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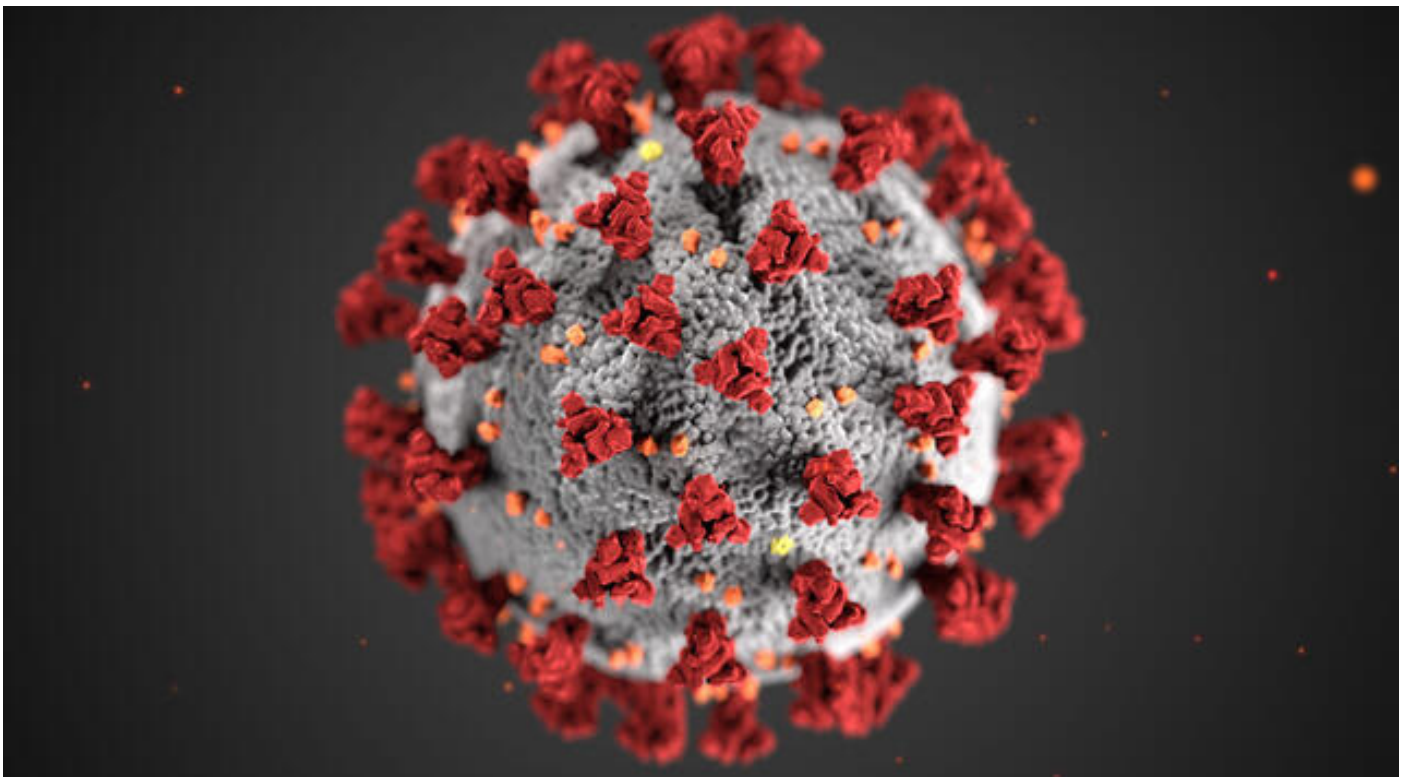


Scientists: SARS-CoV-2 has natural origin

On July 16, 22 scientists published a commentary supporting a natural origin theory for SARS-CoV-2 in the journal *Science China Life Sciences*, citing evidence from an evolutionary understanding and lack of proof of artificial tampering of the virus' genome.

The article came after 24 scientists around the world published an open letter in *The Lancet* medical journal in July stating that the virus most likely originated naturally, and not in a lab.

The commentary said SARS-CoV-2 is extremely well adapted to human populations compared the 2003 SARS-CoV, and must have experienced a shift in adaptability from animal hosts to humans prior to the onset of the current pandemic through natural selection.

"In this view, SARS-CoV-2 could not possibly have evolved in an animal market in a big city and even less likely in a laboratory," the article said.

Wu Chung-I, the corresponding author of the article and a biology professor at Sun Yat-sen University in Guangzhou, South China's Guangdong Province, said that the virus' superior adaptability in humans was most likely acquired over a long evolutionary time frame as the virus accumulated a series of slight enhancements through random mutations.

Wu said the claim of a non-natural origin for SARS-CoV-2 is moot since recent evidence based on mutational signatures shows that the virus' evolution has strictly followed natural laws to the letter.

The article said proponents of a man-made origin theory should be able to find genetic signatures that defy natural laws, such as bar coding commonly used in tracing cell lineages. Otherwise, "it would be more productive to focus on the natural processes in relation to the SARS-CoV-2 origin," it said.

Moreover, the article also points out that the virus would have needed to be screened by natural selection to be as adaptive as it is now.

Wu believes that prior to the COVID-19 outbreak, the virus may have undergone some forms of multistep evolution in human populations, resulting in its extraordinary adaptability. But how exactly this progress occurred remains a mystery.

"There may be a 'biological arms race' between the virus and its animal hosts at the place of origin, then the virus spread to a human population that does not have herd immunity to the new virus," he said.

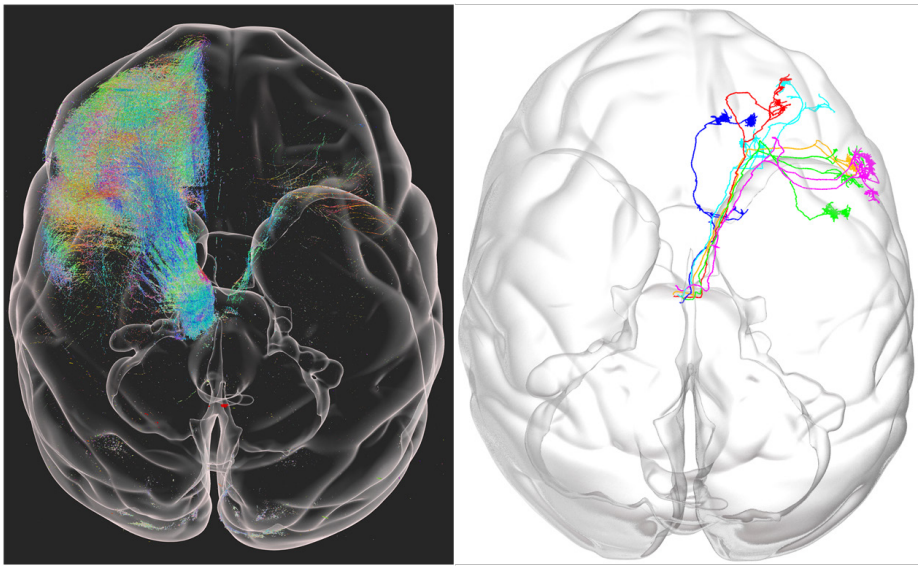
Source: China Daily

The "Brightest Light" to Decode Microworld

[IMAGE: YUAN GUANG / IHEP]

Whole brain mapping of primates enters micron era

A team led by Professor Bi Guoqiang and Professor Lau Pakming at the University of Science and Technology of China (USTC) of the Chinese Academy of Sciences (CAS) and at CAS's Shenzhen Institute of Advanced Technology (SIAT), and their collaborators, have realized three-dimensional (3D) mapping of the entire brain of the macaque monkey at micron resolution. The achievement was based on an updated version of their recently developed high-throughput 3D fluorescence imaging technique VISoR, and an efficient pipeline combining serial sectioning and clearing and three-dimensional microscopy with semiautomated reconstruction and tracing (SMART). The study was published in *Nature Biotechnology*.



