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Innovation Pathway

Advancing Basic Research to Solidify Foundation for China's Strength in Science, Technology

Chinese President Xi Jinping on April 30 urged greater efforts and more concrete measures to strengthen basic research, enhance China's capacity for original innovation, and further solidify the foundation for building the country's strength in science and technology.

Xi, also general secretary of the Communist Party of China (CPC) Central Committee and chairman of the Central Military Commission, made the remarks while attending a symposium on strengthening basic research in Shanghai.

He stressed that basic research is the origin of the entire scientific system and the master switch for all technological issues.

Xi acknowledged that a new round of sci-tech revolution and industrial transformation is accelerating, and that global competition in science and technology is increasingly centered on frontier areas of basic research. He noted that the importance of original and disruptive innovation is becoming increasingly prominent.

"We must seize opportunities, rise to challenges, put basic research high on agenda, advance it with sustained commitment, and strive for continuous achievements," he said.

Xi emphasized the need to strengthen overall planning and top-level design to optimize the systematic layout of basic research.

He called for further clarifying the main targets and key areas of basic research, reinforcing the leading roles of national research institutions and high-level research-oriented universities, as well as encouraging and regulating new types of research and development institutions.

Deep integration of industry, academia, research and application, led by enterprises, should be promoted to smooth the innovation chain spanning basic research, application development and commercialization, Xi said.

He called for strengthening the development of basic disciplines and fostering coordinated development between applied and basic disciplines. *See page 4*



A launching ceremony is held for China's first privately funded scientific research vessel, R/V Haiying Surveyor, in Wenling, east China's Zhejiang province, on May 5, 2026. (PHOTO: XINHUA)

STI Frontier

Time to Industrialize Chip-scale Atomic Clocks

By WANG Xiaoxia & CHEN Xi

Barely the size of a matchbox, the new generation of chip-scale atomic clocks (CSACs) developed by Tianjin Huaxin Technology Co. is ready to enable precise timekeeping for deep-sea oil exploration, commercial satellites, and smart power grids.

The "time magic box" has a volume of just 8 cm³ and power consumption of 0.15 watts, yet can still keep time autonomously without satellite signals, drifting less than one second every 10,000 years. In 2023, China activated its first — and currently only — CSAC production line, breaking the previous foreign monopoly on this critical technology, after a 13-year uphill battle against seemingly impossible physics and engineering odds.

Taming temperature and signal

The journey to produce CSACs began with deceptive simplicity. "We were optimistic at first," recalls Liu Ruiyuan, general manager of Huaxin. "The principles were known." However, their first prototype was a failure, as it could not detect the ultra-weak optical signal needed to lock onto atomic transition frequencies. They had built a "dead clock."

The problem was environmental noise. The critical signal only produced a few thousandths of the power of the laser's intensity and can be completely drowned out by tiny temperature fluctuations. To solve this, the team developed a microfluidic temperature control chip, pushing precision from 0.1°C to an extraordinary 0.001°C. This finally allowed the signal to emerge from the environmental noise.

Unfortunately, the signal remained unstable.

For four years and through hundreds of trials, the team focused on the atomic vapor cell — the "heart" of the device. The type and ratio of buffer gases inside this cell were the key. After endless experimentation, a stable signal finally appeared on a monitor. The atomic clock was "alive." This phase demonstrated that mastering quantum physics is only the first step; conquering micro-system integration and materials science is where true innovation begins.

Engineering the perfect vacuum

Moving a lab prototype to a reliable product required solving vacuum packaging. The entire physics package must be sealed inside a 1 cm³ ceramic cavity, with an extremely low leak rate needed to maintain a 10-year lifespan. *See page 3*

International Cooperation

Sci-tech Labs Promote Global Development Initiative

By LU Zijian

As this year marks the fifth anniversary of the Global Development Initiative (GDI), China's efforts to support education cooperation are gaining momentum. From woodworking equipment to 3D printers and robotic dogs, Chinese enterprises have donated teaching materials for science and technology labs to schools in Laos, Papua New Guinea, Malaysia, and a university in Togo, sparking local students' interest in exploring science and technology.

Shenzhen Foundation for International Exchange and Cooperation, which coordinates the donations and recipients, initiated this sci-tech lab donation project in 2024. *Science and Technology Daily* recently spoke with Li Dan, executive secretary general of the foundation.

