中国科学院 CHINESE ACADEMY OF SCIENCES
CASNewsletter
NO. 177 • July 2021

SCIENCE ACROSS TIME & SPACE

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

CAS Newsletter
– Monthly –
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Learn more

China reports latest findings from space science programs

On July 20, the Chinese Academy of Sciences (CAS) released details of the most recent scientific achievements from its space science programs, including space-based gravitational wave detection, space microgravity experiments, and the observation of black-hole explosions.

According to CAS, Taiji-1, China's first satellite to conduct experiments on key technologies related to space-based gravitational wave detection, has completed all preset experimental tasks. It has accomplished the highest degree of precision in space laser interferometry so far in China.

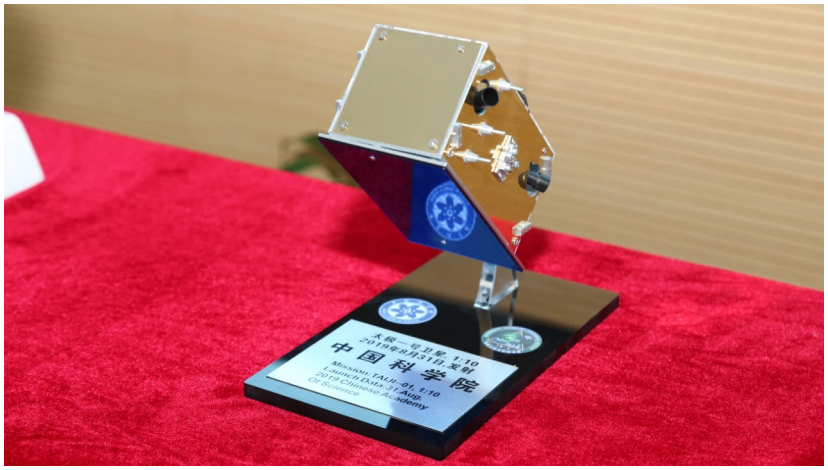
Meanwhile, SJ-10, China's first satellite to conduct microgravity experiments, has for the first time developed a cell embryo into a blastocyst under microgravity conditions, revealing key factors affecting the early embryo development of mammals in a space environment.

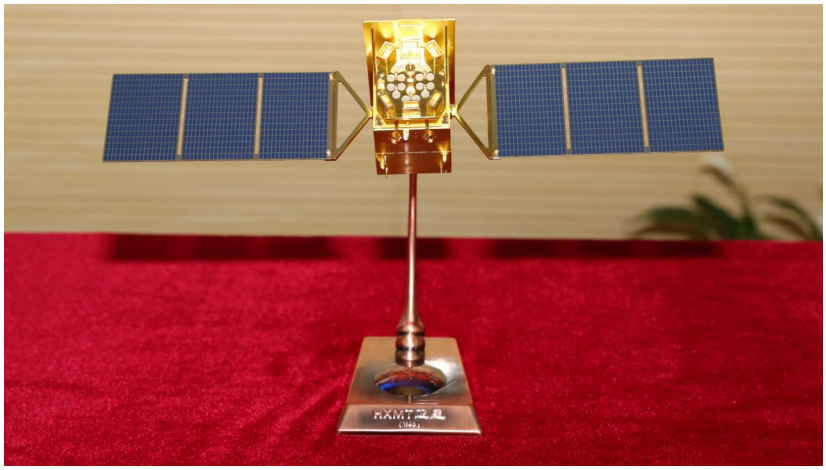
Finally, China's Hard X-ray Modulation Telescope, also known as *Huiyan*, or *Insight*, clearly observed panoramic views of the explosion of black hole binaries for the first time.

The three satellites were all deployed by CAS as part of its space-science pilot project, which was formally established in 2011.

CAS will continue to strengthen the research in space science areas such as the extreme universe, space-time ripples, sun-earth panorama, and habitable planets, in order to better understand the universe, said Wang Chi, Director of CAS's National Space Science Center (NSSC).

Source: Xinhua





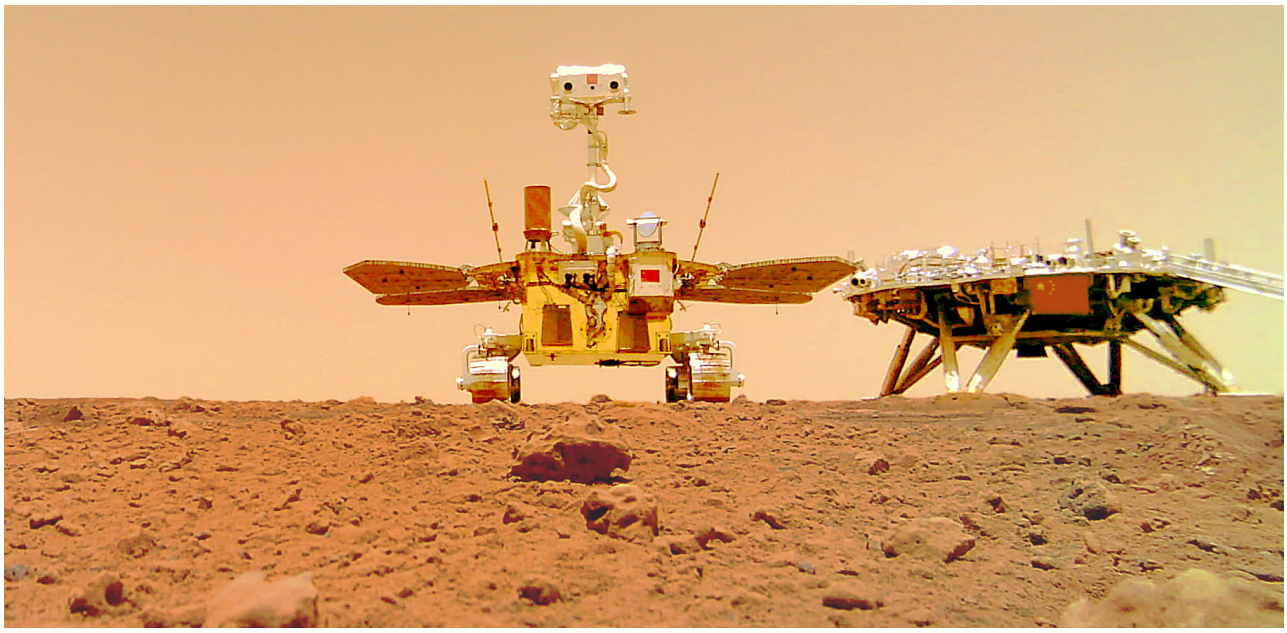
[IMAGES: NSSC]

[IMAGES: CHINA DAILY]

CAS physicist outlines quantum communication progress to USTC audience

Pan Jianwei, a leading Chinese quantum physicist and academician of the Chinese Academy of Sciences (CAS), delivered a speech to the Science and Culture Salon at the University of Science and Technology of China (USTC) on June 17. In the 90-minute talk, themed on "The New Quantum Revolution", he outlined to the audience the country's recent advancement in quantum communication and computing, as well as his team's major short and long-term goals. CAS's Science Communication Research Center (SCRC-CAS) organized the salon, which will be followed by more of the kind.

Source: China Daily



On June 11, 2021, the China National Space Administration published four pictures taken by the Tianwen 1 robotic mission. [IMAGE: CHINA NATIONAL SPACE ADMINISTRATION]

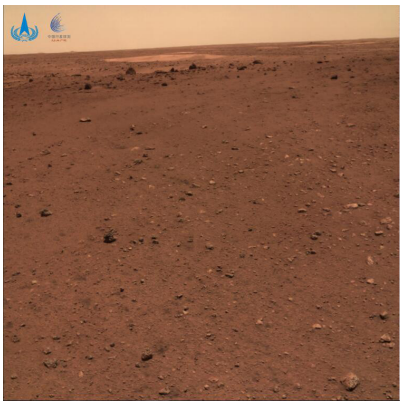
New images of Mars unveiled

China to share scientific findings for the benefit of all

On June 11, the China National Space Administration published four pictures taken by the Tianwen 1 robotic mission, showing the Zhurong rover on the Martian surface and the scene of its landing site.

Three pictures were taken by Zhurong's cameras, and display the rover's upper stage, its landing platform and the environment around the landing site. Another one was shot by a separate camera deployed by Zhurong on Martian soil, showing the rover and the landing platform together.

A fabric Chinese national flag and a drawing of the mascots of the Beijing 2022 Winter Olympics and Paralympic Winter Games are noticeable in the landing platform's picture. Also in this photo, the tracks of Zhurong on the planet surface can be clearly seen.



On June 11, 2021, the China National Space Administration published four pictures taken by the Tianwen 1 robotic mission. [IMAGE: CHINA NATIONAL SPACE ADMINISTRATION]

The photo of Zhurong and the landing platform was created by a small camera which was originally attached to the bottom of the rover and then placed on Martian soil when the rover traveled about 10 meters to the south of its landing platform.

After dropping the camera, Zhurong moved back towards the platform. The process was recorded by the camera, which transmitted the video and pictures to the rover via radio signals.