Populational and individual axon projections of thalamic neurons in rhesus monkeys
[IMAGE: PROFESSOR BI GUOQIANG AND PROFESSOR LAU PAKMING'S TEAM]

Our brain is comprised of nearly a hundred billion nerve cells with delicate and complex connections between them. To fully understand how the brain functions, it is essential to have a high-resolution map showing how the nerve cells are organized and connected within the brain.

At present, it usually takes days to complete 3D imaging of the whole brain of a mouse at micron resolution using state-of-the-art techniques. However, high-resolution brain mapping for nonhuman primates such as the rhesus monkey, although highly desired given their roles in modeling human diseases, has been hindered by a major technical challenge. The brain of a rhesus monkey, more than 200 times larger in volume than that of a mouse, is simply too big.

To overcome this challenge, the researchers developed a high-throughput 3D fluorescence imaging technique, Volumetric Imaging with Synchronous on-the-fly-scanning and Readout (VISoR).

Compared with commonly used 3D optical imaging techniques, VISoR eliminates the time loss caused by moving and pausing while switching fields of view to obtain 2D images, allowing for unblurred imaging when the sample is in continuous motion. In this way, VISoR achieves more than ten times the speed of other 3D imaging methods for large tissue samples.

In addition to the challenge of imaging throughput, difficulty of imaging monkey brains also arises from their complicated cortical folding structures and low tissue transparency. The researchers first sectioned the isolated brain into 0.3-mm slices and then developed reagents to make them thoroughly transparent.

Their improved VISoR2 system allowed them to finish imaging a whole macaque monkey brain in 100 hours at a resolution of 1×1×2.5 microns. The total volume of raw image data acquired from two macaque brains exceeded 1 PB.

The researchers also developed efficient algorithms and software to realize automated 3D imaging reconstruction and semi-automated long-distance tracking of individual neuronal axon fibers. Their initial observations revealed previously unknown characteristics of axonal fiber projection and surprising patterns of fiber turning and routing in the cortical folds.

Professor David C. Van Essen from Washington University in St Louis commended this work as a "technical tour de force that marks a stunning advance in our ability to map long-distance connectivity accurately and efficiently throughout the entire brain of the macaque monkey". He said that besides the technical achievement, their exciting discovery may have profound implications for understanding brain morphogenesis and the principle of 'wiring length minimization'.

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Shanghai team in laser breakthrough

Chinese scientists have successfully taken a novel approach to obtaining free-electron lasing (FEL) that may realize the production and popularization of low-cost, table-top FEL devices with breakthroughs in multiple disciplines.

It was the first time that researchers have been able to obtain FEL based on the laser Wakefield electron accelerator.

A paper about the research result by the Shanghai Institute of Optics and Fine Mechanics (SIOM) of the Chinese Academy of Sciences (CAS), a result of nearly a decade's effort, was published as the cover story of the United Kingdom-based journal *Nature* on July 22.

X-ray FEL can be used to detect the internal dynamic structure of various matters and study the interaction process of light with atoms, molecules and condensed materials, and may lead to breakthroughs in diverse disciplines such as physics, chemistry, structural biology, medicine, materials, energy and the environment.

"The features of FEL, including its super high resolution rates regarding time and space and super strong peak brightness, makes it possible to realize three-dimensional, multimodal imaging of matters with ultra-high precision," said Wang Wentao, a professor of the institute and a co-first author of the paper.

"The application of the potential technology is likely to immensely expand human's understanding of the mystery of life and the evolution of living things," he said.

Experts explained that there are currently eight FEL facilities in operation in the world ranging in size from 300 meters to 3.4 km, but that technology of a radio frequency electron accelerator does not allow small-size FEL facilities that can be popularized.

"We proved the feasibility of the new technical route with the laser electron accelerator with ultra-high acceleration capability, and downsized the facility size from kilometer level to 12 meters," said Leng Yuxin, deputy director of the institute.

Researchers gave an example of potential future application brought by the small-sized FEL facilities. Even if a patient undergoing X-ray imaging moves quickly at the speed of light, a machine with the technology could still produce an image of impressively high resolution.

Source: China Daily

China launches home-grown aeronautic remote-sensing system

China's new aeronautic system for conducting detailed observations and monitoring of Earth's surface passed its final acceptance stage recently and is now formally in operation.

The Chinese Aeronautic Remote Sensing System (CARSS), which consists of two medium-sized manned aircraft together with a range of remote-sensing technologies, was developed by the Aerospace Information Research Institute (AIR) of the Chinese Academy of Sciences (CAS).

According to Ding Chibiao, vice president of the institute, aeronautic remote-sensing images are needed to assess road damage, landslides and collapsed houses when people suffer from severe earthquakes or floods. Remote sensing is widely used in disaster prevention and alleviation, agriculture, forestry and fishery, water conservancy, surveying and mapping.

Compared with space-based remote sensing, aeronautic remote sensing offers higher resolution and precision. It can take pictures of the ground continuously, all day long, producing clearer images.

The CARSS also incorporates the functions of real-time processing and satellite communication, contributing emergency-response operations, including disaster prevention and reduction.

During its trial operations, the system conducted major aeronautic scientific experiments, as well as a calibration flight for the new remote-sensing payload, and a disaster and environmental monitoring flight.

In the next phase, the system will be made available to users in various fields.

Source: Xinhua

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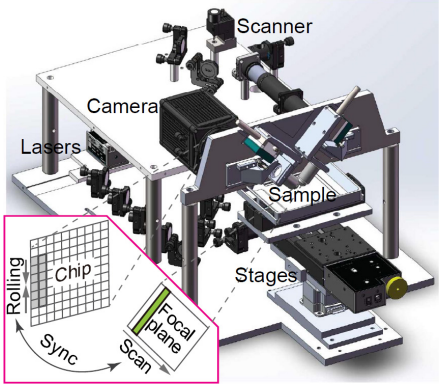
The application of VISoR may be extended to the imaging of other tissues and organs, including samples from clinical pathology. It is anticipated that by combining the huge imaging data obtained with AI analysis, it may be possible to understand the fine 3D structure of the brain and body as well as how it changes in various disease conditions, thus facilitating medical diagnostics and drug developments.

