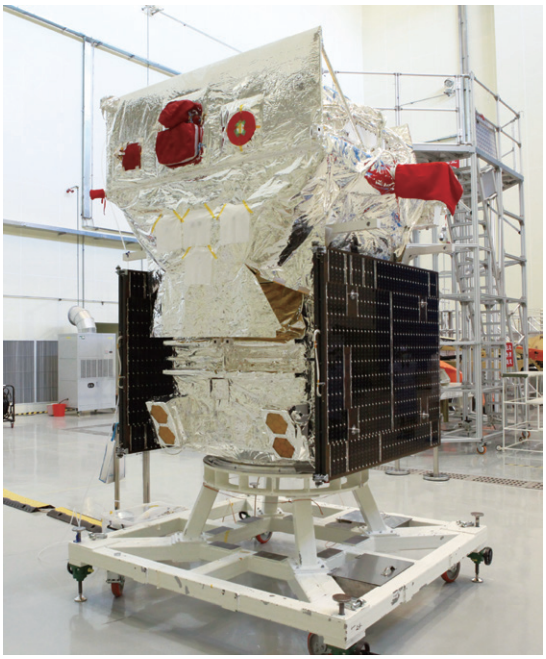
InFocus | *Kuafu*-1's First Strides toward the Sun

Kuafu-1, China's first scientific satellite dedicated to solar observations, was flown into its preset sun-synchronous orbit on October 9. Focusing on the solar magnetic field and prominent solar activities including the solar flares and coronal mass ejections (CMEs), it might help pursue the underlying mechanisms of solar activities and facilitate the forecast of disastrous space weathers, which could hamper navigation systems and other electronic equipment ubiquitous in our daily life.

After in-orbit tests and calibration, the instrument will be put into formal operation and serve the astronomical community. In December, it released the first images from its test observations, after verification of normal operation and satisfactory working condition. The first release immediately caught the eye of top experts.

A mission sponsored under the Strategic Priority Program on Space Science (SPPSS) of CAS, its successful flight and operation is lately chosen by Chinese academicians into the list of top 10 S&T advances in S&T news of 2022.

For more, please refer to page 201.



The satellite as seen before the installation into the CZ-2D rocket. (Image by ASO-S Team)

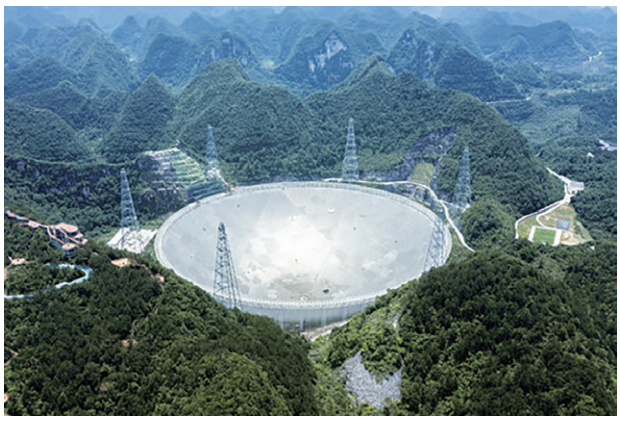
Special | Top S&T Science Advances in the Lens of News

At the turn of the year, Chinese academicians, including Members of the Chinese Academy of Sciences (CAS) and the Chinese Academy of Engineering (CAE), made their choices of the most important S&T advances of China seen through the lens of news.

Prominent in the list are some milestone S&T achievements in physics, chemistry and space science, including progress in the pursuit of basic astronomical/physical questions, successful in-orbit building of China's space station "*Tiangong*" (a Chinese term meaning the heavenly palace in Chinese mythology), and the first launch of the most powerful solid carrier rocket of China.

Particularly, a group of astronomical advances achieved with the aid of FAST, the Five-hundred-meter Aperture Spherical radio Telescope of China, stand in the limelight at the competition.

Turn to page 204 to follow *BCAS*'s special report on the picks by Chinese academicians.