The backdrop to these photos is the reddish, barren Martian surface, on which Tianwen 1's landing capsule touched down on May 15 in the southern part of the Utopia Planitia, a large lava plain within the largest known impact basin in the solar system.

The pictures were released at a ceremony held by the space administration at its Beijing headquarters.

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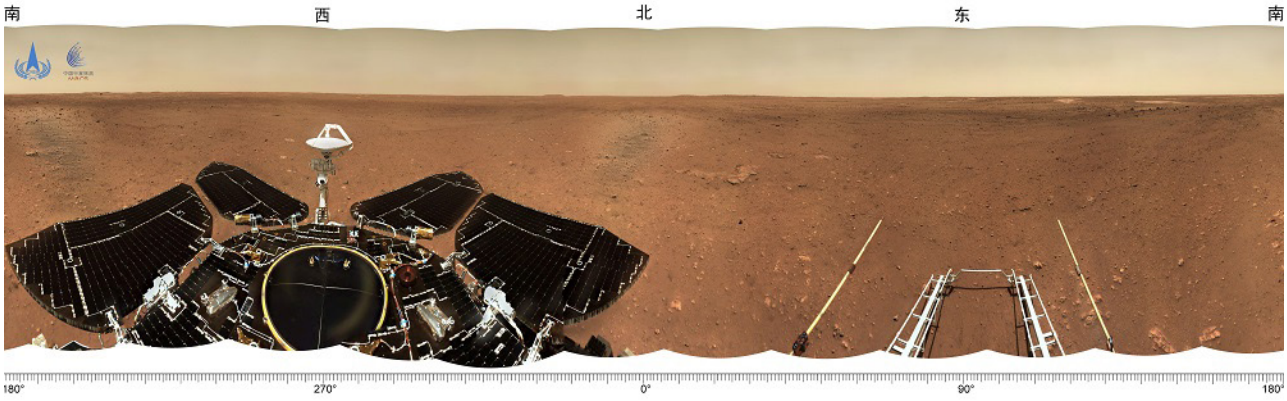

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Zhang Kejian, director of the administration, said at the ceremony that China will share the scientific findings from its space missions with other nations to benefit people from all around the world.

As of June 11, Zhurong has been working on the planet for 28 Martian days, carrying out scientific explorations.

The robot is now hundreds of millions of kilometers from Earth. It is the sixth rover on Mars, following five others launched by the United States.

With an expected life span of at least 90 Martian days, the 240-kilogram Zhurong is tasked with surveying Mars's landforms, geological structures, soil characteristics, the potential locations of water and ice, atmospheric and environmental characteristics, as well as magnetic, gravitational and other physical fields.

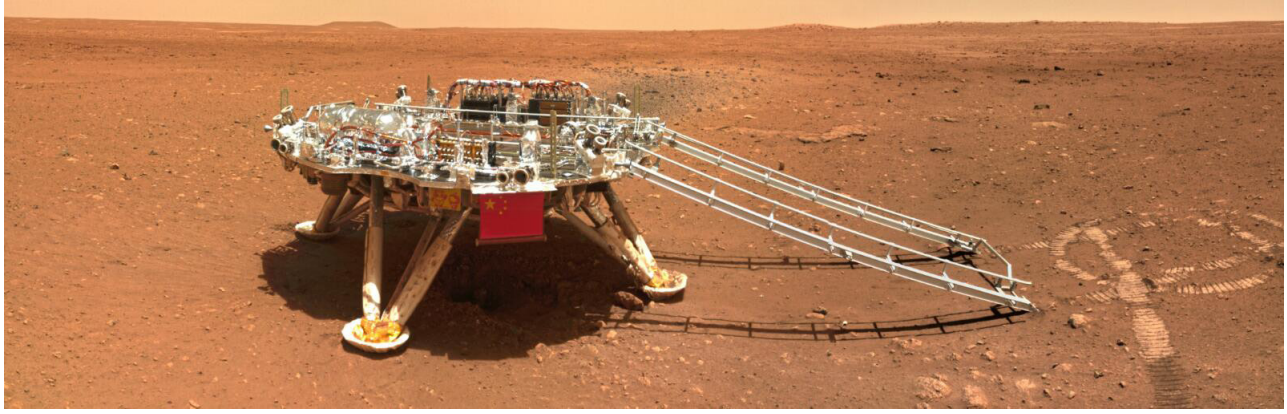
The 1.85-meter-tall robot is propelled by six wheels and powered by four solar panels, and can move at 200 meters an hour on the Martian surface.

Tianwen 1, named after an ancient Chinese poem, was launched by a Long March 5 heavy-lift carrier rocket on July 23 from the Wenchang Space Launch Center in the southernmost island province of Hainan, kick-starting China's first mission to another planet.

Driven by a combination of 48 large and small engines, the spacecraft traveled more than 470 million km and carried out four midcourse corrections and a deep-space trajectory maneuver before entering the orbit of Mars on February 10.

On February 24, Tianwen 1 entered a preset parking orbit above Mars and maintained that orbit to examine the predetermined landing site until May 15, when it descended to a lower orbit to release the landing capsule, which touched down on the Martian surface after a succession of sophisticated maneuvers.

Source: China Daily



On June 11, 2021, the China National Space Administration published four pictures taken by the Tianwen 1 robotic mission.
[IMAGE: CHINA NATIONAL SPACE ADMINISTRATION]

Researchers of the Chinese scientific research vessel *Kexue* deploy an unmanned submersible in the sea in June 2021. [IMAGE: IOCAS]

Chinese researchers carry out in situ experiments to study deep-sea life

Chinese marine scientists aboard a scientific research vessel carried out in situ experiments in the deep ocean to reveal the adaptation mechanisms of deep-sea life to extreme environments.

The Chinese scientific research vessel *Kexue*, or *Science*, returned to Qingdao in East China's Shandong Province recently after carrying out sea trials with China-made equipment, said the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) on June 28.

The IOCAS researcher Wang Minxiao said in previous experiments, deep-sea samples were sent to labs with altered physiological activities due to sudden changes in pressure, temperature and other chemical environments. Scientists were not able to accurately assess actual deep-sea life processes.

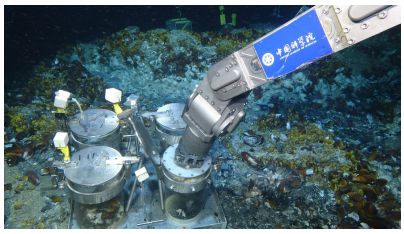


Photo taken in June 2021 shows an undersea experiment conducted by the Chinese scientific research vessel *Kexue*. [IMAGE: IOCAS]

Supported by equipment on the research vessel, the IOCAS scientists built an underwater experimental platform on the deep seabed and conducted in situ experiments, laying a solid basis for revealing the adaptation mechanism of deep-sea life in extreme environments.

In a probe mission, a deep-sea lander continuously detected multiple target objects such as cold seep vent fluid, natural gas hydrate and authigenic carbonate rocks near the vent for a long time. The preliminary results indicate that microorganisms connect with element transformation among the earth's deep lithosphere, hydrosphere near the bottom and dark biosphere.

The data and samples obtained from the experiments will help answer major questions such as the composition of the deep-sea food chain, deep-sea carbon sources and carbon-sink flux, and the origin of life.

Source: Xinhua

Observing Earth: how more than 30 years of China's meteorological satellite data are used by the world

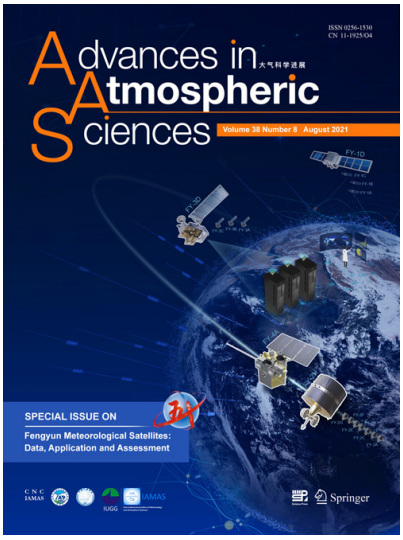
China's first meteorological satellite, *Fengyun*, was launched in 1988. Since then, 17 more *Fengyun* meteorological satellites have been launched, with seven still in operation, to monitor Earth's wind, clouds and, more recently, extreme weather events such as hurricanes and wildfires.

With more than 30 years of Earth observational data freely available to international partners, the *Fengyun* Meteorological Satellite Program works as part of Earth's operational observation system, along with the United States' National Oceanic and Atmospheric Administration satellites and Europe's polar-orbiting meteorological satellite series to provide a more complete picture of weather events and their global impacts.

The journal *Advances in Atmospheric Sciences* published a special issue on July 10 to highlight the *Fengyun* satellites' data applications and to encourage further research among domestic and global collaborators.

Scientists from the Institute of Atmospheric Physics (IAP) of the Chinese Academy of Sciences (CAS) contributed to the special issue with their analysis of differences of cloud top height between satellites and ground-based radars.

"In the last decade, great efforts have been made to improve the performance of the satellites and their onboard instrumentation," said Zhang Peng, Deputy Director of the National Satellite Meteorological Center of the China Meteorological Administration, who organized the special issue. "With extensive, multi-modal observational capabilities on *Fengyun* satellites, international communities have and will continue to make use of this data."