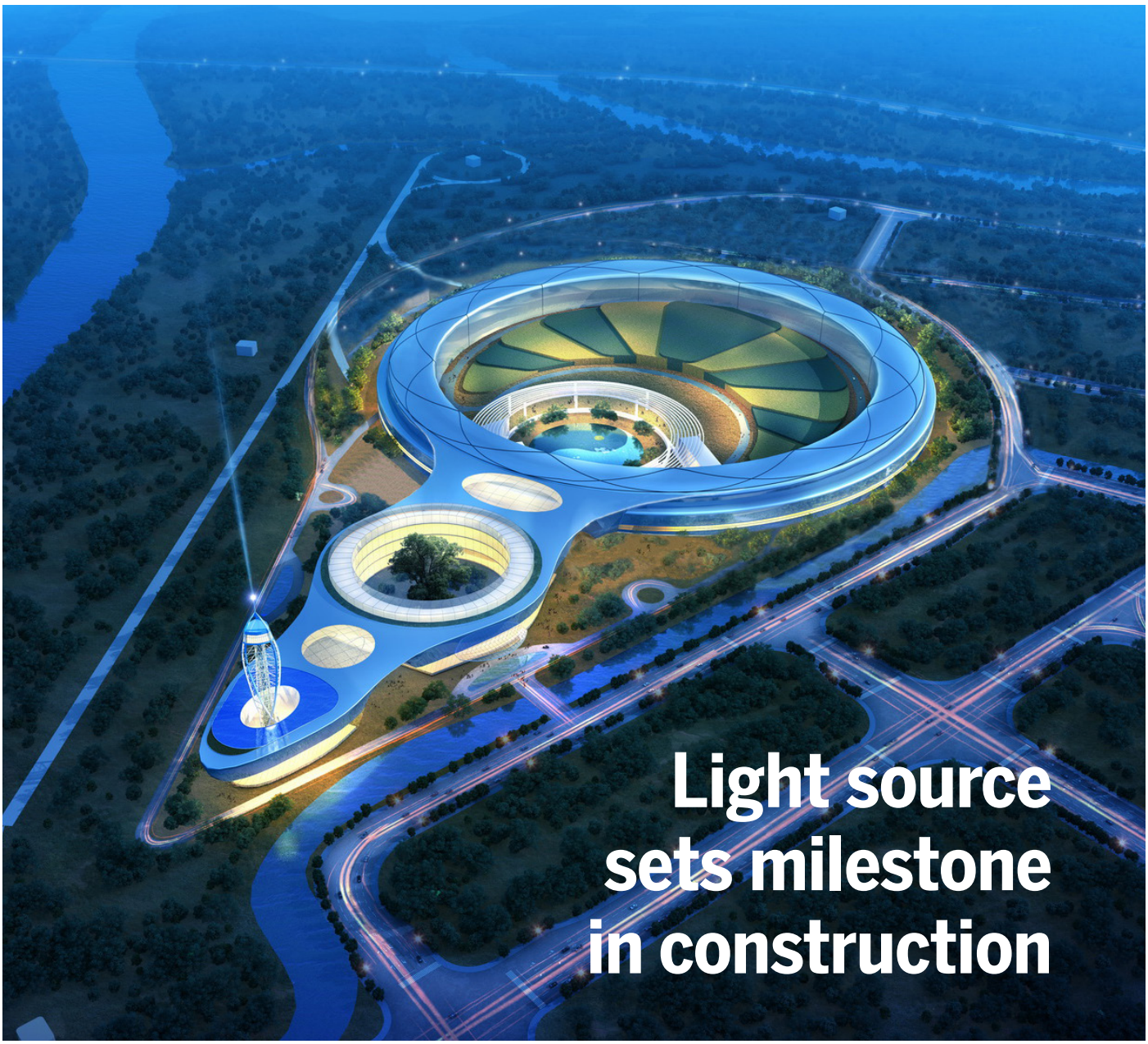
"Hopefully, this technology will be further improved for broader and larger scale applications, to make important contributions to the mapping and understanding of primate and eventually the human brain," said Professor Duan Shumin from Zhejiang University.



Schematic of VISoR2 [IMAGE: PROFESSOR BI GUOQIANG AND PROFESSOR LAU PAKMING'S TEAM]

"Brain connectome at the mesoscopic level is important but so far limited to rodents. This work demonstrates a powerful method that enables researchers to dissect mesoscopic connectome of monkeys at one micron resolution, in four days. It represents a tour de force in this rapidly moving field," said Professor Wang Xiaojing of New York University.

Source: University of Science and Technology of China, Chinese Academy of Sciences



Light source sets milestone in construction

The conceptual design of HEPS [IMAGE: IHEP]

High-energy synchrotron facility installs its first accelerator piece

The first piece of accelerator equipment was installed on the High Energy Photon Source (HEPS), China's first high-energy synchrotron radiation light source, in Beijing on June 28, marking a milestone in the construction of a major scientific instrument that will be used to probe the microstructure of materials for basic research and engineering.

June 28 also saw the launch of the Platform of Advanced Photon Source Technology Research and Development. The 42,640-square-meter facility is adjacent to HEPS and serves as a testing ground for research and experimental instruments before they are installed in the light source.

HEPS' main facility consists of a storage ring with a circumference of 1,360 meters. Construction of the 4.8 billion yuan ($743 million) super-microscope began in 2019 and is set to finish around December 2025, according to the Institute of High Energy Physics (IHEP) of the Chinese Academy of Sciences (CAS).

It is capable of accelerating electrons to the energy level of six giga-electronvolts, making it one of the brightest and most powerful X-ray light sources in the world.

"HEPS will be a key platform for our scientists to make more original breakthroughs in basic sciences and engineering," said Wang Yifang, the director of the institute.

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China begins construction of new survey telescope to detect space debris

Construction of a survey telescope array that will mainly be used to detect space debris in medium and high orbits has begun in Northwest China's Qinghai Province, taking advantage of the plateau region's clear night skies.

The multi-application survey telescope array, MASTA, developed by the Purple Mountain Observatory (PMO) of the Chinese Academy of Sciences (CAS), is under construction in the town of Lenghu, Qinghai, with an average altitude of 3,800 meters above sea level.

