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LEAD ARTICLE

Panoramic photo taken on January 8, 2020 shows China's Five-hundred-meter Aperture Spherical radio Telescope (FAST) under maintenance in Southwest China's Guizhou province. [IMAGE: XINHUA]

World's largest radio telescope starts formal operation

China completed commissioning of the world's largest and most sensitive radio telescope on January 11, putting it into formal operation after a productive three-year trial.

The telescope will gradually open to astronomers around the globe, providing them with a powerful tool to uncover the mysteries surrounding the genesis and evolution of the universe.

All technical indicators of the telescope have reached or exceeded planned levels, and its performance is world-leading, Shen Zhulin, an official with the National Development and Reform Commission, said at a commissioning meeting on January 11.

The Five-hundred-meter Aperture Spherical radio Telescope (FAST) is a single-dish telescope with a diameter of half a kilometer and a receiving area equivalent to about 30 football fields. It is located in a naturally deep and round karst depression in Southwest China's Guizhou province.

Now that it is commissioned, FAST can be used for observations at full capacity, and is expected to make a number of major scientific discoveries in the coming two or three years, said Jiang Peng, the chief engineer of the telescope.

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HOT ISSUE

Research Fronts 2019 released: China is reducing gap between it and US in frontier research

China ranks first in 33 of 137 global research fronts, according to the report "Research Fronts 2019". >> PAGE 3

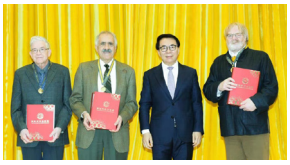
RESEARCH PROGRESS

Major progress achieved in low-cost electrocatalytic materials

Prof. Wang Jiacheng in collaboration with other professors discovered that zirconium nitride (ZrN) catalyst based on cheap earth-abundant elements is a highly attractive alternative to Pt for oxygen reduction reaction in alkaline environments. >> PAGE 5

INTERNATIONAL COOPERATION

Foreign scientists receive medals in China for research contribution



CAS honored three foreign scientists from the Netherlands, the United States and Germany for their contributions to Sino-foreign research cooperation on January 16 in Beijing. >> PAGE 8

SCIENCE STORY

SIAT hosts New Year event for foreign friends

More than 30 foreigners from 17 countries celebrated the Chinese New Year at CAS's Shenzhen Institutes of Advanced Technology on the afternoon of January 9. >> PAGE 9

Edited by Bureau of International Co-operation, Chinese Academy of Sciences
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>> PAGE 1

In over two years, FAST has identified 102 new pulsars, more than the total number discovered by research teams in Europe and the United States during the same period.

It has also improved the timing accuracy of pulsars to about 50 times the previous level, making detection of extremely low-frequency Nahertz gravitational waves possible for the first time.

Dubbed "China Sky Eye," FAST is about 2.5 times as sensitive as the second-largest telescope in the world and capable of receiving up to 38 gigabytes of information per second.

