Top 10

News of S&T Advances for 2025: Chinese Academicians' Picks

A press conference held on January 26 in Beijing unveiled the Top 10 news of S&T advances both in China and overseas for the year 2025 as selected by top scholars of China.

Every January, Members of the Chinese Academy of Sciences (CAS) and the Chinese Academy of Engineering (CAE) cast their votes for the top 10 news of S&T advances for the previous year. Sponsored by CAS and CAE, this ballot has been held for 32 times, as an effort to celebrate science excellence and increase the public awareness of science.

The academicians chose the following as the top 10 news for S&T advances of China for the year 2025:

1. China's "Artificial Sun" Sets New Record with 100-million-degree Plasma Sustaining over 1000 Seconds
2. DeepSeek Charts a Different Course
3. First Experimental Thorium Molten Salt Reactor Makes New Breakthrough in Future Advanced Nuclear Technology of China
4. Liver Cancer Prognosis System Globally Accessible
5. "*Beinao*-1" Completes Full Wireless Implantation
6. Discovery of New Target & Drug Candidate for Parkinson's
7. Emergence of *Zuchongzhi*-3, the Superconducting Quantum Computing Prototype
8. Dual Advances Propel Clean Hydrogen Production
9. "Black Soil Granary" Initiative Achieves Breakthrough
10. On-chip Photonics Enables Full-Spectrum Wireless for 6G

The academicians chose the following as the top 10 news of oversea S&T advances for the year 2025:

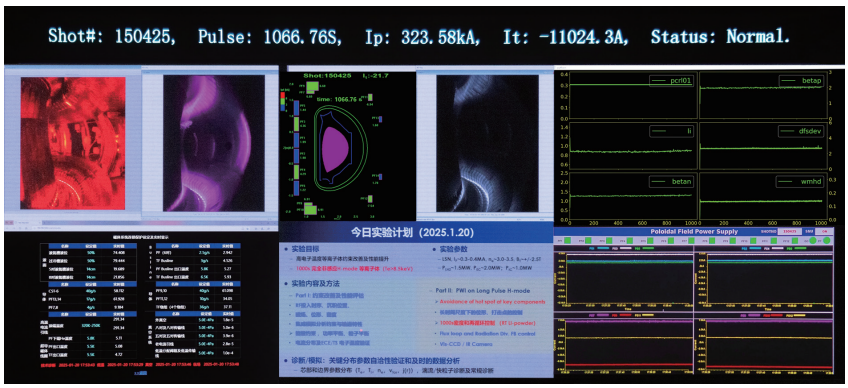
1. Brain-Computer Interface Enables Emotional Speech & Singing
2. "Electro-Photo-Quantum" Trinity Chip
3. Detection of the Most Massive Blackhole Binary to Date, Challenging Blackhole Formation Models
4. Discovery of the Most Energetic Neutrinos to Date, 20 Times the Energy Previously Detected
5. The World's First Visually Observable Time Crystal Created
6. Record Long Pig Kidney Survival in Human
7. Ground-Based Telescope Detects Cosmic Signals from 13 Billion Years Ago for the First Time
8. The Largest Cosmic Map to Date
9. Largest Brain Map Details Intricate Synapse-Level Architecture of Intelligence
10. DeepMind's Gemini Wins the Gold at International Math Olympiad

Top 10 News for S&T Advances of China for the Year 2025

Elected by Members of the Chinese Academy of Sciences and the Chinese Academy of Engineering

1 China's "Artificial Sun" Sets New Record with 100-million-degree Plasma Sustaining over 1,000 Seconds

On January 20, 2025, a team working on the Experimental Advanced Superconducting Tokamak (EAST)—also known as China's "Artificial Sun," set a new world record with its success in steadily operating a high-confinement plasma of 100-million degree Celsius for 1,066 seconds. This "high-quality combustion" marks a significant milestone for controlled nuclear fusion: Signaling a turning point from fundamental research to engineering practice, it sends human beings one more step closer to fusion power generation.



A snapshot from the experiment: The moment marking 1,066 seconds of steady running of the high-confinement plasma at 100 million degrees Celsius. (Credit: ASIPP)

Located at the Institute of Plasma Physics (ASIPP), Hefei Institutes of Physical Science, Chinese Academy of Sciences in Hefei, Anhui Province of China, EAST marks the first fully superconducting tokamak in the world. To tame the extremely hot plasma needed to ignite a nuclear fusion, it uses extremely strong magnetic fields to lock the particles within a limited space, and avoid touching on the container wall. This requires the integration of five extreme conditions into one: ultra-high temperature, ultra-low temperature, ultra-high vacuum, ultra-strong magnetic field, and super-large current. A total of nearly one million components, supported with nearly 2,000 self-owned patents, work in synergy toward the goal of fusion power generation. Since its launch in 2006, this highly complicated device has operated over 150,000 shots of plasma in its experiments.

2 DeepSeek Charts a Different Course

On January 20, 2025, a seismic shift hit the global artificial intelligence community when DeepSeek, a Chinese startup established just over a year before, unveiled its latest model, DeepSeek-R1. The release has triggered, as Silicon Valley investor Marc Andreessen called it, an "AI Sputnik moment," ushering in a new era where Chinese tech is actively challenging U.S. giants.