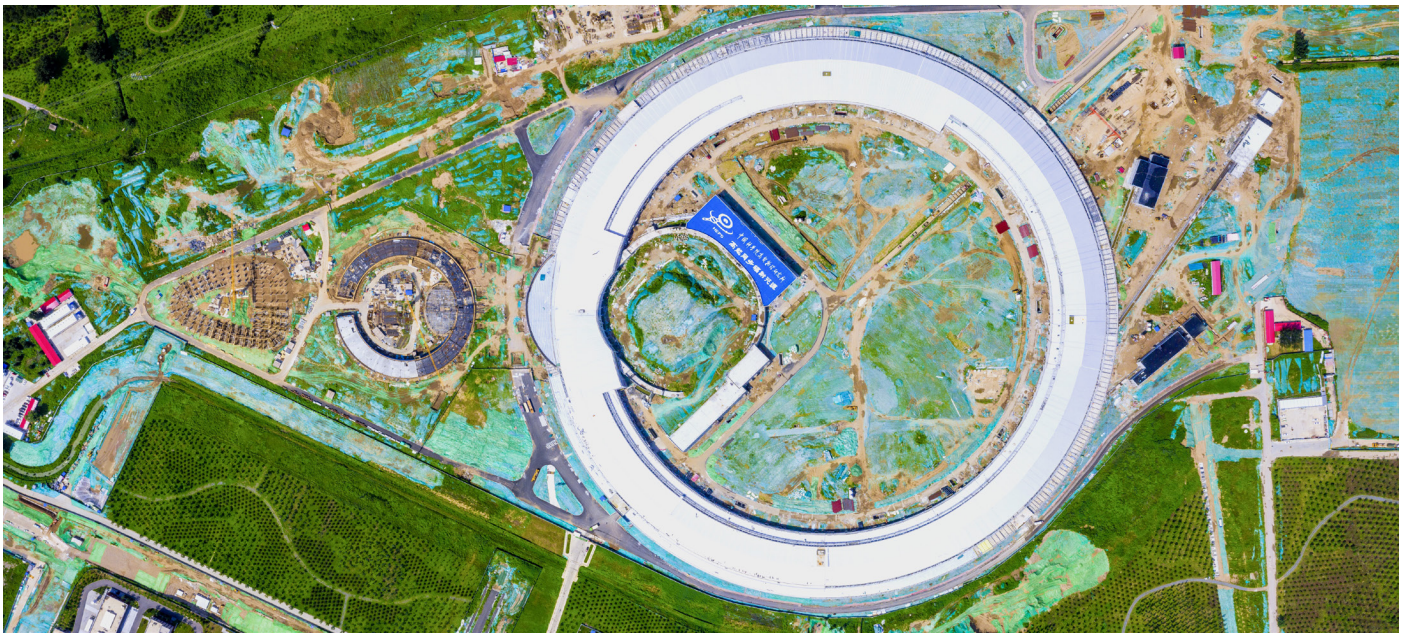
Slated for completion by 2023, the telescope's spectrum is expected to fill China's gap in this technology.

"The survey telescope array can detect small space debris and determine its orbit and laws of behavior, thus providing early warnings and making it possible to avoid debris collisions threatening the safety of spacecraft," said Lei Chengming, a researcher at PMO.

Tian Cairang, executive deputy director of the Lenghu Industrial Park Management Committee, said that Lenghu has become an astronomical observation base that now hosts six scientific research units and eight telescope projects. In the future, it is expected to become the largest astronomical observation base in China and a world-class astronomical research center.

The town, with a total area of 17,800 square km, is located 944 km away from Qinghai's capital of Xining. Its clear nights meet the conditions for a world-class observatory site.

Source: Xinhua



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For decades, scientists have been using extremely bright X-rays produced in synchrotron light sources to study matter at the atomic and molecular level, leading to advances in materials science, biology, medicine, nanotechnology, aerospace technologies and other fields.

There are three synchrotron light sources in operation on the Chinese mainland, located in Beijing, Shanghai and Hefei, East China's Anhui Province. The Shanghai Synchrotron Radiation Facility, which opened in 2009, is currently the most advanced of the three.

HEPS, which is being built in Huairou District's Science City in Beijing, is comprised of accelerators, beamlines and auxiliary facilities that form an overall layout resembling a giant magnifying glass.

The machine can accommodate over 90 beamlines and stations for scientific research. In the first phase, 14 of the beamlines and stations will be made available for researchers in engineering, materials science, energy, medicine, chemistry and other fields.

Source: China Daily

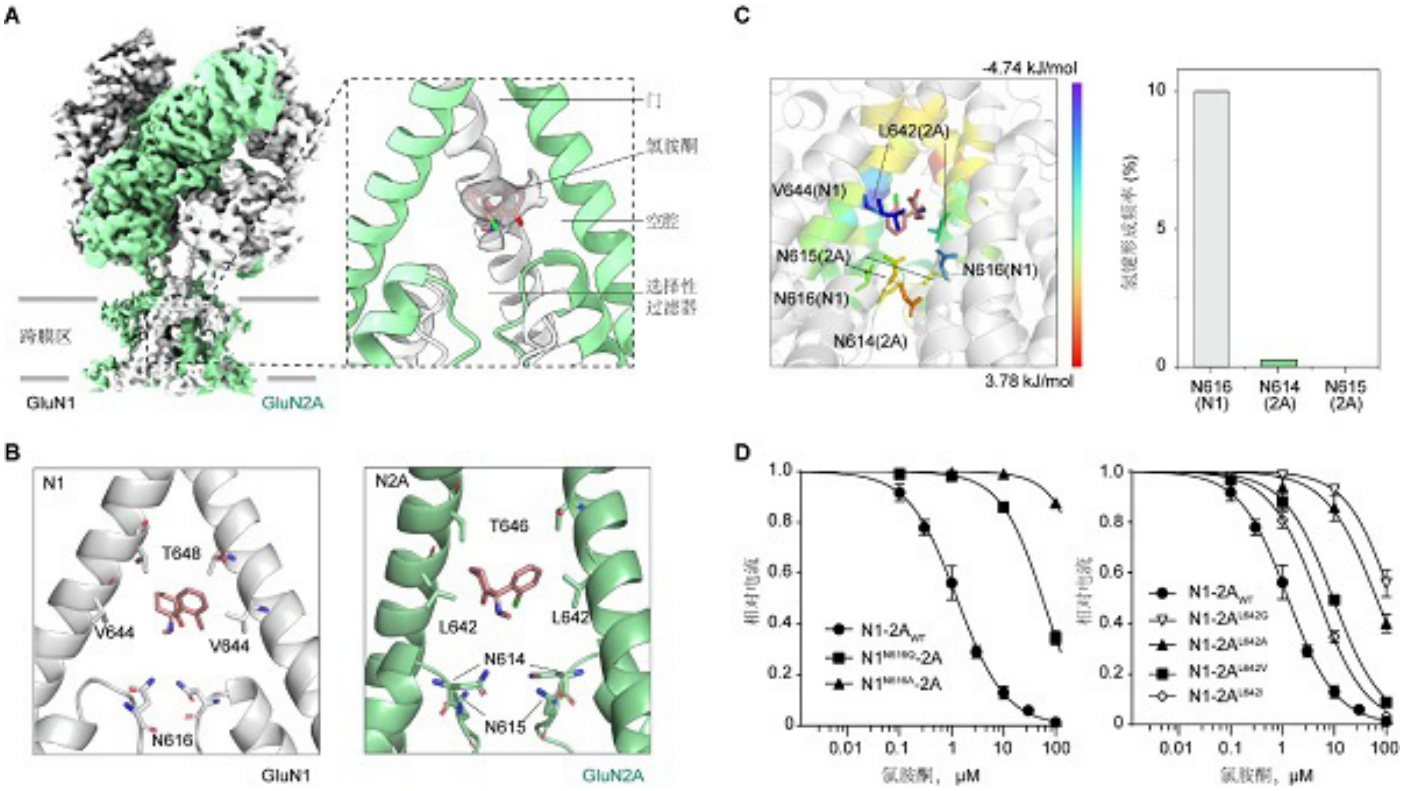

Figure legend: (A) Cryo-EM structures of ketamine bound human GluN1-GluN2A NMDA receptors; (B) Structure model of the binding site of ketamine; (C) Relative binding energy and hydrogen bonding occupancy for residues around ketamine during the molecular dynamics simulation; (D) Ketamine dose-response curves of WT and key residues mutated NMDA receptors. [IMAGE: ZHU SHUJIA'S LAB AND LUO CHENG'S LAB]