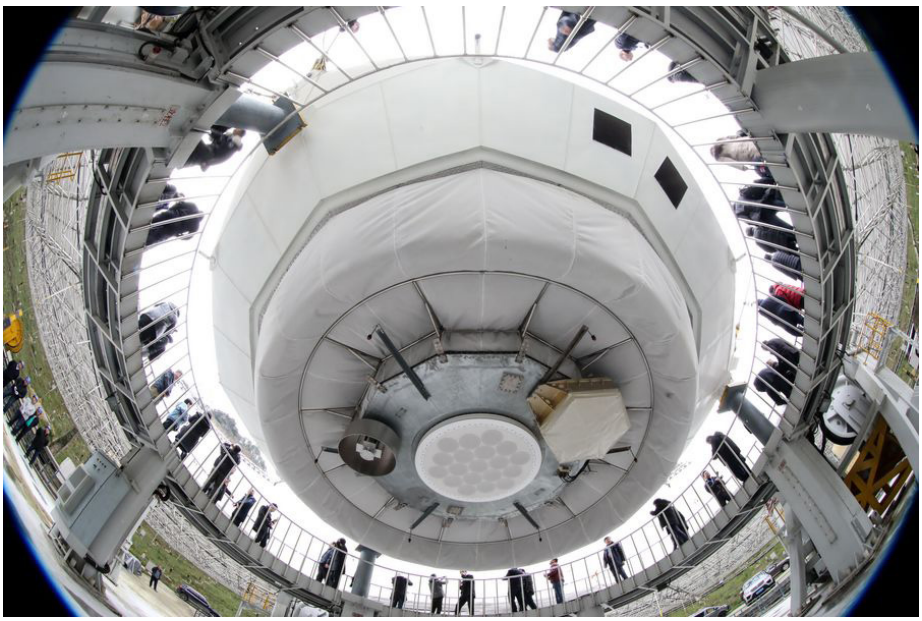
FAST has expanded by a factor of four the volume of the space range that radio telescopes can effectively explore, which means that scientists can discover more unknown stars, cosmic phenomena and laws of the universe, or even detect extraterrestrial life, said Li Kejia, a scientist at the Kavli Institute for Astronomy and Astrophysics at Peking University.

Carl Heiles, a professor of astronomy at the University of California, Berkeley and a member of the National Academy of Sciences of the United States, said FAST provides revolutionary opportunities for astronomy, especially in identifying pulsars and observing interstellar clouds.

At a cost of nearly 1.2 billion yuan (around $170 million), FAST was completed in September 2016, over 20 years after it was proposed by Chinese astronomers.

Yan Jun, former director of the National Astronomical Observatories of the Chinese Academy of Sciences and project manager of FAST, said with growing economic strength and increasing investment in basic scientific research, China is poised to make greater contributions to the common cause of mankind.

Nearly 10 scientists from the United States, Britain and Pakistan have worked at FAST. More global collaborations are expected in areas such as gravitational wave detection and very-long-baseline interferometry (VLBI) as part of its formal operations.



Experts and scholars visit China's Five-hundred-meter Aperture Spherical radio Telescope (FAST) under maintenance in Southwest China's Guizhou province, January 11, 2020. [IMAGE: XINHUA]

Experts and scholars visit China's Five-hundred-meter Aperture Spherical radio Telescope (FAST) under maintenance in Southwest China's Guizhou province, January 11, 2020. [IMAGE: XINHUA]

To ensure FAST's performance, about 7,000 residents living in the vicinity were relocated, before being moved back to a town 10 km away from the telescope. An astronomy-themed park has been built around the site of FAST, drawing a large number of visitors and tourists.

Nan Rendong, who had worked as the chief scientist of a team who selected the site for FAST and oversaw its construction, died in 2017 due to sickness at the age of 72. China honored him with several posthumous titles, including "role model of our times."

Source: China Daily

Research Fronts 2019 Release and Seminar [IMAGE: INSTITUTES OF SCIENCE AND DEVELOPMENT, CHINESE ACADEMY OF SCIENCES]

Research Fronts 2019 released: China is reducing gap between it and US in frontier research

China ranks first in 33 of 137 global research fronts, according to the report "Research Fronts 2019" jointly released by the Institutes of Science and Development of the Chinese Academy of Sciences (CASISD), the National Science Library of the Chinese Academy of Sciences, and Clarivate Analytics on November 26.

The 2019 report identifies a total of 137 research fronts based on the specific commonalities indicated by clusters of highly cited papers, including 100 hot and 37 emerging specialties spanning 10 broad research areas in sciences and social sciences, and interprets them to reveal the evolution of scientific research and innovation trends, helping researchers, policy makers, and research administrators to determine key scientific areas.

"Strong basic research is the foundation of a technological powerhouse," said Bai Chunli, President of the Chinese Academy of Sciences. The world's major science powers are all strengthening strategic planning in basic research in frontier sciences, which will become the new arena for future technological competition, he added.