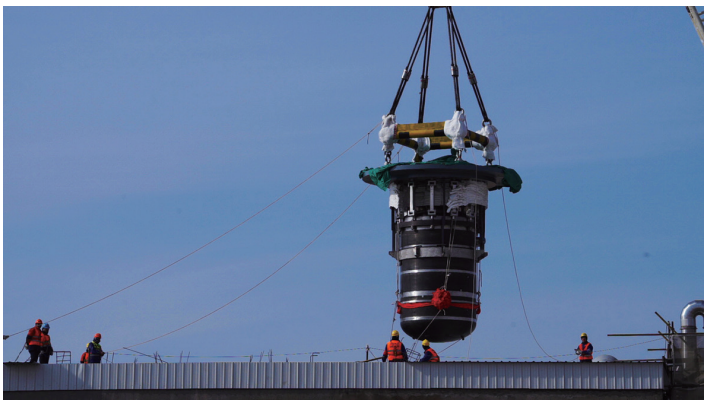
Published in *Nature* (doi: 10.1038/s41586-025-09422-z) in 2025, a report on R1 has stunned the industry by delivering reasoning capabilities—such as mathematics and coding—that are comparable to OpenAI's o1 model. What makes this achievement particularly disruptive is its efficiency: While U.S. tech firms typically spend tens of millions of dollars to train similar models, the total training cost for R1 was approximately $294,000. This ultra-low cost, combined with a fully open-source architecture, led experts to view this as a turning point.

In early 2025, Chinese startup DeepSeek made waves with the release of R1, a low-cost, high-performance model. (Graphic: DeepSeek, Inc.)

"DeepSeek-R1 is a major breakthrough... It not only challenges OpenAI's leading position but also injects new vitality into AI technical development," says Dr. ZHANG Yongdong, Chief Scientist at the State Key Laboratory of Communication Content Cognition and a professor at the University of Science and Technology of China (USTC). By proving that elite performance does not necessarily require exorbitant budgets, DeepSeek implies that China has moved from imitating Western AI to potentially surpassing it.

3 First Experimental Thorium Molten Salt Reactor Marks New Breakthrough in Future Advanced Nuclear Technology of China

The Chinese Academy of Sciences (CAS) announced on November 1, 2025 that the thorium in the fuel of the 2MWT thorium molten salt reactor (TMSR) in Wuwei, Gansu Province of China was successfully converted to uranium. Powered with technologies developed by the Shanghai Institute of Applied Physics (SINAP) under CAS, this experimental reactor is the only TMSR in operation nowadays. Its success in fuel conversion marks the first successful collection of experiment data in an operating TMSR, demonstrating the utilization of thorium resources in TMSR is technically feasible.



The reactor core being installed. (Photo: SIAP)

TMSR is a fourth-generation advanced nuclear energy system internationally acknowledged as an optimal way to utilize thorium resources. Using fluorides as a recycle coolant, it features high safety as well as high efficiency.

CAS set a priority program in 2011 to support the research and development of TMSR-related technologies, aiming to support this future advanced nuclear system with core technologies and provide feasible solutions for scale-up industrial utilization of thorium resources. The success of the experimental TMSR laid a solid foundation for the future development and ensuing construction of research reactors and demonstrative reactors.

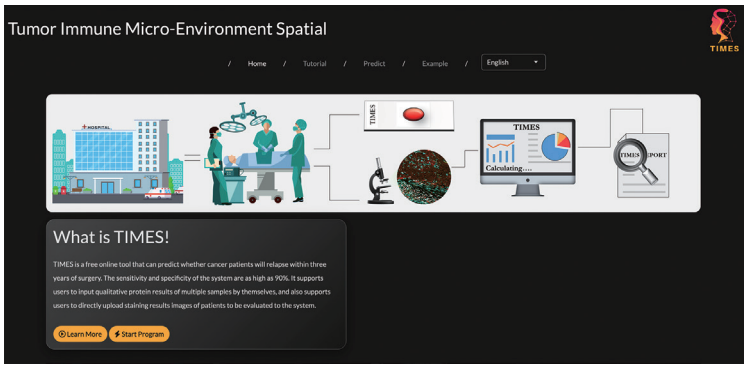
4 Liver Cancer Prognosis System Globally Accessible

Hepatocellular carcinoma (HCC) remains one of the deadliest cancers globally, with nearly 70% of its patients suffering from recurrence after surgery. Traditional staging systems focused on tumor size and spread but overlooked the critical immune landscape within tumors. Dr. SUN Cheng and collaborators from the University of Science and Technology of China under CAS developed the TIMES system, an AI-powered platform decoding spatial immune architecture to predict cancer recurrence. Published as a cover story in *Nature* (doi: 10.1038/s41586-025-08668-x), this work represents a breakthrough in precision oncology.

Using multiplex immunofluorescence imaging, the team discovered that spatial relationships between im-

mune cells matter more than cell counts alone. The team created a freely accessible online platform (https://sun.times.ustc.edu.cn), enabling clinicians worldwide to upload standard pathology slides and receive risk assessments within minutes—no specialized equipment required. Since launch, the platform has served over 3,000 users across 45 countries, democratizing precision medicine in resource-limited settings.

This innovation exemplifies how spatial biology and AI can be translated into practical clinical tools, positioning China at the forefront of next-generation cancer diagnostics.

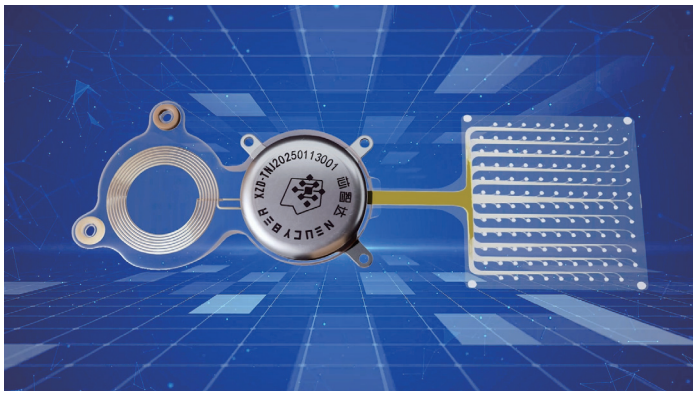


A Digital Clinical Assistant: The interface of the open-access TIMES tool, which allows clinicians to upload images and generate personalized recurrence risk reports. Access the platform at https://sun.times.ustc.edu.cn. (Graphic: USTC)

5 "*Beinao*-1" Completes Full Wireless Implantation

For patients silenced by amyotrophic lateral sclerosis (ALS) or paralysis, brain-computer interfaces (BCIs) offer a digital lifeline, yet the technology has long been limited to small-scale experiments. That is changing rapidly. As of December, 2025, a team led by the Chinese Institute for Brain Research, Beijing (CIBR) and NeuCyber Neurotech had implanted their "*Beinao*-1" (Neucyber Matrix BMI) system in six patients. The semi-invasive device, which captures signals from the brain's surface without penetrating the tissue, allows users to wirelessly control robotic arms to pour water or translate intentions into screen text.

