HARBIN INSTITUTE OF TECHNOLOGY
NEWSLETTER SPECIAL ISSUE 2020

HIT TIMES

HARBIN INSTITUTE OF TECHNOLOGY CELEBRATING ITS 100TH ANNIVERSARY

HIT WON FOUR NATIONAL SCIENCE AND TECHNOLOGY AWARDS

哈爾濱工業大學
HARBIN INSTITUTE OF TECHNOLOGY
1920-2020

HIT HARBIN

HIT WEIHAI

HIT SHENZHEN

HIT TIMES

Harbin Institute of
Technology Newsletter
Special Issue 2020

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We sincerely appreciate your
wholehearted support.

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Message from HIT

HARBIN INSTITUTE OF TECHNOLOGY CELEBRATING ITS 100TH ANNIVERSARY

哈爾濱工業大學
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In order to celebrate its 100th Anniversary, Harbin Institute of Technology (HIT) held a series of celebration activities and broadcasted live online by People's Daily, Bilibili and Sina Weibo.

HIT Alumni Briefing for the Centennial Anniversary Celebration

On May 10th, 2020, the HIT Alumni Briefing for the Centennial Anniversary Celebration was held. HIT Party Secretary Xiong Sihao received the school flag for global delivery. HIT President Zhou Yu made a speech. HIT Executive Vice President and Vice President of the HIT Alumni Association Han Jiecai introduced the overall work of the centennial anniversary.

On behalf of Harbin Institute of Technology, HIT President Zhou Yu conveyed his best regards to current students and faculty members, retired faculty and staff, domestic and overseas alumni, and friends who have joined our endeavors and continue to support HIT. Looking back on the history of 100 years, the development of Harbin Institute of Technology is because of our joint efforts and the strong power of HIT's spirit. Today, all faculty, students and alumni of HIT are bravely committed to building HIT into a well-known world-class university and will continue to explore new research frontiers and scale greater heights in research excellence.

Tree Planting Ceremony

On June 7th, a tree planting ceremony using returned space soil was held in front of the new library. HIT Party Secretary Xiong Sihao and HIT President Zhou Yu unveiled the stele and presented returned space soil to representatives from Weihai campus and Shenzhen campus respectively. They cultivated and watered the tree, together with Vice President of HIT Alumni Association Ren Nanqi,

Deputy Party Secretary of HIT Weihai Wang Jianwen, Vice President of HIT Shenzhen Yao Yingxue, and a 2016 undergraduate from the School of Astronautics Lu Sheng'ao.

Today, the representatives of faculty and students are using the soil and water from HIT's three campuses returned from space to jointly cultivate and water the tree. While growing up with HIT's spirit, the tree not only symbolizes HIT's 100-year tradition of education, but also represents that HIT will continue to inherit and work hard, and continue to strive for the nation and the aerospace industry in the new century.

Unveiling Ceremony of New Library's Name

On the afternoon of June 7th, the unveiling ceremony of new library's name was held in the square of the Electric Building. The new library is called Simin Building, which means thinking thoroughly and benefiting the people. Chairman of Neptunus Group in Shenzhen and HIT alumnus Zhang Simin, HIT Party Secretary Xiong Sihao and HIT President Zhou Yu unveiled the Simin Building together.

Over the past 20 years, Zhang Simin has donated more than 20 million RMB to the university. At the centennial anniversary of HIT, he donated 100 million RMB to help the development and construction of the alma mater in the new centennial. In order to recognize Zhang Simin's outstanding contribution to the development and construction of the university, HIT decided to award him the title of "Lifelong Honorary Director of Harbin Institute of Technology."

HIT Party Secretary Xiong Sihao

HIT Executive Vice President Han Jiecai chaired the ceremony. HIT Vice President Guo Bin, HIT Deputy Party Secretary and Vice President An Shi, HIT Deputy Party Secretary and Discipline Inspection Commission Secretary Yao Limin, HIT Vice President Cao Xibin, HIT Propaganda Minister Wu Songquan, Vice President of HIT Education Development Foundation and HIT Alumni Association Cui Guolan, Vice President of HIT Alumni Association Cai Jujin, HIT president assistants Fan Feng, Shen Yi, Hou Yujie and other representatives attended the ceremony.

Opening Ceremony of HIT's 100th Anniversary Commemorative Seal

On June 7th, the Opening Ceremony of HIT's 100th Anniversary Commemorative Seal was held in the plaza of the Electric Machinery Building. HIT Deputy Party Secretary and Discipline Inspection Commission Secretary Yao Limin attended the ceremony. HIT President Assistant Fan Feng chaired the ceremony.

During the ceremony, Yao Limin declared that the commemorative seal was open to use. Together with National People's Congress Deputy and President of Harbin Alumni Association Tian Likun, Professor Wu Jianqiang from the School of Electrical Engineering and Automation, he put the seal on the commemorative stamp products. The three guests sealed the commemorative stamp products and presented them to the representatives of the museum, the space museum and the archives. The stamp products with the commemorative seal will be collected in the museum, space museum and archives of our university and the commemorative seal will be collected in the HIT Space Museum.

HIT President Zhou Yu

Issuing Ceremony of HIT's 100th Anniversary Commemorative Stamp

On June 7th, the Issuing Ceremony of HIT's 100th Anniversary Commemorative Stamp was held. Heilongjiang Branch of China Post Group Co., Ltd. donated two full page commemorative stamps with the number of 19200607 and 20200607 to our university. Deputy General Manager of Heilongjiang Branch of China Post Group Co., Ltd. Chen Zhao and HIT Vice President Guo Bin delivered speeches respectively. Party Secretary and General Manager of Harbin Branch of China Post Group Co., Ltd. Shao Pei read out the stamp issue notice. HIT President Assistant Hou Yujie chaired the ceremony.

Guo Bin said in his speech that Harbin Institute of Technology has its first exclusive stamp, which fully affirms the university's contribution to national development and scientific and technological progress, embodies the patriotic struggle spirit of our university, which is passed down from generation to generation, and stimulates the new impetus of Harbin Institute of Technology to create a world-class university.

HIT's 100th Anniversary Celebration

On June 7th, HIT's 100th Anniversary Celebration was held in the main building square. Chinese President Xi Jinping sent a congratulatory letter to Harbin Institute of Technology. Minister of the Ministry of Industry and Information Technology Miao Wei attended the ceremony and read the congratulatory letter.

The ceremony was attended by Secretary of the CPC Heilongjiang Provincial Committee Zhang Qingwei, Deputy Secretary of the CPC Heilongjiang Provincial Committee and Governor of Heilongjiang Province Wang Wentao, Chairman of the CPPCC Heilongjiang Provincial Committee Huang Jiansheng, Party Secretary and Chairman of China Aerospace Science and Technology Corporation Wu Yansheng, Party Secretary and Chairman of Harbin Electric Corporation Si Zefu, Deputy Secretary of Heilongjiang Provincial Party Committee Chen Haibo, Deputy Governor of Heilongjiang Province Li Haitao, member and Secretary General of the Standing Committee of Heilongjiang Provincial Party Committee Zhang Yupu, member of the Standing Committee of Heilongjiang Provincial Party Committee and Secretary of Harbin Municipal Party Committee Wang Zhaoli, Secretary and Deputy Director of the Party Group of the Standing Committee of Heilongjiang Provincial People's Congress Hu Yafeng, Deputy Governor of Heilongjiang Province Sun Dongsheng, Mayor of Harbin City Sun Zhe, Deputy Secretary of the Party Group of China Aerospace Science and Technology Corporation Li Benzheng, Secretary General of Heilongjiang Provincial Government Wang Dongguang and HIT former leader Li Sheng.

President of Tsinghua University Qiu Yong, President of Xi'an Jiaotong University Wang Shuguo, former governor of Heilongjiang Province Shao Qihui, HIT former leaders Wang Shuquan, Yang Shiqin and

Planting tree by returned space soil

Guo Dacheng, et al. participated in the ceremony through the video.

Academicians of the CAS and CAE Bao Weimin, Tan Tianwei, Zhang Xue, Liu Yongtan, Huang Wenhu, Cai Hegao, Shen Shizhao, Du Shanyi, Wang Zicai, Qin Yukun, Zhao Liancheng, Ou Jinping, Wei Fengsi, Ren Nanqi, Zhang Tongyi, Gao Wen, Deng Zongquan, Tan Jiubin, Duan Guangren, Ma Jun, former leaders of the university Wu Lin, Wu Manshan, He Zhongyi, Rong Dacheng, Sun Heyi and Jing Rui attended the ceremony

On behalf of the Heilongjiang Provincial Party Committee and the Heilongjiang Government, Zhang Qingwei extended warm congratulations on HIT's centennial celebration. He pointed out that the CPC Central Committee paid high attention to the development and construction of Harbin Institute of Technology, and President Xi Jinping sent a congratulatory letter to highly appraise the remarkable achievements and important contributions made by HIT, and make important instructions for its innovation and development for the future. In the past century, based on Heilongjiang Province, HIT has created brilliant achievements and made important contributions to the national construction and the development of Heilongjiang Province. Heilongjiang Province will, as always, support the "double first-class" construction and provide a better service guarantee.

HIT Party Secretary Xiong Sihao chaired the ceremony and said that we were delighted and excited to receive the congratulatory letter from Chinese President Xi Jinping and felt the great responsibility and mission. The congratulatory letter fully embodies the general secretary and the Party Central Committee's highly positive affirmation, high attention and cordial concern for

Chairman of Neptunus Group Zhang Simin, HIT Party Secretary Xiong Sihao and HIT President Zhou Yu unveiling Simin Building together

HIT, which is a great encouragement for our faculty and students, as well as a deep expectation and deep entrustment for our future development. It also points out the direction of development and provides a fundamental for us to follow to run a world-class university rooted in China.

HIT President Zhou Yu delivered a speech and said that Chinese President Xi Jinping's congratulatory letter fully affirmed the achievements of HIT and it was a great encouragement to our all faculty and students. His hope pointed out the direction of our new century and new starting point and gave us great strength to build a world-class university with Chinese characteristics. Facing the new century, HIT will take the progress of engineering science and technology and innovation to change the world as its mission and become an important force to meet the common challenges of mankind and create a better future. The university has decided to commend 3,926 excellent faculty and teachers who have been employed for more than 30 years, including 1,482 faculty with more than 50 years of employment and 2,444 faculty with more than 30 years of employment. As the teacher representative, Academician Liu Yongtan received the award from HIT President Zhou Yu.

During the ceremony, President of Tsinghua University Qiu Yong, Chancellor of the University of California, Berkeley and member of the American Academy of Arts and Sciences Carol Christ, Chairman of China Aerospace Science and Technology Corporation Wu Yansheng, Academician Liu Yongtan, Deputy Director of the National Computer Network Emergency Response Technical Team/Coordination Center of China Yun Xiaochun, student representative Dr. Miao Yue delivered speeches. ■

HARBIN INSTITUTE OF TECHNOLOGY

Founded in 1920, Harbin Institute of Technology (HIT) was selected as one of the two model universities of China for adopting the academic and educational practices of universities in other countries in 1951. In 1945, HIT was one of the first six universities to receive prioritized support from the state for their overall development and was the only one not located in Beijing. HIT is one of the first nine Chinese universities included in a national plan initiated in 1999 that offers favorite support to universities expected to achieve a leading international reputation. In 2017, HIT made it into the list of institutes in category A in China's Double First Class Plan, China's latest national initiative that aims to create world-class universities and disciplines.

HIT alumni include a great number of high ranking leaders of the CPC, the government and the army. It also takes pride in the achievements of its many graduates serving in China's aerospace industries. The list of our outstanding alumni also includes over 100 presidents of universities and more than 80 academicians of the Chinese Academy of Sciences and Chinese Academy of Engineering.

Renowned as "the cradle of engineers," the university has many firsts:

• In China

The first to establish a school of astronautics;

The first small satellite independently developed by a Chinese university;

The first to achieve satellite-ground laser link communications;

The first talking and chess-playing digital computer;

The first new type long range ocean detection radar system;

The first arc welding robot and spot welding robot;

The first successful man-machine coordinated in-orbit maintenance experiment of the space manipulator on Tiangong-2, etc.

• In the world

The first to reveal the virulent factor of HIV and thereby enabling China's structural biology study of HIV to ascend to an internationally advanced level;

The first to realize the target and multi-beam laser auto-alignment of large laser device;

The first space application of magnetic focusing Hall thruster;

The first to achieve a major breakthrough in the development of the support structure for the largest radio telescopes;

The first to send microsatellites and small satellites developed by universities to enter the moon's orbit;

The first microsatellite (Longjiang-2) that completed Earth-to-Moon transfer, near-moon braking, and circumlunar flight in the world, etc.

Renowned both at home and abroad, HIT boasts its highly competitive disciplines related to science and technology, as is testified by the many awards it has received, such as the "China Manned Space Engineering Collaborative Contribution Award", the "China Manned Space Engineering Outstanding Contribution Collective Award" and the "China Manned Space Engineering Outstanding Contributor Award."

Now at HIT there are 38 academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering. It tops the list of Chinese universities in the number of annually authorized patents, total amount of research funding, and the number of three national major science and technology awards. HIT has produced a large number of achievements that have contributed to major missions, including the first launches of the Long March 7 and the Long March 5, as well as the Tiangong-2 space lab and the Shenzhou-11 manned spacecraft. Additionally 11 disciplines of HIT are ranked among the top 1% on the Essential Science Indicators (ESI) lists, including materials science, engineering science, physics, chemistry, computer science, environmental science and ecology, mathematics, biology and biochemistry, agricultural science, clinical medicine and general social science. In particular, materials science and computer science ranked among the top 1‰, and the engineering discipline ranked among the top 1‱. In the 2020 ranking of *U.S. News & World Report*, HIT ranked 1st on the list of the "Best Global Universities for Electrical and Electronic Engineering" and 6th on the list of the "Best Global Universities for Engineering," respectively.

2020 is the 100th anniversary of Harbin Institute of Technology. Here at HIT's three campuses, you will be captivated by impressive ice and snow scenery in Harbin, golden sand beaches in Weihai and an open atmosphere in Shenzhen. Here at HIT, you will understand the academic spirit it takes pride in: solid foundation, intense practice, strict process and sustained innovation.

With a "one university, three campuses" model and an expanding international network, "HIT is striving to reach its goal of becoming a world-class university," says Zhou Yu, president of HIT and a member of the Chinese Academy of Engineering. ■

HARBIN INSTITUTE OF TECHNOLOGY, WEIHAI

哈爾濱工業大學
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Harbin Institute of Technology, Weihai (HIT, Weihai) was set up in 1985 in Weihai, a nice coastal city of east China, as a part of HIT's "One University, Three Campuses" plan. HIT, Weihai is developing into a well-known campus and keeps pace with HIT as a world-class university.

There are 11 schools and more than 900 staff members, more than 11,000 full-time students, including undergraduates, postgraduates and PhD candidates. It offers 45 undergraduate, 30 postgraduate and 18 doctoral programs. With the high quality of education, the undergraduate admission scores have risen much higher than before. In 2016, the International School of Ocean Science and Engineering was established. This campus has become more open and more internationalized. Many qualified graduates are employed by large state-owned enterprises, emerging high-tech enterprises and international companies. More than 90% of them are satisfied in their new jobs, and most employers unanimously give them favorable evaluations.

Internationalization is a strategic policy of HIT, Weihai. It has developed a wide-range of international partnership networks with

the world-class universities for joint education, including more than 100 international partner universities in America, Australia, European and Asian countries. Every year over 700 students go abroad for international exchange and further study.

HIT, Weihai has built a scientific, normalized, and patterned educating system to ensure the students' quality by all staff participation, the whole process control and general improvement. In recent years, the students have won more than 1,000 international, national or provincial awards in hundreds of students' innovation competitions. The HRT race car team, UAVs, 3D printing and so on have become National-

level Innovation Team. Now, it has developed six colleges successively based on the students' dormitory with more than 100 student clubs, and created the distinct "School+College" integrated college culture. The Lilac College, Lotus College, Firmiana College, Pine College, Bamboo College and Begonia College, with different orientations and aims, are enriching the students' campus cultural and social life and providing a broader platform for students' development.

HIT, Weihai focuses on developing marine research and ocean economy, as well as intelligent manufacturing and smart cities. It has performed more than 1,000 projects, including ocean detection technologies, unmanned vehicles, intelligent robots, new information technology, cyber space security, new materials, water purification, and renewable energy, etc., so as to generate hundreds of patents. The pictures and highlights of this campus can be described by means of four words "One, Two, Three, Four": One Blue (ocean economics), Two Smarts (smart manufacturing and smart cities), Three Priorities (ocean engineering, marine science, and automotive engineering), and Four New Technologies (new generation information technology, new materials, new energy, and new environmental technology). Its research and industry cooperation projects have made great contribution to both regional and national economic growth.

The HIT-Weihai Innovation Park (HIT-WHIP) is a provincial incubator, based on HIT's advantages of talent and technology, through government-university-industry cooperation approaches. The HIT-WHIP has four platforms of innovation, entrepreneurship, service, and foundation. The park engages in developing the industrial technology related to information, materials, marine science, equipment, energy, environmental protection, etc. HIT-WHIP has set up 8 industrial technology research institutes and incubated 30 enterprises till now. As an entrepreneurship base and a quickened station for high-tech research and development, it will be a connectable platform for international technological exchange and ultimately, become a "Silicon Beach in Weihai" driven by Harbin Institute of Technology. ■

HARBIN INSTITUTE OF TECHNOLOGY, SHENZHEN

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Harbin Institute of Technology, Shenzhen (HIT, Shenzhen), formerly founded in 2002 as the HIT Shenzhen Graduate School, is nested in the Great Bay area of Guangdong-Hong Kong-Macao. It currently offers comprehensive degree programs of undergraduate, master, and doctorate studies. It has six academic divisions of science, engineering, management, economics, humanities, and arts, including 23 first-tier disciplines that are structured into ten schools and four research institutes. It currently houses over 6,200 full-time students and over 400 full-time teachers, including 8 full-time academicians. HIT, Shenzhen thus presents a cohort of "Master + Team" that is headed by academicians and followed by young scholars.

HIT, Shenzhen invests in scientific advancement and technological innovation, emphasizing strategic development in New Materials, Equipment Manufacturing, Future Information Technology, Artificial Intelligence, Smart City, Space Science, Oceanographic Engineering, and Biopharmaceutics. From 2015 to 2019, it has successfully applied for over 1,500 research projects, with funding income over RMB1.7 billion. Up to now, 3,636 SCI indexed papers and 5,936 EI indexed papers have been published. It has produced laureates of over 80 scientific awards, including 5 national awards and 17 provincial ones. Innovation platforms have also witnessed outstanding progress, including the International School of Design, the Institute of Shenzhen Global Development, the Key Laboratory Group, the Material Science and Application for Unusual Environment, as well as the Nobel Laureate Sauvage Laboratory for Smart Materials.