"We will need to accurately identify key research fields and trends if we hope to make major original breakthroughs in frontier sciences, solve major science obstacles for national needs, and support our nation's innovation-driven development."

Among the 10 broad areas, the US leads in seven in research activity and influence, while China leads in three: chemistry and materials sciences, math/computer sciences and engineering, and ecology and environmental sciences.

"These three fields are closely related to the requirements for China's growth, and the excellence reflects problem-driven innovation in China," said Pan Jiaofeng, CASISD President.

However, China has significantly fallen behind the US in two fields: astronomy and astrophysics. Though ranking second in physics, biology, earth sciences, and social science fields such as economics and psychology, it is separated from the US by a substantial gap, according to the report.

Leng Fuhai, a CASISD professor, said the US is generally very strong and capable across most frontier fields, while China excels in a few areas but has noticeable shortcomings in others.

A second analytical report entitled "2019 Research Fronts: Active Fields, Leading Countries" was also published, examining and comparing national performances across the 137 research fronts. This report reveals that although China, in second place, was closing the gap, the US was still leading global research in 2019. The UK, Germany and France ranked third, fourth and fifth respectively.

Source: Institutes of Science and Development, Chinese Academy of Sciences

Scientific expedition team unveil survey of Asia's water tower

A scientific expedition team that conducted the second comprehensive research investigation into the Qinghai-Tibet Plateau described the changes, impacts and countermeasures of Asia's water tower at a conference in Beijing on December 18.

The Qinghai-Tibet Plateau has the third largest reserves of ice and snow in the world, following the Antarctic and the Arctic. Dubbed "Asia's water tower", it is home to the headwaters of more than 10 large rivers in Asia.

Its changes affect about two billion people in China and countries involved in the Belt and Road Initiative.

Yao Tandong, a member of the Chinese Academy of Sciences, who serves as the team leader for the expedition project, announced their scientific achievements at the conference.

Top: Yao Tandong, member of the Chinese Academy of Sciences, announces their scientific achievements at the conference. [IMAGE: CAS]

The team joined hands with scientists from many countries to evaluate the importance of 78 water towers around the world, including 16 in Asia, the most important globally.

The top five water tower rivers in Asia are the Indus, Tarim, Amu Darya, Xier and the Ganges-Yarlung Zangbo. The Indus is the most important for its abundant water resources and the huge demands made on it for life and irrigation in its downstream areas.

The scientists found that Asia's water tower is the most vulnerable water tower in the world, and that the Indus is the most vulnerable water tower river in the world.

The Amu Darya, Ganges-Yarlung Zangbo, Xier and Tarim rivers are the top five most vulnerable water tower rivers in Asia.

It is predicted that by 2050, the population of the basin will increase by 50 percent, GDP will grow nearly eight times, temperatures will rise by 1.9 degrees centigrade, and precipitation will increase by 0.2 percent. All of these factors will lead to the increasing vulnerability of the Indus River.

Asia's water tower is warming at twice the global warming rate, which causes imbalance within it.

The main characteristics of that imbalance are accelerated retreat of glaciers, significant expansion of lakes, increase of glacier runoff, and new disasters such as ice avalanches.

The ice avalanches not only threaten the water tower in Asia, but also seriously affect the social and economic development of downstream areas. The imbalance will also cause changes in Asian monsoons, which will affect the environment of China and other parts of Asia.

Based on these scientific findings, the team adopted a new mode of coping with the impact of unbalancing of water towers in Asia based on three-dimensional observations and combining frontier scientific issues and cutting-edge technologies. They established an ice avalanche disaster monitoring and early warning system and provided a new and effective technical guarantee for regional disaster prevention and mitigation.

For example, the research team quickly completed a scientific assessment report on the ice avalanche in the Yarlung Zangbo River which provides a plan for reducing such disasters in the Tibet autonomous region.