Driven by significant state support since CIBR's founding in 2018, the project is scaling aggressively. Chief Scientist Dr. LUO Minmin has planned to expand the clinical trial up to 50–100 patients in 2026. Pushing the boundaries of precision, the team is also preparing "*Beinao*-2" for clinical validation this year. Unlike its predecessor, this invasive system utilizes flexible microelectrode arrays to capture large-scale neuronal firing for 3D spatial control. By integrating these neural signals with artificial intelligence, researchers aim to evolve the technology into "embodied intelligence," fostering a true fusion of human and machine capabilities. This surge in innovation marks not just a competitive milestone in neurotechnology, but a hopeful new era for restoring dignity to those facing severe neurological barriers.



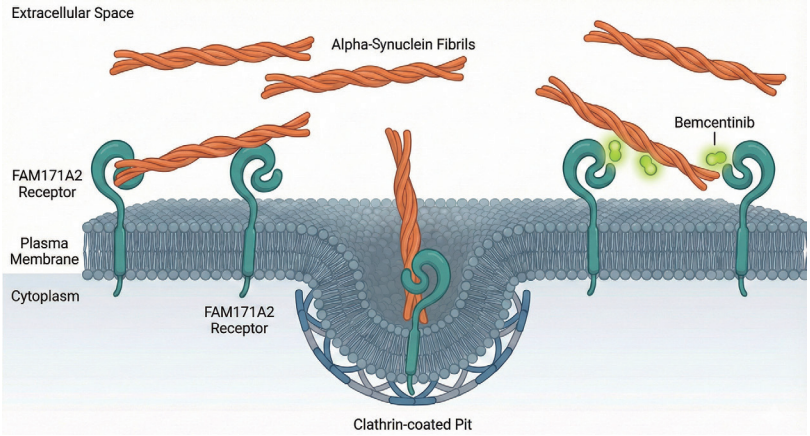
Product image of "*Beinao*-1". (Graphic: CIBR)

6 Discovery of New Target & Drug Candidate for Parkinson's

The relentless progression of Parkinson's disease is driven by the transmission of toxic proteins across the brain—a process that gradually destroys motor and cognitive functions. Pathological α-synuclein fibrils spread between neurons in a prion-like manner, yet the specific receptors facilitating this invasion have long remained a mystery. A collaborative team from Fudan University and the Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences identified FAM171A2 as a key neuronal receptor that mediates the uptake of

these harmful fibrils.

Published in *Science* (doi: 10.1126/science.adp3645) on February 21, 2025, the study revealed that FAM171A2 interacts specifically with the C-terminus of α-synuclein fibrils through electrostatic forces. The researchers found that this receptor is overexpressed in the brains of Parkinson's patients and shows a binding affinity for toxic fibrils that is 1,000 times stronger than for harmless protein monomers. In animal models of pathological α-synuclein propagation, a condition mimicking Parkinson's disease, overexpressing FAM171A2 accelerated the spread of brain pathology—whereas knocking it down provided significant neuroprotection and preserved motor function.



Locking out toxic proteins. Normally, harmful α-synuclein strands (orange) sneak into neuron cells through a "doorway" receptor called FAM171A2 (teal blue). Bemcentinib (glowing green) acts like a shield, blocking this doorway and preventing the toxic proteins from entering the cell. (Illustration generated with AI)

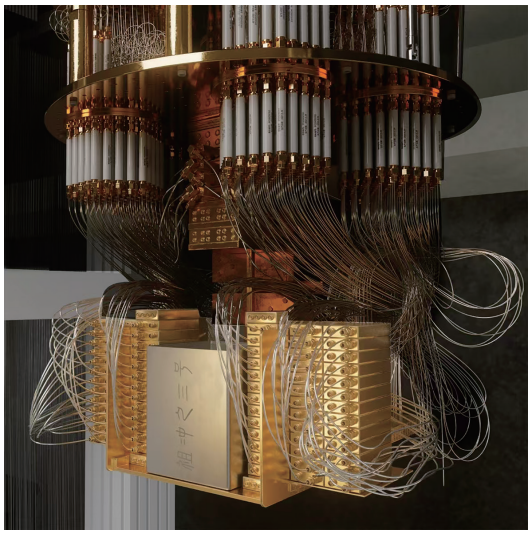
To translate these findings into a potential treatment, the team used AI-driven virtual screening to identify bemcentinib—an existing drug—as an effective blocker of the FAM171A2–fibril interaction. Experiments in mice showed that bemcentinib reduces the internalization of toxic α-synuclein, offering a promising "proof of concept" for disease-modifying therapies. These findings provide a structural blueprint for developing new drugs that could finally slow or halt the progression of Parkinson's disease.

7 Emergence of *Zuchongzhi*-3, the Superconducting Quantum Computing Prototype

On March 3, 2025, a team led by Profs. PAN Jianwei, ZHU Xiaobo and PENG Chengzhi from the University of Science and Technology of China (USTC) under CAS reported in *Physical Review Letters* their successful construction of *Zuchongzhi*-3, a superconducting quantum computing prototype 10^{15} times faster than the most powerful classical supercomputer then available. One of the journal reviewers described it as "benchmarking a new superconducting quantum computer, which shows state-of-the-art performance" and a "significant upgrade from the previous 66-qubit device (*Zuchongzhi*-2)."