HIT, Shenzhen will continue to serve the reformation and experimentation for higher education and attract international talent and collaboration, striving to become the global hub for innovation. It will serve as the vanguard for the centennial of Harbin Institute of Technology to become a leading school in the world. ■

SCHOOL OF ASTRONAUTICS

Introduction

Established in 1987, the School of Astronautics of Harbin Institute of Technology (HITSA) is the first in China dedicated to cultivating talent and conducting cutting-edge research in the field of aerospace. HITSA takes it as its mission to tackle scientific and technical challenges in astronautics and to promote the research serving major national needs, as well as provide a global impact on society-at-large. HITSA has formed a research and teaching system combining fundamental studies and engineering applications characterized by wideness in scope and strong synergism in five disciplines: Mechanics, Control Science and Engineering, Aeronautical and Astronautical Science and Technology, Optical Engineering, Electronic Science and Technology. The major research areas currently include: design of spacecraft and craft systems, deep space exploration, autonomous navigation and control, novel guidance and simulation, advanced composite materials and structures, dynamics and control of aerial vehicles, laser communication, remote sensing and diagnosis, space optics and information technology, and IC design and MEMS, etc.

There are 356 members, including 155 professors, 158 associate professors, four members of the Chinese Academy of Sciences, six members of the Chinese Academy of Engineering, and one foreign member of the Academia Europaea. Professor Du Shanyi and Professor Leng Jinsong were elected as World Fellows of the International Committee on Composite Materials, whose vice president is Professor Leng. Professor Duan Guangren and other three researchers were elected as IEEE Fellows. Professor Gao Huijun was voted one of the world's most influential scientific minds in 2014 by Thomson Reuters.

There are currently 1,600 undergraduate students and 2,000 graduate students enrolled in the school. HITSA has initiated a new talent cultivation mode involving joint training and practical educating. The school has also established the Lilac micro-nano satellite innovation factory for students. The "Lilac-2" satellite, launched by the team of the Lilac micro-nano satellite, is the first micro-nano satellite independently designed, developed and controlled by students, and the "Lilac-1" satellite is a part of the QB 50 Project of European Space Agency.

HITSA has become one of the most important Chinese institutions committed to the education of talented scholars and specialists in astronautics and the advancement of aerospace industry in China. The school enjoys a high reputation abroad for its distinguished contribution in the field, including

but not limited to micro-satellite, laser communication, composite materials and control theory. Up to now, the school has designed and launched 20 micro satellites and was the first to accomplish the task of circumlunar flight of micro satellites. Operationally responsive microsatellite system technology and satellite laser communication technique are at the cutting-edge of technological development.

In the future, by aiming at key enabling technology, cutting-edge technology and concept innovation in astronautics, HITSA will make greater contributions to aerospace technology and industry, by pushing interdisciplinary integration, promoting international collaboration and training top-level innovative talents.

Research Highlights

- **Kuaizhou 1 and Longjiang-2 micro-satellites**

Kuaizhou 1 is a novel space craft for natural disaster monitoring, where a satellite and a launch vehicle are integrated. HITSA boasts record-breaking speed in pushing it from launch preparation to in-orbit application. HITSA is also the developer of Longjiang-2, the world's first micro-satellite that independently completed the Earth-moon transfer, near-moon braking and circumlunar flight. Launched in 2018, this low-cost satellite is designed to test ultra-long wave astronomical observation technology. Equipped with a miniature camera, it has captured stunning images of the Earth and the moon.

- **Laser communication**

HITSA has made breakthroughs on key technologies of satellite laser communications. It conducted China's first test of satellite laser communication link in orbit. Space-to-ground communications with China's Satellite SJ-13 in 2017 reached a data rate of 5 Gb/s and a link distance of 37,500 km.

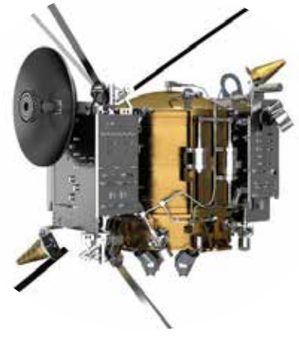
It is the highest reported data rate in high-orbit satellite laser communications to date.

- **Advanced table and equipment**

HITSA scientists lead research in the development of high-precision inertial test equipment, inertial navigation technology, and attitude control of microsatellites. They developed China's first biaxial gyro drift test table, a key instrument for testing the precision of inertial navigation platforms and devices.

- **Advanced composite materials and structures**

HITSA scientists have also made breakthroughs on advanced composite materials and structures, particularly ones that benefit the Chinese aerospace industry and industries in other countries. As examples, scientists from this lab developed the thermal protection composite materials for China's Long March-5 carrier rocket; an in-flight measuring sensor for the reentry capsule of spacecraft; an inflated deployable discrete reinforced membrane boom for satellite attitude control; and the world's first orbital test of an actively-deployed flexible solar array based on shape memory polymer composites, and promoted their application in space. ■



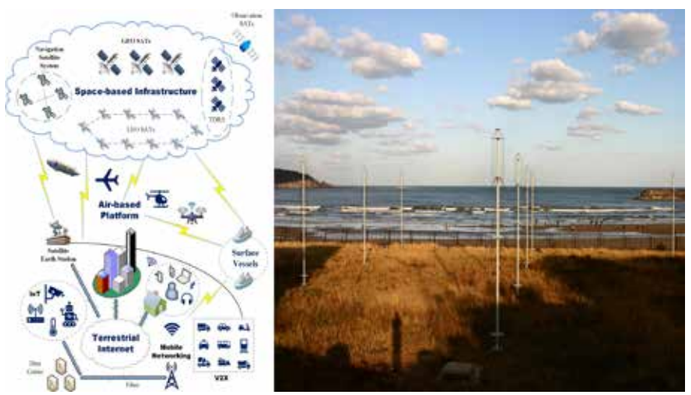
SCHOOL OF ELECTRONICS AND INFORMATION ENGINEERING

Originating from the Department of Radio Engineering in 1959, HIT's School of Electronics and Information Engineering (SEIE) is a leader in research and education ranging from communications engineering, electronics and information engineering, and remote sensing, to electromagnetic field and wireless technologies. The discipline of Information and Communication Engineering was evaluated as an A- in the 4th round of disciplines evaluation by the Ministry of Education in 2016. SEIE has 6 key laboratories of the ministerial and provincial level and has participated in several 2011 Ministry of Education Collaborative Innovation Centers. Combining the international academic frontier with the national major strategic needs, it has formed a number of disciplines with distinctive national economic and aerospace characteristics.

SEIE has always adhered to the fundamental task of cultivating talents by virtue as the central position. It has established a "Research-Oriented, Personalized and Elitism" innovative talent training system and a project-driven innovative talent training mode. Student thesis topics rely on major scientific research projects, with outstanding talent training. A large number of students have graduated from the school. By 2020, SEIE has trained more than 8,300 undergraduates, 3,200 masters and 520 PhD students. They have grown into leading engineering talents in many industrial and information fields, playing essential roles in different positions.

Led by Professor Liu Yongtan, an academician of Chinese Academy of Sciences and Engineering, and a famous radar and signal processing expert, SEIE researchers have been exploring ocean oriented remote monitoring theory and technologies for more than 40 years. Their efforts have led to a new type radar capable of detecting targets at very long ranges for remote ocean surface and vast areas under all weather conditions and at all times. For his outstanding contribution, Professor Liu won the State Top Science and Technology Award. In addition, researchers are working on miniaturized, multi-band and multi-scene new type radar systems.

Another SEIE breakthrough, led by Professor Zhang Naitong, an academician of Chinese Academy of Engineering, is in wireless communications, with a system demonstrating excellent maneuverability and rapid response capacity for data transmission. SEIE researchers have also developed China's first trunked dedicated communication system, for professional users. They are also focusing on mobile communications theory, 5G and beyond, space and satellite communications, localization and navigation. Now, they are exploring innovative communication systems for space-air-ground integrated networks and physical layer security technologies.

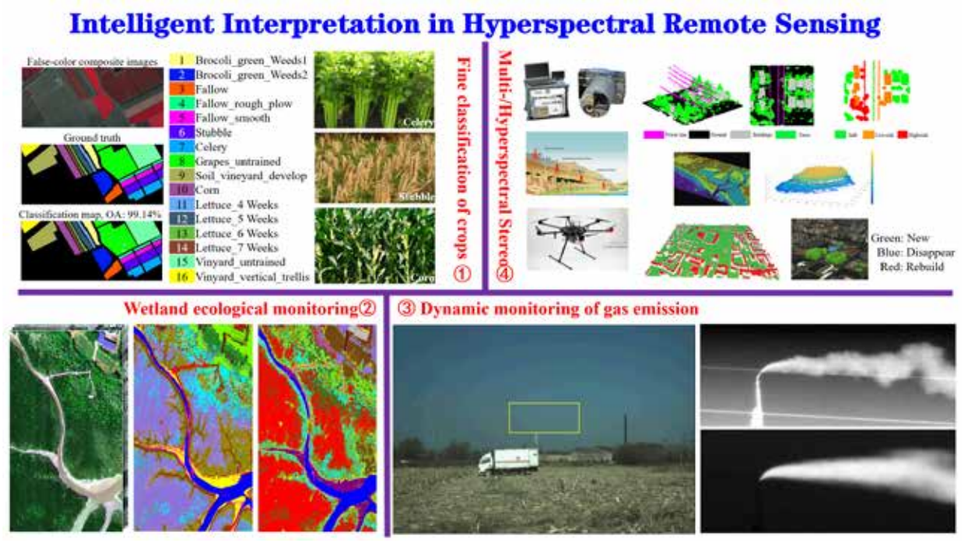


Space-air-ground integrated networks and antenna array

SEIE has been well developing new theories and series techniques for hyperspectral remote sensing image processing and intelligent interpretation of space information sensing in recent years. Key scientific issues include spectral uncertainty, multimodal heterogeneity, and high-order nonlinearity which seriously reduce the original ability of hyperspectral imaging to fine interpretation. This achievement was supported by the key international-cooperation projects funded by the Natural Science Foundation of China and received the first prize of the Natural Science Foundation of Heilongjiang Province. This research was evaluated as an "original achievement" by top international scholars.

SEIE adheres to the principles of international education, with more than 80 international students studying at school, and maintains academic collaboration with universities and scientific research institutes in over 30 countries and regions worldwide. More than 20 faculty hold important positions in international organizations and on editorial boards at various important international journals.

SEIE is forging ahead for the construction of world-class universities and disciplines. ■



Intelligent Interpretation in Hyperspectral Remote Sensing

Movement and transfer mechanisms of China's Yutu lunar rover

SCHOOL OF MECHATRONICS ENGINEERING

The School of Mechatronics Engineering (SME) has evolved along with the 100-year development of Harbin Institute of Technology, and it is a leading institution in mechanical engineering. Since 1920, SME has produced many valued researchers and graduates whose industry contributions range from aerospace and aviation to automobile and energy. SME has carried out engineering distinctive research work on robots and mechatronics, mechanical design theory and methods, ultraprecision and micro/nano manufacture, which provide a number of key technologies and equipment for national major projects such as “Manned spaceflight”, “Deep space exploration” and “Inertial confinement fusion”, etc. SME has made a series of important breakthroughs.

As early as 1985, Cai Hegao, an academician of the Chinese Academy of Engineering, and his team developed Huayu-1 robot, the first industrial robot in China. He also established the State Key Laboratory of Robotics and Systems and carried out research on space robots, micro/nano robots, special robots, and so on. In 2013, Cai's team successfully developed the first space robot in China, and the technical achievements were successfully applied to the SY-7 satellite and the TG-2 space laboratory. Currently, the team is carrying out the research on the manipulator system of the experimental cabin of the Chinese Space Station.

Deng Zongquan, an academician of Chinese Academy of Engineering, and his team are devoted to the research on the design theory and method of the planetary rover mobility system. They construct the atlas database of suspension configuration with the functions of terrain adaptation and multi-wheel independent drive, establish the terramechanics model for wheel-terrain of slip and subsidence, and solve the challenge of obstacle-surmount and anti-subsidence for a planetary rover. The configurations of the six-wheeled rocker suspension and mesh wheel, as well as the pendulum-linkage invented by them was applied by the Chinese lunar rover. The original configuration of the active-passive composite mobility system and bidirectional-extension transfer mechanisms was proposed and used by the Chinese Mars rover.

The equipment on high-powered laser systems for Inertial Confinement Fusion (ICF) is another major research project in SME, and is also the core equipment for high-energy-density physics. In order to make the particulate cleanliness inside the optics assembly better than level 50, and for the optics to survive extremely powerful laser pulses without being damaged, the group developed a series of ultra-precision machine tools for machining nano precision optical surfaces. Now, the team is exploiting the ultra-cleanliness method to develop one highly precise optics assembly for the laser systems. These provide a strong foundation for breakthrough opportunities in ICF. ■

The HIT/DLR Dexterous Hand II, jointly developed by HIT and the German Aerospace Center (DLR)

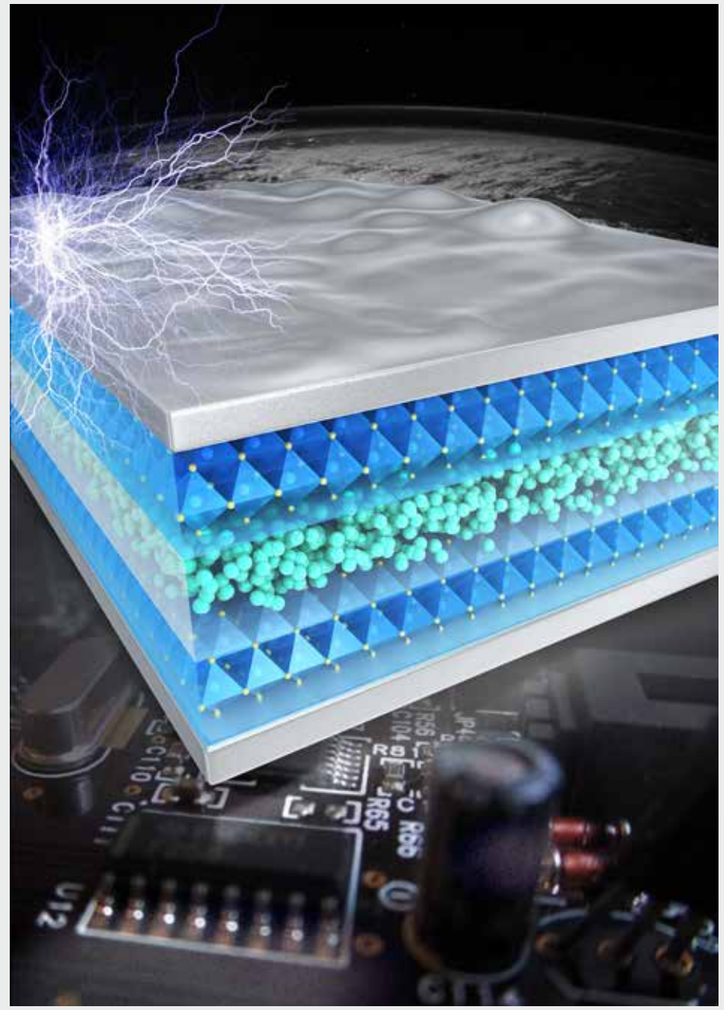
SCHOOL OF MATERIALS SCIENCE AND ENGINEERING

The School of Materials Science and Engineering (SMSE) is a leading institution in metallic materials. Since its founding in 1952, it has produced many valued researchers whose industry contributions range from aerospace and aviation to automobile and communications. According to the Essential Science Indicators (ESI) database, HIT's Materials Science discipline ranks in the top 1% globally.

Home to three national key laboratories on advanced welding and joining technology, precision hot processing of metals, and space environmental materials behaviour and evaluation technology, SMSE has established a comprehensive research programme linking materials design, performance evaluation, process optimization, and equipment development. Focusing on high-performance structural materials, functional materials, composite materials, space materials and their evaluation, it has made a series of important breakthroughs.

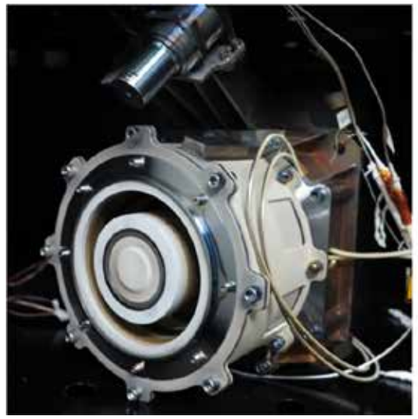
SMSE researchers have made breakthrough results which include high quality welding of new generation rocket engine chamber, large thin-walled shells aluminium alloys welding which was applied to the Tiangong series space station, and laser welding of the large aircraft sidewall of the C919. The team also conduced the foreseeing research including electron beam welding of pure niobium for the superconducting accelerator, micro-joining and nano-joining in the area of electronic packaging and nano-ink printing of flexible electronic devices.

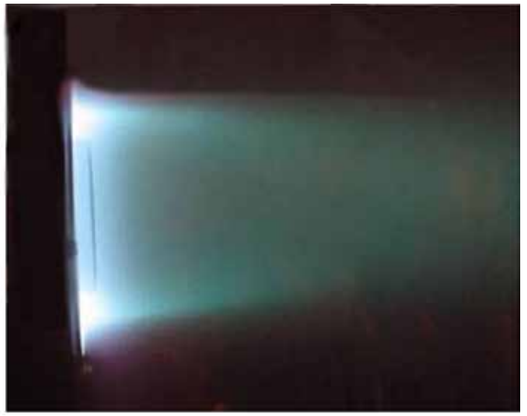
Another SMSE team has prepared metal and ceramic matrix composites with controlled microstructures, stable performance, short processing cycles and are inexpensive to make. A novel antenna-window cover plate and other structures were developed from these composites, which could also have applications in aircrafts and spacecrafts.



Energy storage using opposite double-heterojunction ferroelectricity

SMSE researchers have also made achievements in novel technologies such as high pressure fluid forming, precision micro forming and hot medium pressure forming, etc. The development of numerical control equipment plays a key role in the manufacturing of high reliability thin-walled parts for the Long March rockets and the mass production of automotive safety components and precision parts for electronic products. ■





Magnetic focusing Hall thruster developed by HPPL

SCHOOL OF ENERGY SCIENCE AND ENGINEERING

The School of Energy Science and Engineering grew out of the Department of Power Engineering, which formed in 1954. Three disciplines are available for undergraduate students: Thermal and Power Engineering, Flight Vehicle Power Engineering and Nuclear Reactor Engineering. Focusing on the international frontier of energy science and also the country-oriented major strategic needs, a series of research direction is gradually constructed, such as the clean thermal conversion of energy, advanced energy and system control, flow control coupled with thermal/solid/acoustic in turbo-machinery, infrared thermal radiation characteristics and transmission, and energy storage science.

