Liu Riping	Zhang Chunxiang	0335-8057047
State Key Laboratory of Organic-Inorganic Composite Materials	Beijing University of Chemical Technology	Ministry of Education	Chen Jianfeng	Zhao Jun	010-64428723
State Key Laboratory of Pulp and Paper Engineering	South China University of Technology	Ministry of Education	Lu Fachuang	Chen Zhao	020-87113940-8003

Engineering Field

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Explosion Science and Technology	Beijing Institute of Technology	Ministry of Industry and Information Technology	Wang Cheng	Yang Li	010-68911682
State Key Laboratory of Material Processing and Die & Mould Technology	Huazhong University of Science and Technology	Ministry of Education	Li Jianjun	Li Yanong	027-87543678
State Key Laboratory of Electrical Insulation and Power Equipment	Xi'an Jiaotong University	Ministry of Education	Wang Jianhua	Li Jiaofeng	029-82667884
State Key Laboratory of Safety Control and Simulation of Power System and Large-Scale Power Generation Equipment	Tsinghua University	Ministry of Education	Liang Xidong	Zhou Junyu	010-62795705
State Key Laboratory of Multiphase Flow in Power Engineering	Xi'an Jiaotong University	Ministry of Education	Guo Liejin	Wang Yueshe	029-82667323
State Key Laboratory of Refractory and Metallurgy	University of Science and Technology Beijing	Ministry of Education	Guo Zhancheng	Liu Jinzhou	010-82375828-802
State Key Laboratory of High Performance Complex Manufacturing	Central South University	Ministry of Education	Duan Ji'an	Shen Shaofen	0731-88876504
State Key Laboratory of Structural Analysis for Industrial Equipment	Dalian University of Technology	Ministry of Education	Li Gang	Wu Jinying	0411-84708393

State Key Laboratory of Rail Traffic Control and Safety	Beijing Jiaotong University	Ministry of Education	Tang Tao	Qi Chunhong	010-51684773
State Key Laboratory of Coastal and Offshore Engineering	Dalian University of Technology	Ministry of Education	Dong Guohai	Lu Weihua	0411-84709916
State Key Laboratory of Ocean Engineering	Shanghai Jiao Tong University	Ministry of Education	Yang Jianmin	Li Weijing	021-34207184
State Key Laboratory of Fire Science	University of Science and Technology of China	Chinese Academy of Sciences	Zhang Heping	Chen Jun	0551-63601651
State Key Laboratory of Robotics and Systems	Harbin Institute of Technology	Ministry of Industry and Information Technology	Liu Hong	Ji Junhong	0451-86418231
State Key Laboratory of Mechanical Transmission	Chongqing University	Ministry of Education	Chen Bingkui	Luo Wenjun	023-65106195
State Key Laboratory of Mechanics and Control of Mechanical Structures	Nanjing University of Aeronautics and Astronautics	Ministry of Industry and Information Technology	Xiong Ke	Ding Yi	025-84896316
State Key Laboratory for Strength and Vibration of Mechanical Structures	Xi'an Jiaotong University	Ministry of Education	Wang Tiejun	Li Qingye	029-82665937
State Key Laboratory of Mechanical System and Vibration	Shanghai Jiao Tong University	Ministry of Education	Zhu Xiangyang	Sheng Xinjun	021-34205880
State Key Laboratory for Manufacturing Systems Engineering	Xi'an Jiaotong University	Ministry of Education	Li Dichen	Wang Xinyao	029-83395052
State Key Laboratory of Fluid Power and Mechatronic Systems	Zhejiang University	Ministry of Education	Yang Huayong	Zhang Junhui	0571-87952274
State Key Laboratory of Coal Mine Disaster Dynamics and Control	Chongqing University	Ministry of Education	Lu Yiyu	Wang Qin	023-65106873
State Key Laboratory of Coal Combustion	Huazhong University of Science and Technology	Ministry of Education	Yao Hong	Fan Lingli	027-87545526
State Key Laboratory of Tribology	Tsinghua University	Ministry of Education	Meng Yonggang	Liu Dameng	010-62797646
State Key Laboratory of Engines	Tianjin University	Ministry of Education	Yao Mingfa	Xiao Na	022-27406842-8002
State Key Laboratory of Clean Energy Utilization	Zhejiang University	Ministry of Education	Luo Zhongyang	Guan Wenjie	0571-87952401
State Key Laboratory of Automotive Safety and Energy	Tsinghua University	Ministry of Education	Ouyang Minggao	Zhang Jingyi	010-62773036
State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body	Hunan University	Ministry of Education	Li Guangyao	Han Qi	0731-88821445
State Key Laboratory of Automotive Simulation and Control	Jilin University	Ministry of Education	Chen Hong	Yin Hai	0431-85095090-6150
State Key Laboratory of Traction Power	Southwest Jiaotong University	Ministry of Education	Kang Guozheng	Liao Zhijun	028-87600867
State Key Laboratory of Advanced Electromagnetic Engineering and Technology	Huazhong University of Science and Technology	Ministry of Education	Duan Xianzhong	Meng Li	027-87543128
State Key Laboratory for Geomechanics and Deep Underground Engineering	China University of Mining and Technology China University of Mining and Technology (Beijing)	Ministry of Education	Miao Xiexing	Zhao Chunxiao	0516-83995678
State Key Laboratory of Power Transmission Equipment and System Security and New Technology	Chongqing University	Ministry of Education	Liao Ruijin	Zeng Liqiang	023-65112739
State Key Laboratory of Digital Manufacturing Equipment and Technology	Huazhong University of Science and Technology	Ministry of Education	Ding Han	Zeng Huan	027-87559416
State Key Laboratory of Hydraulics and Mountain River Engineering	Sichuan University	Ministry of Education	Xu Weilin	Fu Xiaoying	028-85403957