Structural basis of antidepressant ketamine action on human NMDA receptors discovered

A recent study published in *Nature* revealed the structural basis of antidepressant ketamine action on human NMDA receptors. This work was performed by researchers from Dr. Zhu Shujia's Lab at the Institute of Neuroscience (ION), the State Key Laboratory of Neuroscience, the Center for Excellence in Brain Science and Intelligence Technology (CEBSIT) of the Chinese Academy of Sciences (CAS), and Dr. Luo Cheng's team at the Drug Discovery and Design Center (DDDC), the Center for Chemical Biology, the State Key Laboratory of Drug Research (SKLDR), Shanghai Institute of Materia Medica (SIMM) of CAS. This work reveals the structural basis of ketamine binding and action on human NMDA receptors, and paves the way for future development of ketamine-based antidepressants.

Major depressive disorder affects about 6-16 percent of the world population, and even leads to suicide. Antidepressants targeted on the monoamine system require prolonged treatment over weeks or months, and are ineffective in one-third of patients. Ketamine, a rapid-acting novel antidepressant, can quickly reduce the core symptoms of depression, notably suicidal ideation within hours after administration, and is effective in patients with treatment-resistant depression. This discovery is the most important recent breakthrough in the field of antidepressants. However, ketamine can induce severe psychotomimetic side effects, like dissociative effects. Moreover, it has the potential for abuse as a recreational drug, which limits its clinical use. Thus, there is increasing scientific and clinical interest in developing rapid-acting antidepressants with fewer side effects.

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Wildfires during the Permian-Triassic transition and the terrestrial ecosystem's vegetation changeover

Volcanic activity drove an increase in the intensity of wildfire events, which in turn disturbed and affected terrestrial ecosystems.

Wildfire is an important part of the Earth's natural environment. It plays a significant role in many environmental and evolutionary innovations in geological history. The End-Permian mass extinction is the biggest extinction event in Earth's history, and the response of terrestrial vegetation systems to this event has been highly studied in recent years. Nowadays more and more records of wildfire are reported from the Late Paleozoic, and the investigations focusing on wildfire are of great significance for learning about the collapse of terrestrial ecosystems and the vegetation changeover during the Permian-Triassic transition.

Recently, the Late Paleozoic research group from the Nanjing Institute of Geology and Palaeontology of the Chinese Academy of Sciences (NIGPAS), together with Nanjing University and Yunnan University carried out a systematic study focused on charcoals and $\delta^{13}C_{org}$ from the upper Permian of the Dalongkou section in Northwest China's Xinjiang Uygur Autonomous Region and of the Lengqinggou section in Southwest China's Guizhou Province. The results were published in *Earth-Science Reviews* and *Frontiers in Earth Science*.

In the Dalongkou section, charcoals from several stratigraphic horizons in the lower-middle Guodikeng Formation evidenced the frequency of paleo-wildfires during the late Permian. The reflectance values of the charcoals indicate that surface fires were dominant throughout the sequence, with fire regime changing in the upper of the Guodikeng Formation from higher reflectance to extremely low reflectance. It probably hints at vegetation impoverishment and a

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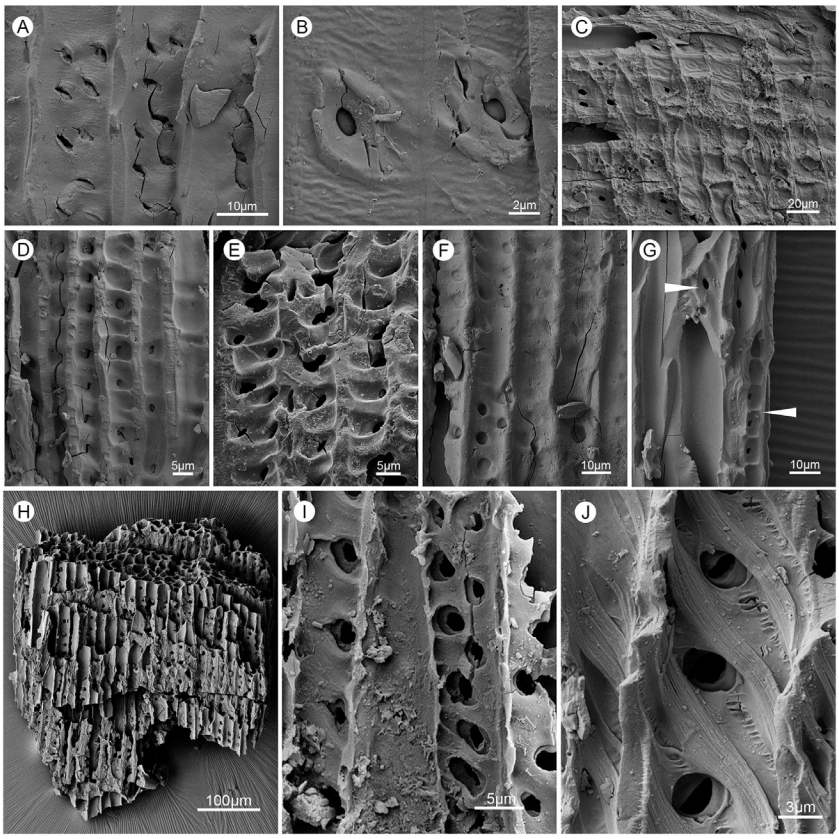
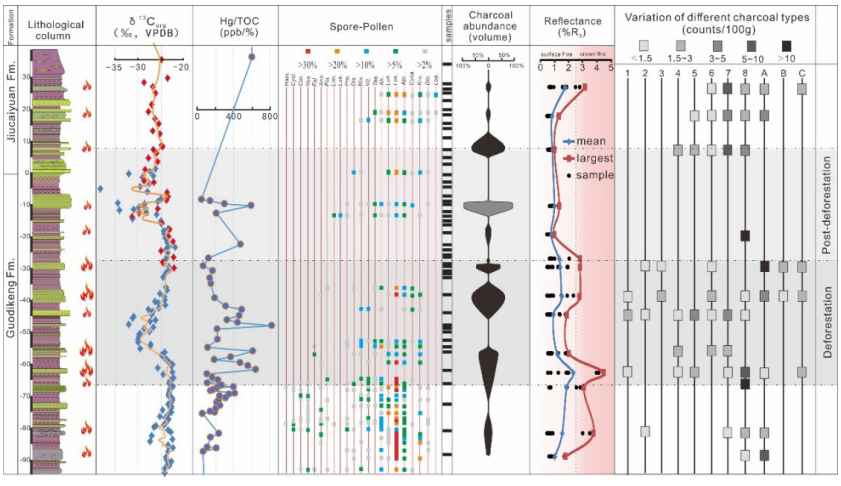


SEM images of charcoal from the Dalongkou section in Northwest China's Xinjiang Uygur Autonomous Region [IMAGE: NIGPAS]



Co-variation diagrams for the $\delta^{13}C_{org}$ values, Hg/TOC values, charcoal abundance, reflectance and types of fossil charcoal in the Dalongkou section [IMAGE: NIGPAS]

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lack of fuel during that time. The distribution of all categories of the charcoals, the difference of cuticles and the evidence of spore-pollen also support the deforestation stage. In addition, the coupling of the Hg/TOC peaks and the organic carbon isotope ($\delta^{13}C_{org}$) values and the abundance of the charcoals in the sequence indicates that volcanic activity could be the deep-seated driver for wildfires and the $\delta^{13}C_{org}$ change.