Featuring 105 qubits and 182 couplers, the performance of *Zuchongzhi*-3 is significantly enhanced compared with its predecessor *Zuchongzhi*-2.

To evaluate its capabilities, the team tested the system with an 83-qubit, 32-layer random circuit sampling task. The results demonstrated that *Zuchongzhi*-3 outpaced the then world's most powerful classical supercomputer based on the best algorithms by 15 orders of magnitude. It was also one million times faster than the results published by Google in October 2024. This marked the most powerful quantum supremacy among worldwide counterpart systems at that time.



The low-temperature testing system for *Zuchongzhi*-3, the superconducting quantum computer reported in March 2025. Integrating 105 qubits and 182 couplers, this prototype achieved the most powerful quantum supremacy at that time. (Image by USTC)

Now the team is actively advancing in quantum error correction, quantum entanglement, quantum simulation, and quantum chemistry.

8 Dual Advances Propel Clean Hydrogen Production Technology

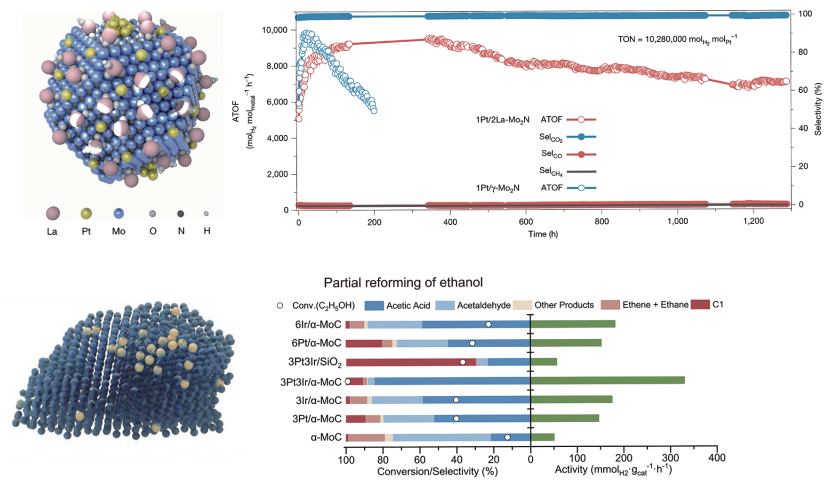
Hydrogen is central to future clean energy systems, yet its production faces two critical hurdles: the instability of efficient catalysts and the heavy carbon footprint of current methods. Two recent studies by Peking University (PKU) addressed these challenges through distinct, innovative pathways.

In the first study, published in *Nature* (doi: 10.1038/s41586-024-08483-w), a team led by Prof. MA Ding tackled the durability dilemma. High-performance catalysts often degrade rapidly because their reactive supports oxidize and collapse in water. To prevent this, the researchers developed a "shielding" strategy by depositing inert nano-overlays—specifically lanthanum oxide—onto a molybdenum nitride support. This protective coating blocked redundant surface sites where oxidation typically initiates, while leaving the active interfacial sites exposed for the chemical reaction. The resulting catalyst maintained its structure and high activity for over 1,000 hours of operation. It achieved a turnover number of 15.3 million hydrogen molecules per platinum atom, exceeding previous records by an order of magnitude.

While the first study secured the catalyst's lifespan, the second focused on eliminating emissions.

In a parallel breakthrough reported in *Science* (doi: 10.1126/science.adt0682), the same team and their collaborators achieved hydrogen production with zero carbon dioxide emissions. Using a platinum-iridium catalyst supported on molybdenum carbide, they engineered a reaction path that activates water and ethanol but prevents the breakage of carbon-carbon bonds. Consequently, the carbon was not released as CO_2 but retained to form acetic acid. This "hydrogen production—carbon preservation" process generates clean fuel while creating a high-value industrial byproduct, reducing carbon emissions by over 60 percent compared to traditional methods.

Together, these complementary breakthroughs address the critical bottlenecks of longevity and sustainability, paving the way for a robust and economically viable hydrogen economy.



Two new paradigms for hydrogen production. *Top*: Lanthanum (La) nano-overlays shield the reactive support from oxidation, enabling the catalyst to maintain its structure and high activity for over 1,000 hours of operation. *Bottom*: A platinum-iridium catalyst supported on molybdenum carbide facilitates hydrogen production with zero CO_2 emissions, reducing the carbon footprint by over 60% while generating high-value acetic acid as a byproduct. (Graphic: Peking University)

9 "Black Soil Granary" Initiative Achieves Breakthrough

Northeast China hosts one of the world's four major black soil regions, yet unsustainable land use has driven severe degradation that threatens food security. To address this, the "Black Soil Granary" science and technology initiative convened its 2025 annual meeting on April 9 in Harbin, revealing major breakthroughs. Led by the Northeast Institute of Geography and Agroecology (IGA), Chinese Academy of Sciences, the initiative gathered over 1,300 researchers from 90 institutions to establish a sky-ground integrated monitoring system and complete the nation's first 10-meter resolution remote sensing mapping of soil carbon and nitrogen. The team innovated a degradation control theory centered on enhancing the "inherent soil fertility" and developed comprehensive technologies for slope and gully erosion control. Beyond soil conservation, they utilized solid-phase

breeding chips to cultivate the "*Dongsheng* 22" soybean—now ranking among the top ten nationally in promotion area—with the wider "*Dongsheng*" series covering over 13 million *mu* (86,6671 hectares). The project also launched the "*Honghu*" series of intelligent machinery, which breaks foreign technical monopolies, and the "*Fuxi*" smart agriculture management system—a cascade machine learning system for 15-day global weather forecast.