State Key Laboratory of Hydraulic Engineering Simulation and Safety	Tianjin University	Ministry of Education	Zhong Denghua	Song Meilin & Bai Yuchuan	022-27403500
State Key Laboratory of Water Resources and Hydropower Engineering Science	Tsinghua University	Ministry of Education	Li Qingbin	He Guojian & Chen Min	010-62797481
State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering	Hohai University Nanjing Hydraulic Research Institute	Ministry of Education	Yu Zhongbo	Guo Zhihui	025-83786606
State Key Laboratory of Water Resources and Hydropower Engineering Science	Wuhan University	Ministry of Education	Lu Wenbo	Wang Fang	027-68772275
State Key Laboratory of Civil Engineering Disaster Prevention	Tongji University	Ministry of Education	Ge Yaojun	Xu Le	021-65982398
State Key Laboratory of Advanced Welding and Joining	Harbin Institute of Technology	Ministry of Industry and Information Technology	Feng Jicai	Cao Jian	0451-86418146
State Key Laboratory of Alternate Electrical Power System with Renewable Energy Sources	North China Electric Power University	Ministry of Education	Liu Jizhen	Zhang Hong	010-61773778
State Key Laboratory of Subtropical Building Science	South China University of Technology	Ministry of Education	Xiao Dawei	Zhao Jie	020-22236019
State Key Laboratory of Geomechanics and Geotechnical Engineering	Wuhan Institute of Rock and Soil Mechanics, Chinese Academy of Sciences	Chinese Academy of Sciences	Feng Xiating	Ruan Hang	027-87198413
State Key Laboratory of Rolling and Automation	Northeastern University	Ministry of Education	Wang Zhaodong	Zhang Ying	024-83687220

Medical Field

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
State Key Laboratory of Oncogenes and Related Genes	Shanghai Cancer Institute	National Health and Family Planning Commission	Gao Weiqiang	Ding Guangju	021-64177401
State Key Laboratory of Pathogen and Biosecurity Microorganisms	Academy of Military Medical Sciences of the PLA Academy of Military Science	Logistic Support Department of the CMC	Cao Wuchun	Lin Lei	010-66948607
State Key Laboratory for Infectious Disease Prevention and Control	Chinese Center for Disease Control and Prevention	National Health and Family Planning Commission	Xu Jianguo	Xue Dongmei	010-58900789
State Key Laboratory for Diagnosis and Treatment of Infectious Diseases	Zhejiang University	Ministry of Education	Li Lanjuan	Zhu Danhua	0571-87236426
State Key Laboratory of Trauma, Burns, and Combined Injury	Third Military Medical University of Chinese People's Liberation Army (PLA)	Training and Administration Department of the CMC	Jiang Jianxin	Yang Xue	023-68757404
State Key Laboratory of Proteomics	Academy of Military Medical Sciences of the PLA Academy of Military Science	Logistic Support Department of the CMC	He Fuchu	Wang Yan	010-61777004
State Key Laboratory of Molecular Oncology	Cancer Institute, Cancer Hospital, Chinese Academy of Medical Sciences	National Health and Family Planning Commission	Zhan Qimin	Shao Meng	010-67762694