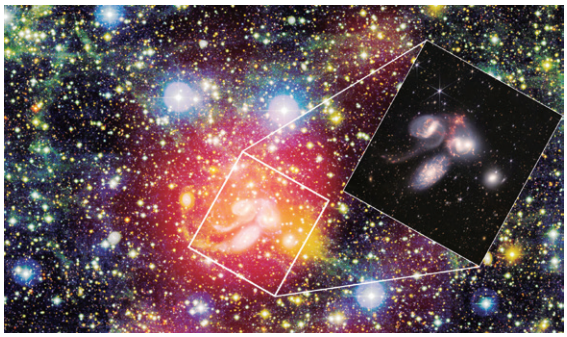
FAST in aerial view. (Image by FAST team at NAOC)

Highlights | Largest Gaseous Structure Revealing Possible Violent Scenario in Early Galaxy Formation

FAST, which caught the eye of the public in the ballot for annual top S&T advances in news, has earned this close attention with its outstanding observational performance and sensitivity. The discovery of the largest gaseous structure in the universe, an atomic-hydrogen cloud, provides the latest example.

Working with FAST, the team led by Prof. XU Cong at the National Astronomical Observatories, CAS (NAOC) stared into the vicinity of Stephen Quintet, a mysterious galaxy ensemble, and found this colossal cloud. Their observation and analysis unveiled a possible scenario in the early formation of the ensemble, where violent crushes could have involved, based on the distribution and velocities of the gases.

For more, see page 213.



The atomic-hydrogen gaseous structure (the red halo) discovered in the vicinity of Stephan's Quintet, put next to the inset of an infrared image of the same galaxy group released by James Webb Space Telescope. (Image credit: NAOC, NASA, ESA, CSA & STScI)

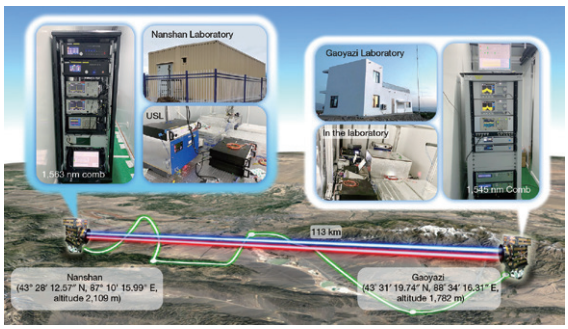
Highlights | Top the Mountain

Members of the scientific expedition team are sampling ice and snow at the summit of Mt. Qomolangma.

On May 4, China's scientific mountaineering expedition team reached the peak of Mount Qomolangma, accomplishing their "Earth Summit Mission". Led by CAS Member Dr. YAO Tandong, over 270 participants from 16 research groups participated in the expedition. They achieved many breakthroughs and set new high-altitude scientific records. For example, they set up the world's highest weather station at an altitude of 8,800 meters. The insights gained from this mission will benefit both science and the public. For more, please turn to page 217.

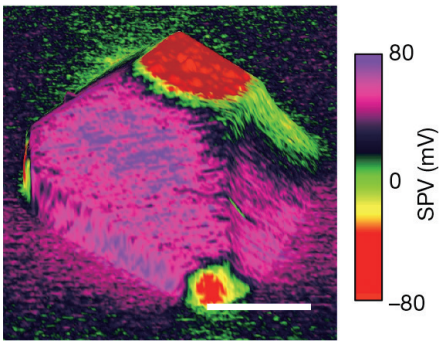
Highlights | Harmonizing Clocks Across Distances

In a study published in *Nature* on October 5, a research team led by Prof. PAN Jianwei and his colleagues from the University of Science and Technology of China (USTC) reported the free-space dissemination of time and frequency with 10^{-19} instability over 113 kilometers, paving the way for the future development of global-scale optical clock networks and precision timekeeping. This can be compared to empowering a violinist in New York and a pianist in Philadelphia to perform a harmonious duet with flawless synchronization, despite being separated by approximately 113 kilometers (70 miles). Discover more about this fascinating advancement on page 220.



The experimental setup leads to a free-space time–frequency dissemination with 10^{-19} instability over 113 kilometers. (Image by USTC)

Highlights | Imaging the Charge Transfer in Photocatalyst Particles

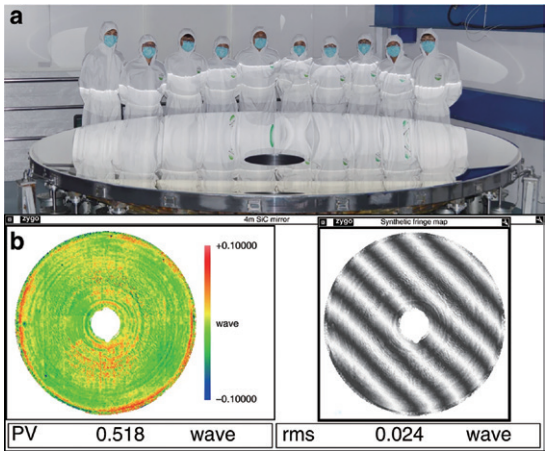


In a recent *Nature* study, a team of CAS scientists from the Dalian Institute of Chemical Physics (DICP) has made progress in understanding photocatalytic processes by monitoring excited charge carriers on single photocatalyst particles, which could lead to the development of new photocatalytic materials and a better appreciation of how to tune photocatalyst particles for solar-to-fuel conversion. Read the full story on page 221.