The HIT Plasma Propulsion Lab (HPPL), led by a Distinguished Professor Yu Daren, focuses on promoting theoretical and technical research on Hall thrusters. An important breakthrough of a magnetic focusing Hall thruster is achieved by controlling the electron conduction and ion acceleration using a specially designed magnetic field. The plume divergence half-angle of this thruster is reduced to 15°, and thus the thruster performance (specific impulse and efficiency) is largely enhanced. This thruster was mounted on a geosynchronous satellite (launched on

Professor Tan Heping and his team are committed to the study of thermal radiation

November 3, 2016) and was successfully operated. This technology won the National Scientific and Technological Progress Award of China in January, 2020.

Professor Tan Heping is one of the leaders in the thermal radiation field of China. In order to solve the difficulty in verifying numerical solutions of radiative transfer, Professor Tan's team systematically developed analytical and numerical methods for radiative transfer and expanded new directions of computational thermal radiation. Aiming at the bottlenecks in space-based optical detection, such as detection, identification and threat assessment of weak target signals under complex backgrounds and strong interference, they pioneered interdisciplinary research directions of thermal radiation and space-based optical inspection. They also carried out research on common fundamental scientific issues, including the acquisition of high-temperature radiation properties and regulation of thermal radiation. By providing basic parameters, analysis methods, software, and technical solutions, their research results have been applied in many engineering fields of aerospace. ■

SCHOOL OF ELECTRICAL ENGINEERING & AUTOMATION

The School of Electrical Engineering & Automation (SEEA) originated from the Department of Electrical & Mechanical at the beginning of the establishment of Harbin Institute of Technology. It was also one of the earliest electrical engineering departments in China. Due to the major national needs and the international academic frontiers in aerospace, high-end manufacturing, transportation, clean energy and other fields, the SEEA has formed a research system combining basic research and engineering application in the fields of electrical machines and apparatus, power electronics and power drives, electric power system and its automation, electrical engineering theory and new technology, etc. It has built a national research center and talent-recruiting base for micro and special electrical machine engineering technology and for the international advanced electric power drive technology. It has become the cradle of cultivating top-notch innovative talents leading the future technology and industrial development in the field of electrical engineering. In addition, it has also become an important national level resource of R&D of electric drives in extreme environments, high-precision servo, and highly reliable electric apparatus, which has strongly supported China's manned space development and national major infrastructure construction. In the future, the school will aim at "intelligent manufacturing", "smart energy" and "smart city," and make greater contributions to human society through the cross integration of energy science, information science, material science, life sciences, etc.

SEEA is particularly known for its research on electric drives in extreme environments. By improving design methods of electrical machines and control technologies of drives, SEEA researchers have developed special electrical machine systems with high precision, a large speed range, and high resistance to extreme environments. The electrical machine systems have been used in manned spaceflight, deep-space, deep-sea, and deep-Earth explorations, high-end computer numerical control (CNC) machines, and industrial robots, leading the rapid and healthy development of the domestic electrical machine system industry and winning the 2nd prize of the National Technological Invention Award. ■

The special electrical machines for extreme environments (2nd prize of the National Technology Invention Award)

Loose particles auto-detecting system for highly reliable products (2nd prize of the National Scientific and Technological Progress Award)

SCHOOL OF INSTRUMENTATION SCIENCE AND ENGINEERING

Professor Tan Jiubin, academician of CAE and the academic leader of SISE

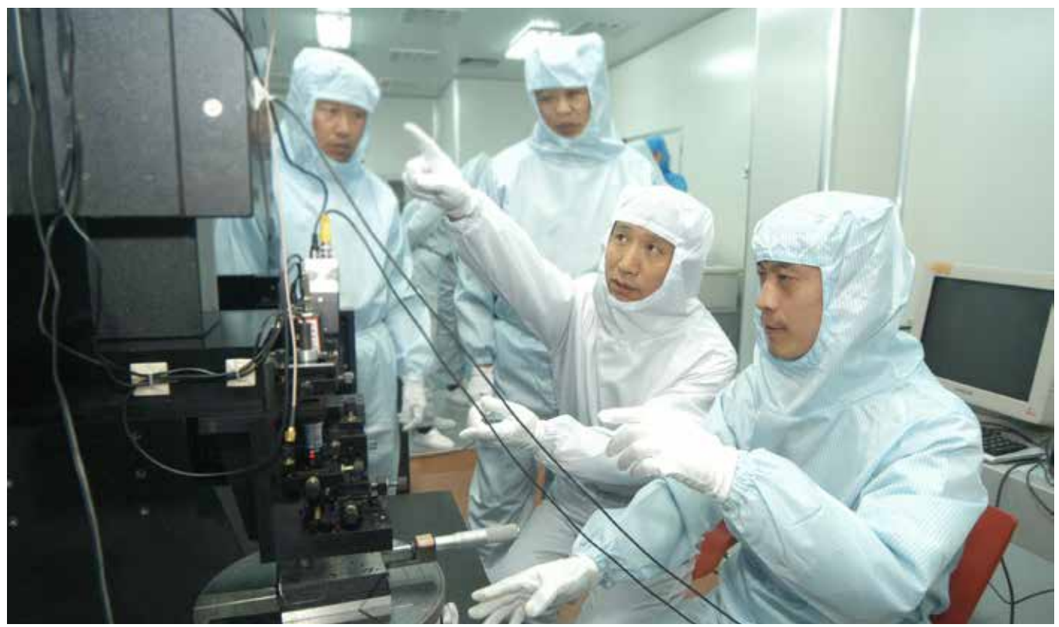
As one of the earliest Chinese subjects dedicated to instrumentation, the subject of precision instruments in the School of Instrumentation Science and Engineering (SISE) of Harbin Institute of Technology (HIT) was founded in 1952. It is also one of the disciplines with the largest scale and the strongest overall strength in China. Currently, it has three specialties for undergraduates: Precision Instruments, Measurement & Control Technology and Instruments, and IntelliSense Engineering.

Led by Professor Tan Jiubin, an academician of the Chinese Academy of Engineering (CAE), it is oriented to broad fields related to the manufacturing of high-grade, precision and advanced equipment, large-scale scientific projects and precision medicine, and is pledged to the research and development of ultra-precision measurement methods and instrument technology, remote ultra-high-resolution laser measurement technology, label-free non-invasive microscopy methods and instrument technology, etc. It has developed a series of instruments based on new principles to solve key measuring problems in the above mentioned fields. In recent years, SISE has authorized more than 550 invention patents at home and abroad, established more than 30 international standards, national standards and industry standards, published more than 1,200 high-level academic papers, and won more than 60 national and provincial major scientific and technological achievement awards represented by the first prize of National Technological Invention Award. In ShanghaiRanking's Global Ranking of Academic Subjects, it ranked at the top from 2017 to 2019.

SISE is an open and international school and it has established a long-term and substantive exchange and cooperation relationship with a number of international first-class academic institutions, such as the University of Oxford, Physikalisch-Technische Bundesanstal (PTB), and the National Physical Laboratory (NPL). With the help of the international high-end instrument forum of CAE and the series international symposiums on precision engineering measurement and instrument, the SISE holds a large-scale international conference once a year, and over 200 famous experts and scholars come from all over the world every year to discuss and exchange ideas about new problems, new technologies and new trends faced by the international front measurement and instrument field. This series of conferences has become one of the top international conferences in the field of measurement and instrumentation.

In the direction of ultra-precision measurement methods and instrument technology, it proposed an error-separation method to eliminate the theoretical errors of instruments and successfully developed a cylindrical measurement standard instrument based on new principles. After the testing and comparison with the measurement standard instruments of international authoritative laboratories, it is in the leading position in accuracy around the world and makes such measurement values accurate and consistent across the country. In the direction of remote ultra-high-resolution laser measurement technology, it proposed an active collaborative detection method with a spatial displacement resolution of 1 nm and power saving of more than 630 times, providing new technologies for future scientific experiments in space. In the direction of non-invasive microscopy methods and instrument technology, it presented a confocal optical and ultrasonic harmonic generation microscopy method, which enables the super-resolution and noninvasive imaging of 3D living cells and deep tissues, providing powerful tools for biomedical research and medical diagnostics. It solves a major problem in the field of modern biomedical imaging.

The scholars of SISE take the opportunity of quantization of basic units in SI, closely integrate digitalization, networking, intellectualization and precision, and make use of the most advanced achievements in modern photonics, electronics, acoustics, materials, precision mechanics, dynamics, control, etc. to continuously invent new principle instruments, and support the high-quality development of high-end equipment manufacturing, large scale scientific engineering and precision medicine. ■



Professor Tan working with his team members in laboratory

The 3rd Lilac International Conference on Application of Statistics finished successfully in 2019

Message from HIT
HIT TIMES 2020

Professor BảoChâu Ngô, winner of Fields Medal in 2010, visited our school

SCHOOL OF MATHEMATICS

The School of Mathematics, previously known as the Department of Mathematics, is always open to the whole world using the language of math. Based on pure mathematics, we are also concerned with applied mathematics, computational mathematics and statistics. There are 91 faculty members in our school, including a winner of the National Science Foundation for Distinguished Young Scholars, a winner of the Heilongjiang Science Foundation for Distinguished Young Scholars. They are all active in various fields, including functional analysis and applications, algebra, number theory, combination, topology, ordinary differential equations and dynamical systems, geometrical analysis, partial differential equations and harmonic analysis, science and engineering calculations, physical geography, inverse problem and applications, operational control and optimization, probability theory, as well as statistics. With the efforts of all faculty and staff, our subject of mathematics came to be the 101st-150th in QS World University Ranking and the 76th of the world ranking for the major of mathematics announced by the *U.S. News & World Report*. Our subject of mathematics got an A- and statistics got a B in the fourth subject evaluation by the Ministry of Education.

In pure mathematics, according to the development of the theory of the geometry of Orlicz spaces, led by Professor Wu Congxin, the department was one of research centers of Orlicz spaces. Based on space theory, Professor Fu Yongqiang developed a new method to prove the existence of solutions to variable exponent Laplace equations which was cited more than 40 times by mathematicians and is now called the method of space division. The pseudo almost periodic functions defined by Professor Zhang Chuanyi have been playing an important role in many fields and were regarded as a crucial achievement after Eberlein introduced the weak almost periodic functions. His first three articles and book published in 2003 on this subject have been cited more than 500 times. Two articles of Professor Wei Junjie and his coauthors about the distribution of the roots for exponential polynomials have been cited as a lemma more than 150 times and 100 times respectively.

In applied and computational mathematics, there are first scholars who have studied inverse problems in our school. Their results have dealt with seismic line of more than 100,000 kilometers in the Daqing oil field. Professor Ma Jianwei, a winner of the National Science Foundation for Distinguished Young Scholars, won the CGS Technology Innovation Awards (2nd prize) in 2018 and the Natural Science Award of Heilongjiang Province (1st prize) in 2019 due to his contribution in physical geography.

In recent years, our young faculty are playing a more and more central role in many fields: in pure mathematics, such as number theory, analysis, algebra and geometry; in applied and computational mathematics, such as seismic study, machine learning, picture processing and numerical method of differential equations; as well as in statistics, such as financial statistics, big data, biostatistics, industrial statistics and quantum statistics.

The School of Mathematics is a place where you can feel the miracle of mathematics, where you can translate amazing mathematical theory into real life and where you can explore secrets from lots of data. We welcome mathematicians and students in all fields to join us and to be part of our family since we are using the language of the world, mathematics. ■

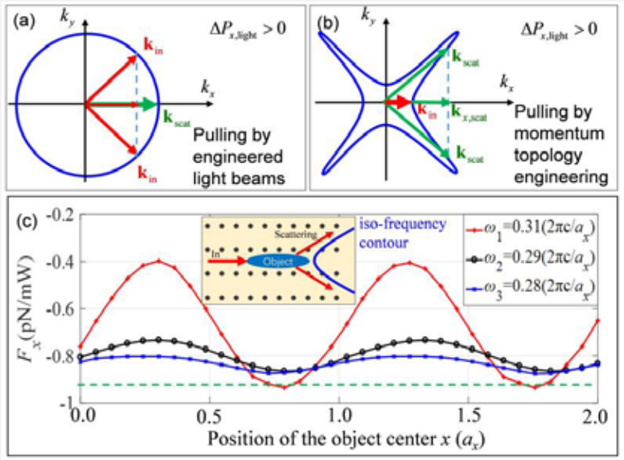
SCHOOL OF PHYSICS

The School of Physics has four key research areas: optics, condensed matter physics, particle and nuclear physics, and plasma physics. Optics is one of the state key disciplines equipped within the Ministry of Industry and Information Technology (MIIT) key laboratories and Heilongjiang provincial key laboratories. While simultaneously promoting basic and interdisciplinary scientific research, the School of Physics carries out researches in micro-nano optical regulation and application, photoelectric functional materials, quantum detection, plasma, and particle physics. The school undertook one major project of the 973 Program, and led the planning and construction of three areas of the Space Environment Ground Simulation Infrastructure of the National Big Science Project, including atomic molecular physics, space particle radiation, and plasma environment research. Under the guidance of the academicians of the Chinese Academy of Engineering (CAE), Dr. Lv Yueguang and Dr. Gu Min, our school has made great progress with high-quality research achievements over recent years. In the past five years, more than 600 SCI papers have been published in high-impact peer-reviewed journals including *Physical Review Letters*, the *Science* family of journals, the *Nature* family of journals, *Advanced Materials, Light*, and *Physical Review Journals*. Our discipline is listed among top 1% of the global ESI list in 2011, ranked 12th by the Ministry of Education, and ranked B^+ in the national discipline assessment 2016.

The School of Physics attaches great importance to building a strong faculty team and supporting students' learning and research. There is a National Experimental Teaching Demonstration Center for applied physics, an MIIT and Provincial College Physics Experimental Demonstration Center, and a Provincial Virtual Experimental Teaching Center. The MIIS Research Teaching Innovation Team and Heilongjiang Provincial Physics Teaching and Research Team provide faculty with teacher training and rich resources. Many instructors have won awards in national teaching competitions; one of them won the first place in the National Junior Faculty Teaching Competition in physics. Our undergraduate team participated in the China Undergraduate Physics Tournament (CUPT) and won the National Special Award for six consecutive years from 2014 to 2019 and were national champions for four of those years. The undergraduate team won the Special Award of the 2019 National Material Design Invitational Tournament. The Youth League Branch of class 1311101 was awarded as the National Demonstration Youth League Branch, and Feng Hanqi won the National Top 100 Youth League Secretary.

The School of Physics values opening up and international communication. The Sino-Russia Joint Research Center for Plasma Physics and Application is established, and the Sino-Russia Joint Campus project is currently under construction. Currently, there are two foreign chief academic advisors, two special lecturers, and two foreign instructors.

The School of Physics will continue to develop upon its existing key areas with a focus on interdisciplinary research and innovation and the construction of basic infrastructure. By actively training and bringing in talented junior faculty, it is advancing the scientific and technological research and fostering innovative students in an open and inclusive environment. ■



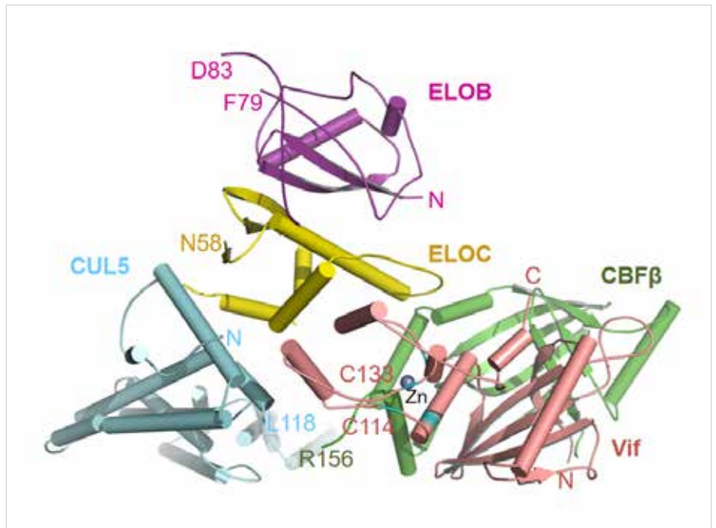
Principle illustration (a, b), and results (c) of the momentum-topology-induced optical pulling force in an engineered photonic crystal structure

SCHOOL OF LIFE SCIENCE AND TECHNOLOGY

School of Life Science and Technology (SLST), founded in 2011, is a newly established college at Harbin Institute of Technology (HIT) aiming at training future leading talents in interdisciplinary sciences. SLST has two first-class doctoral degree disciplines (Biomedical Engineering and Biology). According to 2019 and 2020 U.S. News & World Report Rankings of the Best Global Universities, HIT's Biology and Biochemistry was ranked in the top ten in China. Witnessing a comprehensive reform and innovation in its system and mechanism of integrating scientific research and talent training, the HIT Center for Life Sciences (HCLS) was founded in 2016. At SLST and HCLS, researchers have gained outstanding achievements in various biological disciplines.

Revealing the molecular mechanism of HIV

The human immunodeficiency virus (HIV)-1 protein Vif subverts the antiviral activity of human viral restriction factors by hijacking cellular proteasomal degradation pathway. A team led by Professor Huang Zhiwei has determined a crystal structure of the Vif-CBFβ-CUL5-ELOB-ELOC complex for the first time, which reveals the structural basis for Vif hijacking of CBFβ and CUL5 E3 ligase complex, laying a foundation for the rational design of novel anti-HIV drugs. This discovery is of great scientific significance and provides the structural basis for developing novel anti-HIV drugs.

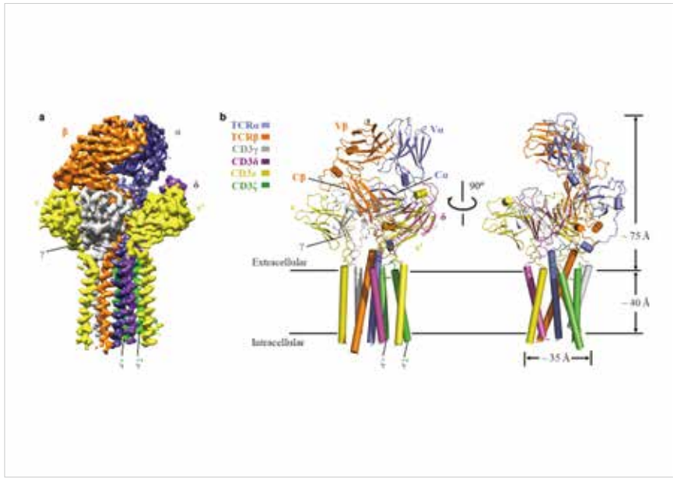


Overall structure of Vif-CBFβ-CUL5-ELOB-ELOC complex

Unveiling of the assembly of human T cell receptor apparatus

T cells are a critical component of the vertebrate adaptive immune system. T cells mediate immune responses involving recognition of antigen peptides bound to major histocompatibility complex (pMHC) through TCRs. The TCR–CD3 complex is formed through noncovalent association of TCR with a CD3 signaling apparatus consisting of the γ, δ, ε and ζ subunits.