The work of the Lengqinggou section shows that charcoals from the Xuanwei Formation occurred more frequently, with higher reflectance and diversity, while those from the Kayitou Formation exhibit low reflectance and diversity. This phenomenon supports the point that the vegetation changed from rainforest to herb land between the two formations. Meanwhile, the fire regime also changed from high temperature crown fire to ground fire with lower temperature. Furthermore, an ash bed in the uppermost coal in the Xuanwei Formation was of interest. Detailed sampling shows that an abrupt excursion of $\delta^{13}C_{org}$ and reduction of charcoal abundance occurred immediately above the volcanic ash. It suggests that the intense wildfire associated with volcanism culminated at that time, leading to the eventual vegetation changeover of the terrestrial ecosystems in Southwest China during the Permian-Triassic transition.

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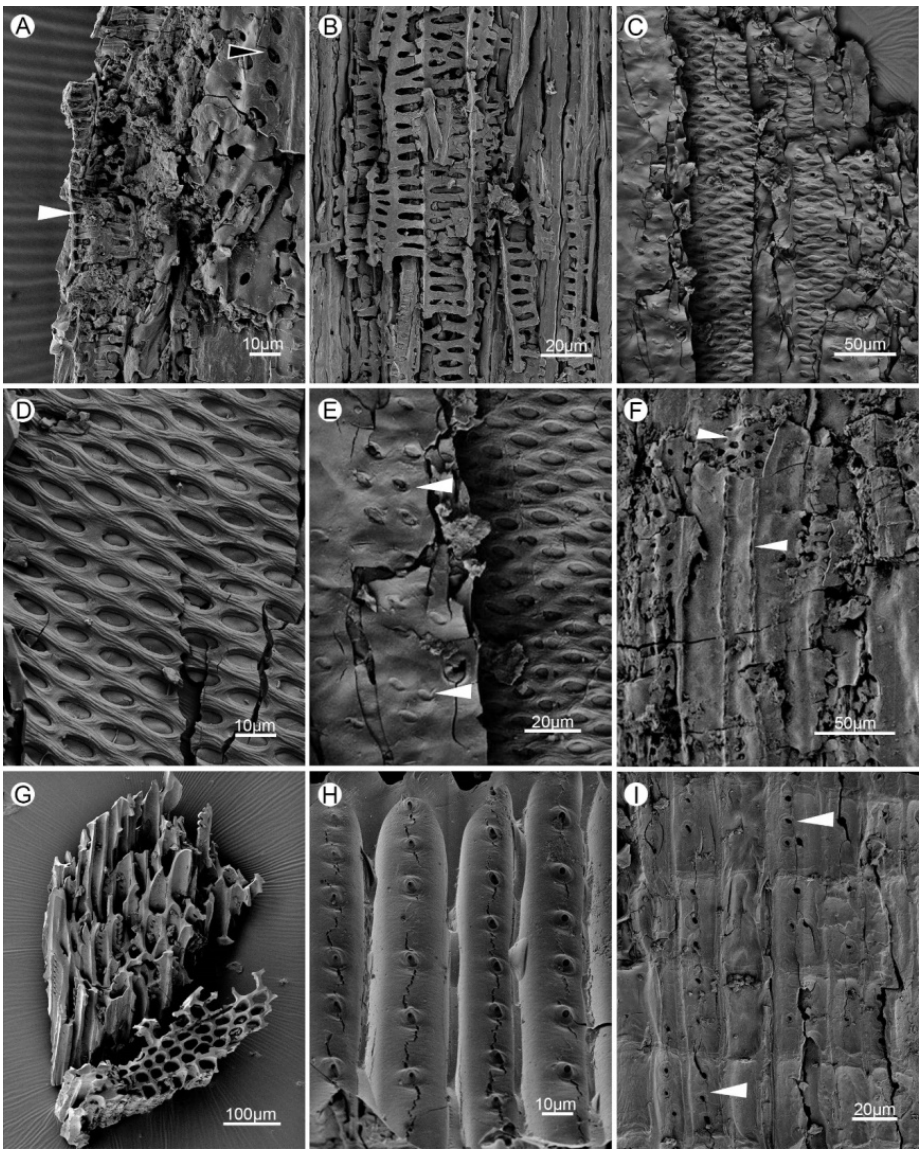
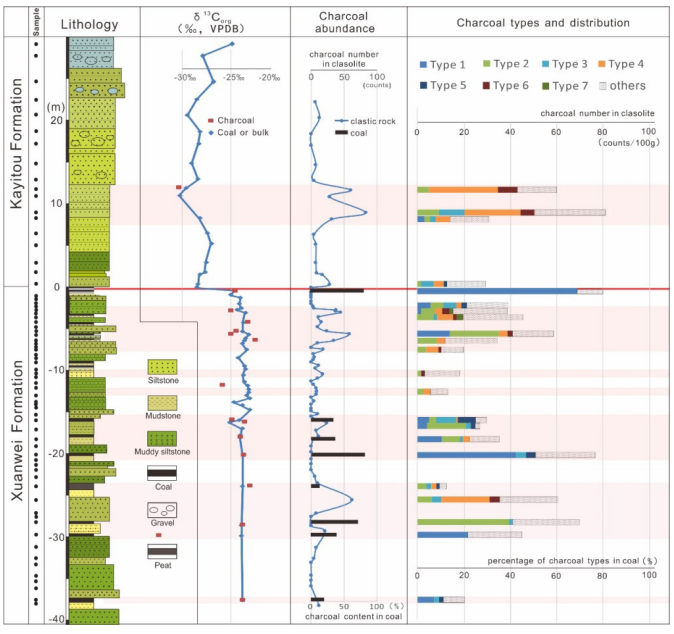
Nanjing Institute of Geology and Palaeontology,
Chinese Academy of Sciences
(NIGPAS)

Source: Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS)



Above: SEM images of charcoal from the Lengqinggou section in Southwest China's Guizhou Province
[IMAGE: NIGPAS]



Left: Stratigraphic column and $\delta^{13}C_{org}$, charcoal abundance and types of fossil charcoals in the Lengqinggou section, Southwest China's Guizhou Province
[IMAGE: NIGPAS]

Zhang Yijun (L), Minister Counsellor of the Chinese Embassy in Kenya and Robert Wahiti Gituru, co-director of the Sino-Africa Joint Research Center (SAJOREC) at the SAJOREC botanical garden on June 24, 2021 [IMAGE: XINHUA/LI YAN]

Kenyan botanist hails Kenya-China scientific cooperation

Kenyan botanist Robert Wahiti Gituru has hailed Kenya-China scientific cooperation which has made tangible achievements during the COVID-19 pandemic.