They also established a monitoring and early warning system in the Yarlung Zangbo River, which includes a ten-meter monitoring tower at the ice-blocked section and all-weather monitoring technology to record data that are then transmitted to the platform of the scientific research office through satellite and mobile signals.

Source: Institute of Tibetan Plateau Research, Chinese Academy of Sciences

Major progress achieved in low-cost electrocatalytic materials

The huge consumption of fossil fuel has led to environmental pollution and an energy crisis. It is foreseeable that, in the near future, limited carbon-based fossil energy will be replaced by endless renewable energy, of which fuel cells and metal-air batteries are the best candidates as sources. However, the Pt catalyst used in the fuel cells is so expensive that its cost accounts for about 20 percent of the total cost of the fuel cell. The high cost limits the wide applications of fuel cells. Therefore, the development of low-cost electrocatalytic materials with high activity and stability still remains a great challenge.

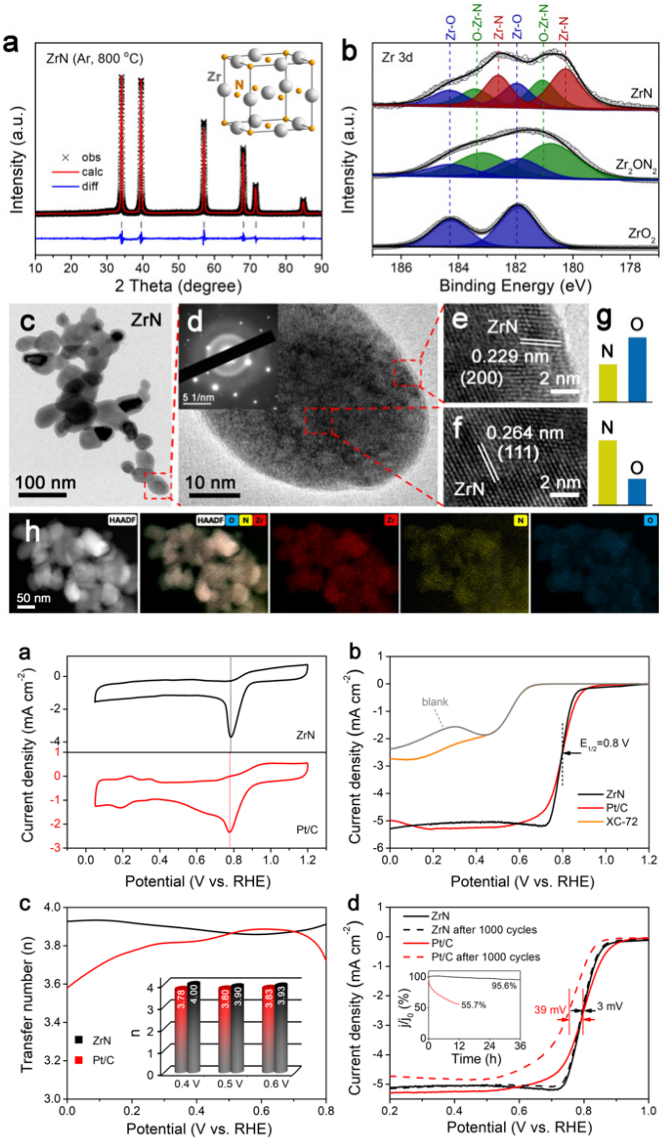
Recently, Prof. Wang Jiacheng from the Shanghai Institute of Ceramics of the Chinese Academy of Sciences, in collaboration with Prof. Yang Minghui from the Ningbo Institute of Materials Technology and Engineering, also of CAS, Prof. J. Paul Attfield from the University of Edinburgh and Prof. Tiju Thomas from the Indian Institute of Technology of Madras Adyar, discovered that zirconium nitride (ZrN) catalyst based on cheap earth-abundant elements is a highly attractive alternative to Pt for oxygen reduction reaction (ORR) in alkaline environments. The ZrN catalyst features low cost, high activity and superior stability. The study was published in *Nature Materials* (doi: 10.1038/s41563-019-0535-9) under the title "Zirconium Nitride Catalysts Surpass Platinum for Oxygen Reduction".