Professor Huang's team has determined a high-resolution cryo-EM structure of the human TCR–CD3 complex containing eight subunits, which reveals the structural basis for the TCR–CD3 complex assembly, providing clues to TCR triggering and a foundation for the rational design of immunotherapies that target the complex. This work greatly enhances our understanding of the "triggering" mechanism, which allows T cells to recognize and respond to aberrant peptide antigens by elucidating the first structure of the membrane assembly between a clonotypic T cell receptor and its CD3 co-receptor.

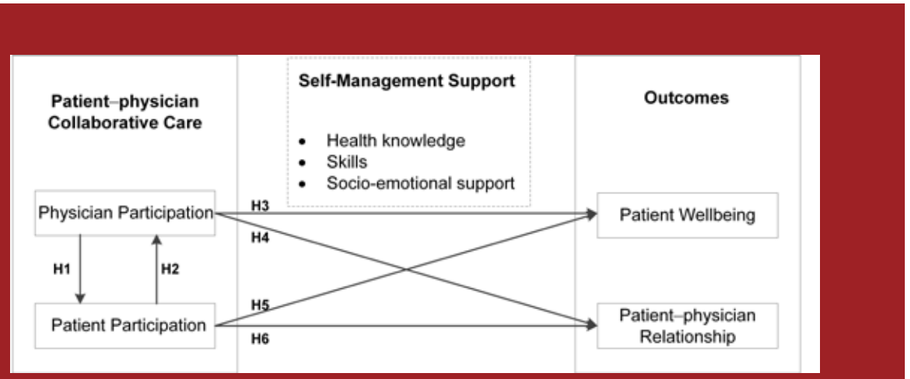


3D reconstruction and atomic model of the human TCR-CD3 complex

First special academic zone of HIT

As the first special academic zone of HIT, HCLS is empowered by unparalleled freedom in research, graduate programs, personnel employment and financial flexibility within the university. HCLS recruits outstanding young scientists from all over the world, and provides an internationally competitive start-up package. HCLS has state-of-the-art core facilities including cryo-electron microscopy, imaging, mass spectrometry, antibody platforms and SPF animal room.

HCLS is committed to being a world-class fundamental life science research institution in China. HCLS is delighted to welcome talented and ambitious young PIs to join us to enjoy exciting scientific discoveries.



Theoretical Framework- the Role of ICT in Chronic Disease Management (Liu, Liu & Guo, MISQ, 2020)

SCHOOL OF MANAGEMENT

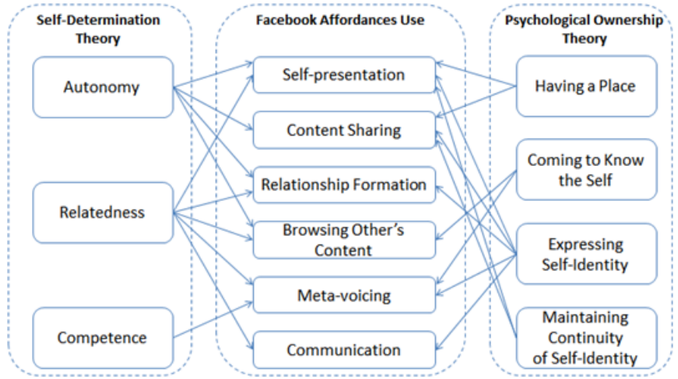
The school of Management is one of the leading business schools in China and Asia, with a global reputation for its research and educational programs. A series of outstanding research results have been achieved in big data and business analytics, e-health, social science, etc. and published in top journals like *MIS Quarterly, Information Systems Research, Journal of Management Information System, INFORMS Journal on Computing, Nature Human Behavior*, etc. In addition, more than twenty major domestic and international awards have been won in the latest 5 years.

Using a difference-in-difference-in-differences framework and matched hotels across two large travel agencies, Professor Ye Qiang's team found that managerial responses have a significant and positive impact on the volume of subsequent customer reviews. The impact on the review valence is not evident, which can be attributed to the unique design of identity disclosure in their research context. The results offer managerial implications to service providers on how to improve customer engagement in the interconnected online environment. Zhang Nan coauthored with Karahanna Elena, Xu Xin, and Xu Yan developed a needs–affordances–features (NAF) perspective on social media use which posits that individuals' psychological needs motivate their use of social media applications to the extent to which these applications provide affordances that satisfy these needs. The theory has implications for social media research and technology acceptance research. It provides a new lens and common vocabulary for future studies.

The eHealth team addresses societal challenges rising from demographic changes with emerging technologies. Guo Xitong et al. have done a series of research focuses on eHealth with special interests in healthcare data enabled service management for citizens' wellness. They have found that physician-driven ICT usage facilitates patient-physician collaborative care and patient self-management support, which may improve chronic disease patient wellbeing and patient-physician relationships. They have also extended the social exchange theory into the professional domain and built a professional capital exchange model to understand the motivation of doctors to participate in ICT supported services provision and value co-creation. Moreover, they have investigated physicians' online-offline behavior dynamics and advocated for the social value of online healthcare platforms.

Wu Hang coauthored with Camerer et al. conducting a worldwide scientific collaboration project, aiming to provide much needed evidence and insight about the replicability of social science experiments. The team replicated 21 experimental studies published between 2010 and 2015 in the two most prestigious general science journals, *Nature* and *Science*. The study finds a significant effect in the same direction as the original study for 62% of the studies and the effect size of the replications is on average about 50% of the original effect size. In addition, the study finds that peer beliefs of replicability are strongly related to replicability, suggesting that the research community could predict which results would replicate and that failures to replicate were not the result of chance alone.

Xia Hao et al. propose a combinatorial optimization scheme that reconstructs a system of roles to reduce the cost of role management. The role-refinement problem is shown to be a novel generalization of the classical set-cover problem and thus strongly NP-hard. Two polynomial-time approximation algorithms are provided with their performance guarantees established. This project was inspired by the business need of a major service provider of SAP security and its CEO has incorporated the project's solution in their products.



NAF Model for Facebook Affordances Use (Karahanna, Xu, Xu, and Zhang, MISQ, 2018)

SCHOOL OF HUMANITIES, SOCIAL SCIENCES AND LAW

The School of Humanities, Social Sciences and Law (SHSCL) is the largest liberal arts academic community among the engineering disciplines at the campus. It is focusing the "new liberal arts" to research different humanities scenes. With the fields of law, economics, literature, art, and other humanities and social sciences, SHSCL provides the ideal of "interdisciplinary" research.

Connecting with the original modern academic heritage of Harbin since 1920, SHSCL has made historical achievements in the development of Humanities and Social Sciences, such as natural dialectics, human history of science and technology, network sociology, outer space law, cyberspace security law, etc., and now it has developed into four major academic categories, including economics, law (including sociology), Chinese language and literature, and art with bachelors, master and doctoral levels degrees, including:

- Two doctoral programs in sociology and international economic law and social governance (global compliance direction);
- Five master's programs in sociology, theoretical economics (political economy, world economy), applied economics (international trade), law (international law, civil and commercial law, criminal law and jurisprudence) and social work;
- Three kinds of four-year undergraduate programs, a three-year double degree program and two-year cross supplementary undergraduate program, in the disciplines of law, sociology, economics, Chinese language and literature (only recruiting foreign students).

SHSCL is one of the most global and internationalized colleges in HIT. It not only has hundreds of foreign students, but also has established scientific research cooperation and teaching exchange mechanism with dozens of universities abroad. SHSCL consists of the Department of Sociology, the Department of Economics, the Department of Law, the Department of Chinese Language and Literature, and the Art Education Center, with more than 10 specialized research institutions, four laboratories and two library centers.

Accompanied by the academic frontier of science and engineering, SHSCL is waiting for you to come. ■

SCHOOL OF MARXISM

Since its establishment in 2011, the School of Marxism has always adhered to the educational policy of CPC, and has conscientiously implemented the spirit of the national conference on ideological and political work, the national education conference and the ideological and political theory teacher forum, and has made rapid development in teaching, scientific research and other aspects. At present, there are 72 full-time teachers in the School of Marxism at all three campuses, as well as two first-class discipline postgraduate programs of Marxist Theory and Philosophy, and a doctoral training direction of Marxist Sociology (Marxist Theory and Social Practice).

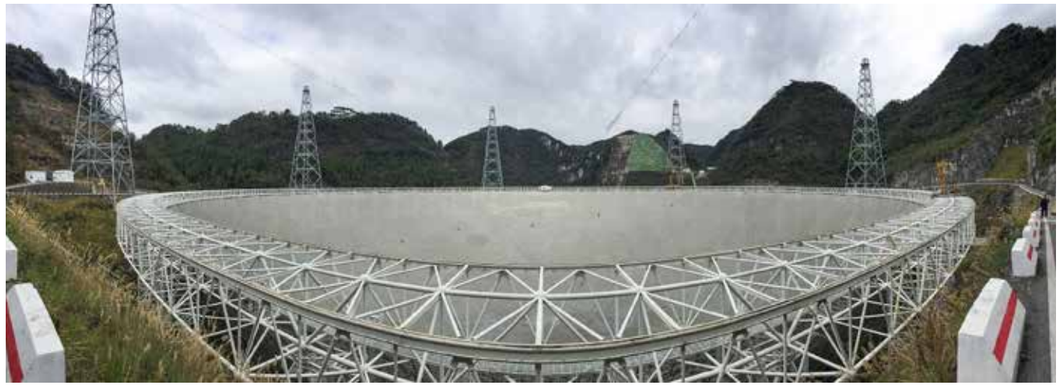
As the dean of the School of Marxism, Xu Fengzhen has played her role as a leader, bringing out a team of ideological and political theory teachers with higher teaching level and the stronger scientific research ability. These include one cultural expert and "four first batch" talent in the Publicity Department of the CPC (Xu Fengzhen), one advanced individual in theoretical propaganda at the grassroots level (Xu Fengzhen), one influential pacesetter of ideological and political teachers in national colleges and universities (Xu Fengzhen), two experts in communication evaluation of the National Philosophy and Social Sciences Project (Xie Yongmei and Liu Zheng), two experts in communication evaluation of the Philosophy and Social Sciences Project of the Ministry of Education (Xie Yongmei and Liu Zheng), one expert in the "Chief Expert of Marxist Theoretical Research and Construction Engineering" of the Ministry of Education (Peng Gang), one evaluation expert of the undergraduate teaching of the Ministry of Education (Peng Gang), one nominee (Gong Rumin), three teaching pacesetters of ideological and political courses in colleges and universities (Xu Feng Zhen, Wu Weiwei and Gong Rumin), one teaching backbone (Zhao Ailun), five specially appointed communication review experts for academic dissertations of the Ministry of Education (Xu Fengzhen, Wu Weiwei, Huang Jinhua, Liu Zheng and Wu Yongzhong), one education and training expert of colleges and Universities under the Ministry of Industry and Information Technology (Gong Rumin), and one national high-level expert of China Education Press of the Ministry of Education (Huang Jinhua).

This team inherited the spirit of "800 Heroes" at HIT, carrying forward a fine tradition and paying attention to ideological and political theory teaching and Marxism studies. It sticks to the main position of ideological and political course in the university, and implements the requirements of General Secretary Xi Jinping's "six requirements" for ideological and political teachers, and builds up the ideas and beliefs of young students with socialism with Xi Jinping Thought on socialism with Chinese characteristics for the new era, promoting them with firm belief. It is always adhering to the position of the nation and the people, inspiring young students with a sense of family and country; mastering the Marxist ideological method, enlightening young students with dialectical thinking; expanding horizons, guiding young students with vision and knowledge; promoting the main theme consciously, leading young students with upward energy; acting as the role model consciously for learning and conduct oneself, and influencing young students with noble sentiments. It has actively carried out research on teaching reform, presided over more than 50 projects, published more than 40 papers, published more than 20 books, and won more than 60 awards.

At the same time, the teachers have actively carried out academic research, and it is in the basic principles of Marxism, the Sinicization of Marxism, ideological and political education, basic issues of modern Chinese history, dialectics of nature and ideological and political theory teaching reform and innovation, especially in the field of Xi Jinping Thought on socialism with Chinese characteristics for a new era. We have achieved outstanding academic achievements in various fields such as the study of socialist ideology with distinctive characteristics, and have made remarkable achievements: since 2015, we have presided over 14 projects of the National Social Science Foundation (such as one major projects of the NSSF by Ye Ping), one key project supported by the National Publishing Fund (Huang Jinhua), one project supported by cultural experts of the Publicity Department of the CPC and the self-selected funding projects of the "four batch" talents (Xu Fengzhen), one special project of the Ministry of Education of Marxist Theoretical Research and Construction Engineering (Peng Gang), one major project of the Ministry of Education of Humanities and Social Sciences Base of the European Research Base (Peng Gang), and one special project of the Marxist Theory Research and Development Project of the Ministry of Education. Moreover, there are 47 important academic papers published in journals and newspapers, such as *Marxism Research, Philosophy Research, People's Daily, Guangming Daily*, 21 works in state-level publishing houses, and more than 30 awards.

Professor Xu Fengzhen

Due to its remarkable achievements in various aspects, the School of Marxism was awarded the first batch of Key Marxist Colleges in Heilongjiang Province in 2016, and the top-grade project of “Philosophy and Social Sciences Discipline System Innovation Engineering Discipline in Heilongjiang Province" in 2018. In the future, it will use the spirit of congratulatory letter from General Secretary Xi Jinping to HIT for the centennial celebration as a guide, take advantage of the momentum, impact the first-level discipline doctoral program of Marxist Theory and the national key school of Marxism vigorously, build the school into a teaching base for excellent Marxist theoretical talent and an academic highland for launching scientific research products of Marxism, and an ideological front that leads the progress of contemporary Chinese society. ■



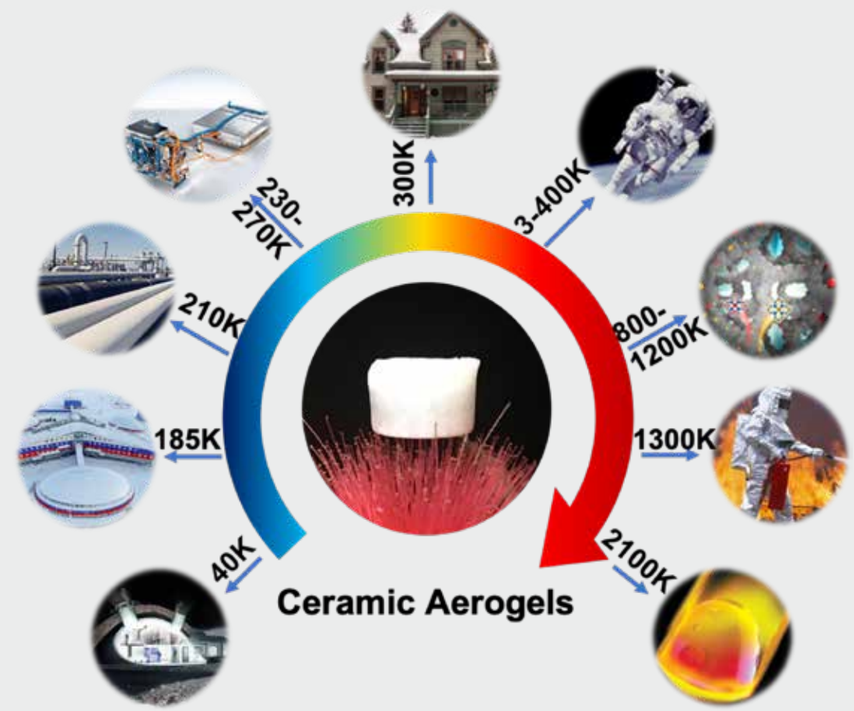
Research on support structure scheme for active reflector of Five-hundred-meter Aperture Spherical Telescope (FAST)

SCHOOL OF CIVIL ENGINEERING

Starting in the Department of Railway Construction in 1920, the School of Civil Engineering (SCE) has come a long way to become a leader in high-performance structural engineering, multi-disaster prevention and new civil engineering materials. It established China's first civil engineering program in 1950, as well as its mechanics program, and both are national key disciplines, ranking among the top two in the country and passed National Professional Certification Assessment in 1995. Both disciplines are also listed in "Double First-Class Disciplines" project. Additionally, HIT's civil engineering discipline was ranked 24th by *U.S. News & World Report* in 2019.

It has a first-class teaching team of 150 faculty members, led by four members of the Chinese Academy of Engineering .

SCE is a key contributor to the national construction industry housing advanced research platforms, including the National and Local Joint Engineering Center of Low Carbon Construction Technology in Cold Regions and the Ministry of Education Key Laboratory of Structures Dynamic Behavior and Control. Here the new generation of engineering design theory with the core of "engineering whole system life cycle optimization theory" was initiated. The theoretical system of long-span spatial structure design was constructed systematically. The group of scientists in SCE creatively proposed the



Double-negative ceramic aerogel thermal superinsulation material

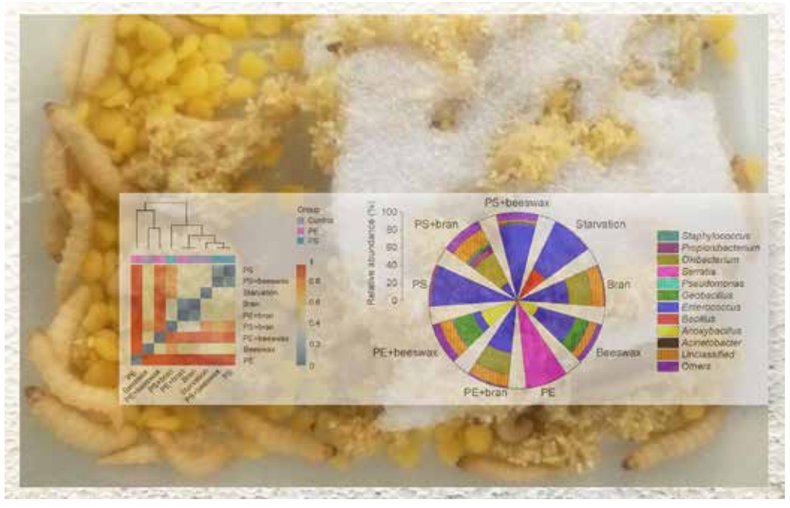
active reflector cable net system of the world's largest Five-hundred-meter Aperture Spherical Telescope (FAST), which solves the key technical problems of super long-span, ultra-high precision, active shape-changing function. The 'seismic design theory system based on behavior' was put forward to support the seismic design of thousands of important and complex projects. The research work in SCE leads the development of structural health monitoring (SHM) and vibration control and the developed SHM and vibration control techniques have been successfully applied in the Guangzhou TV Tower and the Water Cube project for 2008 Beijing Olympic Games. Scientists in the SCE developed a thermal super-insulating ceramic aerogels with double-negative-index meta-structure to solve the brittle nature, which plagued the ceramic thermal super-insulating materials for nearly a century. The work was published in the journal of *Science*.