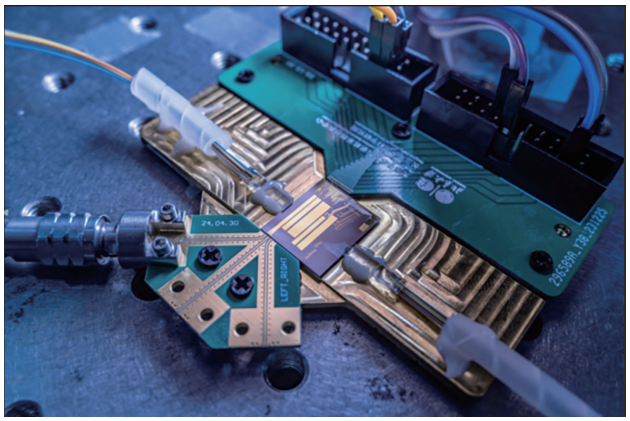
Secure the granary, secure the bowl: This field serves as a demonstration zone for the "Black Soil Granary" science and technology initiative, a massive scientific initiative led by the Chinese Academy of Sciences. By deploying advanced technologies—from satellite monitoring and AI-driven machinery to degradation control centered on enhancing the "inherent soil fertility"—researchers are working to reverse soil degradation and ensure this critical region continues to feed the nation. (Graphic: IGA)

The innovations have been crystallized into replicable frameworks—such as the "Longjiang Model" and "Sanjiang Model"—tailored to specific regional conditions (doi: 10.1051/bcas/2025007). The "Longjiang Model" targets the medium and thick black soil regions facing compaction and organic decline; by deeply incorporating crushed straw to construct a fertile plow layer, it has increased plow depth by 15 cm and crop yields by over 10%. Meanwhile, the "Sanjiang Model" addresses the constraints of albic soil (white clay) and sloping farmland through subsoil mixing and intelligent erosion monitoring, successfully reducing soil and water loss by over 70%. These innovations support the national strategy of sustainable resource utilization and ensure the long-term productivity of the region.

10 On-chip Photonics Enables Full-Spectrum Wireless for 6G

Future wireless networks demand dynamic access to full spectrum resources to support data-intensive applications like extended reality and remote surgery. However, traditional electronic hardware is limited by single-band operation and cannot seamlessly adapt to different frequencies without bulky, complex equipment. As reported in *Nature* (doi: 10.1038/s41586-025-09451-8) on August 27, 2025, a research team led by Profs. WANG Xingjun and SHU Haowen from Peking University (PKU) and Prof. WANG Cheng from the City University of Hong Kong has now developed a universal integrated photonic chip to solve this challenge.

The researchers fabricated an ultrabroadband chip based on thin-film lithium niobate that integrates the entire wireless signal processing function into a tiny footprint. Unlike conventional electronic schemes that suffer from noise accumulation, this new architecture utilizes an integrated optoelectronic oscillator. It achieves precise frequency locking via a high-precision micro-ring resonator, allowing the system to cover a frequency range from 0.5 GHz to 115 GHz—spanning nearly eight octaves. Experiments showed the system supports wireless transmission rates exceeding 120 Gbps, meeting the peak requirements for next-generation 6G communication. This reconfigurable hardware ensures reliable connections even in complex environments and paves the way for AI-native networks that can simultaneously handle data transmission and environmental sensing.



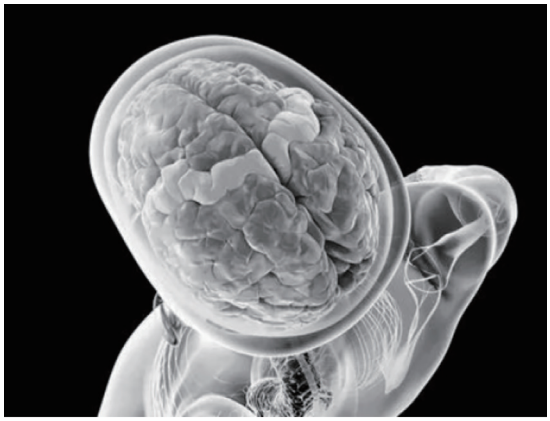
The prototype of a ultrabroadband integrated photonic chip. (Graphic: PKU)

Top 10 News of Oversea S&T Advances for the Year 2025

Elected by Members of the Chinese Academy of Sciences and the Chinese Academy of Engineering

1 Brain-Computer Interface Enables Emotional Speech & Singing

Amyotrophic lateral sclerosis (ALS) often robs patients of their ability to communicate clearly, leaving them with only the ability to make sounds or mouth movements. While earlier brain-computer interfaces allowed for some text-based communication, they were generally slow and produced robotic, monotone audio. In the summer of 2025, a research team at the University of California, Davis, developed a system that uses artificial intelligence to decode brain waves into expressive speech and even song.



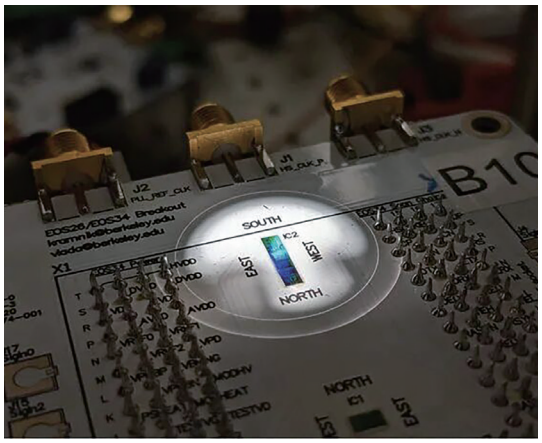
Electrodes implanted in the motor cortex help recording brain activity related to speech. (Graphic: Kateryna Kon)

The study, published in *Nature,* involved a 45-year-old man who had lost intelligible speech due to ALS. The researchers implanted 256 microelectrodes into the region of his brain that controls speech movement. Using deep learning algorithms to capture signals every 10 milliseconds, the system translates neural activity into audio almost instantaneously. Unlike earlier models that required seconds to process output, or could only output audio when the subject imitated a complete sentence, this new technology mimics the user's own voice and captures nuances like intonation, stress, and pitch. It could respond with voice within 10 milliseconds after the subject's neural system signaling an intention to talk. The participant was able to converse naturally and even sing, marking a significant leap toward restoring fluid, human connection for people with severe speech impairments.