In this study, the scientists produced fine ZrN NPs using a urea–glass route at moderate temperatures, and showed that ZrN can replace and even surpass Pt as a catalyst for oxygen reduction in alkaline environments. In addition, ZrN has a higher stability than the Pt/C catalyst. In a zinc-air battery device, the performance of commercial Pt catalysts deteriorates significantly after a period of time; while the performance of ZrN catalysts deteriorates much more slowly.

In the future, the research team will further cooperate with industry to bring this research outcome into practical use in the clean energy field. It is expected to answer global concerns about energy crisis problems and environmental pollution.

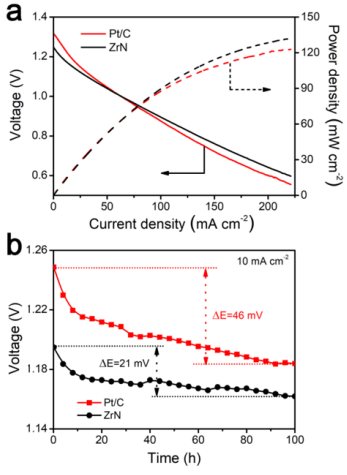
For more information, please contact:
Prof. Wang Jiacheng
Shanghai Institute of Ceremics, Chinese Academy of Sciences
E-mail: jiacheng.wang@mail.sic.ac.cn

Source: Shanghai Institute of Ceremics, Chinese Academy of Sciences



Top: Fig. 1 Characterization of ZrN NPs [IMAGE: PROF. WANG JIACHENG'S GROUP]

Above: Fig. 2 ORR catalysis properties of nanoparticulate ZrN and Pt/C in an O_2-saturated 0.1 M KOH solution [IMAGE: PROF. WANG JIACHENG'S GROUP]



Right: Fig. 3 Zinc–air batteries using nanoparticulate ZrN or Pt/C cathodes [IMAGE: PROF. WANG JIACHENG'S GROUP]

Mechanism of REV7 recruitment by SHLD during DNA double-strand break repair discovered

DNA double-strand breaks (DSBs) are extremely vicious DNA lesions that may cause carcinogenesis or cell death if not properly repaired. In vertebrate cells, there are two main repair pathways: non-homologous end-joining (NHEJ) and homologous recombination (HR); both are employed in eliminating the cytotoxic DSBs and thereby ensuring genomic integrity. The decision-making process of repair pathways is a critical step during DSB response, which is spearheaded by 53BP1 and its downstream effectors.

A recently characterized four-subunit complex, named Shieldin, acts downstream 53BP1 to protect DNA from resection and facilitate NHEJ repair. SHLD3 is the most apical subunit within complex and it constitutes the DSB recruitment module of Shieldin along with REV7. SHLD3 and REV7 are essential for correct localization of Shieldin at DSB sites, but how they interact with one another remains unknown. A new study by Chinese and American researchers has now revealed the underlying mechanism. This research enhances understanding of how the DSB recruitment module assembles within the Shieldin complex.

The study was conducted by Dr. Zhou Zheng's group from the Institute of Biophysics (IBP) of the Chinese Academy of Sciences and Dr. Gong Zihua's group from the Cleveland Clinic Lerner Research Institute in the United States. Results were published online in *Journal of Biological Chemistry* on December 3, 2019 in an article entitled "Structural basis for shieldin complex subunit 3–mediated recruitment of the checkpoint protein REV7 during DNA double-strand break repair".