In July 2024, the foundation delivered the first batch of teaching materials, including woodworking tools to the China-aided Phiawath Complete Secondary School in the Lao capital Vientiane.

Why woodworking equipment?

Li said the foundation visited Southeast Asian countries before the donation and went to the school. After talking with the headmaster and teachers, the foundation found that the school needed woodworking tools and machinery, such as saws, planes, and drills, for cutting, planing, and shaping wood. Therefore, the foundation decided to deliver woodworking equipment to help enhance students' operational capability via handwork.

Feedback from the school said the students use the equipment extensively and the interaction in class is also good. Li said the foundation assesses the needs of the recipient organizations to ensure the donated goods meet those needs.

Donations also include high-tech equipment like 3D printers to prepare students for the future. "Education is about the future. It takes 10 years to grow trees, but a hundred years to cultivate people. We wish to start with the younger generation, fostering their scientific and technological thinking so they can better prepare for the future," Li said.

The foundation also organizes demonstration courses to help teachers and students use the donated equipment, combining theoretical explanations with hands-on operation.

For Université de Lomé in Togo, a French-speaking state, which received donated robots, 3D printers and subtractive equipment, the foundation asked the donor to make demonstration videos and added French subtitles so that the teachers and students could understand the videos. *See page 3*

New Graphic

BY THE END OF MARCH

China's Valid
Invention Patents

5.53 million

remaining the world's top filer of patents
for several consecutive years

AT PRESENT

China holds 61% of global AI patents

Source: China National Intellectual Property Administration
Designed by SONG Ziyan / Science and Technology Daily

Building Smart Shield Against Natural Disasters

— China-Pakistan Belt and Road Joint Laboratory on Smart Disaster Prevention of Major Infrastructures

By LI Linxu, WANG Xiaolong & YAO Yan

When the worst earthquake in Pakistan's history occurred, Syed Shah was only in third grade. But the memory remains indelibly etched in his mind. "The earth was roaring, the sky spinning, walls cracking, and buildings collapsing. I could hear nothing but crying. I was terrified."

The powerful 7.8-magnitude earthquake struck northern Pakistan on October 8, 2005. The disaster claimed approximately 73,000 lives and caused the collapse of over 600,000 homes across the country.

The earthquake also altered the life trajectory of Khan Shahzada, then a junior engineer at the Pakistan Water and Power Development Authority, working alongside Chinese contractors. "Witnessing the tragic aftermath of the earthquake firsthand prompted me to shift my career focus toward earthquake engineering," Shahzada, now a professor at the University of Engineering and Technology, Peshawar, said.

Today, their life trajectories have converged at the China-Pakistan Belt and Road Joint Laboratory on Smart Disaster

Prevention of Major Infrastructures. Some are pursuing their studies here, while others are conducting research.

Tackling shared needs

"The intention behind establishing the joint lab was to better address natural disasters like earthquakes that both China and Pakistan face," said Professor Xu Zhaodong of Southeast University. Both countries are located on the Eurasian Seismic Belt, which accounts for approximately 15 percent of the world's earthquakes.

A report released in 2023 shows that since 2001, earthquakes have become the deadliest type of natural disaster for Belt and Road Initiative (BRI) partner countries.

"A significant number of BRI partner countries are located in seismically active zones or regions prone to typhoons, while incidents such as fires also occur periodically. According to available estimates, the cumulative annual economic losses resulting from such disasters across these countries over the past two decades have exceeded one trillion RMB," Khan Muhammad, counsellor for scientific and technological affairs, Embassy of Pakistan in China, said.

"The destruction of major infrastructure under the impact of multiple hazards, such as earthquakes and storms, is the direct cause of immense economic loss and casualties," Xu said.

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Chinese and Pakistani students conduct experiments together at the China-Pakistan Belt and Road Joint Laboratory on Smart Disaster Prevention of Major Infrastructures. (PHOTO: LI Linxu / Science and Technology Daily)

WECHAT ACCOUNT



E-PAPER



China to Advance Energy Conservation, Carbon Reduction

Policy Express

By TANG Zhexiao

China is committed to advancing high-standard, high-quality energy conservation and carbon reduction, according to a guideline jointly issued by the General Office of the Communist Party of China Central Committee and the General Office of the State Council.

Identifying five key areas for driving energy conservation and carbon reduction, the guideline underscores that efforts shall be integrated into all aspects and the entire process of economic and social development.