2 "Electro-Photo-Quantum" Trinity Chip

On July 17, 2025, a joint team from Boston University, the University of California, Berkeley, and Northwestern University reported in *Nature Electronics* their successful development of the world's first "electro-photo-quantum" integrated chip system. This marks the first time that quantum light sources and stable control electronic circuits have been integrated on a single chip, using a standard 45-nanometer semiconductor manufacturing process, laying the foundation for the mass production of "quantum light factory" chips and the large-scale construction of quantum systems.

Just as traditional electronic chips rely on electric current and optical communication systems on lasers, future photonic quantum technologies will also need a stable source of "quantum light" to enable computa-



In an experiment, the packaged circuit board with the chip mounted is tested under a probe station microscope. (Image source: Boston University, USA)

tion, communication or sensing. To this end, the researchers built a set of "quantum light factories" on a silicon chip, each only about 1 square millimeter in size, yet capable of stably generating pairs of correlated photons—the key resource for quantum information applications.

A key challenge in this work was to confine the design of photonic devices within the strict specifications of commercial complementary metal-oxide-semiconductor (CMOS) platforms while preserving their quantum optical performance. This required the team to co-design electronics and quantum optics as a unified system from the outset. The chip, based on a standard 45-nanometer CMOS platform, features a built-in feedback stabilization mechanism that can effectively manage disturbances caused by temperature variations and manufacturing errors.

3 Detection of the Most Massive Blackhole Binary to Date, Challenging Blackhole Formation Models

The LIGO-Virgo-KAGRA (LVK) Collaboration observed the heaviest blackhole merger ever detected. Joining three major gravitational-wave detectors, the collaboration picked up signals from two merging giants. The two, approximately 100 and 140 times the solar mass, respectively, finally coalesced into a single black hole about 225 times as massive as our Sun. Designated GW231123, the source was first caught on November 23, 2023 during the fourth LVK observing run.

This discovery was officially announced on July 14, 2025, at the 24th International Conference on General Relativity and Gravitation (GR24) and the 16th Eduardo Amaldi Conference on Gravitational Waves, held in Glasgow, Scotland.

This discovery challenges conventional theories about how blackholes grow. The two original black holes kept spinning rapidly, at a rate of about 40 times per second, approaching the theoretical stability limit. Their masses go far beyond predictions given by standard stellar evolution theories. Blackholes are classified into three categories: stellar-mass (a few to 100 times the mass of the Sun), intermediate-mass, and supermassive, with intermediate-mass black holes being extremely rare. The masses of the black holes in this merger are close to or exceeding the stellar-mass range, and their formation cannot be explained by the traditional supernova explosion mechanism. Judging from their rapid spins, experts speculate that they might have grown from smaller blackholes through successive mergers. This has provided a new perspective for studying blackhole formation.

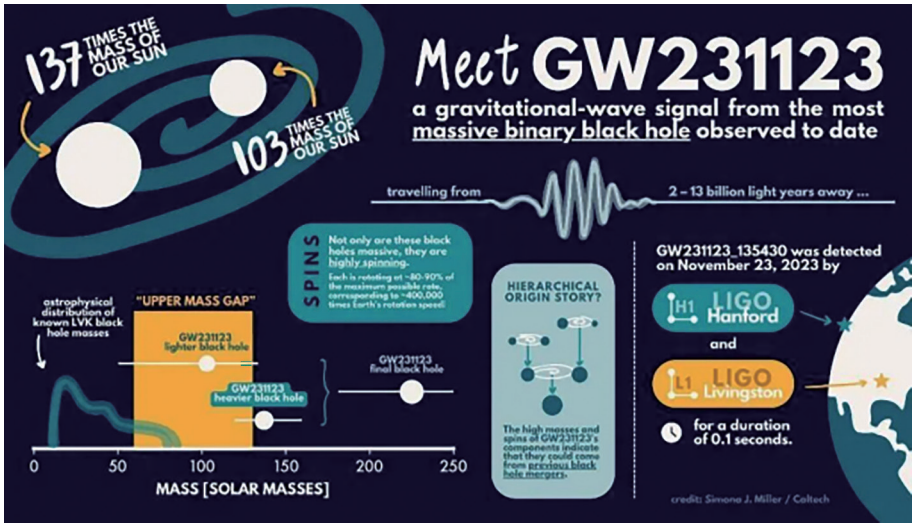


Illustration of the merger process of the binary black hole GW231123. (Image credit: California Institute of Technology)

4 Discovery of the Most Energetic Neutrinos to Date, 20 Times the Energy Previously Detected

The KM3NeT (Cubic Kilometre Neutrino Telescope) collaboration from Europe published a paper in *Nature* on February 11, 2025, announcing the detection of the most energetic cosmic neutrinos ever recorded. The researchers believed that these particles have originated outside the Milky Way, though their exact source remains unknown.

Engineers prepare to install a detector into the underwater KM3NeT network. (Image credit: Paschal Coyle CNRS)

On February 13, 2023, the Astroparticle Research with Cosmics in the Abyss (ARCA) detector picked up the signal of a high-energy muon. Researchers estimated the particle had an energy of approximately 120 petaelectronvolts (PeV, 1 PeV = 10^{15} eV), and the neutrino that produced this muon possessed even higher energy, around 220 PeV. The particle passed through the entire detector and triggered signals in more than one-third of the active sensors. The tilt of its trajectory and the enormous energy provides strong evidence that the muon originated from a cosmic neutrino interacting nearby with the detector. This event has been named KM3-230213A.