Since 2013, SCE has been awarded the National Science and Technology Awards continuously. In 2019, it was approved as an innovative research group of the NSFC.

SCE has trained more than 30,000 graduates, many of whom go on to make a real impact in civil engineering. ■

SCHOOL OF ENVIRONMENT

The School of Environment (SE) boasts long history and splendid culture. Over the past 100 years, HIT has achieved fruitful results in discipline construction, talent cultivation, scientific research and international cooperation. Thousands of outstanding graduates have passed through its high-level faculties, including four members of the Chinese Academy of Engineering (CAE). Housing seven national research platforms for creating sustainable solutions to the world's challenges, the SE has become an important base for the cultivation of high-level innovative talent and scientific research in ecological environment. During all the rounds of discipline ranking by the Ministry of Education, HIT's Environmental Science and Engineering has entered the top list. In the fourth round of evaluation, this program received an A^+ score and Municipal Engineering, an affiliated discipline of Civil Engineering, got A score. SE is the only department that has a State Key Laboratory, National Engineering Research Center, National Engineering Laboratory, National Innovation Research Group, International Base of Innovation and Foreign Intellectual Introduction, National International Cooperation Base and National Virtual Experiment Teaching Center at the same time. SE has made remarkable achievements in the research direction of wastewater treatment and resource recovery, drinking water safety, disposal and recycling of solid waste, water chemistry and environment functional materials, air pollution control, and environmental ecotechnology.



Plastic bio-degradation by greater wax moth larvae

SE has over 100 faculty and owns a high-level educational team that composed by four members of the CAE and four winners of the National Science Foundation for Distinguished Young Scholars. It also boasts five innovative groups supported by China's Ministry of Education, the National Natural Science Foundation, the Ministry of Science and Technology, and Heilongjiang Province separately.

SE will consistently meet the need of national strategic ecological conservation as well as major national demand. It will also stand on the international scientific and technological frontiers in environmental science related areas. SE will strengthen talent cultivation featuring a firm foundation, strong practice, strict process and innovation and cultivate outstanding innovative leading talent in the field of ecological conservation. All talent we cultivate will respect natural laws and engineering ethics, and will be full of multi-dimensional knowledge, innovative thinking and international vision, communication and collaboration skills, scientific and technological innovation ability. They will solve complex engineering problems and possess lifelong learning wills as well as good moral character, persistent belief and spirit of patriotism.

A wide range of international cooperation approaches and security mechanisms have been established. SE has employed more than 50 long-term cooperation experts, including 11 adjunct doctoral supervisors. Every year about 300 teachers and students will attend international conferences for academic exchange and nearly 60 foreign famous scholars will give lectures here.

Based on the "Double First-Class Universities of China" development project, the School of Environment is striving to stand on the international academic frontier, meet national demand, strengthen discipline's advantages and characteristics, and choose our own influential disciplinary orientations. A world-class talent cultivating system will be set up and innovative human resources training modes and mechanisms will be carried out. We believe in 3 to 5 years, SE will develop its disciplines into vital bases of carrying out scientific and technological innovation, cultivating all kinds of high-level talent. SE will endeavor to build world-class environmental and engineering disciplines and provide technical support to solve global environmental problems. SE is moving forward toward a world-class school. ■

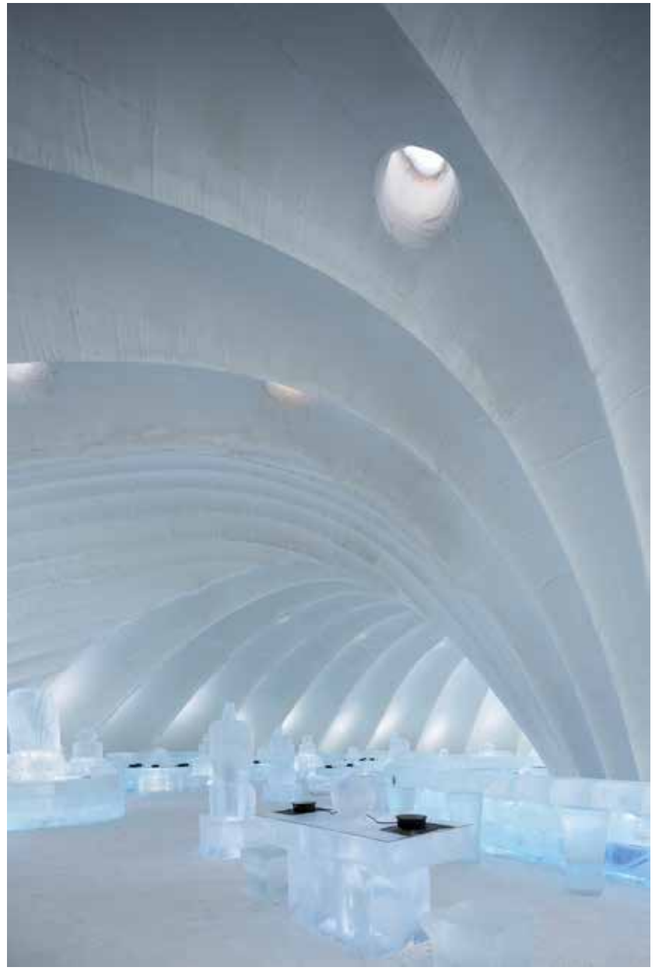
Daylight environment simulation based on artificial sky

SCHOOL OF ARCHITECTURE

The School of Architecture (SA) at Harbin Institute of Technology is one of the oldest architecture schools in China, as well as the leading institution guiding the research and education of human-environmental science. SA has comprehensive human-environmental disciplines, comprising architecture, urban and rural planning, landscape architecture, design, heating, gas supplying, ventilation engineering, etc.

As a key role in people's livelihood, the architectural industry has been playing a fundamental character in national and local economic and social development over a century. Meanwhile, it also played a driving role in cultural heritage and development. The architectural discipline at HIT began with the construction needs of the Middle East Railway (a transportation line connecting Eurasia and the Siberian Railway Spur Line), which directly promoted the construction of several towns along the line and their socio-economic development. In the past century, SA has integrated Chinese and Western architectural culture, deeply cultivated regional characteristics, closely followed the development of science and technology, explored future architecture, and achieved numerous pioneering accomplishments.

Facing global issues such as the energy crisis and environmental pollution, based on the regional characteristics of cold buildings, SA explores major basic scientific issues and key technologies in the cold building science and engineering field. As early as the 1980s, SA presided over the construction of China's first energy-saving demonstration community. Now, SA is hosting the design of the 2022 Winter Olympics Chongli Prince Town's Ice and Snow Town Project. Breakthroughs have been made in the field of Chinese cold architecture design.

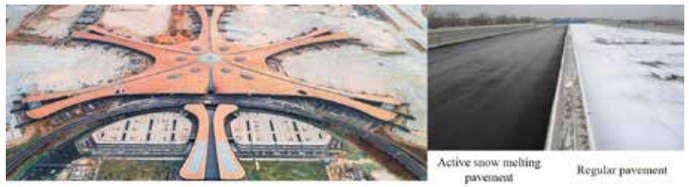

Innovation of ice and snow architecture and structure

Meanwhile, SA aims at the problem of convergence of cultural characteristics under a realistic background, taking Northeast China's regional characteristic culture as a profound base, and relying on the study of the protection of cultural heritage in cities and towns along the Middle East Railway, for which it has won the United Nations Asia-Pacific Cultural Heritage Protection Honor Award. Moreover, SA creatively launched the International Ice and Snow Innovation Design and Construction Competition that has promoted innovative research and international exchange on snow and ice buildings.

In recent years, in the context of the rapid development of global information technology and artificial intelligence technology, SA has pioneered and expanded the frontier crossing fields of Computational Design in China, established a green performance-oriented building digital energy-saving design theory, proposed a cold building form multi-objective optimization design method, explored the green performance neural network prediction method for cold buildings, developed dynamic building information modeling technology under performance-driven thinking, and developed the GANN-BIM architectural computational design platform. The research results have been applied to many cold construction projects and won China's architectural design gold and silver awards. In addition, in light of the national innovation-driven strategy for the training of professional talents, SA explored the talent training system for the construction industry under the new engineering education concept, and was approved for the new discipline of Intelligent Architecture and Construction.

The SA Human Environmental Discipline Group is committed to creating a good living environment for human beings and establishing excellent urban and architectural culture. In recent years, SA has continuously optimized resource allocation, integrated and expanded research platforms, and provided sustainable support for the scientific development of human settlements and the cultivation of innovative talents. In addition, China's current urbanization process, energy, natural resources, and health challenges provide SA with a good opportunity to conduct proactive research projects. In the future, SA will make a greater contribution to global education and research on human settlements. ■

SCHOOL OF TRANSPORTATION SCIENCE AND ENGINEERING



Application of active snow melting technology on pavement surface at Beijing Daxing Airport

The School of Transportation Science and Engineering (STSE) is one of the earliest bases for training talents in the modern transportation area in China. The discipline of Traffic and Transportation Engineering, like HIT, has existed for a hundred years. It entered the ranks of the world-class discipline group of Civil Engineering at HIT. STSE has won seven National Science and Technology Awards, such as the 2nd prize of the National Technological Invention Award, the 2nd prize of the National Scientific and Technological Progress Award, and has accomplished over more than 300 major national projects, provincial and ministerial projects. Scientific and technological achievements were applied to the reconstruction project of Chang'an Street, the highway construction for the Beijing Daxing International Airport, the airfield runway of the Lhasa GA Airport and the Beipanjiang bridge. In order to fulfill the "Country with a Strong Transportation Network" strategy, the "Belt and Road Initiative," and the "Arctic Strategy," STSE is going to build one international innovative research platform for future transportation, five research centers on intelligent transportation, traffic big data, intelligent transportation infrastructure, green transportation and sustainable development, and traffic simulation. Besides maintaining the characteristics of the cold region, expanding the advantages of traditional disciplines, and combining with big data and artificial intelligence, our college will focus on carrying out collaborative research on intelligent transportation technologies such as considering people, vehicles, roads, and clouds together to meet major national strategic needs.


Application of health monitoring technology to the hong kong-zhuhai-macao bridge

Technology and in-situ detection device of anti-icing functional asphalt pavement in cold regions

In 2018, this project won the 2nd prize of the National Technological Invention Award. The project is aimed at solving the key issue of pavement operation safety in cold regions. The main technical principle is to develop low-freezing fillers that reduce road adhesion and improve the skid resistance of the pavement surface.

Three key technologies, namely a low-freezing point filler with a wide temperature range and slow release characteristic, an optimization design method for a low-freezing point asphalt mixture, and testing methods and devices for pavement ice and skid resistance have been proposed and provides new technologies and new approaches to solve the problem of pavement operation safety in winter.

This innovation has greatly enhanced the international competitiveness of China's key technologies. The achievements have been applied to more than 80 projects in 19 provinces and cities in China, including the 2020 Beijing Winter Olympic Stadium Road and the Beijing Daxing Airport Expressway, effectively reducing the traffic accident rate by 37.5% and the mortality rate by 25.1%, with significant economic and social benefits.

Transportation infrastructure smart O&M cloud

A data processing model for multi-source information fusion of online health monitoring, offline detection, traffic information, and traffic environment of transportation infrastructure is proposed based on different kinds of technologies such as artificial intelligence, big data, and cloud computing. Based on big data probabilistic modeling and digital inversion, a three-level assessment and safety pre-warning technology for traffic infrastructure service safety performance is proposed. Using blockchain technology, a smart operation and maintenance (O&M) cloud platform integrating service safety information and intelligent traffic information of the infrastructure structure was developed. This achievement has built the connection between infrastructure service safety information and intelligent traffic information, solving the problems of multi-source information fusion and information fragment connectivity, and providing a digital platform for intelligent operation and maintenance of transportation infrastructure. The project won the 2nd prize of the National Scientific and Technological Progress Award, and was applied in key projects such as the Sutong Bridge, the Xihoumen Bridge, the Harbin Second Ring Elevated Viaduct, the Jiamusi Songhua River Bridge, etc., effectively improving the level of intelligent operation and maintenance of large-scale infrastructure.

Multi-source traffic state big data distributed interactive processing technology

Distributed interactive processing technology for multi-source traffic big data

To fully excavate and utilize multi-source traffic big data and unify data resources and computing resources through a distributed data system, this technology integrates multi-source traffic big data to achieve efficient query, storage, analysis and other important functions, and build a multi-source big data-oriented traffic state information presentation platform, which is used to assist in the monitoring, optimization and control of the whole transportation system. This ensures the safety and smoothness of traffic, improves the operational efficiency of vehicles and reduces traffic pollution. This research achievement has significantly improved the urban traffic operation efficiency and traffic management decision-making level of the above cities.

STSE has never forgotten the original aspiration and mission of educating for the Party and the country. Under the guidance of the "Country with a Strong Transportation Network" strategy, STSE will continue to cultivate designers of global landmark projects, creators of super projects, explorers of dream projects, and the leader of a powerful country, striving to build a world-class high-level transportation school with distinctive discipline characteristics. ■

FACULTY OF COMPUTING

In April 2020, HIT announced the creation of the Faculty of Computing (Computing@HIT). There are three schools in the faculty, including the School of Computer Science and Technology, the National Pilot School of Software, and the School of Cyberspace Security. The mission of Computing@HIT is to integrate computing-related teaching and research resources from three campuses of HIT to better serve the national strategic needs and accelerate the development towards world-class computing disciplines.

Computing@HIT can be traced back to the discipline of computer science and technology which was founded in 1956 and is one of the earliest computer science disciplines in China. In 1985, the Department of Computer Science and Technology was established. In 2000, the School of Computer Science and Technology was founded. In the past 64 years, it has made significant contributions to the national economy and social development. The creation of Computing@HIT is considered as the fourth milestone of this glorious history.

There are 143 full-time faculty and staff, including 46 professors, 69 associate professors, and three adjunct academicians of the Chinese Academy of Engineering/Sciences. It is ranked as an A in the 2017 discipline evaluation of China, No. 21 on U.S. News and World Report's "Best Global Universities for Computer Science" list in 2020, and No. 35 in the Computer Science and Engineering category of the 2020 ARWU Rankings.

Programs and leading research directions in Computing@HIT include: computer science and computing theory, computer architecture, artificial intelligence, machine learning, data management and big data analysis, cyberspace security, intelligent software engineering, Internet services computing, bioinformatics, Internet of Things, fault-tolerant computing, natural language processing, intelligent robotics, and intelligent human-computer interactions. Faculties are continuously devoting to the research of cutting-edge computing and interdisciplinary technologies, and have made influential achievements with high practical value and international impact.

The following are some representative research works conducted by faculty of Computing@HIT:

Artificial intelligence on natural language processing (NLP)

NLP refers to using computers to process human languages. There are 6,763 popular characters used daily by Chinese people, and how to input Chinese characters into computers is a challenging task. Sentence-level Chinese pinyin IME, which can exploit the context information for intelligent spelling-character conversion, is the most important Chinese IME in China today. A comprehensive Chinese Language Technology Platform (LTP), which has won many championships in several international NLP evaluation campaigns, is providing fundamental and advanced NLP techniques such as Chinese word segmentation and syntactic analysis to hundreds of corporations and universities. Professor Li Sheng received Lifetime Achievement Award of Association for Computation Linguistics (ACL) in 2015.

Artificial intelligence on computer vision and multimedia

The focuses are image enhancement, image/video compression, visual understanding, and multimedia analytics. The image/video compression techniques have made indispensable contributions to the Chinese national

standards AVS1, AVS2 and AVS Patent Pool. The state-of-the-art deep image denoising network DnCNN has been cited more than 1,500 times (by Google Scholar statistics) in the past three years and has been officially included in the Matlab R2017b Image Processing Toolbox and Deep Learning Toolbox. Sign language and lip reading, handwritten Chinese character recognition, multi-currency recognition, palmprint recognition, and an assistant training system for short-track speed skating, have been extensively deployed in many corporations, national education and training organizations.

Bioinformatics algorithms and large-scale population genomics studies

High-throughput sequencing (HTS) technologies are ubiquitously used and many large-scale genomics studies have been carried out around the world. Nowadays, a genomics data deluge emerges, i.e., exabyte-level HTS data are available, and how to analyze large-scale genomics data effectively and efficiently is a new challenge to computer science. In recent years, Professor Wang Yadong and his team have developed over 50 advanced bioinformatics algorithms for large-scale genomics data analysis, especially focusing on some fundamental tasks, such as read HTS read alignment and genome variation detection.

Computational complexity theory and efficient algorithms for big data computing

Conventional computational complexity theory and polynomial time algorithms are no longer applicable to big data computing. In recent years, Professor Li Jianzhong and his team have been investigating a new computational complexity theory and efficient algorithms for big data computing. They proposed an innovative sublinear time based criterion for tractable problems of big data computing and presented a random-access Turing machine (RATM) for supporting the sublinear time computation. Fundamental problems of the new complexity theory for big data computing are solved, such as the complexity structure of the problem space of big data computing, the complexity of parallel computation and the complexity of approximate computation for big data computing. By their innovative work, the inherent computational complexity of many problems of big data computing could be determined, and a set of sublinear time algorithms for solving big data computing problems are designed and analyzed.

Computing@HIT has formed its distinctive traditions and characteristics of education and research, and has cultivated numerous outstanding computer talents. Students are intensively put into research and development of key challenging national projects and can gain great exercise of their academic and engineering capabilities. Close collaborations with a variety of industries also facilitate smooth linking between their in-campus study and future careers. Computing@HIT has passed the Engineering Education Accreditation by ABET. As a result, students are well known for their comprehensive knowledge, expertise, and outstanding capability of solving complex engineering problems. It has established multi-level and multi-dimensional international collaborations with more than 40 international university and corporate partners. Above 10 joint programs and joint labs are being conducted, and intensive international academic exchange is promoting students and faculties to have broad international visions.

Over the past 64 years, Computing@HIT has conferred 732 doctoral, 2,201 master's, and 7,502 bachelor's degrees. Currently, there are 2,593 enrolled students in the faculty, including 1,679 undergraduate students, 543 postgraduate students, and 371 PhD candidates. There are a total of 135 foreign students studying here.

SCHOOL OF INTERNATIONAL STUDIES

Professor Jia Yuxin, former president of IAICS (International Association for Intercultural Communication Studies)

The School of International Studies (SIS, formerly known as the School of Foreign Languages) at Harbin Institute of Technology has about 150 faculty members, about 400 undergraduate students and 80 postgraduate students, and also provides foreign language courses for about 15,000 non-English major students at both undergraduate and postgraduate levels each year. There are 7 departments, including the English Department, the Russian Department, the Japanese Department, and the First Department of English for Non-English Major Undergraduates, the Second Department of English for Non-English Major Undergraduates, the Third Department of English for Non-English Major Undergraduates and the Department of English for Non-English Major Postgraduates. There are also 6 research centers, including the Research Center for Intercultural Communication, the Institute for Canadian Studies, the Research Center for Russian Language and Culture, the English Education and Research Center, the Center for Translation Studies and the Australian Studies Center. The school offers 3 BA programs: BA in English and English Literature, BA in Russian and BA in Japanese. At the postgraduate level, it has 4 master's programs: MA in Foreign Linguistics and Applied Linguistics, MA in English Language and Literature, MA in Russian Language and Literature, and Master of Translation and Interpretation. It will also start offering minor degrees in international relations, area studies and international organizations.