Gituru, co-director of the Sino-Africa Joint Research Center (SAJOREC), based at Kenya's Jomo Kenyatta University of Agriculture and Technology, said Kenyan and Chinese researchers jointly discovered six new plant species and one new animal species in 2020.

They also published more than 60 quality academic research papers as well as a monograph, Gituru said on June 24.

"We are training continually young African scientists through our friends and collaboration with the Chinese side. They are offering scholarships for African students to study in the Chinese Academy of Sciences (CAS) institutions," he said.

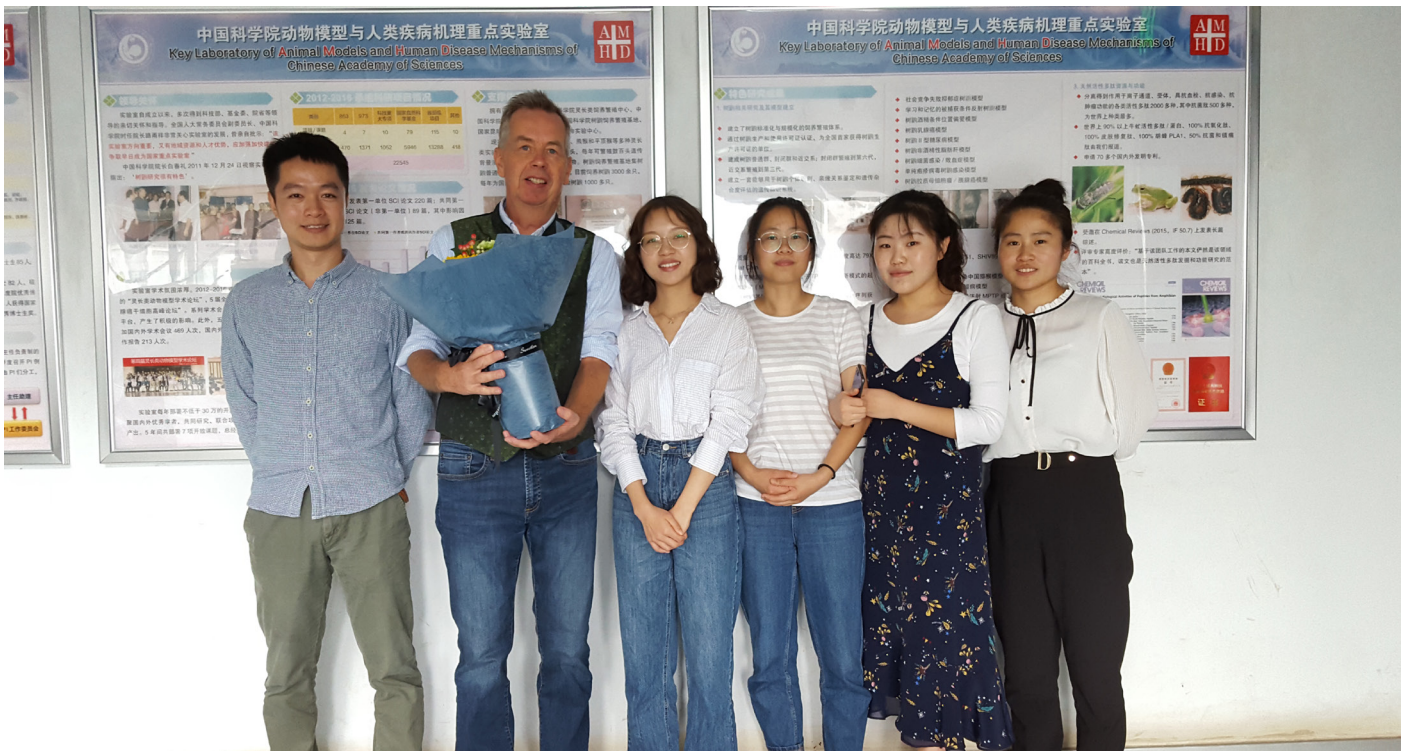
Gituru said 46 young African scholars who are currently studying in China will return to Africa and carry on the study.

"The SAJOREC is the best example of China-Kenya cooperation on agricultural technologies, biodiversity and food safety," said Zhang Yijun, Minister Counsellor of the Chinese Embassy in Kenya.

When inspecting the center on June 24, Zhang said the SAJOREC has cultivated hundreds of African postgraduate students and professionals.

Since its establishment in 2013, the SAJOREC has put forward more than 45 joint research programs focusing on biodiversity investigation, pathogenic microorganism detection, geographic science and remote sensing, high-yield and high-quality crop cultivation demonstration as well as land and water resources management.

Source: Xinhua



A productive PIFI research stay and enriching cultural experience

I am Christoph Wilhelm Maria Turck from Germany. I am very honored to have received a PIFI Visiting Scientist Program Award for the project entitled "Molecular pathways and brain circuits pertinent to psychiatric disorder pathobiology using rhesus monkey models" carried out in collaboration with Professor Hu Xintian at the Kunming Institute of Zoology (KIZ) of the Chinese Academy of Sciences (CAS). I spent a very productive month at KIZ in August/September of 2019 and plan to come back in the near future.

Brain disorders are a significant disease burden worldwide, including in China. Research endeavors that are geared towards an improved understanding of the pathobiology of these disorders will ultimately be the key to successful treatment. Psychiatric disorders start at an early age. Early intervention through a precision medicine approach will ensure an improved quality of life for patients and consequently an economic benefit for society. Our collaborative project aims to study the effects of early adversity to the development of depression-like behavior in an animal model: the rhesus monkey. The overall goals are to improve the understanding of psychiatric disorder etiology and the delineation of biosignatures. As part of this project, we collected cerebrospinal fluid specimens from rhesus monkeys at several time points. In collaboration with my former PhD student Zhang Yaoyang who is heading the proteomics research group at CAS's Shanghai Institute of Organic Chemistry, the samples were subsequently subjected to comparative proteomics and metabolomics analyses. Our preliminary data indicate that several molecular pathways are affected in the monkeys that exhibit a depression-like phenotype. These studies will be further extended during my upcoming stays at KIZ.

I enjoyed my time at KIZ very much. Right from the beginning Professor Hu integrated me into his research group, and his group members made my stay at KIZ very comfortable. In addition to my research activities I did some travelling to explore Yunnan Province. A particular highlight was a trip to the ancient city of Lijiang and its surrounding landscape. Another activity that I have very fond memories of during my time in Kunming is the Chinese Cooking School where I learned to prepare delicious dishes like *ma po dou fu*, *xi hong shi chao ji dan* and *gong bao ji ding*.

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I would like to take this opportunity to thank everybody at KIZ for the great hospitality and the stimulating discussions that have already resulted in a joint research publication. Under the guidance of Director Professor Yao Yonggang and Professor Hu, KIZ has now finished the construction of a new Primate Research Facility that is second to none worldwide. This will enable exciting new research directions. I very much look forward to being involved in this new facility and can't wait to return to KIZ to continue our research projects.