State Key Laboratory of Respiratory Disease	Guangzhou Medical University	Guangdong Science & Technology Department	Zhong Nanshan	Zheng Jinping	020-83062879
State Key Laboratory of Oncology in South China	Sun Yat-sen University	Ministry of Education	Zeng Yixin	Peng Min	020-87343170
State Key Laboratory of Stem Cell and Reproductive Biology	Institute of Zoology, Chinese Academy of Sciences	National Health and Family Planning Commission	Zhou Qi	Ning Lina	010-64807312
State Key Laboratory of Oral Diseases	Sichuan University	Ministry of Education	Zhou Xuedong	Lin Yunfeng	028-85503487
State Key Laboratory of Brain & Cognitive Sciences	Institute of Biophysics, Chinese Academy of Sciences	Chinese Academy of Sciences	He Sheng	Zhou Xin	010-64861049
State Key Laboratory of Cognitive Neuroscience and Learning	Beijing Normal University	Ministry of Education	Li Wu	Yang Jing	010-58800126
State Key Laboratory of Kidney Diseases	301 Hospital or People's Liberation Army (PLA) General Hospital	Logistic Support Department of the CMC	Chen Xiangmei	Zhu Hanyu	010-66935462
State Key Laboratory of Biochemical Engineering	Institute of Process Engineering, Chinese Academy of Sciences	Chinese Academy of Sciences	Ma Guanghui	Wang Lijun	010-82545001
State Key Laboratory of Biotherapy	Sichuan University	Ministry of Education	Wei Yuquan	Yang Jinliang	028-85502796
State Key Laboratory of Reproductive Medicine	Nanjing Medical University	Jiangsu Science & Technology Department	Sha Jiahao	Wang Lirong	025-86862908
State Key Laboratory of Experimental Hematology	Institute of Hematology, Hospital of Hematology, Chinese Academy of Medical Sciences	National Health and Family Planning Commission	Cheng Tao	Wang Min	022-23909417
State Key Laboratory of Bioactive Substance and Function of Natural Medicines	Institute of Materia Medica, Chinese Academy of Medical Sciences	National Health and Family Planning Commission	Yu Shishan	Ye Xianrong Liu Yang	010-83162679
State Key Laboratory of Natural Medicines	China Pharmaceutical University	Ministry of Education	Li Ping	Liu Ehu	025-83271382
State Key Laboratory of Natural and Biomimetic Drugs	Peking University	Ministry of Education	Zhou Demin	Song Shuxiang	010-82805739
State Key Laboratory of Cell Biology	Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Chinese Academy of Sciences	Zhu Xueliang	Lu Yang	021-54921629
State Key Laboratory of Cellular Stress Biology	Xiamen University	Ministry of Education	Han Jiahuai	Wang Xuekun	0592-2185361
State Key Laboratory of Cardiovascular Disease	Fuwai Cardiovascular Hospital, Chinese Academy of Medical Sciences	National Health and Family Planning Commission	Hu Shengshou	Zhang Xueyan	010-60866093
State Key Laboratory of New Drug Research	Shanghai Institute of Materia Medica, Chinese Academy of Sciences	Chinese Academy of Sciences	Jiang Hualiang	Lou Xiaorong	021-50806600-2219
State Key Laboratory of Ophthalmology	Sun Yat-sen University	Ministry of Education	Liu Yizhi	Liu Xialin	020-87330341
State Key Laboratory of Medicinal Chemical Biology	Nankai University	Ministry of Education	Li Luyuan	Wang Shanshan	022-85358796
State Key Laboratory of Medical Molecular Biology	Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences	National Health and Family Planning Commission	Liu Depei	Geng Chao	010-69156420

State Key Laboratory of Medical Genomics	Shanghai Jiao Tong University	Ministry of Education	Chen Saijuan	Chen Chao	021-34187207
State Key Laboratory of Medical Immunology	Second Military Medical University of Chinese People's Liberation Army	Training and Administration Department of the CMC	Cao Xuetao	Yu Yizhi	021-55620605-63
State Key Laboratory of Medical Neurobiology	Fudan University	Ministry of Education	Zheng Ping	Liu Yan	021-54237398
State Key Laboratory of Pharmaceutical Biotechnology	Nanjing University	Ministry of Education	Gao Xiang	Wang Xiaoning	025-89684060
State Key Laboratory of Phytochemistry and Plant Resources in West China	Kunming Institute of Botany, Chinese Academy of Sciences	Chinese Academy of Sciences	Chen Jijun	Lin Xian	0871-65223322
State Key Laboratory of Cancer Biology	Fourth Military Medical University of Chinese People's Liberation Army	Training and Administration Department of the CMC	Fan Daiming	Tian Mi	029-84771466

Contact Information of Pilot National Laboratories

Laboratory Name	Supporting Units	Department in Charge	Director	Contact Person	Telephone
Beijing National Laboratory for Molecular Sciences (Planned)	Peking University Institute of Chemistry, Chinese Academy of Sciences	Ministry of Education Chinese Academy of Sciences	Xi Zhenfeng Wan Lijun	Han Yanli & Li Ling & Yao Jingjing	010-62562693
Beijing National Laboratory for Condensed Matter Physics (Planned)	Institute of Physics, Chinese Academy of Sciences	Chinese Academy of Sciences	Wang Yupeng	Zhu Chunli	010-82649410
Hefei National Laboratory for Physical Sciences at the Microscale (Planned)	University of Science and Technology of China	Chinese Academy of Sciences	Tang Shuxian	Yan Qing	0551-63600458
Tsinghua National Laboratory for Information Science and Technology (Planned)	Tsinghua University	Ministry of Education	Lu Jianhua	Wu Keying	010-62797486
Shenyang National (Joint) Laboratory for Materials Science	Institute of Metal Research, Chinese Academy of Sciences	Chinese Academy of Sciences	Lu Ke	Liu Shuwei	024-23971951
Wuhan National Laboratory for Optoelectronics (Planned)	Huazhong University of Science and Technology and other units	Ministry of Education	Ye Chaohui	Luo Weihua	027-87792516
Pilot National Laboratory for Marine Science and Technology (Qingdao)	Ocean University of China Institute of Oceanology, Chinese Academy of Sciences First Institute of Oceanography, State Oceanic Administration Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences Qingdao Institute of Marine Geology		Wu Lixin	Wang Yingxia	0532-83590060