The cover of the special issue shows both geostationary and polar orbiting *Fengyun* satellites, all of which are circling the full disk image of Earth captured by the FY-4A (center) satellite. Extensive Earth observation data from *Fengyun* satellites are continuously received and archived in the National Satellite Meteorological Center of China database, which are available to global users. [IMAGE: *ADVANCES IN ATMOSPHERIC SCIENCES*]

Such capabilities include image navigation, radiometric calibration, multiband optical imaging, atmospheric sounding, microwave imaging, hyperspectral trace gas detection, full-band radiation budget measuring and more — in short, an extensive list of ways to monitor weather events and atmospheric changes of Earth. Zhang also co-authored a data description paper, which summarizes not only the data available, but how international users can access it.

The critical factor, Zhang said, is in how these data can be applied. The rest of the special issue features work undertaken in each of the 2019 conference's sections: retrieval algorithms, used to interpret raw data; products validation, which cross-references satellite data with Earth-based observations; numerical weather predictions, or how to predict future weather using models of current atmospheric conditions; and climate and environmental predictions, which involves using satellite data to estimate surface effects of atmospheric changes.

On July 5, *Fengyun* 3E, the world's first early morning orbit weather satellite was launched. It will improve global weather forecast by filling in the data gap in a certain time of a day and assist in achieving 100 percent global data coverage every six hours.

"*Fengyun* satellites will continue to play an important role in Earth sciences in the future, especially as the international community continues to collaborate and apply this data to research that benefits us all," Zhang said. "The new epoch for comprehensive Earth observations has begun."

Source: Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences

China's EarthLab begins trials as country's first facility exploring earth system interactions

The Earth is a sphere, and it comprises spheres: the atmosphere, hydrosphere, cryosphere, lithosphere and biosphere — in short, all of the cycles that interact to influence Earth's weather and climate.

On June 23, in order to better study how these different planetary spheres interact and the impact they have, China launched EarthLab.

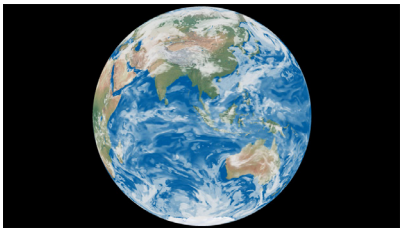
The lab's researchers will begin trials to demonstrate the facility's ability to integrate simulations and observations in order to make more accurate projections, and to provide scientific foundations for the prediction and mitigation of things like natural weather disasters.

An introduction to the facility was published on June 23 in *Advances in Atmospheric Sciences*.

"Since the Earth system is extremely large and complex, traditional theories and observations are too limited to meet the overall requirements of the scientific research community," said Zhang He, EarthLab researcher affiliated with the Institute of Atmospheric Physics (IAP) of the Chinese Academy of Sciences (CAS), and corresponding author of the study.

EarthLab is the first comprehensive virtual Earth laboratory in China which can be used to simulate the physical climate system, environmental systems, ecological systems, solid earth systems, and space weather systems as a whole, using a high-performance scientific computing platform.

EarthLab outreach hall [IMAGE: ZHU JIANG]



Simulation by CAS-ESM 2.0, the key software systems of EarthLab [IMAGE: ZHANG HE]

In partnership with Tsinghua University, IAP began construction of EarthLab in 2018. It is expected to become fully operational and open to universities and research institutes across the world in 2022.

Weather, climate and environmental disasters occur frequently and seriously, with grave losses of life and property. Consequently, a global Earth simulation system, as well as a high-precision regional environmental simulation system, is urgently needed to better predict climate and environment variability, as well as prevent and mitigate natural disasters more effectively.

"Our ultimate goal is to predict Earth systems on a vast range of time scales, from seconds to hundreds of years, and of spatial scales, from 10 meters to millions of meters," Zhang said.

Along with other Earth simulators around the world, the development and construction of EarthLab will advance the understanding not only of the Earth's spheres and their interactions, but also the Earth's past, present and future.

EarthLab's Chinese name is *Huan*, which means "a place as vast as the Earth where people live and upon whose land they depend".

Source: Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences

File photo taken on September 7, 2020 shows desertification control workers making straw-checkerboard barriers in the Tengger Desert, along the construction site of the Qingtongxia-Zhongwei section of the Wuhai-Maqin highway in Northwest China's Ningxia Hui Autonomous Region. [IMAGE: XINHUA/FENG KAIHUA]

Chinese experience in desert-control helps to green the world

A strong wind blew over Zhongwei, a city near the Tengger Desert in Northwest China's Ningxia Hui Autonomous Region and one of the driest places in the country, covering everything in a thin layer of dust.

Zhao Yang, an associate fellow at the Shapotou Desert Research and Experiment Station (SDRES) of the Chinese Academy of Sciences (CAS), was working in a lab culturing a kind of cyanobacteria key to new desert-control technology.

The station was the birthplace of the use of vast stretches of artificial straw-checkerboard, a technique used to stop sand encroachment which was implemented in China over 60 years ago.

Today, Chinese researchers at the SDRES are dedicated to developing new techniques in combating desertification in China, and have contributed massively to the world's largest greening areas over the past 20 years.

Combating desertification

Zhao is happy to see the progress taking place using the new desert-control technique.

According to Zhao, it naturally takes around 10 years for a cyanobacteria crust to form on the surface of the sand, which helps prevent it from moving. However, by hybridizing a special bacterial strain, extracted from biological soil crust in the Tengger Desert, with the cultured cyanobacteria, researchers at the SDRES have successfully cut the crust formation time to just one year.

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"The new technique has now been implemented. The experimental field under my supervision alone is a huge 33.3 hectares, not to mention the fields supervised by my colleagues in other parts of China," said Zhao, who has been working at the SDRES for 11 years.

Zhao's work is a microcosm of China's efforts to combat desertification, which dates back to over 60 years ago.

When China's first railway through the Tengger Desert began operation in 1958, foreign experts invited to design the railway predicted that it would likely be buried in sand in just 30 years.

However, the wisdom of Chinese researchers has provided a way out. Straw structures, which resemble checkerboards, proved to be the most convenient, environmentally friendly and cheapest way of stopping sand encroachment. Within the checkerboards themselves, the surface of the sand forms a hard crust over time and prevents the sand from moving.

With ample sand-control experience, Ningxia is building its first highway crossing the Tengger Desert, which is expected to be completed in 2021.

In recent years, China has pushed ahead in its greening efforts across the country. Official data shows that in 2020 alone, the country improved the ecology of 2.83 million hectares of grassland, having carried out desertification prevention-and-control work on over 2.09 million hectares of land.

Sharing experience with the world

While making headway in combating desertification over the past several decades, China has shared its techniques and experience in sand control with other countries.

In 1977, China shared the anti-desertification technique used in Shapotou at the UN Conference on Desertification in Nairobi. Since then, dry straw-checkerboards have been used in many parts of the world as an effective way to combat desertification.

"Chinese experience can benefit the world," said Iraqi agricultural engineer Sarmad Kamil Ali, who was in China in 2013 to learn about sand control.

"The Chinese always surprise the world with creative methods to overcome the difficulties they face. They have different methods to fix the dunes, and I found out recently that they are using more advanced technologies in fixing the sand dunes," he said.

Since 2005, the research team from CAS's Xinjiang Institute of Ecology and Geography (XIEG) has been exporting mature desertification control technologies to Central Asia and Africa.

A researcher examines plants at CAS's Shapotou Desert Research and Experiment Station (SDRES) in Northwest China's Ningxia Hui Autonomous Region, June 16, 2021. [IMAGE: XINHUA/LU YING]

Demonstration bases have been built in many countries, such as those for the ecological restoration of shrub grasslands in Ethiopia, desert plant breeding and the mechanical desertification control in Mauritania, according to Zhang Yuanming, head of the XIEG.

Noam Weisbrod, Director of the Jacob Blaustein Institutes for Desert Research at the Ben-Gurion University of the Negev in Israel, was impressed by the sand control efforts during his trip to North China's Inner Mongolia Autonomous Region several years ago.

The impact of climate change is very similar across different drylands around the globe, Weisbrod said. "I'm a great believer in international cooperation. There is a lot of room for Israel-China cooperation on these topics."

Desert biodiversity

Despite China's achievements in desert-control, researchers believe that the country's anti-desertification methods still need to prove that they can withstand the test of time.

"We should not be complacent with what we have found in desert control," said the SDRES director Li Xinrong. "We need to do more theoretical research in the field."

For Li, the ultimate goal of sand control is not to eliminate deserts, but to improve the biodiversity of desert ecosystems and find a way for humans and deserts to live harmoniously.

"Deserts are an indispensable part of nature and a valuable resource," said Li. "The Earth would not be a beautiful place without them."