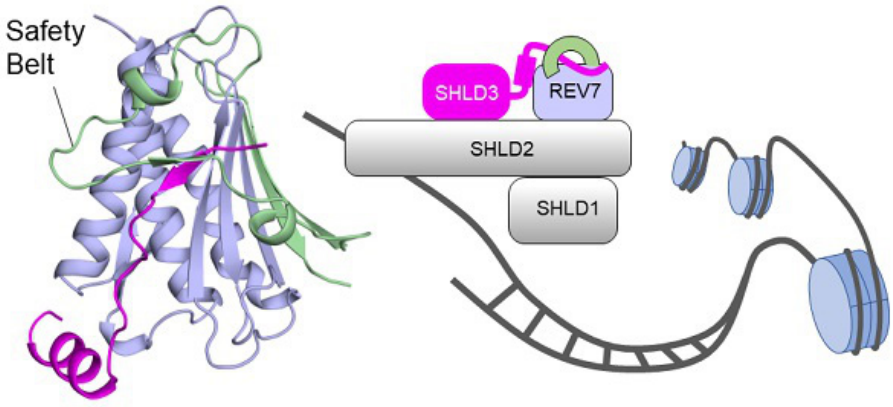


Figure: Overall structure of SHLD3-REV7 complex and their roles in DSB repair
[IMAGE: DR. ZHOU ZHENG'S LAB]

Zhou's team firstly identified the minimal REV7-binding domain (RBD) in SHLD3 after several rounds of screening. Through Isothermal Titration Calorimetry (ITC), SHLD3-RBD was shown to have a high-affinity binding ability to REV7 (with low-nanomolar affinity). Then the researchers successfully assembled a stable SHLD3-REV7 complex and determined high-resolution complex structures by using X-ray crystallography.

The structures revealed that SHLD3-RBD binds REV7 in a unique ladle-shaped conformation, with its N-terminal loop and C-terminal α-helix (αC-helix) acting as "stem" and "base", respectively. Through extensive in vitro and in vivo binding analyses, the scientists found that both parts of SHLD3-RBD are indispensable for REV7 recognition.

In addition, via surface plasmon resonance (SPR) assay, the researchers present a binding kinetic view of REV7-SHLD3 interaction. The results show that the "safety-belt" region, which plays a role in binding other proteins, is essential for SHLD3-REV7 binding, as it retards the dissociation of the RBD from the bound REV7.

This study reveals the molecular basis of the SHLD3-REV7 interaction, provides critical insights into how SHLD3 recruits REV7, and paves the way for development of medicines for cancer treatment.

For more information, please contact
Prof. Zhou Zheng
Institute of Biophysics, Chinese Academy of Sciences
E-mail: zhouzh@ibp.ac.cn

Source: Institute of Biophysics, Chinese Academy of Sciences

CAS President Bai Chunli (R, Front) signs an agreement with CNES President Jean-Yves Le Gall on space science research cooperation on January 13 in Beijing. [IMAGE: BUREAU OF INTERNATIONAL COOPERATION, CHINESE ACADEMY OF SCIENCES]

CAS President meets with French delegation to talk about further cooperation

Bai Chunli, President of the Chinese Academy of Sciences (CAS), met with a French delegation on January 13 in Beijing for extensive discussions on scientific research and education cooperation between China and France.

The delegation consisted of Frédérique Vidal, Minister of Higher education, Research and Innovation of France, Laurent Bili, French ambassador to China, Antoine Petit, Chairman and CEO of the French National Centre for Scientific Research (CNRS), Jean-Yves Le Gall, President of the Centre National D'Etudes Spatiales (CNES), and Gérard Mourou, 2018 Nobel Prize Winner in Physics.

Zhang Yaping, Vice President of CAS, attended the meeting.

Bai signed cooperation agreements with Petit and Le Gall respectively on the environment and biodiversity, and space science research.