Certain high-energy astrophysical events in the universe, such as the accretion of supermassive black holes at the centers of galaxies, supernova explosions, and gamma-ray bursts, remain not fully understood to this day. These events generate flows of cosmic ray particles, and some cosmic rays may interact with matter or photons surrounding their sources, thereby producing neutrinos and photons. During their propagation, such most energetic cosmic rays may also interact with photons of the cosmic microwave background radiation, giving rise to ultra-high-energy neutrinos.

5 The World's First Visually Observable Time Crystal Created

The time crystal is a form of matter that repeats periodically in the time dimension, just as how atoms are arranged in a repeating spatial pattern in ordinary crystals. Previously, time crystals only existed in complex quantum matter, but physicists have developed a method to create a time crystal visible to the naked eye under specific conditions.

The time crystal in the lens of a microscope. (Image: *Nature Materials*)

As published in *Nature Materials* on September 4, 2025, the research involved rod-shaped liquid crystal molecules possessing both liquid and solid properties. By simply shining light on the liquid crystal, the researchers generated ripples that twisted the molecules on its surface. These ripples continued to move at varying rhythms for hours, despite the changed external conditions. Such rhythms were not synchronized with any externally applied force, meeting the two core defining criteria for a time crystal.

In 2012, Frank Wilczek, a Nobel laureate in Physics, first proposed the concept of a time crystal. The time crystal as Wilczek envisioned resembled a perpetual motion machine—a substance that could cycle infinitely in a naturally stationary state. Although a research team mathematically disproved Wilczek's idea in a paper, researchers soon figured out that there might exist oth-

er types of time crystals. For instance, ordered time crystals can exist in special systems that are in constant change rather than in rest. The renewed concept of time crystal is now made real.

These thin time crystal films, the researchers said, can be embedded in banknotes for anti-counterfeiting verification. When light passes through multiple sets of such time crystals each with distinct characteristic patterns, the researchers explained, not only unidirectional ripples but also dynamic two-dimensional barcodes could be produced. Such barcodes are extremely difficult to counterfeit, and can also be used for information storage.

6 Record Long Pig Kidney Survival in Human

A genetically modified pig kidney, transplanted along with the animal's thymus gland, functioned normally for a record 61 days in a brain-dead human recipient—the longest survival yet for a pig organ in a person. The researchers successfully reversed immune rejection episodes twice using standard treatments, marking the success in overcoming the human rejection of a pig xenograft for the first time.

In July 2023, Robert Montgomery prepares to transplant a pig kidney into a brain-dead man in New York. (Graphic: Shelby Lum)

In two studies published in *Nature* on November 13, 2025, a team led by surgeons at NYU Langone Health transplanted a single-gene-edited pig kidney (with α1,3-galactosyltransferase knockout to reduce immediate rejection) into a 57-year-old brain-dead man whose own kidneys had been removed. Attached under the kidney's capsule was thymic tissue from the same pig—an approach known as a thymokidney. The thymus, a gland that educates immune cells to distinguish self from foreign, appeared crucial in moderating the human immune response. By the study's end, human immune cells were developing in the pig thymus, and tests showed recipient T cells reacting less aggressively to pig antigens.

The kidney produced urine, balanced electrolytes, filtered drugs, and maintained complex functions like protein retention throughout the planned 61-day monitoring period. Early immune activity involved natural killer cells and antibody deposits but did not impair function until day 33, when antibody-mediated rejection struck. Doctors treated it successfully with conventional immunosuppression, later addressing a mixed rejection episode.

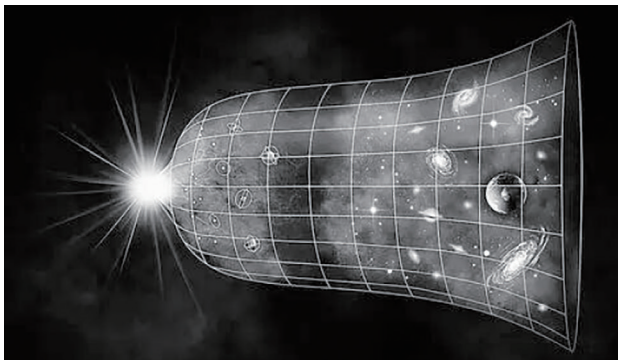
In recent years, around a dozen living patients have received genetically modified pig organs—hearts, kidneys, livers, or thymuses—but most failed quickly due to rejection or loss of function. Previous brain-dead recipient studies saw pig kidneys survive only weeks. The thymus co-transplant, building on decades of primate research, restrained attacks and may have prevented protein loss that plagued prior attempts.

Robert Montgomery, director of the NYU Langone Transplant Institute and lead surgeon, highlighted the thymus's role in promoting tolerance, noting superior outcomes in animal models with thymokidney versus kidney alone. Co-developer Megan Sykes from Columbia University emphasized its potential to reduce long-term rejection risks. While challenges remain—including unidentified pig antigens triggering antibodies and infection risks from immunosuppression—the findings provide critical insights into immune mechanisms and pave the way for safer clinical xenotransplants to address organ shortages.

7 Ground-Based Telescope Detects Cosmic Signals from 13 Billion Years Ago for the First Time

Scientists from Johns Hopkins University and the University of Chicago used a ground-based telescope located high on the Andes Mountains of Chile to observe polarized microwave signals from the early universe. Pub-

lished in *The Astrophysical Journal* on June 11, 2025, this marks the unveiling of the mysterious look of the infant cosmos, from a time just a few hundred million years after its birth, by a ground-based instrument for the first time. This is an extremely critical yet largely uncharted era in astronomy, known as the Cosmic Dawn.