Source: Xinhua

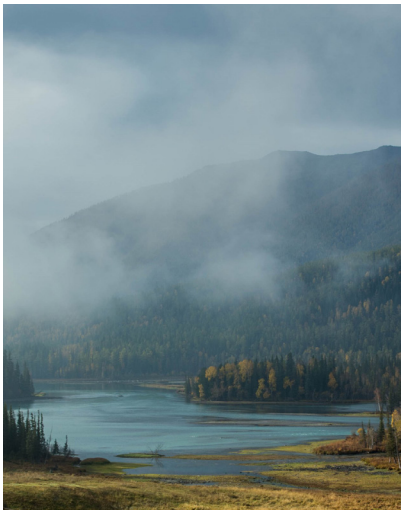
Planting trees to save the planet: the Chinese experience

A coordinated global effort to reduce the production of greenhouse gas emissions from industry and other sectors may not stop climate change, but Earth has a powerful ally that humans could partner-up with to achieve carbon neutrality: Mother Nature.

An international team of researchers called for the use of natural climate solutions to help "cancel" produced emissions and remove existing emissions as part of a comprehensive plan to keep global warming below 1.5 degrees Celsius — the point at which damage to human life and livelihoods could become catastrophic, according to the United Nations' Intergovernmental Panel on Climate Change.

The researchers published their invited views on March 24 in *Advances in Atmospheric Sciences*. "The Earth is heating up, and climate change has become a major environmental concern for the whole planet," said first author Dr. Qin Zhangcai, professor at Sun Yat-sen University and the Southern Marine Science and Engineering Guangdong Laboratory. "In this work, we want to highlight the important role of nature and human action in mitigating climate change."

Called "natural climate solutions", largely land-based ecosystems, such as forests, agriculture, grasslands and wetlands, could sequester carbon emissions from industry and store them in trees, grass and soil. While the energy and industrial sectors are essential in their commitment to reduce emissions, Qin said, they are both insufficient and unable to rectify already emitted greenhouse gases.



Nature's gift to a carbon neutral society
[IMAGE: YE YANGYONG]

"Natural climate solutions have been recognized as one of the most cost-effective and readily available options that can be used to supplement energy and industrial mitigation in the climate portfolio," Qin said.

He pointed to China, which has launched several nationwide ecological projects over the past half a century, as an example of success, although these projects were not intended as natural climate solutions at the time they were initiated. The Natural Forest Protection Project, for instance, was implemented to help mitigate mass flooding in 1998 but has since contributed to more than half of the country's natural carbon sinks.

"China started its first major projects in the 1970s, and it took over 40 years and several phases to finally reshape its degraded landscapes," Qin said. "Studying China's past experiences offers a shortcut to learning how Mother Nature can help us deal with climate change."

According to Qin's team, the use of natural carbon solutions, if managed properly under local and global guidance, could result in the achievable mitigation of the equivalent of nearly 15 trillion pounds of greenhouse gases per year — which would account for more than 10 percent of current global annual greenhouse gas emissions. That's more than a quarter of the annual global emissions reduction of 50 percent needed in the next 10 years to reach net zero by the 2050s, as set out in the Paris Agreement.

Qin and the team are now establishing a systematic and comprehensive evaluation strategy for large-scale natural climate solutions, to help avoid any potential failures in an effort to help advance mitigation efforts.

"We call for global collaboration and immediate actions in natural climate solutions," Qin said. "This is our best shot to achieve a carbon neutral society globally."

Co-authors of this study include researchers from Conservation International in the United States, the Institute of Botany of the Chinese Academy of Sciences (IBCAS), CAS's Institute of Atmospheric Physics (IAP), and the Institute of Biological and Environmental Sciences of the University of Aberdeen in the United Kingdom.

Source: Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences

Chinese Academy of Sciences releases white paper on black soil region in Northeast China

The Chinese Academy of Sciences (CAS) released the "White Paper on Black Soil Region in Northeast China (2020)" in Harbin, Northeast China's Heilongjiang Province, on July 9. It is the first time that a white paper on black soil region has been released in China.

The white paper includes the research results of CAS on the protection and utilization of black soil in Northeast China for more than 40 years, as well as survey data from Chinese ministries, commissions and institutions and universities.

The white paper is comprised of the introduction of black soil, the types and formation process of different black soil, the changes of black soil and the reasons for these changes. It also puts forward the innovative work and research direction for the good use and conservation of black soil land in the future.

The total area of the black soil region in Northeast China is 1.09 million square kilometers, of which the typical black soil cultivated land area is 18.533 million hectares.

The black soil region in Northeast China is the most important region for commodity grain production in China, with the annual output of corn, rice and soybeans accounting for a high proportion and the amount of grain transferred reaching one third of the total amount of the country. Due to its vital role in grain production, the black soil region in Northeast China ensures the country's food security.

However, several decades of overexploitation and unsustainable land use practices, as well as climate change, have caused substantial loss of soil and soil productivity, directly affecting the stability of food production in the region.

Technological innovation is believed to be the fundamental way to make good use of and conserve black soil. A scientific understanding of black soil region is highlighted as the precondition for technological innovation.

By releasing the white paper, we hope to help the whole society have a clear scientific understanding of black soil land, and promote joint efforts to protect and use the black soil region, said CAS.

We will work on providing scientific and technological support for the good use and conservation of black soil, and continue to publish the research progress on the protection and utilization of black soil land in Northeast China through the release of white papers.

Since its establishment, CAS has always attached importance to agricultural research, and has been conducting original innovation and research on key core technologies for the strategic and forward-looking issues of China's agricultural development. It has made outstanding contributions to the development of agriculture in China.

A cooperation framework agreement on technological breakthroughs on the use and conservation of black soil land was also signed between CAS and Heilongjiang Province, on the same day as the release of the white paper.

According to the agreement, CAS cooperates with the provinces of Heilongjiang, Jilin, and Liaoning, as well as the Inner Mongolia Autonomous Region on major scientific and technological research tasks that provide systematic solutions for the protection and utilization of black soil land, in order to ensure national food security and ecological security.

The research tasks aim to solve the major issues that threaten China's food and ecological security, such as serious black soil degradation and overdraft in Northeast China, by making full use of long-term science research results, technologies, and data.

To date, the Chinese Academy of Sciences has signed the framework agreements with the provinces of Heilongjiang, Jilin, and Liaoning.

Source: Bureau of Science & Technology for Development, and Bureau of Science Communication, Chinese Academy of Sciences

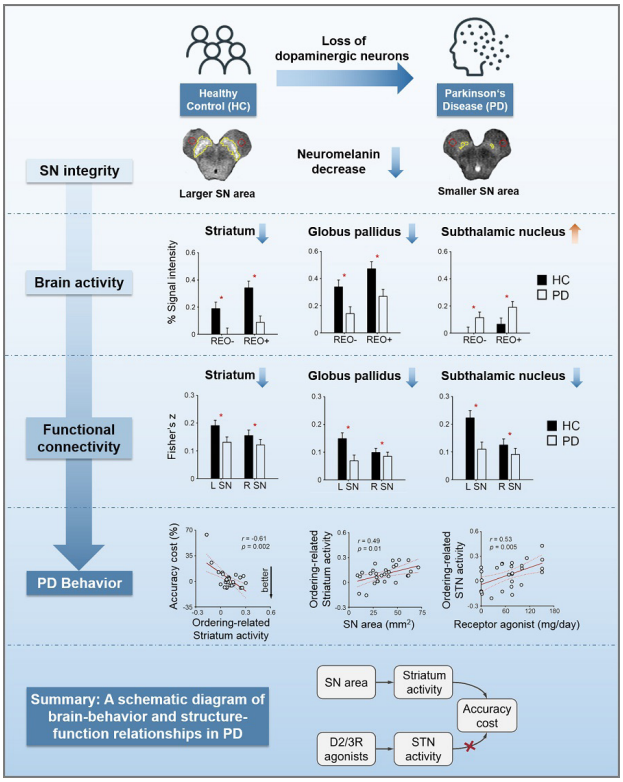
Substantia nigra damage and sequential working memory deficits in Parkinson's disease

A recent study published in the *Journal of Neuroscience* demonstrated that damage to the substantia nigra (SN) correlates with basal ganglia dysfunction and poor sequencing performance in Parkinson's disease (PD). This work was performed by researchers from Dr. Ye Zheng's lab at the Institute of Neuroscience (ION), Center for Excellence in Brain Sciences and Intelligence Technology (CEBSIT) of the Chinese Academy of Sciences (CAS), and Professor Jin Lirong's team at the Department of Neurology, Zhongshan Hospital of Fudan University.

Idiopathic PD is the second most common age-related neurodegenerative disease. It is characterized by the progressive death of dopaminergic neurons in the SN pars compacta. PD's primary motor symptoms include resting tremor, rigidity, and the slowness of movement. Patients with PD also develop a series of non-motor symptoms such as cognitive decline, sleep disorders, and autonomic nervous system dysfunction. Cognitive impairment is one of the most common non-motor symptoms in PD, significantly impacting patients' quality of life and functional independence. There is no cure for PD. Anti-parkinsonian drugs such as levodopa and dopamine receptor agonists are used to alleviate motor symptoms.