In the energy green transition, the document proposes strict control over fossil fuel consumption and refined management of the installed capacity and power output of coal-fired power units.

Unreasonable growth of energy consumption will be curbed, non-fossil energy and new energy storage sectors scaled up, and the development of new power systems accelerated. Innovative business models including direct green power access and smart microgrids will be encouraged to boost green electricity consumption.

Technological innovation is the core pillar for advancing energy conservation and carbon reduction.

The guideline backs the application of digital, intelligent and green technolo-



CHN ENERGY Guohua's HG14 Project located in Dongying, Shandong province. (PHOTO: XINHUA)

gies to upgrade traditional industries. It also calls for accelerated growth of advanced manufacturing, high-tech industries and modern service industries, alongside cultivation of green and low-carbon sectors.

In addition, it highlights greater technological innovation and wider application of high-efficiency, energy-saving equipment.

Priority will be given to popularizing advanced, applicable facilities such as high-efficiency boilers, permanent magnet motors, high-performance re-

frigeration systems, green lighting equipment and high-temperature heat pumps.

The development of green transportation infrastructure will be stepped up, as well as smart facilities and equipment at transportation hubs and expressways. Energy-saving and low-carbon transport vehicles, electric and hydrogen heavy-duty trucks, and green-fueled vessels will be promoted.

The green transformation of digital infrastructure is a major focus. The guideline pushes forward energy-saving

and low-carbon retrofits for computing power facilities, communication base stations, data centers and other infrastructure, supporting the development of green, low-carbon, intensive and recyclable computing facilities.

International dialogue and practical cooperation on energy conservation and carbon reduction will be deepened, and bilateral and multilateral technical collaboration strengthened. The plan also includes learning from global advanced practices.



National Standards Define Development of Emerging Tech

By TANG Zhexiao

China recently issued a batch of important national standards, ranging from emerging industries to ecological and environmental protection fields.

In the emerging technology sector, the State Administration for Market Regulation (SAMR) has released 18 national

standards, covering key areas including intelligent connected vehicles, semiconductor devices, brain-computer interfaces (BCI), and BeiDou navigation chips. The standards are primed to propel the high-quality development of cutting-edge technologies.

According to documents from the National Standardization Administra-

tion, the national standard "GB/T 47346-2026" for information technology — BCI visual evoked potential data coding and decoding will become effective on October 1 this year.

To reinforce power consumption safety, eight national standards have been issued for products including lithium-ion batteries, portable power supplies, and industrial power supply systems. Furthermore, 19 national standards related to electromagnetism, nanotechnology, communications and electroacoustic equipment and materials were launched to facilitate the safe and orderly development of relevant industries.

In the manufacturing sector, SAMR released 14 national standards, including those for intelligent ships and marine methanol-fueled engines, which cover ship design and construction, power systems, and safety protection. These standards aim to promote the safe, intelligent, and green development of China's

shipbuilding industry.

Meanwhile, in response to the application and industrial development of new materials, 10 national standards for new materials, including silicon carbide single crystals and carbon fiber-reinforced composites, now have clearly defined technical requirements and testing methods.

In the field of ecological and environmental protection, two mandatory national standards on energy efficiency for products such as electric washing machines, washer-dryers, and air blowers have been issued, which play a vital role in promoting energy and water conservation and advancing green and sustainable development.

In addition, three national standards on greenhouse gas emissions accounting and reporting have been introduced, providing technical support for greenhouse gas emissions management.



Building Smart Shield Against Natural Disasters

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Xu pointed out that the field of disaster prevention and mitigation for major infrastructure currently faces several urgent challenges: limited understanding of cascading multi-disaster mechanisms, lack of advanced big data-driven monitoring systems, and constraints in effective emergency response.

"Faced with shared needs of disaster prevention and mitigation, it is only natural for China and Pakistan to establish a cooperation platform," Muhammad said. He added that the joint lab was founded against this backdrop, with the goal of enhancing disaster management capabilities through sci-tech innovation and knowledge sharing.

Consolidating the foundation of cooperation

As early as 2014, the two sides conducted joint research on viscoelastic damping and resilience enhancement technology for post-earthquake

structures, and completed Pakistan's first viscoelastic civil damping project at Vison High School.

"These early collaborations laid a solid foundation for the expansion of partner institutions and ongoing academic and technical exchanges between the two sides," Muhammad said.