In addition to a focus on foreign language learning, the teaching and research staff of SIS also engage in research in a wide array of areas—linguistic studies (theoretical linguistics, sociolinguistics, psycholinguistics, pragmatics, cross-cultural communication, etc.), applied linguistics (TESOL, SLA, etc.), intercultural communication, literary theory, British literature, American literature, Canadian literature, Australian literature, theories and methodology for translation and interpretation, international studies, areas studies, international relations, etc. Among these research fields, the research at SIS in intercultural communication takes a leading position in Mainland China, exerting a great impact in Hong Kong, Taiwan and abroad.


HIT SIS faculty members attending a seminar on foreign language education

SIS has developed partnerships with universities in many countries such as Britain, America, Canada, Australia, New Zealand, Netherlands, Germany, Russia, South Korea and Japan. The cooperative relationships take different forms which include the exchange of students and staff, joint-degree programs and collaborative research initiatives, etc. Some have brought to fruition valuable and beneficial opportunities to our partners and us. For example, our exchange of scholars with the School of Education at Durham University helped us become a major participant of an ERSMUS+ project in 2017. An exchange program created between SIS and the School of Modern Languages at the University of Warwick enable us to receive Warwick students who work as TAs at HIT and to send our students to Warwick. We are also collaborating with the Graduate School of Humanities and Social Sciences of the University of Melbourne on a joint-degree program which grants the degree of Master of Translation to our students.

It is our long-standing hope that we can expand our scope of international partnerships and collaborate with more universities abroad in offering enriching educational experience to students and promoting studies in a wide range of subjects. We also look forward to welcoming in our institutions international students who seek opportunities for undergraduate and postgraduate education that will help them achieve major advances in their academic and professional careers. If you are interested in becoming part of our enterprise to become an institution with an even greater impact, we will be more than glad to be contacted and please send your email to qiulihua@hit.edu.cn. ■

• Olympic and world champions lead the school marathon

SPORTS DEPARTMENT

The Sports Department of Harbin Institute of Technology was founded in 1950, and was formerly known as the Sports Teaching and Research Office. Since its origin, physical education class was officially taken as a compulsory courses of HIT students. In the past 70 years, with the care of the school leaders and the joint efforts of several generations of sports faculty, the school's physical education has developed vigorously.

The Sports Department currently has 67 teachers, including six professors, 44 associate professors, three master supervisors, two teachers with doctorate degrees, 33 with master's degrees, four with the certificates of national athletes, two with the certificates of international athletes, and seven with the certificates for international referee. In 2018-2019, World Badminton Champion-Chen Jin and Olympic Speed Skating Champion-Zhang Hong were recruited through introduced talent.

Currently, more than 40 PE courses are offered for the undergraduates and postgraduates, including ball games, track and field, swimming, martial arts, bodybuilding, ice and snow sports and other sports events. Many courses have been rated as "Provincial Quality Courses", "Provincial Quality MOOC", "Provincial Innovation Courses" and other excellent courses. The teachers have rich working experience of being the referees in world-class sports events, completing scientific research projects at the national, provincial and ministerial level, and publishing sports books and core periodicals articles.

HIT attaches great importance to the construction of student sports team, enrolls students with special sports skills every year, and develops high-level sports teams and Sunshine sports teams. Excellent results have been obtained in recent years: In the 24th World University Winter Games in 2009, Gao Ming and Zhang Zhiqiang won the gold medals of men's 5,000-meter short-track speed skating. Students of the track team not only won the championships but broke records both in the National Collegiate Sports Game and the National Collegiate Championships. The men's basketball team won third place in Chinese University Basketball Association. Students of swimming team won gold medals in the National Collegiate Championships. Table tennis, speed skating, badminton, football, fencing and other sports teams have strong strength for provincial colleges and universities, and their competition results are among the best.

The school and the department are concerned about the health of teachers and students. To emphasize on extracurricular physical training and campus sports culture construction, we hold more than 10 on-campus competitions, such as a school relay race, bodybuilding competition, track and field meet, ball games, swimming competition, ice and snow sports festival, etc. In the meantime, in order to enrich the campus sports cultural life, strengthen the physique and promote learning, students can join the activities of sports associations, PE communities and sports clubs in their spare time. Full sports facilities and comfortable fitness environments, gyms, stadiums and swimming pools are open to teachers and students all year round.

On the new century development path of HIT, the Sports Department will make continuous efforts to carry forward the tradition, pursue excellence, serve teachers and students, and promote the development of the school physical education. ■

• Skating lesson preparation of teachers

• Skiing course teaching

SCHOOL OF CHEMISTRY AND CHEMICAL ENGINEERING

The School of Chemistry and Chemical Engineering at Harbin Institute of Technology (HIT) was established in the 1930s, proudly as one of the first such departments in the nation. Leveraging its traditional strength in applied chemistry, the school has made major contributions to development and applications of novel chemical engineering materials.

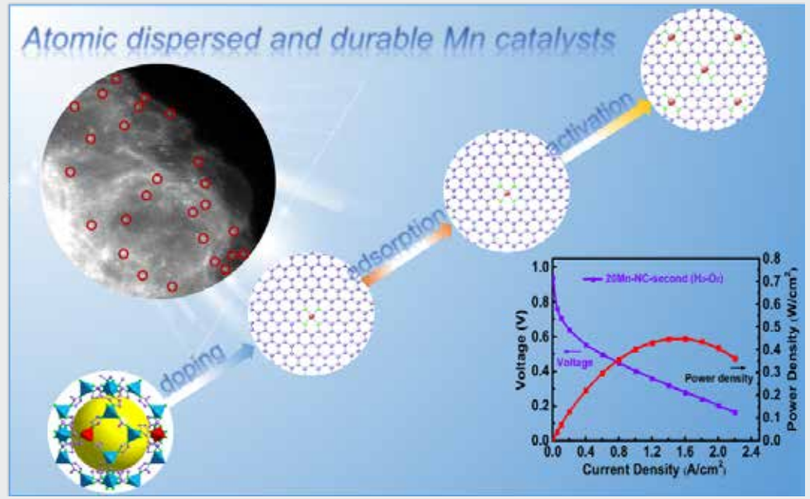
Novel aerospace materials

Spacecraft typically operate in complex and extremely harsh environments, presenting a significant challenge for their materials. With strong capability of integrated technology innovation, the researchers are both committed to developing new chemical materials for special applications in spacecraft, and making significant contributions to the society based on our engineering-oriented achievements.

Professor Huang Yudong's team is committed to developing advanced high performance resin materials and related technologies. New high temperature resistant silicon resins with excellent mechanical and electromagnetic performance were developed for demanding aerospace applications with the outstanding 600°C tolerance, setting a new record. The application range of polymer matrix composites in aerospace areas has thus been greatly expanded. They also developed novel forced solution impregnation technologies—now widely used in the nation's aerospace industry—for markedly improved quality uniformity of polymer composites.

Yang Chunhui's team has achieved growth large-sized mid-far infrared nonlinear optical crystal $ZnGeP_2$—the crystal as large as 60mm in diameter was grown and 100W laser output was realized. They also developed eco-friendly and low-cost methods for scale-up production of aerogel insulation materials, silane coupling agents, and high-purity polycrystalline SiC materials.

Wu Xiaohong's group tailored functional surface coatings for specific spacecraft applications. The significant examples are *in situ* grown thermal-control coatings on light alloys, and advanced super-black coatings with broadband spectrum absorption performance.



Preparation method and fuel cell performance of Mn-N-C catalyst with atomically dispersed Mn-N4 sites

Novel energy

The researchers also focus on developing renewable energy technologies to address the global challenge of sustainable development. They have studied electrochemical energy storage and catalysis, making the breakthrough in the efficient use of energy resources.

Nickel foam technology invented by Professor Wang Jisan is a milestone for the booming rechargeable battery industry in China. Professor Du Chunyu's study on controlled modulation of crystallographic textures of oxide cathode materials contributed to fabrication of high performance lithium-ion batteries.

Novel Mn-N-C electrocatalysts with comparable operation potential with traditional catalysts and superior durability were developed by Professor Wang Zhenbo as a promising low-cost Pt-free catalyst for oxygen reduction reaction in proton exchange membrane fuel cells.

Surficial and interfacial chemistry

Inspired by the hierarchical structure of water striders, Pan Qinmin's group first reported a novel superhydrophobic buoyant material that readily carries loadings exceeding its nominal limit. Practical implications were demonstrated by a real aquatic microrobots capable of walking and jumping on/over water. ■

Architectural Renderings of Space Environment Simulation Research Infrastructure (SESRI)

SPACE ENVIRONMENT SIMULATION AND RESEARCH INFRASTRUCTURE

The Space Environment Simulation and Research Infrastructure (SESRI), operated by the Institute of Space Environment and Material Science, is a ground-based large-scale space science and technology experimental platform currently being constructed at Harbin Institute of Technology, and it will be completed and open to users worldwide in 2022. SESRI is dedicated to studying major basic scientific issues in the fields of space materials, devices, life, plasma and magnetospheric physics, etc., with world-leading capabilities of simulating a wide range of space environment factors. Equipped with advanced multi-parameter in-situ analysis and dynamic measurement systems, SESRI offers research platforms surrounding three categories of scientific problems, i.e., the spatial and temporal evolution of the structures and performance of materials and devices in the integrated space environment and the physical nature of environmental effects, the laws and mechanisms of life activity phenomena in space environment, the distribution and evolution of space plasma and the physical mechanism of its interaction with spacecraft. Researches at SESRI will deepen the understanding of the laws and mechanisms governing the interaction between spacecraft and space environment, advancing the development of space science and technology.

SESRI is located in the Science and Technology Innovation City of Harbin's Songbei District, near the beautiful Songhua River. The total investment is about 1.5 billion RMB. It covers an area of about 360,000 m^2 and is divided into an experimental and office area, and a living and supporting area. There are four major systems in SESRI: the integrated space environment simulation and research system, the simulation and research system of space magnetic environment, the simulation and research system of space plasma environment, and the numerical simulation and central monitoring system. The first three research systems can be further divided into seven research subsystems.

The Integrated Space Environment Subsystem is the core of SESRI. Its major task is the ground simulation of six major environments in our solar system, including vacuum, temperature, charged particle radiation, electromagnetic radiation, space neutral gas, and solid particles.

The Ion Irradiation on Device Subsystem, which is composed by a high-energy ion irradiation terminal, a low-energy ion irradiation terminal and an analysis and test platform, is used to simulate materials and devices working in space environments.

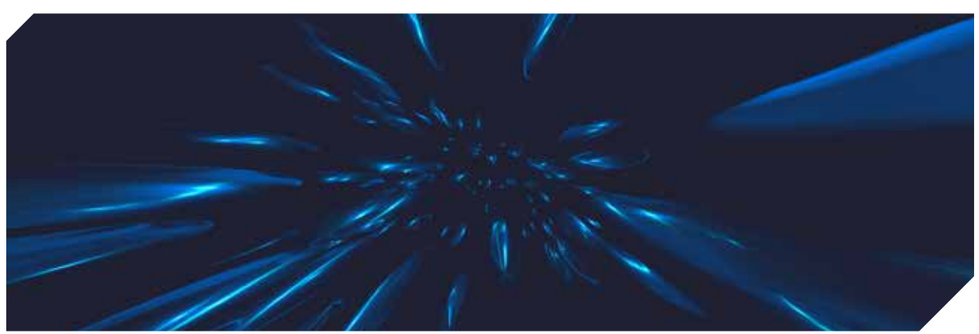
The Ion Accelerator Subsystem, including a 6MV tandem accelerator, two microbeam lines, and a linac+synchrotron accelerator is designed for providing particle sources for other research systems.

The Micromechanism Analysis Subsystem, including an in-situ/semi-in-situ/off-line analysis and test platform, is designed to perform microscopic physical mechanism analyses of aerospace materials and devices from the atomic and molecular level.

The Space Life Science Subsystem, including a microbeam irradiation cell microscopy research terminal and a multi-factor coupling biological research terminal, is designed to reveal the laws and mechanisms of the phenomena of life activities under the space environment factors, and to improve the ability of humans to enter and adapt to space.

The Space Magnetic Environment Subsystem is schemed to combine active and passive shielding methods to achieve a nearly zero magnetic field environment and then simulate the space magnetic field precisely.

The Space Plasma Environment Subsystem, composed of a Near-Earth Space Plasma Environment Simulation Part and Near-Space Plasma Environment Simulation Part, can be used to investigate essential space plasma phenomena. ■



AWARDS & HONORS

HIT WON FOUR NATIONAL SCIENCE AND TECHNOLOGY AWARDS

On January 10th, the annual "National Science and Technology Awards" ceremony was held in Beijing. President Xi Jinping, also General Secretary of the Communist Party of China (CPC) Central Committee and Chairman of the Central Military Commission, and other leaders, such as Li Keqiang, Wang Huning, and Han Zheng attended the ceremony and presented the awards. Harbin Institute of Technology won four awards, including one National Natural Science Award, two National Technological Invention Awards and one National Scientific and Technological Progress Award.

The project "Metallurgical Mechanism and Control of Microstructure and Performance for Special Welding" led by Professor Feng Jicai from the School of Materials Science and Engineering won the 2nd prize of the National Natural Science Award. A project led by Professor Liu Hong from the School of Mechatronics Engineering and the project "Technical System Establishment and Application of Special Motor for Extreme Environments" led by Professor Zou Jibin from the School of Electrical Engineering and Automation won the 2nd prizes of the National Technological Invention Awards. A project led by Professor Yu Daren from the School of Energy Science and Engineering won the 2nd prize of the National Scientific and Technological Progress Award.

The ceremony honored 296 projects in total, including 46 National Natural Science Awards, 65 National Technological Invention Awards, and 185 National Scientific and Technological Progress Awards. Ten foreign experts won the International Science and Technology Cooperation Awards. ■

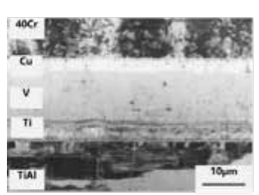
PROFESSOR FENG JICAI WON THE 2ND PRIZE OF THE NATIONAL NATURAL SCIENCE AWARD

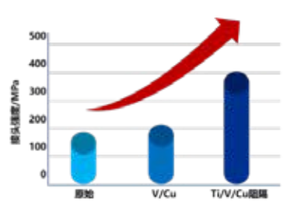

国家自然科学奖
证 书

On January 10th, 2020, the project "Metallurgical Mechanism and Control of Microstructure and Performance for Special Welding" led by Professor Feng Jicai won the 2nd prize of the National Natural Science Award. Professor Feng Jicai is the first scholar in welding who has achieved the National Science Foundation for Distinguished Young Scholars. He is also the president of the China Welding Society.

Welding, which is one of the key technologies for advanced manufacturing, has been widely applied in aeronautics, astronautics and automobile industries. The demand for dissimilar materials welding has been growing as the requirement for welding structures is becoming higher. However, commonly used fusion welding cannot fulfill the need for reliable dissimilar materials joining. Thus, it is essential from both the science and engineering aspects to develop a novel approach to joining dissimilar material. To fulfill the national strategic demand and extract scientific problems from welding manufacturing, the research group led by Professor Feng Jicai focuses on the joining of dissimilar materials with distinct properties, including joining ceramics with metals and joining dissimilar metals, using brazing, welding brazing and diffusion bonding. Professor Feng's group has pioneered and led the research on special welding of dissimilar materials. They aim to reveal the nature of the welding process and solve the basic problem of welding, which involves developing a novel welding method for joining dissimilar materials, demonstrating the effect of the interfacial structure on the residual stress distribution in the joint, and revealing the mechanism of special welding metallurgy.

The related research results have been applied in the fabrication of key products in the aerospace and automobile industries. Part of the results won the 1st prize of the Natural Science Award of Heilongjiang Province in 2016 and the 1st prize of the Natural Science Award of China's Ministry of Education in 2004. ■





PROFESSOR ZOU JIBIN WON THE 2ND PRIZE OF THE NATIONAL TECHNOLOGICAL INVENTION AWARD

Professor Zou Jibin is the Director of the Special Motor Research Center from the School of Electrical Engineering and Automation at HIT. His project "Technical System Establishment and Application of Special Motor for Extreme Environments" won the 2nd prize of the National Technological Invention Award.

Special motors for extreme environments need to withstand a wide temperature range of 350 ℃ , a deep sea depth of 11,000 meters, or a deep well logging over 200 ℃ high temperature and 140MPa pressure environment. Meanwhile, extreme detection equipment has more stringent requirements on efficiency, volume and weight, and the reliability of motor systems. This project independently invented the structure of a high-temperature and high-pressure motor, as well as control and test methods in extreme environments, which significantly improve the environmental resistance of the motor system compared with traditional motor technology.

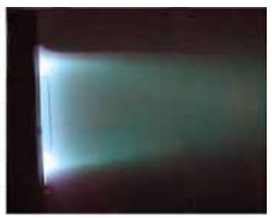
This project develops many kinds of aerospace, deep-sea and deep-earth special motors and drives, which are successfully applied to major national missions, such as the Yutu lunar rover, the Shenzhou series spaceship, the Jiaolong deep-sea manned submersible, and a logging while drilling system. This project establishes the technical system of the special motor for extreme environments and brings significant social and economic benefits. ■

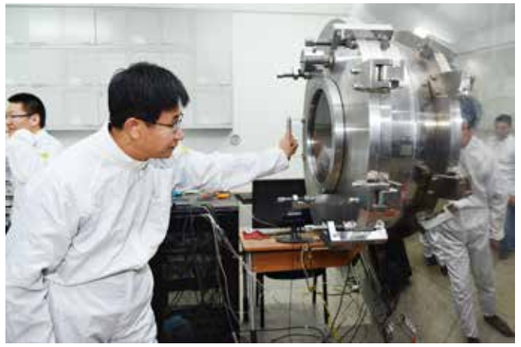
PROFESSOR YU DAREN WON THE 2ND PRIZE OF THE NATIONAL SCIENTIFIC AND TECHNOLOGICAL PROGRESS AWARD

Professor Yu Daren is the Director of the Aerospace Plasma Propulsion Key Laboratory of the Ministry of Industry and Information Technology from the School of Energy Science and Engineering at HIT. In January, 2020, his research on magnetic focusing Hall thruster won the 2nd prize of the National Scientific and Technological Progress Award.