The ability to process sequential information online is essential for a broad spectrum of daily activities, from making a conversation (what to say first) to scheduling a day's activities (what to do first). In healthy brains, a neural system for sequential working memory comprises the prefrontal cortex and basal ganglia, which include the striatum, globus pallidus, and subthalamic nucleus. In their previous work, the researchers found that PD patients' poor sequencing performance correlated with the hyper-activation of the subthalamic nucleus and weakened functional connectivity between the subthalamic nucleus and striatum.

To better understand the neurobiology of sequential working memory deficits in PD, the researchers measured the area of the SN pars compacta with high neuromelanin signals in 29 patients with PD and 29 healthy control participants, using neuromelanin-sensitive structural magnetic resonance imaging (MRI). The researchers also measured participants' behavioral performances and brain activity when they conducted a digit ordering task during functional MRI scanning. In the digit ordering task, participants were asked to remember a sequence of four digits and recall the digits in ascending order. In half of the trials, the digits appeared in ascending order, and participants only had to remember the original sequence. In the other half of the trials, the digits were fully randomized, and participants had to reorder the digits. Sequencing performance was measured by contrasting the two conditions.



Differences between patients with Parkinson's disease (PD) and healthy control participants (HC) in the substantia nigra (SN) integrity, regional brain activity, and interregional functional connectivity. The basal ganglia include the striatum, globus pallidus, and subthalamic nucleus (STN). [IMAGE: CEBSIT]

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Researchers design cesium manganese bromides nanocrystals with color-tunable emission

Cesium lead halide perovskite $CsPbX_3$ (X: Cl, Br, I) nanocrystals (NCs) with a narrow photoluminescence (PL) emission band have been widely applied in light-emitting devices. However, their toxicity and poor stability has triggered the development of lead-free metal halide perovskite NCs.

It is highly desirable to obtain tunable red/green/blue emissions for display application. However, lead-free perovskite NCs generally exhibit broadband emissions with poor color purity.

Recently, a research group led by Professor Han Keli from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) developed a phase transition strategy to design cesium manganese bromides NCs with tunable red/green/blue emissions and a high color purity.

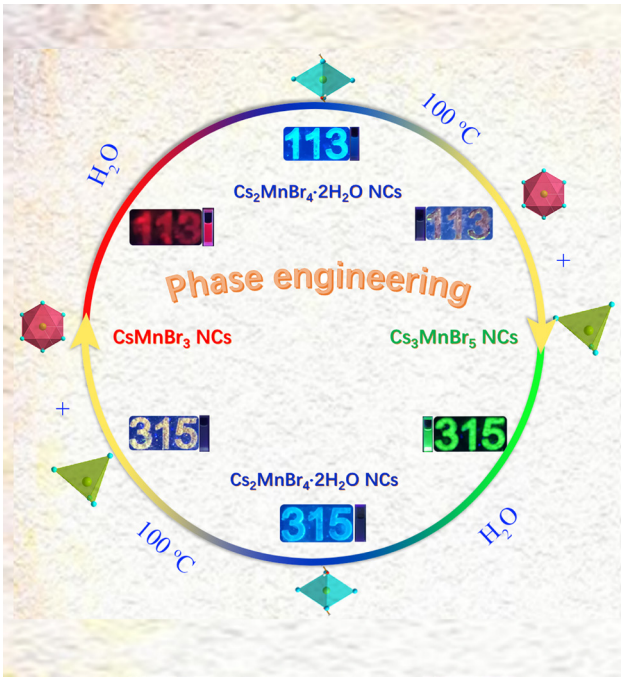
This study was published in *Angewandte Chemie International Edition* on June 20.

The researchers selectively synthesized one dimensional (1D) $CsMnBr_3$ NCs (red-color emission) and zero dimensional (0D) Cs_3MnBr_5 NCs (green-color emission) with a pure phase. Such a phase transition could be triggered by isopropanol: from 1D $CsMnBr_3$ NCs to 0D Cs_3MnBr_5 NCs.

Furthermore, in a humid environment, both 1D $CsMnBr_3$ NCs and 0D Cs_3MnBr_5 NCs could be transformed into 0D $Cs_2MnBr_4{\cdot}2H_2O$ NCs (blue-color emission). $Cs_2MnBr_4{\cdot}2H_2O$ NCs could inversely transform into a mixture of $CsMnBr_3$ and Cs_3MnBr_5 phase during the thermal annealing dehydration step.

This work highlights the tunable optical properties in single component NCs via phase engineering and provides a new avenue for future endeavors in light-emitting devices.

"Moreover, this proposed strategy is important in obtaining the stability of NCs against destruction by air and water and provides a unique approach for the application of this material in anti-counterfeiting," said Professor Han.



A unique phase transition strategy to engineer the emission color of lead-free cesium manganese bromides nanocrystals, which achieves a tunable red/green/blue emission with high color purity
[IMAGE: YANG BIN AND KONG QINGKUN]

This work was supported by the National Key Research and Development Program of China, the National Natural Science Foundation of China, the Scientific Instrument Developing Project of CAS, Liaoning Revitalization Talents Program, and the Dalian City Foundation for Science and Technology Innovation.

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Dalian Institute of Chemical Physics (DICP),
Chinese Academy of Sciences

Source: Dalian Institute of Chemical Physics (DICP), Chinese Academy of Sciences

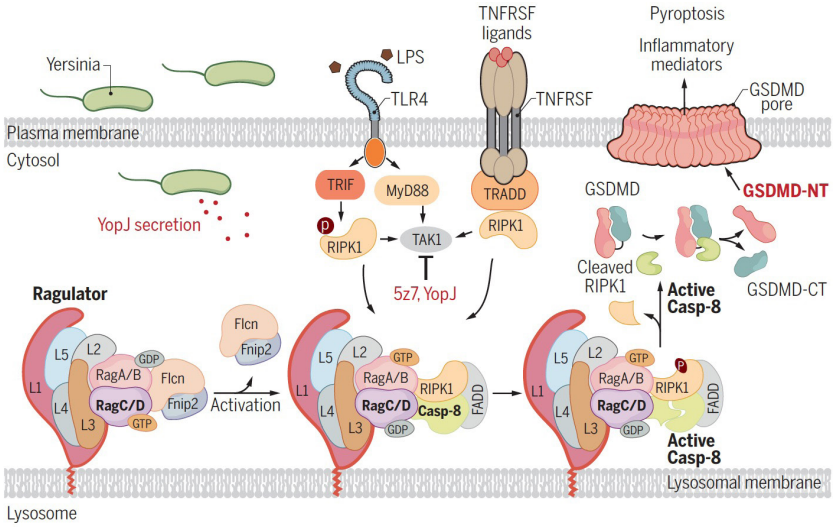
Researchers reveal new mechanism underlying pyroptosis induced by *Yersinia* infection

Multiple strategies have been employed by pathogenic bacteria to sabotage host innate immune-signaling in order to facilitate their infection.

Previous studies revealed that the *Yersinia* effector protein YopJ targets and inhibits transforming growth factor-β–activated kinase 1 (TAK1) to block pro-inflammatory cytokine production. To counteract this, host cells undergo pyroptosis via initiating receptor-interacting serine/threonine-protein kinase 1 (RIPK1)–dependent caspase-8–directed gasdermin D (GSDMD) cleavage. However, how the RIPK1-caspase-8-GSDMD axis is instructed during *Yersinia* infection remains unknown.

In a study published online in *Science*, Professor Liu Xing's group at the Institut Pasteur of Shanghai (IPS) of the Chinese Academy of Sciences (CAS), and Professor Judy Lieberman's group at Harvard Medical School, discovered, via an unbiased CRISPR screen, a critical and unexpected role of the lysosomal membrane-resident Rag-Ragulator complex in *Yersinia* infection-triggered pyroptosis.

The researchers found that loss of components of Rag-Ragulator complex resulted in the failure of pyroptotic cell death in response to *Yersinia* infection, suggesting an essential role of Rag-Ragulator complex in caspase-8–mediated pyroptosis.



Rag-Ragulator mediates activation of a FADD-RIPK1-caspase-8 complex to trigger pyroptosis in response to *Yersinia* infection. [IMAGE: IPS]

Furthermore, they showed that upon infection with pathogenic *Yersinia* or its mimic (lipopolysaccharide plus TAK1 inhibitor), a FADD-RIPK1-caspase-8–containing complex was recruited via Rag-Ragulator complex to lysosomal membrane, and this process depended on Rag GTPase activity and Rag-Ragulator lysosomal binding but not Ragulator-activated mechanistic target of rapamycin complex 1 (mTORC1).

This study uncovered a critical role of Rag-Ragulator in TAK1 inhibition-induced pyroptosis during *Yersinia* infection. The new role of Rag-Ragulator in caspase-8-mediated pyroptosis confirms its key function as a central hub for monitoring environmental cues in order to decide not only whether a cell proliferates, but also whether it survives.

Also, this study shed new light on lysosome's role in pyroptosis and in innate immune responses. Future studies will explore the mechanistic details of pyroptosis to manipulate this process for therapeutic benefits.