Scientists used facet and defect engineering to redistribute charge on the photocatalytic particles (indicated by SPV, mV) that facilitates the water-splitting reaction. (Image by DICP)

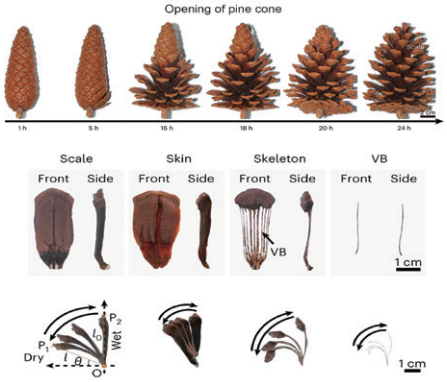
Highlights | Crafting World's Largest Silicon Carbide Aspheric Mirror

In a study published in *Light: Science & Applications* on October 26, a research team led by Dr. ZHANG Xuejun at the Changchun Institute of Optics, Fine Mechanics, and Physics (CIOMP) of the Chinese Academy of Sciences triumphed in crafting the world's largest silicon carbide aspheric mirror, boasting an astounding 4-meter diameter. This monumental breakthrough heralds a new era in telescopic imaging quality and detection capabilities, opening doors to profound advancements in the realms of astronomy and earth observation. Discover the full story behind this awe-inspiring innovation on page 223.



Fabrication of a 4.03-meter silicon carbide (SiC) aspheric mirror. (Image by CIOMP)

Highlights | Nature's Hidden Marvel: Ultra-Slow Motion of Pine Cones Inspires Cutting-Edge Soft Actuators

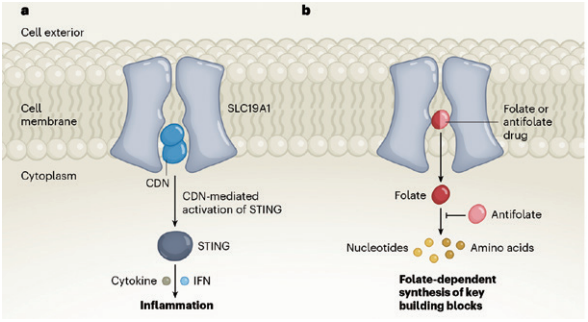


The typical slow hygroscopic geometric reshaping of a pine cone and its hierarchical components of scale, skin, skeleton and vascular bundle (VB). (Image by TIPC)

Imagine meandering through a tranquil forest, where you might come across pine cones strewn across the forest floor. These seemingly ordinary objects possess an extraordinary ability to alter their shape in response to humidity. In a groundbreaking study published in *Nature Materials*, a research team led by Dr. WANG Shutao at the CAS Technical Institute of Physics and Chemistry (TIPC) and Dr. LIU Huan from Beihang University unveiled the secret behind the ultra-slow hygroscopic motion of pine cones. This discovery has inspired the development of cutting-edge soft actuators for stealth applications. Discover the humble pine cone's remarkable story on page 225.

Highlights | Structural Insights into Folate Transporter May Offer Clues for Anticancer Drugs

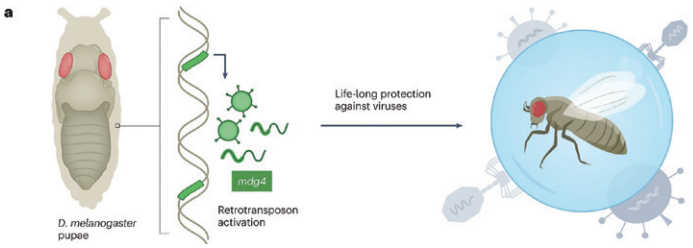
In a new *Nature* study, scientists at the CAS Institute of Biophysics (IOB) have made a remarkable discovery: the transport protein SLC19A1, once thought to be limited to transporting B9 vitamins and antifolate drugs, also functions as a transporter of cyclic dinucleotides (CDNs). These signaling molecules play a crucial role in stimulating immune system responses, unveiling a hidden talent that could pave the way for enhanced immunotherapy and cancer treatments. Delve into the captivating details of this new discovery on page 226.