Bai extended a warm welcome to Vidal. He said in order to implement the two joint declarations between China and France, CAS has recently strengthened collaboration with French government departments and research institutions in the environment, biodiversity, space science, artificial intelligence, energy and infectious disease prevention and control.

Bai described the progress of CAS in integrating science and education and developing large scientific devices and satellites, and expressed his hope of promoting cooperation in these areas between the two sides. He added that the cooperation agreements reached between CAS, the CNRS and the CNES are of great significance in that regard.

Vidal congratulated and fully affirmed the fruitful cooperation between the two sides in various fields. She hoped they will further enhance their joint efforts in the environment and biodiversity, particle physics and space science, and promote exchanges between the young scientists of the two countries.

Representatives of CAS's related research bureaus and institutes, and staff of the French Embassy in China, participated in the event.

Source: Bureau of International Cooperation, Chinese Academy of Sciences

Foreign scientists receive medals in China for research contribution

China's top science academy honored three foreign scientists from the Netherlands, the United States and Germany for their contributions to Sino-foreign research cooperation on January 16 in Beijing.

Bai Chunli, President of the Chinese Academy of Sciences (CAS), conferred the Academy's Award for International Scientific Cooperation on Dutch astronomer Richard Gordon Strom, American physicist Sokrates Theodore Pantelides and German environmental scientist Ewald Schnug.

Professor Strom has cooperated with CAS for about 30 years. He is the only foreign expert participating in the Five-hundred-meter Aperture Spherical radio Telescope (FAST) project in China.

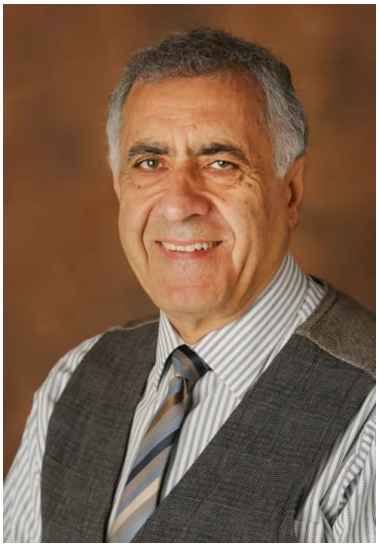
Apart from his contributions to the project's pre-research, establishment and construction, Strom promotes the Academy to cooperate with the global radio astronomy community and helps train Chinese researchers.

Pantelides is a professor at Vanderbilt University in the United States and a pioneer in the field of semiconductor physics. Over the past two decades, he has carried out substantive cooperation with CAS in developing new low dimensional materials.

According to Pantelides, the award is recognition of a partnership that can provide a multifaceted outreach between the Chinese and American scientific communities.

Ewald Schnug is a German researcher in soil and environmental science. He has worked with the Academy for more than 20 years, bringing advanced fertilizer processing technology into China.

Ewald Schnug



Sokrates Theodore Pantelides

Richard Gordon Strom

Launched in 2007, the CAS award has been given to 37 foreign scientists. Many of the winners also received China's national award for international cooperation in science and technology.

Source: Xinhua

SIAT hosts New Year event for foreign friends

Group Photo [IMAGE: SIAT]

Foreigners play a puzzle game together. [IMAGE: SIAT]

More than 30 foreigners from 17 countries celebrated the Chinese New Year at Shenzhen Institutes of Advanced Technology of the Chinese Academy of Sciences (SIAT), on the afternoon of January 9, the first Chinese New Year Event held this year for international students and staff.

"In the past 13 years SIAT made significant achievements. It has an open and excellent environment for foreign students and staff to study and work hard here," said Vice President Zheng Hairong. On behalf of the Party and administration leaders of SIAT, Zheng extended his greetings for the upcoming Spring Festival, introduced the main work and development of SIAT in recent years, and shared his own experience of studying abroad.

Professor Horst Voge and Professor Olaf Eichstadt, as representatives of foreign staff, described their experiences as international teachers working in the institute as well as their learning experiences and ways of doing scientific research with the foreign students.