For more information, please contact:
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Institut Pasteur of Shanghai (IPS), Chinese Academy of Sciences

Source: Institut Pasteur of Shanghai (IPS), Chinese Academy of Sciences

China's Contribution to the Human Genome Project

CHINESE ACADEMY OF SCIENCES BUREAU OF INTERNATIONAL CO-OPERATION

Symposium held to review progress of the Human Genome Project

A symposium to mark the international Human Genome Project (HGP) and Chinese scientists' participation in 1 percent of the project was held by the Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences (CAS), CAS's Beijing Institute of Genomics/China National Center for Bioinformation, and Chinese genomics company BGI on June 26.

A group of officials and experts reviewed the history of the HGP over the past 21 years and exchanged ideas on the applications of the research, as well as the development of life sciences.

The HGP, which was launched in October 1990 and dubbed "a moonshot for life science", produced the first draft of the human genetic code on June 26, 2000 and published it in February 2001. In 1994, the Chinese Human Genome Project (CHGP) was initiated by scientists including Tan Jiazhen, Wu Min, Qiang Boqin, Chen Zhu, Shen Yan and Yang Huanming. CAS's IGDB set up the Human Genome Center in August 1998. In October of that year, the Chinese National Human Genome Center was approved to launch sub-centers in Shanghai and Beijing almost at the same time.

In July 1999, the human genome research center of CAS's IGDB applied to join the international HGP Consortium on behalf of China, and was approved to become its sixth nation to participate in the project, following the United States, the UK, Japan, Germany and France.

In June 2000, the consortium announced the completion of the draft human genome sequence. In February 2001, the consortium published a paper in the scientific journal *Nature*, releasing the map of human DNA. In April 2003, the six members of the consortium jointly announced the completion of the HGP.

CAS academician Chen Zhu said in his congratulatory letter that the completion of the HGP is a milestone event in the history of human science, which has brought revolutionary changes to human understanding of diseases and species evolution. China's participation in the project is of great significance and highlights the outstanding contributions made by Chinese scientists to human science, he added.

Since the release of the draft human genome sequence 21 years ago, the research based on it has made a spurt of progress, which not only promotes the development of biology and biomedicine but also helps facilitate multidisciplinary cooperation among genetics, biochemistry, molecular biology and information science.

Source: Institute of Genetics and Developmental Biology (IGDB), Chinese Academy of Sciences

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The researchers found that the SN areas with high neuromelanin signals were significantly smaller in patients with PD than in healthy participants, indicating disease-related damage to the SN pars compacta. In the digit ordering task, the striatum and globus pallidus were hypo-activated, the subthalamic nucleus was hyper-activated, and the functional connectivity between the bilateral SN and basal ganglia regions was significantly weakened in patients with PD than in healthy participants. Moreover, PD patients with smaller SN areas tended to exhibit weaker ordering-related striatal activation and worse sequencing performance. Anti-parkinsonian drugs such as dopamine receptor agonists could modulate ordering-related subthalamic activation but could not improve the sequencing performance of patients with PD. The findings suggest that damage to the SN pars compacta may lead to sequential working memory deficits in PD, mediated by basal ganglia dysfunction.

This work, entitled "SN integrity correlates with sequential working memory in Parkinson's disease", was published online in the *Journal of Neuroscience* on June 8, 2021. Liu Wenyue at CAS's ION, CEBSIT, and Dr. Wang Changpeng and Dr. He Tingting of Zhongshan Hospital of Fudan University are co-first authors. Dr. Ye Zheng at CAS's ION, CEBSIT, and Professor Jin Lirong of Zhongshan Hospital of Fudan University are co-corresponding authors. Lu Yuan at CAS's ION, CEBSIT, and Su Minghong and Dr. Zhang Guanyu at CAS's Institute of Psychology (IP) contributed to this work. This work was supported by the National Natural Science Foundation of China and the Shanghai Municipal Science and Technology Commission.

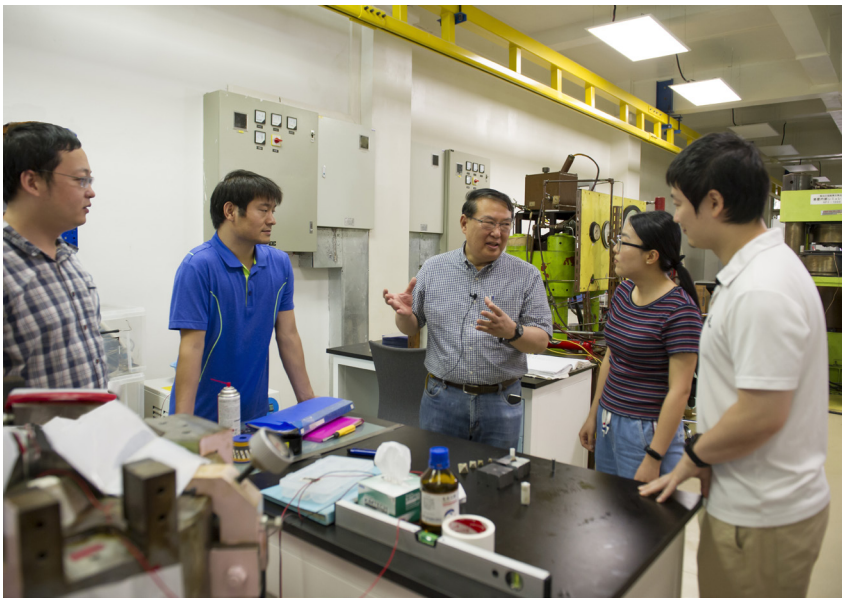
Source: Institute of Neuroscience (ION), Center for Excellence in Brain Science and Intelligence Technology (CEBSIT), Chinese Academy of Sciences

Migrating Elephants — Harmonious Coexistence Between Man and Nature

Science knows no borders: Eiichi Takahashi's research journey from Japan to China

On the campus of the Guangzhou Institute of Geochemistry (GIG) of the Chinese Academy of Sciences (CAS), an elderly man is often seen: he is of average build, with black-rimmed glasses on his round face, a checked shirt neatly tucked into his jeans, and a black backpack over his shoulders; and his stride firm and steady — all this reveals a refined and precise scholar.

He is Eiichi Takahashi, a world-renowned experimental petrologist from Japan who has made significant contributions to research on magma genesis, mantle plumes, and high-pressure phase diagrams. Four years ago, after retiring from the Tokyo Institute of Technology (Tokyo Tech), he lost no time in moving to China to take up his new position as a full-time research professor at GIG. To carry on with his beloved research in Guangzhou, a city in South China's Guangdong Province, is in his own words "my best retired life".



Takahashi guides young scientists at GIG.

Lifelong pursuit of a teenage dream

Eiichi Takahashi was born in Hamamatsu city, Japan in 1951. His passion for science can be traced back to his teenage years. When he was a junior high school kid, a teacher whom he was greatly indebted to inspired him: one should take seeking truth, rather than chasing after fame and wealth, as the ultimate purpose of life. It was from there that his science dream took flight. Particularly mesmerized by rocks and volcanoes, he, as a high school student, once wrote a letter to Hisashi Kuno, a well-known professor in petrology at Tokyo University whom he had never met. In the letter he raised seven questions about one of the professor's studies. "Quite surprisingly, he wrote me back!" Relating this anecdote, Takahashi, now almost 70 years old, is still visibly excited, not to say how ecstatic he was then. He began to work very hard right away, determined to get into Tokyo University to study earth science.

At last, the teenager's dream came true. Takahashi went straight from his bachelor's degree to PhD studies at Tokyo University. After graduation, he went to the US to undertake postdoctoral research at the Carnegie Institute of Washington. Later he came back to Japan and taught at Okayama University and then Tokyo Tech, where he was one of the starting members of the Department of Earth and Planetary Sciences. He has devoted his life to research on mantle rocks and volcanic rocks by integrating indoor high-temperature and high-pressure experiments and the study of rock samples collected in the field, with the aim of explaining magma genesis and ultimately of understanding how the Earth was formed in the first place and developed through time.

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Takahashi (with an orange loudspeaker at the center in the front row) takes undergraduates on a field trip to Hawaii to investigate lava.

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Throughout his career spanning over 40 years, what Takahashi most takes pride in is several groundbreaking achievements mostly made in the 1980s. In the early 80s, he and his supervisor Professor Ikuo Kushiro determined for the first time the depth at which a variety of basaltic magma originates by conducting experiments that simulated the melting process of mantle peridotite 30 to 90 km deep in the Earth. In the following years, Takahashi increased the pressure of his melting experiments considerably to 25 GPa, equivalent to the pressure 720 km deep in the Earth. In this way he investigated the possible chemical composition of the magma ocean which might have covered the Earth 4.5 Ga years ago, which opened a window into the study of the Earth's magma ocean from the perspective of petrology and geochemistry. Throughout the 80s, by using a self-developed multi-anvil apparatus, Professor Eiji Ito and Takahashi worked together to determine the nature of the 660-km-depth boundary which separates the upper and lower mantle. Takahashi also utilized high-pressure experiments to study the origin of voluminous magma in mantle plumes such as those in Hawaii and Columbia River flood basalt. His research outcomes have been published in some of the world's top journals, such as *Nature*, *Science*, *Journal of Geophysical Research*, *Earth and Planetary Science Letters*, and *American Mineralogist*, and the papers have enjoyed numerous citations and guided research developments in several fields.