Scientists used a telescope in Chile to detect light scattered by the universe's first stars, offering new insights into the early cosmos. (Image credit: Shutterstock)

Such signals were once thought only observable by space telescopes. Cosmic microwaves are extremely weak, and their polarized signals are just one millionth of their intensity. Even worse, radio interference, atmospheric disturbances, weather changes and other factors on the ground can mask or distort their signals. Therefore, such observation missions have long been carried out by satellites in space. However, the Cosmology Large Angular Scale Surveyor (CLASS) project has achieved this groundbreaking measurement on the ground with a uniquely designed ground-based telescope.

The researchers explained that the universal signal they discovered this time is like a cosmic-scale "glare," revealing how light from the Cosmic Dawn was scattered. They compared and analyzed CLASS data with past observations by satellites to identify sources of interference and narrow down the range of the common signals from the Cosmic Dawn.

This study not only helps scientists more precisely define the signal of the epoch of reionization in the cosmic microwave background radiation, but also provides a clearer picture of the early universe.

8 The Largest Cosmic Map to Date

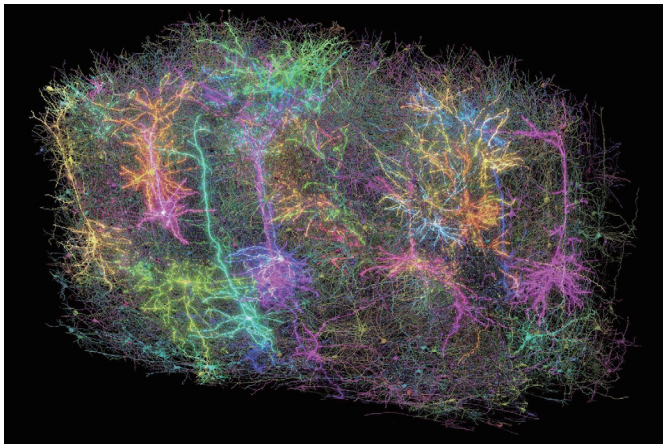
On June 6, 2025, an international research team officially released the largest cosmic map to date, together with all associated observational data. Named COSMOS-Web, the map is built from data collected by the James Webb Space Telescope (JWST), encompassing more than 780,000 galaxies and spanning 13.5 billion years—98% of the entire cosmic history. These data are challenging human understanding of the early universe.

The COSMOS-Web map traces back to about 300 million years after the Big Bang, when the first stars shed their first light. The number of ancient galaxies captured by JWST far exceeds expectations. Astronomers once thought that galaxies would be extremely rare within the cosmos' first 500 million years, yet JWST discovered 10 times more galaxies of this period than Hubble did. More surprisingly, the team also detected several supermassive blackholes—celestial bodies that were completely undetectable in the Hubble era.

A snapshot of the sky from the COSMOS-Web interactive catalogue. (Image credit: COSMOS-Web)

These findings challenge the current cosmic evolution model. It was previously believed that forming a galaxy with a mass of one billion suns would take at least several hundred million years, but the new data indicate that the universe seemingly formed a large number of stars and complex structures in just a few hundred million years. Still, further detail is to be researched and analyzed.

9 Largest Brain Map Details Intricate Synapse-Level Architecture of Intelligence



A rendering of more than 1,000 brain cells reconstructed from the analysis of a cubic millimeter of mouse brain tissue. (Graphic: Allen Institute)

Mapping the precise connections of the brain has long been considered an insurmountable challenge in neuroscience. In 1979, molecular biologist Francis Crick famously stated that it would be impossible to create an exact wiring diagram for even a single cubic millimeter of brain tissue. However, a collaborative team of researchers from Baylor College of Medicine, Stanford University, the Allen Institute, and Princeton University has turned that impossibility into reality.

In April of 2025, the scientists published a suite of studies in *Nature* and its sister journals under the collection of "The MICrONS Project"—detailing the largest and most comprehensive functional map of a mammalian brain to date. The project, known as MICrONS, focused on a one cubic millimeter section of a mouse visual cortex. The team first recorded neural activity while the mouse watched videos, then sliced the tissue into 25,000 ultra-thin layers for electron microscopy. Using artificial intelligence to reconstruct the 3D volume, the resulting map contains over 200,000 cells, 4 kilometers of axons, and 523 million synapses—the connection points between cells. This 1.6-petabyte dataset reveals that inhibitory cells are not random suppressors of activity but part of a highly selective, coordinated network. Comparable in significance to the Human Genome Project, this resource provides a foundation for decoding the physical structure of intelligence.

10 DeepMind's Gemini Wins the Gold at International Math Olympiad

The International Mathematical Olympiad (IMO) has long been seen as a battleground for the world's brightest young mathematical minds. However, in July 2025, the competition witnessed a historic shift when Google DeepMind's advanced "Gemini" model, equipped with a specialized "Deep Think" capability, achieved a verified Gold Medal standard.

Unlike previous iterations that struggled with complex multi-step reasoning, this version of Gemini successfully solved five out of six problems, securing 35 out of a possible 42 points. This performance significantly outperformed the Silver Medal level achieved by DeepMind's AlphaProof system in 2024. The model navigated through the four core pillars of the competition—algebra, combinatorics, geometry, and number theory—producing solutions that official IMO judges described as astonishingly clear and precise. The "Deep Think" architecture allows the model to pause and deliberate before generating an answer, effectively simulating human "System 2" thinking. This breakthrough indicates that artificial intelligence has crossed a critical threshold: moving from probabilistic text generation to rigorous, reliable logic. Experts suggest that these enhanced reasoning capabilities will not only transform mathematics education but also serve as a catalyst for automated scientific discovery in physics and engineering.

The Gemini model won gold at the 2025 Math Olympiad. (Illustration generated with AI)