"I am so glad to be a member of SIAT; there are plenty of opportunities for us," said Adeleye Oluwatosin Adeshakin, the winner of this year's President's Award of SIAT. Oluwarotimi Williams Samuel, a CAS-PIFI (CAS President's International Fellowship Initiative) winner of last year, also shared his 8-year research and life experience in China at the event.

After the meeting, participants went to the Shenzhen Reform and Opening-up Museum and Shenzhen Happy Coast for a visit. The surging tide of China's reform and opening-up has deeply impressed all the international friends, giving them a deeper understanding of the rejuvenation of the Chinese nation and the development of Shenzhen.

"China's speed amazed the world," said everyone present at the event. "It is indeed an honor to work and study in SIAT, so that we have the opportunity to witness and participate in the development of Shenzhen and China as a whole. We will spare no efforts to become excellent ambassadors for the dissemination and exchange of Chinese and foreign cultures!"

Source: SIAT

Xi honors two academicians with China's top science award

President Xi Jinping presented China's top science award to Huang Xuhua and Zeng Qingcun on January 10 for their outstanding contributions to scientific and technological innovation.

Huang Xuhua, a member of the Chinese Academy of Engineering, was the chief designer of the country's first-generation nuclear submarines.

Born in Guangdong Province in 1926, Huang later joined a research institute of the former China Shipbuilding Industry Corporation, and has been engaged in the research and development of nuclear submarines for about 30 years. He won the Medal of the Republic in 2019 for his outstanding contributions to the nation.

Zeng Qingcun, 85, is a famous meteorologist from the Institute of Atmospheric Physics under the Chinese Academy of Sciences (CAS).

His theory of numerical weather prediction solved the problems of timeliness and stability in calculating multi-scale weather change processes and is the basis of global numerical weather prediction technology.

Zeng's visionary study on global climate change has brought him international acclaim and a host of accolades, including the world's top prize for meteorological work.

Friday's ceremony also honored 296 projects, with 46 winning the State Natural Science Award, 65 the State Technological Invention Award, and 185 the State Scientific and Technological Progress Award.

Ten foreign experts won the International Science and Technology Cooperation Award.

Source: Xinhua

Science magazine: China's archaeological discovery a top 10 breakthrough

The discovery of a fossilized Denisovan jaw in the Qinghai-Tibet in China, which was led by two Chinese scientists, was listed among the Top 10 Breakthroughs of the Year by *Science* magazine on December 20.

The two researchers were Chen Fahu, a member of the Institute of Tibetan Plateau Research, Chinese Academy of Science, and Zhang Dongju, associate professor of the College of Earth and Environment Sciences, Lanzhou University.

Their results have been added to the list of the top 10 archaeological discoveries by the American Journal *Archeology* and included as a top 10 news item of 2019 by *Science News* magazine.

The fossil was found in Xiahe county, Northwest China's Gansu province. Archeologists have verified that the fossil can be dated back 160,000 years, after comprehensive analysis of its physique, molecular nature, living environment and human adaptation.

It is believed to be the first fossil of a member of the hominin species known as Denisovans to be found outside the Denisova Cave in southern Siberia's Altay Mountains.

A 3D model of a Denisovan mandible found in Baishiya Karst Cave in Xiahe county, Northwest China's Gansu province [IMAGE: INSTITUTE OF TIBETAN PLATEAU RESEARCH, CHINESE ACADEMY OF SCIENCES]

Prior to the discovery, scientists considered a site in Nwya Devu, about 300 kilometers northwest of Lhasa, to be the oldest archaeological site in the Tibetan Plateau.

Archeologists have verified that the fossil can be dated back 160,000 years, and the finding signals that ancient humans lived in the plateau that long ago, much earlier than the 40,000 years suggested by previous archaeological discoveries.

Source: Institute of Tibetan Plateau Research, Chinese Academy of Sciences