With his remarkable achievements, Takahashi has won many international awards. At 36, he got the F.W. Clarke Award, which is presented by the Geochemical Society to honor a single outstanding contribution to geochemistry or cosmochemistry by an early-career scientist, with only one awardee

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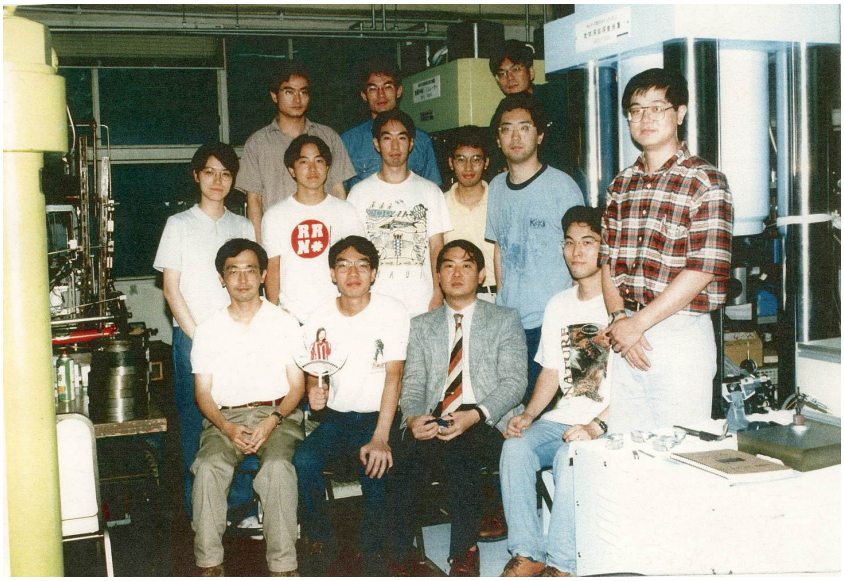
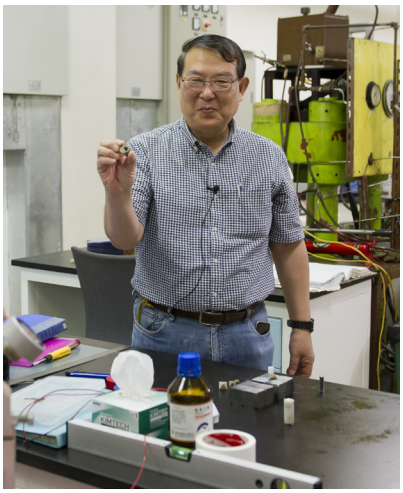
each year. At 65, he was elected as an American Geophysical Union (AGU) Fellow. Founded in 1919, the AGU is one of the world's most influential academic organizations in earth sciences. Starting from 1962, it elects Fellows among all its members annually to honor their pioneering research work, with the selection ratio smaller than one to 1,000.

For Takahashi, science is his job, but more importantly his number one hobby, even before classical music and fine art. He emphasizes more than once that in doing science what comes first should be curiosity — that is the pure desire to explore the unknown. Only when one sees science in an artistic view can one enjoy it, and as a result be more likely to achieve something big — this, he says, is the key to success for many great scientists, as well as the most important piece of advice he wants to share with young researchers. He also says that the best part of science is making friends with people from all over the world through connection in work. In regard to this, he specifically quotes "Is it not a delight to have friends coming from afar?" — a famous sentence from the Chinese classic *Lunyu*, or *The Analects of Confucius*.

With love and passion, even hardships became tolerable. In 2009, he fell off a seaside cliff by accident when gathering samples on Japan's Miyakejima Island. As he was burdened with heavy collected rocks, one of his feet hit the hard lava rock violently, resulting in an instantly broken ankle. Fortunately he survived thanks to a timely boat rescue. This accident condemned him to two months in hospital, three months in a wheelchair, and one year with walking sticks. But even when he was in hospital, he asked his students to visit him for weekly seminars and discussion on research progress. While telling these stories of hardship and danger in scientific exploration, he keeps his usual smile on his face. As a matter of fact, in everyday conversation he is always radiating cheerfulness and enthusiasm that are more commonly seen in the young — that is a reflection of his optimistic nature and single-minded pursuit.



Takahashi (front row, third from the left) built his research team and laboratory at Tokyo Tech.



Takahashi shows in his hand the high-pressure assembly: MgO octahedral pressure medium.

Contributing to others' success, from Japan to China

In 2017, Takahashi, then 65, retired from Tokyo Tech after nearly 30 years of service, and came to work at GIG with the support from the CAS President's International Fellowship Initiative (PIFI), which is a funding scheme of CAS that enables foreign professionals at different stages of their career to visit or work at CAS institutes with flexible options of duration, with the aim of further internationalizing CAS's brainpower and soliciting the wisdom of scientists globally. (So far, PIFI has granted funding to Takahashi three times in a row, which has helped to ensure the success of his scientific work in China.) So what made him choose to keep himself busy in a foreign land when he could have enjoyed an easy life in his late years? His answer is simple: "Why wouldn't you if you have a chance to do your hobby?"

In fact, Takahashi's personal contact with China began more than two decades ago, when he took his first Chinese postdoc, Wang Wuyi,

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who later became the vice president of Research and Development at the Gemological Institute of America (GIA) in New York. At the invitation of Wang, Takahashi traveled to China for the first time in 2000 to visit the China University of Geosciences, Beijing, and the Nanjing University. Takahashi's second student from China was Ren Zhongyuan, who as a PhD student then took part in a Japan-US joint research project on Hawaiian volcanoes from deep underwater perspectives and produced fruitful results. In 2007 Ren returned to China and has worked as a research professor at GIG ever since. Interestingly, Takahashi's last PhD student was from China too. The high caliber of these Chinese young researchers made a deep impression on him. During the last few years before retirement, he hosted several scientists and students from GIG who performed experiments in his laboratory and later helped to move the laboratory to China.

What led to Takahashi's final decision to take up employment with GIG was an invitation from Professor Xu Yigang, CAS Member and former director of the institute. They had been friends even before that as they shared common research interest in magma genesis in mantle plumes and came across each other from time to time at international symposiums. In view of GIG's pure research environment and high research levels, Takahashi was delighted to accept the job offer.

One of the frontiers in earth sciences, Takahashi's specialty, high-pressure experiment simulation, is an important approach to studying deep earth processes, and deep earth research is crucial to understanding how the Earth developed into a habitable planet. Therefore, the study of high-pressure experiments is extremely important to GIG, which is reorganizing its state key laboratories for deep earth research. As China still lags behind in terms of high-pressure experiments, the advent of a top scientist like Takahashi will be far-reaching, not only for GIG's development in the long run but also for the country's endeavors to catch up.

Specialized instruments are indispensable to high-pressure experiments. It took Takahashi two years to move almost half of his laboratory in Japan to GIG. All the equipment was donated by Tokyo Tech based on a collaborative agreement with GIG, including a piece of multi-anvil apparatus weighing more than 20 tons with a manufacturing cost of about seven million Chinese yuan.

When asked what he expects to achieve in China, Takahashi replies, "I am a pretty old person now. So I myself am not eager to achieve my own success. But if I can contribute to other people at GIG or other places in China, I am very happy." As he explained, he is now working hard as an engineer at GIG to facilitate his colleagues' research. He is mentoring Li Li, an engineer, in improving pressure calibration of the multi-anvil high pressure apparatus, as accuracy of pressure values is vital to high-pressure experiments. He is also collaborating with professors like Xiong Xiaolin, Song Maoshuang and Liu Xingcheng on many research projects utilizing the multi-anvil press. In addition, he is working with postdoc Yuto Sato and Professor Xia Xiaoping in an effort to set up the first standard system in China for analysis and measurement of water in minerals, so that it can be applied to the study of magma genesis and Earth dynamics and help to explain the mechanism of the big mantle wedge in East Asia as well as the magma genesis of Mount Emei in Southwest China's Sichuan Province and Hainan basalts in South China's Hainan Province.

Apart from providing technical assistance to scientists as an engineer, Takahashi would also like to continue working on the issue he has been studying all his life: magma genesis of Hawaiian volcanoes. Here his dual role is worth mentioning: he is an engineer that develops and manages instruments, and at the same time a scientist that does research with the help of instruments — taking care of both the technology side and the research side as such is common in Japan's scientific world, and is actually a widely accepted practice. To illustrate this, Takahashi makes a comparison with classical music, of which he is a fan: if a composer can play the piano as brilliantly as Beethoven did, he is more likely to create a great sonata; in a similar vein, if a scientist knows everything about a piece of equipment, he can develop or modify it by himself to enable it to better serve the needs of his own research.

Takahashi has not only brought advanced laboratory apparatus and technology to GIG but has also introduced two excellent Japanese scientists, Professor Akira Tsuchiyama and postdoc Yuto Sato as mentioned above who now work there full-time.