Source: Christoph Wilhelm Maria Turck, Kunming Institute of Zoology (KIZ), Chinese Academy of Sciences

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Previous studies have revealed that ketamine, as a pore blocker of NMDA receptors that are an important glutamate-gated ion channel in the brain, could inhibit the channel activity of NMDA receptors on the postsynaptic membrane to regulate synaptic plasticity and further rescue the stress-induced spine loss in the cortex and hippocampus. Thus, it is important for the development of ketamine-based antidepressants to illustrate the binding site of ketamine in the NMDA receptor and the structural basis of ketamine's action on NMDA receptors.

In this study, the researchers determined the cryo-EM structure of human GluN1-GluN2A NMDA receptors in complex with ketamine, and found the electron density map of ketamine in the transmembrane domain of NMDA receptors. The result confirmed the binding pocket of ketamine was in the central vestibule between the channel gate and selectivity filter. The vestibule is formed by hydrophobic valine (V644 in GluN1 subunits) and leucine (L642 in GluN2A subunits), while the top and bottom of the vestibule are formed by polar threonine and asparagine, respectively. To gain more insight into the interaction between ketamine and the residues around the vestibule, they carried out molecular dynamics simulation to calculate the movement of ketamine in the binding site. The result showed that L642 in GluN2A made the greatest contribution to relative binding energy during ketamine binding through the hydrophobic interaction, while N616 in GluN1 formed hydrogen bonds with ketamine among the three asparagines at the bottom. These two amino acids, L642 in GluN2A and N616 in GluN1, were identified as key residues forming hydrophobic interaction and hydrogen bonds with ketamine, respectively. In addition, mutations at these two key residues led to the reduced potency of ketamine in blocking the NMDA receptor channel activity.

In conclusion, the authors have uncovered the binding pocket of ketamine in the central vestibule of NMDA receptors, and further validated that hydrophobic interaction of L642 in GluN2A and hydrogen bond formed with N616 in GluN1 are essential to stabilizing the binding of ketamine in NMDA receptors. This discovery paves the way for future development of ketamine-based antidepressants.

This work entitled "Structural basis of ketamine action on human NMDA receptors" was published online in *Nature* on July 28. Zhang Youyi, Ye Fei and Zhang Tongtong are the first authors with equal contribution. Dr. Zhu Shujia and Dr. Luo Cheng are corresponding authors.

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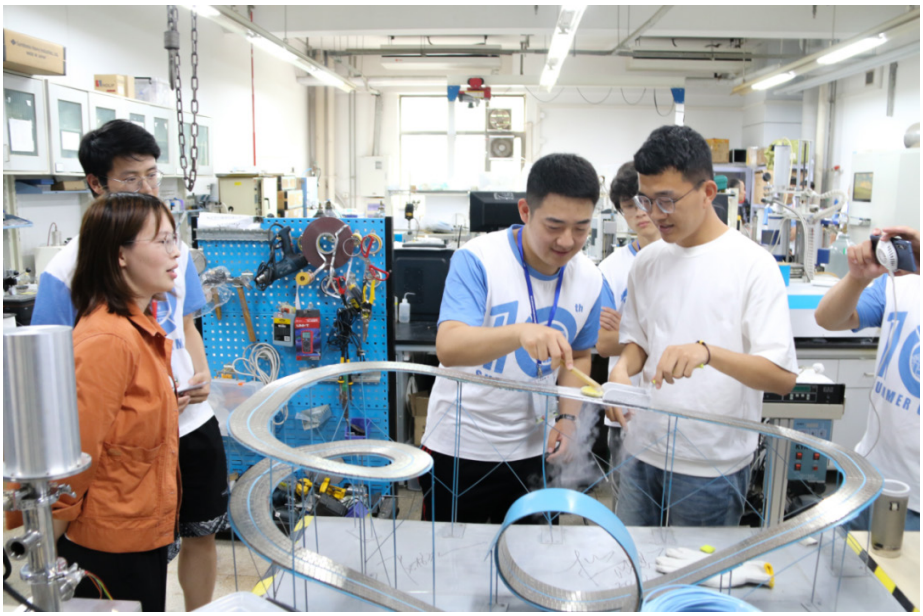
Shanghai Institute of Materia Medica (SIMM),
Chinese Academy of Sciences

Source: Shanghai Institute of Materia Medica (SIMM), Chinese Academy of Sciences

Inspiring Future Scientists

The Chinese Academy of Sciences hosts a summer camp every summer for young students from home and abroad. The camp aims to bring together excellent young scientists to exchange ideas on potential solutions to global issues through science and technology. It is a great pleasure to share the latest scientific discoveries and discuss the development of science with future scientists.

Source: Chinese Academy of Sciences

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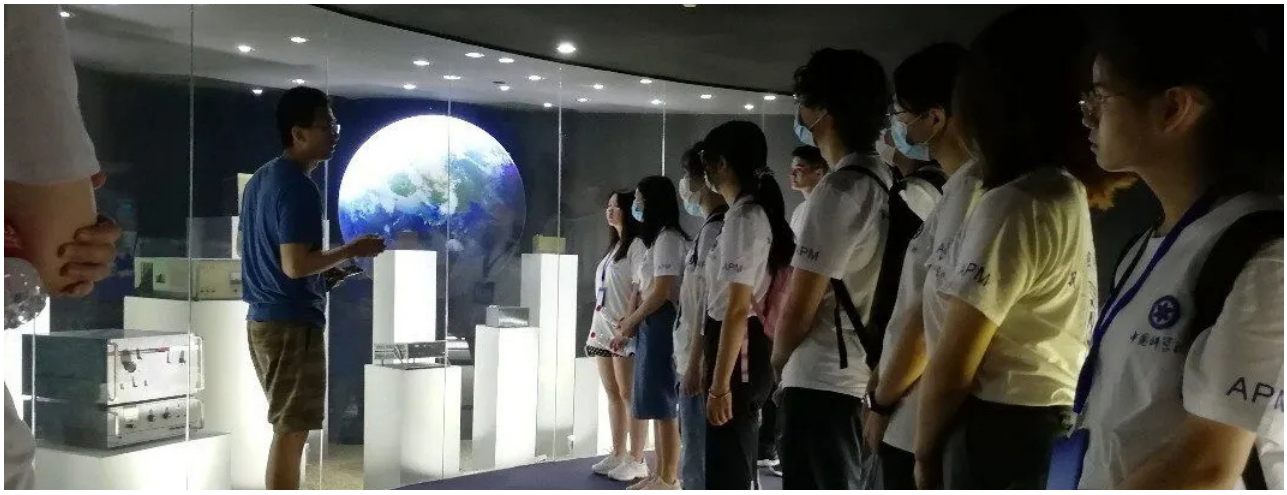
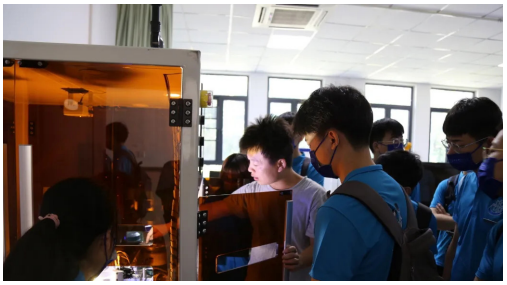



快乐星球



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