The Hall thrusters developed by Russia and America suffer from the problem of large plume divergence angle, which leads to high energy ion bombardment on the thruster channel and solar panel. The thrust, specific impulse, and lifetime of the propulsion platform are largely reduced.

In the past decades, Professor Yu Daren and his team focused on solving the above problem. They proposed a theory on controlling the plasma plume of the thruster and on-orbit adjusting it in a wide range; they built a model to describe the plasma oscillation phenomenon in the discharge channel of the Hall thruster and revealed the physical mechanism of its plume divergence; they found the method to increase the gas retention time and enhance the ionization process by using a rotating gas flow. Based on these efforts, they finally broke through the





magnetic focusing technology, and made a new generation of Hall thruster. In November, 2016, this thruster was adopted on the SJ-17 satellite. This was the first in-orbit flight of a magnetic focusing Hall thruster in the world.

The plume divergence angle was largely reduced, from 40° of the previous Hall thrusters to 8.3° of this new thruster. The corrosion rate in the thruster channel was reduced by 60%, the thrust-to-power ratio of the system was increased by 13%, and the effective thrust was increased by 50%. The discharge oscillation in the thruster was reduced by 65%, and its start-up time was reduced from minutes to sub-seconds. This research solved a key problem in the area of aerospace electric propulsion in the world, significantly increased the payload capacity of the satellites, and realized an inter-generational development of the electric propulsion system of China. ■

HIT RANKED 6TH OF BEST GLOBAL UNIVERSITIES FOR ENGINEERING

BEST GLOBAL UNIVERSITIES U.S.News & WORLD REPORT 2020

U.S. News & World Report announced the Best Global Universities for Engineering in 2020. Harbin Institute of Technology (HIT) was ranked 6th on the list.

These well-regarded universities from around the world have shown strength in producing research related to a variety of engineering topics. These include aerospace engineering, mechanical engineering, electrical engineering and civil engineering. All rely on the basic engineering concept of using math and science to solve problems. These are the world's best universities for engineering. ■

TWO HIT PROFESSORS ON THE LIST OF WOMEN IN AI

The Women in AI list names the world's most influential female scholars from the fields of artificial intelligence. Recently, the 2020 Women in AI list recognized 179 female scholars. Professor Qin Bing and Professor Yao Hongxun from Harbin Institute of Technology were on the list.

Qin Bing is a professor and doctoral supervisor of the School of Computer Science and Technology, HIT. She is vice director of the research center of Social Computing and Information Retrieval of HIT (HIT-SCIR), a member of the council of the Chinese Information Processing Society of China, and the vice director of the Language and Knowledge Computing Committee of Chinese Information Society of China. She is also a leader of the State Key Program of the Natural Science Foundation. Professor Qin has research interests in Natural Language Processing, Knowledge Graph, Text Comprehension, Generation, Sentiment Computing, etc. She has published more than 100 papers in international top conferences such as ACL, EMNLP, IEEE TKDE. In addition, she has directed a number of key research projects of the National Natural Science Foundation of China and the Ministry of Science and Technology. A number of her research results have been incorporated into enterprise products. She has won the 1st prize and 2nd prize of Heilongjiang Scientific and Technological Progress Award.

Yao Hongxun is a professor and doctoral supervisor of the School of Computer Science and Technology, HIT. Her research focuses on the fields of computer vision intelligence, multimedia data analysis and understanding, video surveillance, and pattern recognition. She was elected into the Program for New Century Excellent Talents in University. She is also a special government allowances expert in Heilongjiang Province and served as the Executive Director of the China Society of Image and Graphics, etc. She has published more than 200 papers in the international top journals and conferences, and directed a number of key research projects of the National Natural Science Foundation of China, “863” and “973” projects. Professer Yao won the 2nd prize of Heilongjiang Scientific and Technological Progress Award twice and won the 2nd prize of Heilongjiang Teaching Achievement Award twice.

“Women in AI”, released by Tsinghua-CAE Joint Research Center for Knowledge & Intelligence (K&I), the Institute for Artificial Intelligence, Tsinghua University, and Beijing Zhiyuan Artificial Intelligence Research Institute, aims to select the most influential and active female scholars in the field of artificial intelligence worldwide through analyzing the “AMiner Academic Data”. 179 female scholars were analyzed and selected from the list of 2000 influential AI scholars in artificial intelligence all over the world.

In terms of nationality, the 179 female scholars come from 21 countries. More than 60% of the scholars were from the United States, and 12 female scholars come from China. Besides, American female scholars account for 10% of all scientists from USA on the list of “AI 2000.” In addition, the female artificial intelligence scholars from the United Kingdom, Canada, and France also occupy more than 15% in the list. In contrast, female scholars in China just account for only 7% of the whole of Chinese AI scholars in AI 2000. ■

ULTRAFAST CONTROL OF VORTEX MICROLASERS

On February 28th, 2020, Professor Song Qinghai's research group from Harbin Institute of Technology, Shenzhen, reported an ultrafast control mechanism for microlasers, which applied the concept of bounded states in the continuum (BICs), breaking the long-standing trade-off between ultralow energy consumption and ultrafast switching. The research paper titled "Ultrafast Control of Vortex Microlasers" was published in *Science*.

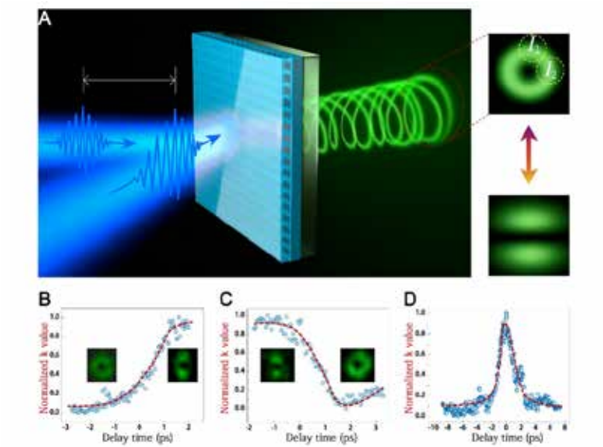
An all-optical switch is a kind of device that controls light by light, which plays an essential role in next-generation quantum computing and quantum information. In past decades, the requirements for all-optical switches have been categorized as low energy consumption, high speed, strong modulation ratio, small footprint, and on-chip integration. The small foot-print and on-chip integration are quite easy for current nanotechnologies. However, the trade-off between low energy consumption and high speed is a severe challenge. The conventional approach focuses on enhancing the light-matter interaction via on-chip integrated micro- or nano-cavity. This works very well at the beginning. The relative high Q factor of a resonator can effectively increase the local electromagnetism, but the corresponding mode lifetime ($\tau \propto Q/\omega$) also restricts the response of the switch. The other techniques with ultra-small effective mode volume, such as plasmonic nanostructures, are limited by the huge coupling and the propagating loss.

Professor Song's group has been working on the microlasers to solve the above trade-off. They focus on laser emissions from the topologically protected BIC. Compared with accidental BIC, the topologically protected BIC is extremely sensitive to symmetry-breaking perturbations. As a result, both the gain of materials and the symmetry become key parameters to control. Owing to the far-field characteristics of BICs, the transition from BIC microlasers to conventional lasers represents a re-distribution of the laser emission instead of a direct switching on/off of the lasing mode. This makes the switching process is not limited by the lifetime of resonant mode. Since the BICs can eventually have infinitely large Q factors, the laser

thresholds can be reduced by orders of magnitude. In this sense, the BIC microlaser can break the trade-off between low energy consumption and high speed. Therefore, it is possible to realize the ultrafast optical switching that matches all the requirements of modern classic and quantum information.

In square-latticed $MAPbBr_3$ perovskite periodic nanostructure, the researchers have realized single mode laser emissions with donut beam profiles. As expected, they have confirmed the relationship between the symmetry of the pumping profile and the emission beam profile. By applying the second beam with spatial and temporal deviation, the four-fold rotational symmetry of square lattice is broken in a very short time and the BIC laser degrades to conventional photonic crystal lasers with two linearly polarized lobes. The transition and the vice versa take place in a time of 1-1.5 ps. A complete transition from a donut to two lobes and back to a donut has also been realized within 2-3 ps. Such kind of switching time is more than an order of magnitude faster than the BIC microlaser lifetime, clearly demonstrating that the limitation of laser lifetime on the switching time is broken.

Professor Song Qinghai from HIT, Professor Yuri Kivshar from Australian National University, and Professor Ge Li from City University of New York are the corresponding authors. Ph.D. student Huang Can from HIT is the first author of this paper. The research was supported by the NSFC, the Ministry of Science and Technology, the Shenzhen Science and Technology Innovation Commission, the National Key Laboratory of Tunable Laser Technology, the Key Laboratory of Micro Nano Optoelectronic Information System Theory and Technology, the Ministry of Industry and Information Technology, and the Extreme Optical Collaborative Innovation Center. ■



Ultrafast control of the quasi-BIC microlasers

(A) Schematic of two-beam pumping experiment. Two beams are spatially detuned with a distance d < 2R, being shifted temporally with a delay time τ. The insets show the far-field emission patterns from the perovskite metasurface under both symmetric and asymmetric excitations.

(B) Transition from a BIC microlaser to a linearly-polarized laser. $I_{1,2}$ are the intensities at the marked regions in the insert to (A). Insets show the corresponding beam profiles.

(C) Reverse process of (B)

(D) Transition from a donut beam to two-lobe beam and back within a few picoseconds. Red curves are guiding lines for the calculation of the transition time.

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INHIBITION MECHANISMS OF AcrF9, AcrF8, AND AcrF6 AGAINST TYPE I-F CRISPR-Cas COMPLEX REVEALED BY Cryo-EM

Recently, a group led by professor Huang Zhiwei from HIT's School of Life Science and Technology (SLST) and the HIT Center for Life Sciences (HCLS) and Professor Wah Chiu from Stanford University published a paper titled "Inhibition Mechanisms of AcrF9, AcrF8, and AcrF6 against Type I-F CRISPR-Cas Complex Revealed by Cryo-EM." In this study, the structures of three Acr proteins (AcrF9, AcrF8, and AcrF6) inhibiting Csy complex were resolved for the first time using cryo-electron microscopy, with resolutions of 2.57Å, 3.42Å, and 3.15Å, respectively. The publication of this paper enriches the molecular mechanism of anti-CRISPR proteins, and provides a theoretical basis for related scientific research and applications.

The co-evolution between prokaryotes and viruses has been going on for millions of years. Prokaryotes utilize an adaptive immune system composed of CRISPR and CRISPR-related (Cas) genes to combat

viruses. The type I-F system requires a crRNA-guided surveillance complex (Csy complex) to recognize foreign DNA and recruit a nuclease-helicase protein (i.e., Cas2/ 3) for DNA degradation. The Csy complex is comprised of four types of Cas proteins (Cas5f-8f) and a single 60-nt crRNA, with a stoichiometry of $Cas5f_1 6f_1 7f_6 8f_1$:$crRNA_1$. To survive inside the prokaryotic host cells, viruses have developed various strategies to compromise the CRISPR-Cas systems, including the anti-CRISPR (Acr) proteins. However, the mechanism by which AcrF9, AcrF8 and AcrF6 inhibit the csy complex remains unknown.

Here we obtain three structures of previously unresolved Acr proteins (AcrF9, AcrF8, and AcrF6) bound to the Csy complex using electron cryo-microscopy. The 68-residue AcrF9 is composed of a pair of antiparallel β-sheets separated by a single α-helix, and two copies bind to a single Csy complex. The research group observed interactions between AcrF9 and the Csy complex, with multiple hydrogen bonds and hydrophobic interactions. Notably, a lysine-rich region of the Cas7f subunit (K76, K78, K84, and K256) has been reported to be critical for DNA binding by the Csy complex, and it also interacts extensively with AcrF9, suggesting that AcrF9 may competitively bind to the DNA binding sites of the Csy complex. Actually, AcrF9 mutants (Q38A and F40A) abolish the inhibition of AcrF9, and the substrate DNA is rapidly degraded. Supporting the notion that AcrF9 exerts its anti-CRISPR function via competitively binding to DNA binding sites on the Cas7f subunits of the Csy complex. Additionally, AcrF9.1 also contacts with Cas8f. This interaction leads to an overall conformational change that causes the loop region of Cas8f to move into the closed position, locking the complex with AcrF9. Through cryo-electron microscopy and in vitro cleavage activity assays, we found that AcrF8 binds to the csy spiral backbone to prevent DNA hybridization. Unlike AcrF9 and AcrF8, AcrF6 binds at the junction between Cas7.6f and Cas8f to inhibit DNA duplex splitting.

Professor Wah Chiu and Professor Huang Zhiwei are correspondent authors of this paper. Kaiming Zhang and Shanshan Li from the Department of Bioengineering of Stanford University, and Wang Shuo and Zhu Yuwei from the SLST of HIT are co-first authors. ■

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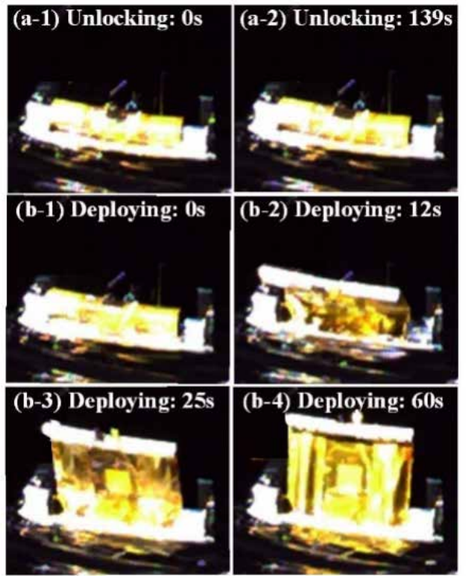
WORLD'S FIRST SPACEFLIGHT ON-ORBIT DEMONSTRATION OF A FLEXIBLE SOLAR ARRAY SYSTEM BASED ON SHAPE MEMORY POLYMER COMPOSITES

A research group led by Professor Leng Jinsong from the Center for Smart Materials and Structures, Harbin Institute of Technology, made a study progress on the world's first spaceflight on-orbit demonstration of a flexible solar array system based on shape memory polymer composite (SMPC). Without traditional electro-explosive devices or motors/ controllers, the rollable SMPC flexible solar array system (SMPC-FSAS) based on SMPCs was developed and on-orbit validated. The SMPC-FSAS consists of a pair of rolling-out epoxy-based SMPC variable-stiffness tubes with clamping one piece of flexible blanket solar array, and a pair of cyanate-based SMPC releasing mechanisms. On December 27th, 2019, the locking function of the SMPC releasing mechanisms of the SMPC-FSAS flight hardware was normal when launching aboard the SJ-20 Geostationary Satellite. On January 5th, 2020, the SMPC-FSAS successfully unlocked and deployed. The two releasing mechanisms successfully unlocked actuated by the cyanate-based SMPC laminates. The epoxy-based SMPC variable-stiffness tubes with lenticular cross section also deployed and approached an approximate 100% shape recovery rate.



On-orbit releasing and deployment demonstration of the SMPC-FSAS flight hardware which was performed on SJ-20 Geostationary Satellite on 5th Jan., 2020:
(a-1)-(a-2) unlocking process in space;
(b-1)-(b-4) deploying process in space

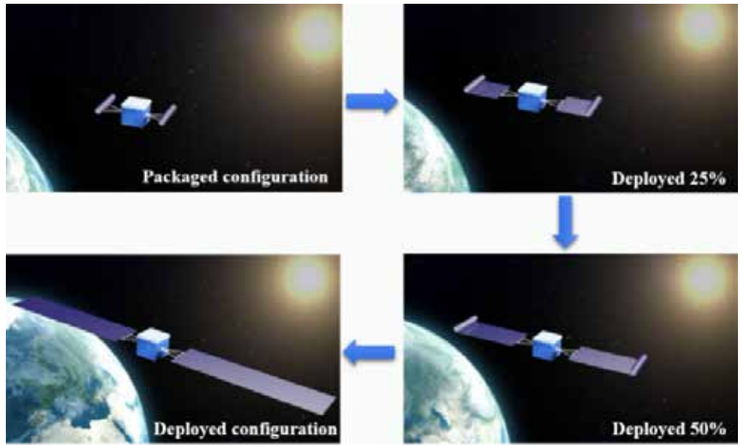


Illustration of deployment process of huge space solar arrays made by SMPC

As a new type of releasing mechanism, the SMPC releasing mechanisms of SMPC-FSAS realized low impact and repeatable testability, which show the possibility to replace traditional electro-explosive devices. The SMPC could be applied for ultra-large space deployable structures. The current study and on-orbit successful validation of the SMPC-FSAS may accelerate the related productions to be used for next-generation releasing mechanisms as well as space deployable structures, such as new releasing mechanisms with repeatable testability and ultra-large space deployable solar arrays. ■

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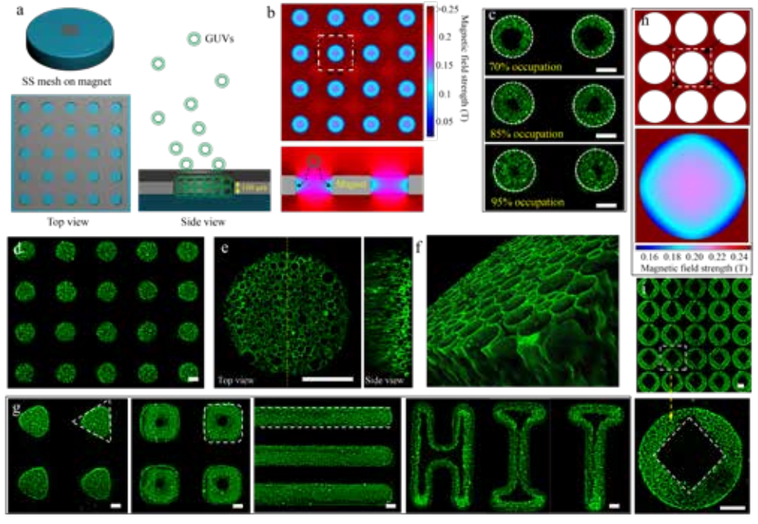
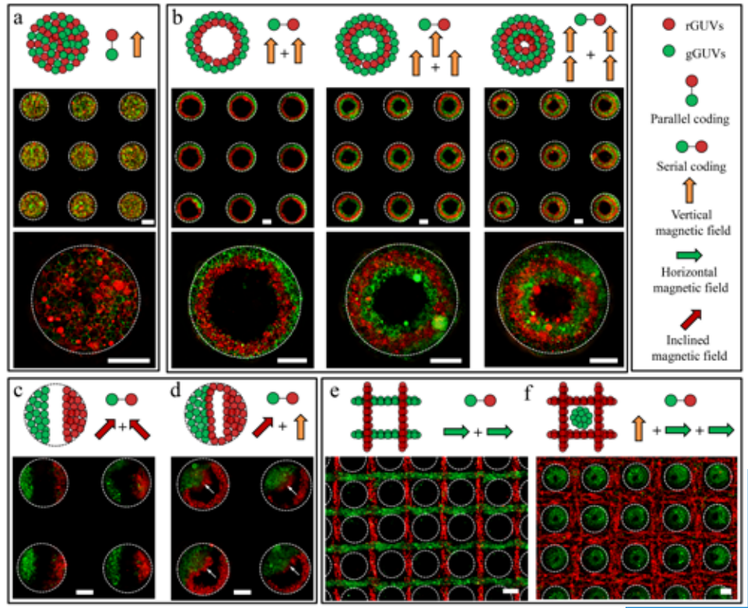
ARTIFICIAL TISSUES FROM GIANT UNILAMELLAR VESICLES / CELLS EXHIBIT COLLECTIVE BEHAVIOR

Professor Han Xiaojun's group from the State Key Laboratory of Urban Water Resource and Environment, School of Chemistry and Chemical Engineering has made a significant progress on tissue mimics based on their strong background in artificial cells. The research article titled "Programmed Magnetic Manipulation of Vesicles into Spatially Coded Prototissue Architectures Arrays" was recently published in a high impact *Nature* family journal *Nature Communications*.