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Talent and tenderness beyond science

Besides research, Takahashi is also engaged in administration with exceptional achievements. In 2002, the Japanese government set up the 21st Century Center of Excellence (COE) Program to introduce positive competition between universities in the country. After failing in its first application for the Program in the year dedicated to the earth science category, Tokyo Tech appointed Takahashi as program leader for the second attempt. Under his leadership, the university's application entitled "How to build habitable planets" came first among some 300 rivals nationwide across all categories of disciplines in the year when the Program application was open for the last time. The university's performance in conducting the Program afterwards was evaluated as excellent, which paved the way for the later establishment of the Earth-Life Science Institute (ELSI) at the university. Takahashi also served as the university's library director. During his tenure, the costs of the electronic accessibility of international research journals soared, and consequently many universities in Japan stopped buying the service. However, keenly aware of the importance of e-journals to a research-focused university, Takahashi made great efforts both internally and externally: liaising with different departments within the university and visiting several universities in the US to discuss countermeasures. In the end, he managed to maintain his university's subscription of e-journals. Such is the man that "looks up at the sky while planting his feet on solid ground" — Professor Liu provides a metaphorical description of Takahashi, his former teacher and current co-worker, who not only has lofty ideals in science, but is also experienced in the ways of the world and always ready to address practical issues.

It has impressed many colleagues that Professor Takahashi finds something interesting in almost everything, often laughing with his head tilting back and eyes turning into crescents. When talking about cooking, one of his hobbies, he makes a funny joke by saying "Cooking is similar to experimental petrology. For cooking, you can choose your 'starting materials' and you can choose your heating temperature, spices, seasonings, etc." Takahashi is easygoing and prefers to do everything by himself, always in a meticulous manner. When he was still working in Japan, he offered to host a visit for a group of Chinese students, which was supported by the Sakura Science Exchange Program. He himself led the 10-day trip throughout, and before that he personally took care of such basic matters as hotel booking and trial run of traveling routes. Recently when he had to fill in an application form in Chinese by hand, despite a Chinese colleague's repeated offer of help, he insisted on copying the Chinese characters by himself stroke by stroke. In spite of mistakes in the first few drafts, he did not stop until he got everything correct on a single sheet.

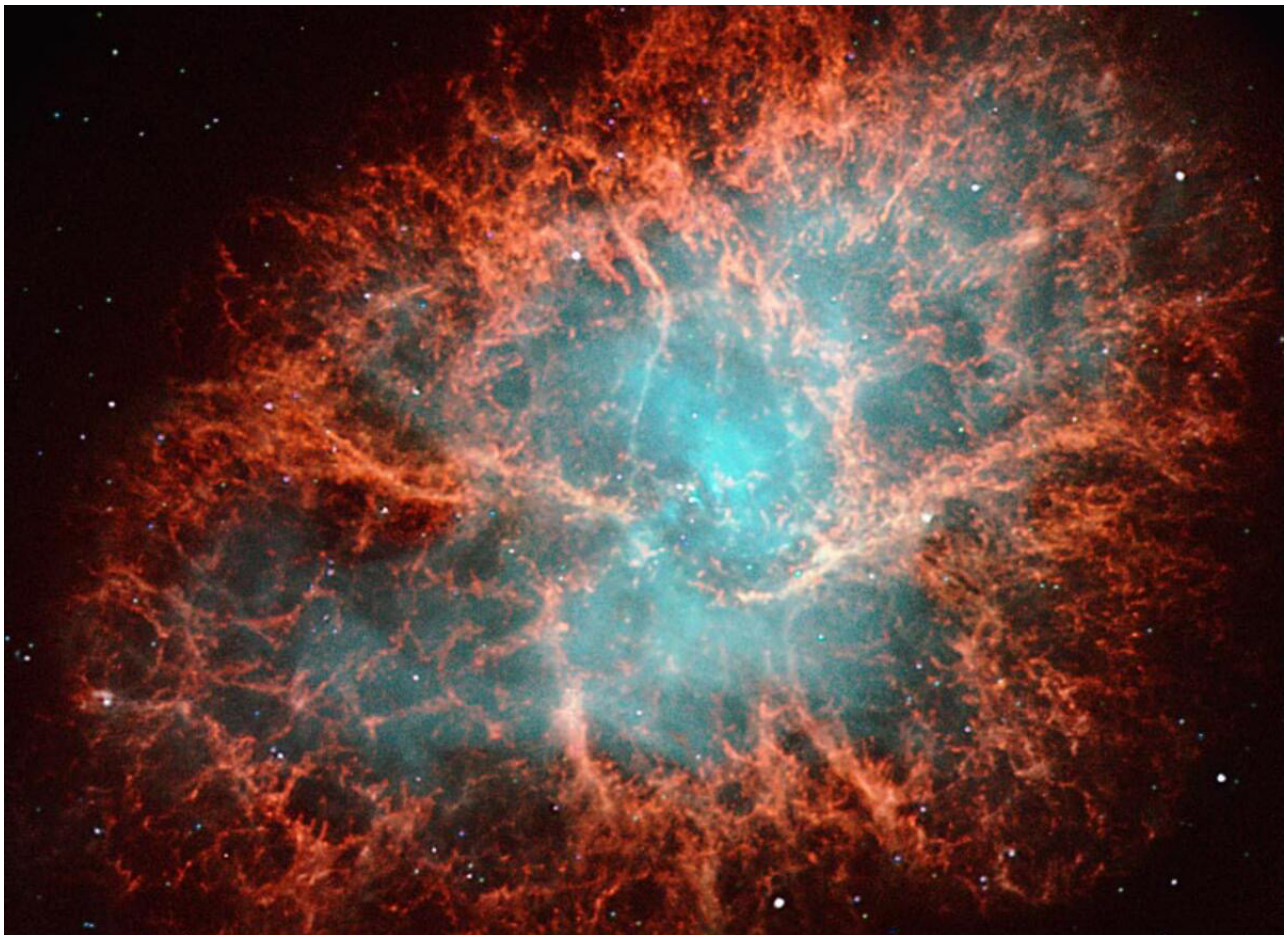
When he learnt that GIG would do an interview with him, without being asked he carefully prepared dozens of PPT slides containing photos that he selected according to the question list, and even inserted notes in English. On the first slide is a photo of him and his family during a hike on Mount Togasa on Japan's Izu Peninsula, and a few Japanese words that combine to mean "Happy New Year" have been added to the photo in sort of a formal way. He has made it a rule to have a get-together with his children and grandchildren at the beginning of every year as well as every summer. He says he was a workaholic as a young man, so much so that he stayed overnight in his office three days a week, which lasted for one year. However, as he approached middle age, something unexpected happened in his life and it suddenly dawned on him that instead of immersing himself entirely in his work, he should pay more attention to the people around him — his family, co-workers, and students. Pointing at a photo taken at the party celebrating his retirement from Tokyo Tech, he tells us, "In this picture, there are five couples who are all former students of mine, with their children", his voice tender.

This is Takahashi's fourth year in China. Deeply interested in the country's ancient history, he has with him a Japanese version of *Shiji,* or *Records of the Grand Historian of China*, and one of his recently planned travel destinations is Yinxu in Anyang, Central China's Henan Province, the ruins of an old city in China some 3,300 years ago. He also enjoys Guangzhou's inclusiveness and speaks highly of the local cuisine.

It is his wish to go on with his work here. He says he wants to bear witness to China's development amid global transformations and continue helping Chinese young people scale new heights in science.

(Photos provided by Eiichi Takahashi and Gao Wei)

Source: Guangzhou Institute of Geochemistry (GIG), Chinese Academy of Sciences



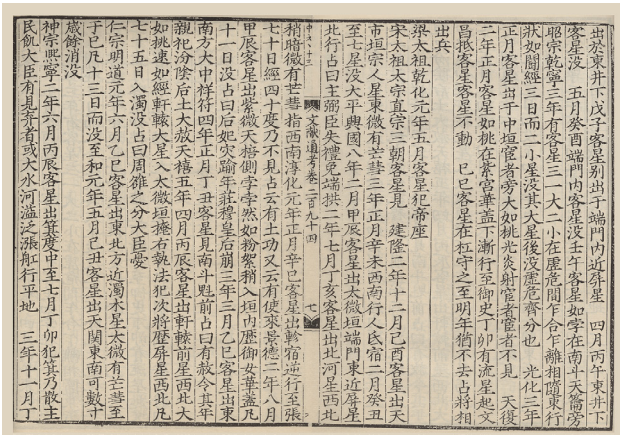
The Crab Nebula from the Nordic Optical Telescope [IMAGE: WALTER NOWOTNY]

LHAASO's measurement of Crab Nebula brightness yields new UHE gamma-ray standard

The Large High Altitude Air Shower Observatory (LHAASO), one of China's key national science and technology facilities, has accurately measured the brightness over 3.5 orders of magnitude of the standard candle in high-energy astronomy, thus calibrating a new standard for ultra-high-energy (UHE) gamma-ray sources. The standard candle is the famous Crab Nebula, which evolved from the "guest star" recorded by the imperial astronomers of China's Song Dynasty (960-1279).

Results were published in *Science* on July 8. The LHAASO International Collaboration, which is led by the Institute of High Energy Physics (IHEP) of the Chinese Academy of Sciences, completed this study.

Source: Institute of High Energy Physics (IHEP), Chinese Academy of Sciences



Historical records of the guest star in 1054
[IMAGE: IHEP]