"Since the establishment of the joint lab, the two sides have developed a regular exchange mechanism, leading to deeper cooperation in areas such as joint R&D, talent cultivation, standard formulation, and the promotion of applicable technologies," Chen Zhongfan, professor of Southeast University, said.

"The joint lab provides world-class facilities and cutting-edge technologies, helping us move toward a higher level of smart disaster prevention," Shahzada said. Through this platform, he secured an open fund project and is currently developing a

construction guideline for stone masonry structures in Pakistan.

"Looking ahead, we plan to further promote the localization and implementation of Chinese technical standards, jointly formulate standards for seismic resistance, flood control, and smart monitoring, and facilitate the pilot application of Chinese technologies in major projects in Pakistan," Xu said.

Planting friendship trees

In September 2023, during the Chinese team's visit to Pakistan, both sides jointly planted three saplings on the campus of the International Islamic University in Islamabad.

"Today, the saplings we planted have grown, just as the fruits of our cooperation continue to multiply," Chen said. "By the time we see these 'friendship trees' again, our collaboration will have reached a new height."

The joint lab is cultivating more interdisciplinary technical talent in the

field of smart disaster prevention for the two sides.

"As the host institution of the joint lab, we use smart disaster prevention as an entry point to deeply integrate civil disaster prevention and mitigation with multiple disciplines such as AI, big data, and information management," said Guo Tong, head of the School of Civil Engineering at Southeast University. "This provides the joint lab with a cutting-edge interdisciplinary theoretical and technical environment, as well as comprehensive support for talent cultivation."

Shah, a survivor of the earthquake 20 years ago, is studying smart disaster prevention technology at Southeast University. "After completing my master's degree this year, I plan to pursue my PhD here," Shah said. "In the future, I hope to apply the knowledge I have gained here in disaster prevention and mitigation efforts in my hometown."

Case Study

Intelligent Mining Sparks Hegang Revival

By TANG Zhexiao & ZHU Hong

It's quiet at the world's largest intelligent graphite mine, where all-electric unmanned mining trucks travel steadily along the stepped mine roads, automatically handling loading, unloading and intelligent obstacle avoidance — all free of mechanical noises and human intervention.

That's the scene at the Yunshan Graphite Mining Area in Luobei county, Hegang city, Heilongjiang province, where 5G connectivity covers the entire open-pit mine like an invisible net.

A few kilometers away, in the smart control center, dozens of large screens display real-time data on mining, crushing, mineral processing and transportation. With the click of a mouse, operators ensure the entire mine operates like clockwork from this compact command hub.

This mining area is now undergoing a silent technological revolution, driving the former "coal city" to accelerate its integration into strategic emerging industries such as new energy, new materials and aerospace.

Intelligent reshaping of production methods

"In the past, mine production scheduling relied heavily on manual driving. Now, we can maintain stable mine operations from the dispatch center, with higher production efficiency and more reliable safety," said Yu Yuxing, general manager of Longxing Graphite Development Co., Ltd., a subsidiary of China Minmetals Corporation.

Equipped with a complete "5G + Industrial Internet" system, the Yunshan Graphite Mine has pivoted to full-process digitalization and intelligence, covering ore body modeling, directional blasting, mineral processing and deep processing. Real-time data transmitted to the backend is mined and analyzed by AI systems, enabling technicians to make decisions and issue instructions more efficiently and scientifically.

Currently, the Yunshan Graphite Mine is the world's largest intelligent graphite mine in terms of both single-reserve volume and production scale, with an annual capacity of six million tonnes. Many of its innovative achievements have been recognized with national and provincial-level awards.

The transformation in production methods reflects a shift in the city's development philosophy. Hegang sees intelligence as the core of the graphite industry's transformation, integrating digital transformation and smart mine construction into its overall industrial development plan.

According to an official from the Hegang Municipal Bureau of Industry and Information Technology, the city has rolled out dedicated policies to support digital transformation, guided enterprises in building smart workshops, and

helped them secure nearly 100 million RMB from national and provincial subsidies and incentive funds.

Promoting green transformation

Inside the production workshops, graphite purification equipment operates quietly, pipelines are neatly arranged, and dust is barely visible — reflecting Hegang's commitment to green development.