Structural insights into the SLC19A1 protein. (Credit: Larry H. Matherly & Zhanjun Hou/*Nature*)

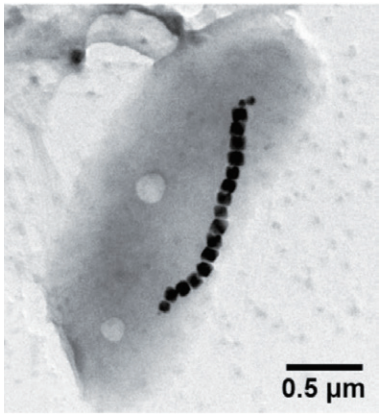
Highlights | A Gain of Adult Immunity in Fruit Flies from the Activation of an Endogenous Retrovirus (ERV) at the Pupal Stage

A recent breakthrough study led by researchers from the CAS Shanghai Institute of Biochemistry and Cell Biology (SIBCB) and Duke University School of Medicine uncovers how the activation of a specific endogenous retrovirus (ERV) family in fruit flies bolsters their adult antiviral defenses. Dive into this captivating report that not only redefines our understanding of ERV mobility's evolutionary benefits in animals but also sets the stage for further investigation into this intriguing new aspect of developmental immune system training. The related study was published in *Nature Genetics* on November 17. For the full story, please turn to page 228.



The activation of the endogenous retrovirus (ERV) family *mdg4* at the fruit fly pupal stage bolsters adult antiviral defenses. (Image by Botto & Faulkner/*Nature Genetics*)

Highlights | Unlocking Gene Networks Behind Magnetosome Formation in Magnetotactic Bacteria

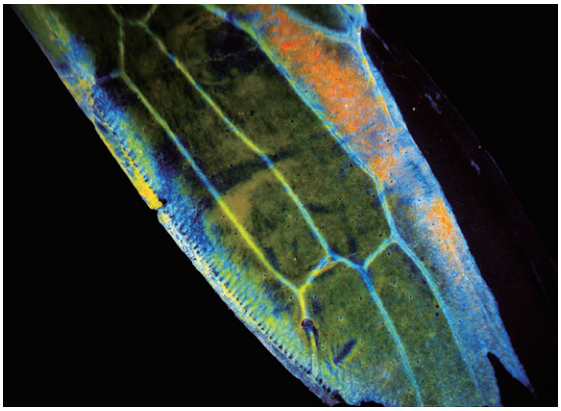


In a study published in the *National Science Review*, researchers led by Dr. LI Jinhua from the Institute of Geology and Geophysics (IGG) of the Chinese Academy of Sciences studied the genetic basis of magnetosome biomineralization in magnetotactic bacteria (MTB), which create magnetosomes to align and move like a tiny compass needle. By analyzing MTB genomes, they identified genes controlling magnetosome crystal morphology and phylum-specific magnetosome magnetite morphology. This research offers new insights into magnetosome gene function and chain assembly and may have practical applications in nanomedicine and nanotechnology. Read the full story on page 230.

TEM image of a magnetotactic bacteria cell that contains a single magnetosome chain. (Image by IGG)

Highlights | Nature's Ingenious Armor: Unraveling the Secrets of Chitin Biosynthesis

Ever marveled at the remarkable strength and resilience of insect exoskeletons or the structural support in mushrooms? The secret lies in chitin, a versatile natural material abundant in the animal and fungal worlds.



A close-up of the wing of a leafhopper; the wing is composed of chitin. (By Zituba, CC BY-SA 3.0)

Featured in the October 13 issue of *Nature*, a team of scientists led by Dr. GONG Yong at the Institute of High Energy Physics of the Chinese Academy of Sciences and Dr. YANG Qing at the Institute of Plant Protection of the Chinese Academy of Agricultural Sciences reported five cryo-electron microscopy structures of a chitin synthase, known as *Ps*Chs1, derived from a devastating soybean root rot pathogen. Their discoveries unveil the intricate mechanisms behind chitin biosynthesis, paving the way for potential applications in agriculture, biotechnology, and beyond. Delve into the captivating world of chitin on page 232.