In nature, cells self-assemble into spatially coded tissular configurations to execute higher order biological functions as a collective. This mechanism has stimulated the recent trend in synthetic biology to construct tissue-like assemblies from protocell entities, with the aim to understand the evolution mechanism of multicellular organisms, create smart materials or devices, and engineer tissue-like biomedical implant. However, the formation of spatially coded and communicating micro-architectures from large quantity of protocell entities, especially for lipid vesicle-based systems that mostly resemble cells, is still challenging. In this paper, they magnetically assemble giant unilamellar vesicles (GUVs) or cells into various microstructures with spatially coded configurations and





spatialized cascade biochemical reactions using a stainless steel mesh. GUVs in these tissue-like aggregates exhibited uncustomary stability in hypotonic or hypertonic conditions in comparison with individual GUVs suspensions, which made them robust models for application in synthetic biology and cell biology, and suggests possible clues for the evolution of multicellular cells on early earth. Via the spatial coding of GUVs or cells, designated GUVs were illumined and cell death was triggered by enzyme reactions, proving the ability of the model to mimic the spatialized biochemical processes in natural tissues. This work paved the way for the study of higher-order tissue behaviors via the groundbreaking manipulation of diamagnetic objects into defined 3D structures. The artificial tissues formed using their method may find great potential in the field of biomedical engineering.

The paper was financially supported by the National Natural Science Foundation of China. ■

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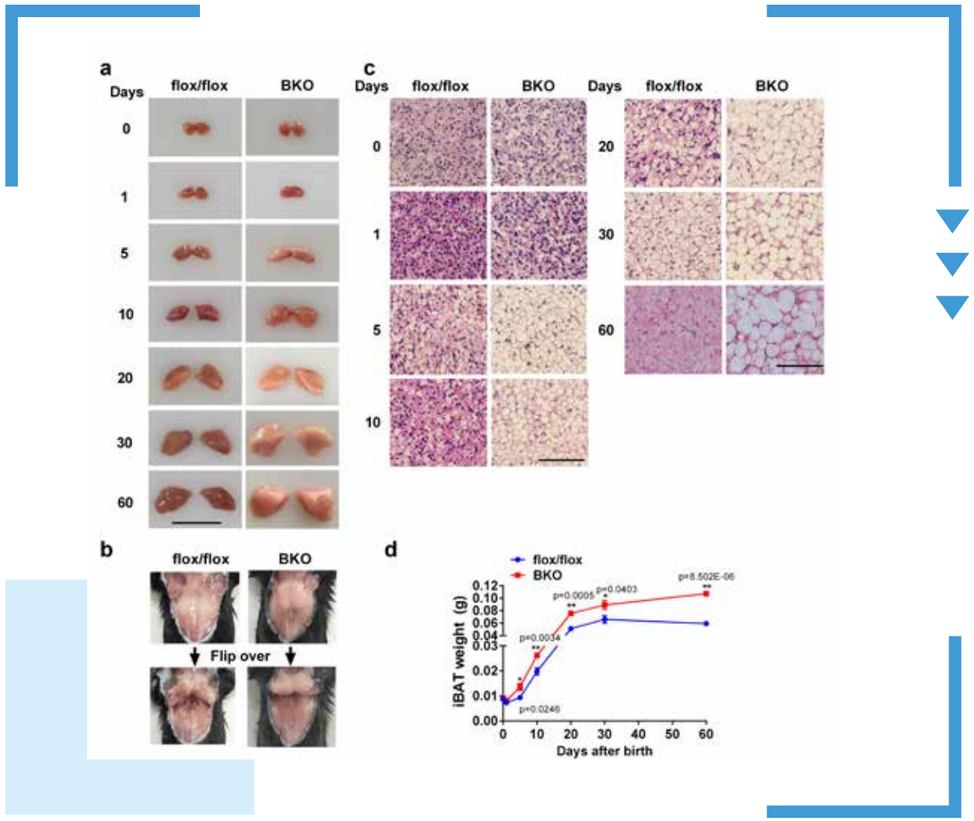
NEW STUDY ON THE KEY ROLE OF METTL3 IN THE REGULATION OF BROWN ADIPOSE TISSUE POSTNATAL DEVELOPMENT IN MICE

Dr. Chen Zheng's group from HIT Center for Life Science (HCLS) reveals the molecular mechanism of the postnatal development of brown adipose tissue (BAT). The research group identified METTL3 as a key regulator in BAT postnatal development. The research paper titled "METTL3 is Essential for Postnatal Development of Brown Adipose Tissue and Energy Expenditure in Mice" was recently published in *Nature Communications*.

BAT undergoes rapid postnatal development and then protects against cold and obesity into adulthood. However, the molecular mechanism that determines postnatal development and maturation of BAT is largely unknown. In this study, Dr. Chen Zheng's group show that METTL3 is an interscapular brown adipose tissue (iBAT) -enriched RNA methyltransferase and its expression increases significantly in iBAT after birth. BAT-specific deletion of *Mettl3* (BKO) severely impairs maturation of BAT, and BKO mice display abnormal, enlarged and "whitening" iBAT roughly after 5 days of age. This is the most severe phenotype that has not been shown in the literatures. BKO mice show decreased energy expenditure and are prone to HFD-induced obesity. RNA-seq data show that genes related to developmental maturation, respiratory electron transport chain, adaptive thermogenesis, and energy deprivation are dramatically downregulated, whereas genes associated with inflammation, muscle system process, and muscle cell development are significantly upregulated. This mRNA expression pattern in BKO



mice is strongly associated with decreased m^{6}A modification of *Prdm16, Pparg*, and *Ucp1* transcripts.

This study provides the first evidence that m^{6}A writer METTL3 plays an essential role in the postnatal development of iBAT and adaptive thermogenesis. The insights provided by this study will guide future investigations exploring the mechanisms of RNA m^{6}A pathway (including other writer, reader and eraser proteins) in controlling postnatal development of iBAT and energy metabolism.

PhD student Wang Yuqin performed most of the experiments. Other contributors include Gao Ming, Zhu Fuxing, Li Xinzhi, Yang Ying, Yan Qiuxin, Jia Linna and Xie Liwei.

This work was financially supported by the National Natural Science Foundation of China. ■

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ULTRA-LARGE ELECTRIC-FIELD-INDUCED STRAIN IN LEAD-FREE PIEZOELECTRIC CRYSTALS

Recently, Professor Tian Hao and Professor Zhou Zhongxiang from Harbin Institute of Technology collaborated with Professor Wang Ke and Professor Li Jingfeng from Tsinghua University to publish a paper titled "Ultra-Large Electric-Field-Induced Strain in Sodium Sodium Crystals" in *Science Advances*.

Piezoelectric materials are a kind of important functional material which can realize the conversion of mechanical energy and electrical energy, being widely applied in the fields of MEMS, energy recovery, medical diagnosis, and wireless communication. In 2019, the global market size for piezoelectric materials and devices has exceeded USD 25 billion, among which lead-based piezoelectric materials, represented by lead zirconate titanate (PZT), occupy the majority of the market share. However, for environmental reasons, the use of lead-based piezoelectric materials in electronic products may not be exempted after 2021, according to the EU RoHS directive. Hence, lead-free substitutes will be a new track for some applications of electronic materials in the future. Currently, the global market scale of lead-free piezoelectric materials is growing at an annual growth rate of 20.8%, and is expected to exceed USD 400 million in 2024.

In recent years, there are numerous studies on lead-free piezoelectric materials. Among many leaf-free piezoelectric materials, $K_{1-x}Na_xNbO_3$ (KNN) has a great potential because of its high piezoelectric coefficient and high Curie temperature. The research team of Professor Tian and Professor Zhou innovatively introduced the component gradient during crystal growth to grow the high-quality KNN single crystal with a controllable component gradient. The electric-field-induced strain of the KNN crystal is up to 0.9% at 1 kV/mm, and the large piezoelectric coefficient of 9,000 pm/V is realized (FIG. 1). Moreover, piezoelectric properties of the crystal do not decay with temperature in the range of 25°C–125°C, showing excellent temperature stability. Hence, the overall performance is better than that of lead-based single crystals.

The team confirmed that the high piezoelectric properties are due to the switching of non-180° domains by in-situ high energy X-ray diffraction. By investigating the domain and polarization characteristics of compositional-gradient crystals, they found that the super-large piezoelectric response only exists in crystals with the potassium/sodium ratio of 43/57 where domain structures exhibit the complex herring-like patterns (FIG. 2).

The paper's co-first authors include Dr. Hu Chengpeng and Dr. Meng Xiangda from Harbin Institute of Technology and Zhang Maohua, a postgraduate from Tsinghua University. Other collaborators include Professor John E. Daniels from the University of New South Wales, Professor

Wenwu Cao from Pennsylvania State University, Professor Li Li from Harbin Engineering University, and Lu Qieni from Tianjin University. This research work is supported by the National Natural Science Foundation of China and other funding.

In addition, Professor Tian Hao and Dr. Wang Yu from Harbin Institute of Technology collaborated with Professor Li Fei and Professor Xu Zhuo from Xi'an Jiaotong University and Professor Chen Longqing from Pennsylvania State University and together reported the latest research of high-performance transparent piezoelectric materials in *Nature*. By using the method of alternating polarization, the research team achieved the relaxation of ferroelectric single crystals with high piezoelectric and electro-optic properties and optical transmittance close to the theoretical limit. ■

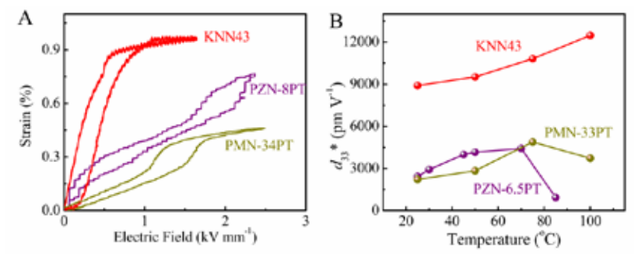

FIG. 1 Piezoelectric properties of KNN crystal (KNN43)

(a) Comparison of the electric-field-induced strain of KNN43 crystal with other lead-based materials at room temperature

(b) Temperature dependence of d_{33}*

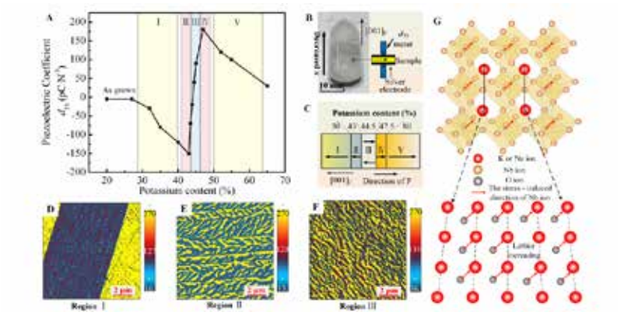

FIG. 2 Piezoelectric properties and domain structures of KNN crystals

(a) Piezoelectric coefficient d_{33} versus potassium content

(B) The photo of KNN crystal

(C) Schematic diagram of macroscopic spontaneous polarization direction versus components

(D-F) Domain structure of crystals with different K contents (0.37, 0.43, and 0.45), respectively

(G) Schematic diagram of component-gradient-induced restoring force of domain switching

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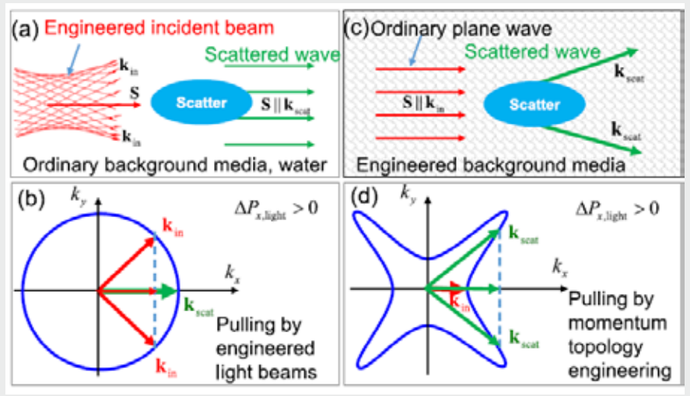
2.Chaorui Qiu, Bo Wang, Nan Zhang, Shujun Zhang, Jinfeng Liu, David Walker, Yu Wang, Hao Tian, Thomas R. Shrout, Zhuo Xu, Long-Qing Chen and Fei Li. Transparent ferroelectric crystals with ultrahigh piezoelectricity. Nature, 2020, 577: 350–354

BREAKTHROUGH ON OPTICAL PULLING FORCE GENERATION

Recently, a group led by Professor Ding Weiqiang from the School of Physics at Harbin Institute of Technology achieved a breakthrough on advanced optical manipulation. The research paper titled "Momentum-Topology-Induced Optical Pulling Force" was published in *Physical Review Letters*.

Recently, the counterintuitive optical pulling force (OPF) has attracted much attention due to its rich physics and potential applications in biophysics, nanotechnology, and quantum physics. In practice, however, it's a great challenge to generate an OPF, which exists only in science fictions several years ago.

In this research, an ingenious mechanism to obtain robust OPF via engineering the topology of light momentum is reported in a carefully designed photonic crystal. In this structure,



the topology of light momentum is transformed from the conventional convex shape to a concave shape. When the incident wave is scattered from axial to off-axial directions, the momentum of the light field increases surprisingly, rather than decreases as usual. As a result, according to the linear momentum conservation law, the object gets an efficient and stable OPF. This work greatly deepens the understanding of light momentum, and pave the way for a new class of advanced optical manipulation technique.

This has been the second breakthrough achieved by Ding's group in the field of optical manipulation, since they discovered the self-induced optical pulling effect in 2018 (Physical Review Letters, 2018, 120, 123901). Ding's group has carried out a series of innovative investigations in the interdisciplinary of nano photonics and optical force, which makes them a worldwide leading team in the field of optical manipulation. This work was supported by the National Natural Science Foundation of China. ■

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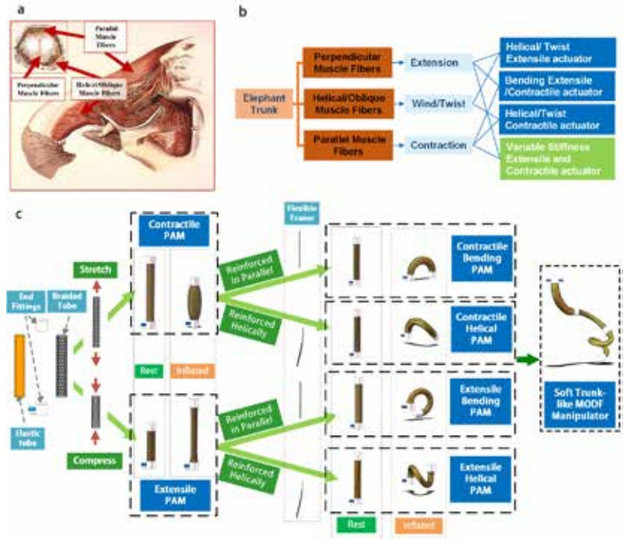
NEW PROGRESS IN BIONIC BENDING AND HELICAL PNEUMATIC ARTIFICIAL MUSCLES

As the soft robotic field flourishes, research on soft actuators has gained increased attention from the general field of robotics. Compared with robots built with rigid structures and components and motors, soft robots have the merits of greater power density, good compliance, high flexibility, safer interaction and excellent environmental adaptability. With these advantages, soft robots are gradually expanding into new fields closer to human life, such as health care, family life, education, services and entertainment and playing an increasingly important role in human society. Recently, a group led by Professor Leng Jinsong from the National Key Laboratory of Science and Technology on Advanced Composites in Special Environments at Harbin Institute of Technology (HIT) published a paper titled "Novel Bending and Helical Extensile/Contractile Pneumatic Artificial Muscles Inspired by Elephant Trunk" in *Soft Robotics*. This work was conducted by the team led by Professor Leng from HIT and Professor Norman M. Wereley from University of Maryland, College Park. They developed a series

of extensile/contractile bending and helical Pneumatic Artificial Muscles (PAMs). Through the establishment of mathematical models and performance characterization experiments, the authors systematically analyzed and studied the axial, bending and helical PAMs via three-dimensional curved surface clusters and provided a reference map for the designers and researchers.

A soft manipulator with multiple degrees of freedom inspired by an elephant trunk was developed to explore the potential application of bending and helical PAMs. A contractile PAM has a large output or load capacity, while extensile PAM can produce more deformation. So according to the output characteristics, the researchers used a contractile PAM in the first section to bear the maximum load, and extensile PAM in the second section to provide a wider range of motion. Meanwhile, the helical PAM was mounted at the end to grasp objects in a way that mimics the movements of the elephant trunk. The total length and maximum diameter of the whole soft arm are 65.5cm and 2.5cm respectively. Thus the length/diameter ratio of the flexible manipulator can reach to 26.2, even larger than the real elephant trunk. It is expected to be used in medical care such as surgical robots and endoscopic devices.

The bending and helical PAMs can also be widely applied to a wide variety of situations, including soft sorting manipulators, force feedback devices, assistant exo-suits, search robots, and bionic robots. ■



PAMs inspired by the elephant trunk

(a) Muscle fiber distribution of elephant trunk

(b) The bionic methodology of PAMs

(c) Schematics and fabrication of bending and HE-PAMs/HC-PAMs and the soft trunk-like MDOF manipulator based on these PAMs. HC, helical contractile; HE, helical extensile; MDOF, multi-degree-of-freedom; PAM, pneumatic artificial muscles

Reference

Qinghua Guan, Jian Sun, Yanju Liu, Norman M. Wereley, Jinsong Leng. Novel bending and helical extensile/contractile pneumatic artificial muscles inspired by elephant trunk. Soft Robotics, 2020, DOI: 10.1089/soro.2019.0079

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