As a carbon allotrope, graphite boasts lubricity, electrical conductivity, corrosion resistance and high-temperature resistance. It is a premium mineral resource in China and plays a crucial role in the development of high-tech industries.

"Graphite undergoes a remarkable transformation here, evolving from ordinary refined powder into high-end materials, with the entire process complying with green and environmental protection requirements," said Sun Nuo, technical director of China Minmetals (Heilongjiang) Graphite Industry Co., Ltd.

As one of China's largest graphite industry clusters, the Luobei Graphite Industrial Park implements unified collection, centralized treatment and standard-compliant discharge of all wastewater and solid waste, allowing enterprises to focus fully on production without environmental concerns.

Building on this foundation, Hegang has continued to promote the integration of graphite resources and the popularization of green technologies. In 2019, China Minmetals Corporation built the country's first green zero-carbon industrial demonstration park, where clean energy is widely applied, transportation systems operate in a low-carbon manner, and mining and transportation processes are fully electrified.

Currently, the Yunshan Graphite Mine has reserves exceeding 1.5 billion tonnes, making it the world's largest single-crystalline graphite mine in terms of resource scale. At the end of 2025, the mine was successfully designated as a national green mine.

Home to 37 graphite enterprises, the city has a production capacity of 6.5 million tonnes of annual ore mining, 1.1 million tonnes of refined graphite powder, and 540,000 tonnes of deep-processed products.

Expanding its product lineup beyond traditional refined graphite powder, Hegang now offers high-value-added products such as ultra-high-purity graphite and high-performance anode materials, having built a complete industrial chain for new energy materials.

Hegang currently supplies more than 80 percent of the natural graphite raw materials used for anode production in China. The city plays a pivotal role in safeguarding the national new energy materials industry and its supply chains, as well as mitigating external resource shocks.



Staff work at the intelligent control center of China Minmetals (Heilongjiang) Graphite Industry Co., Ltd. in Luobei county, Hegang city. (PHOTO: XINHUA)

U.S. Visa Vetting Policy Threatens Academic Exchanges



By QI Liming & HU Dingkun

About 20 Chinese scholars with valid and legal visas, were unreasonably questioned by U.S. Customs and Border Protection (CBP) at the Seattle-Tacoma International Airport recently and denied entry. Given the ongoing malicious questioning and harassment of Chinese scholars at this airport, the Ministry of Foreign Affairs of China and the Chinese embassy and consulates in the U.S. have cautioned their citizens traveling to the U.S. to have a heightened sense of safety awareness and avoid entering the country through this airport.

Since 2025, the U.S. has significantly tightened its immigration policies. Immigration enforcement agencies such as U.S. Immigration and Customs Enforcement (ICE) and CBP have vigorously cracked down on illegal immigrants domestically, leading to an increase in deportation, and strengthened border checks. Foreign nationals have become the primary targets of enforcement. It is not uncommon for international scholars to encounter discriminatory law enforcement practices in the U.S., including unreasonable questioning, denial of entry, visa revocation, and even detention, due to their nationality, political remarks, or social media content.

In February 2025, a Russian-American researcher from Harvard University was denied visa and detained upon entry into the U.S. on the grounds of "carrying prohibited items," resulting in the interruption of his related research. It was not until April this year that the U.S. court ruled that the visa revocation was illegal.

In March 2025, Philippe Baptiste, French minister responsible for Higher Education and Research, stated that a



Travelers wait in long lines at the George Bush Intercontinental Airport in Houston, Texas on March 27, 2026. (PHOTO: VCG)

French space scientist, who was to attend an academic conference in the U.S., was denied entry because his mobile phone contained text messages criticizing the U.S. government's scientific policies. Meanwhile, in January this year, a Chinese scientist working at Meta had his visa revoked when returning to the U.S.

The U.S. is home to numerous academic organizations and is one of the most important host countries for international academic conferences. However, the discriminatory immigration enforcement policies in the country are causing widespread concern among the academic community. The situation has become so serious that it is affecting the participation of foreign scholars in these conferences, resulting in a significant reduction in the scale of some conferences and a substantial decline in the effectiveness of academic exchanges.

In June 2025, the International Society on Thrombosis and Haemostasis (ISTH) conference was held in Washington, D.C., U.S. The proportion of participants from outside the U.S. dropped from 75 percent in previous years to 55 percent. The number of participants from Canada alone decreased by 55 percent compared to two years ago.

Thomas Reiser, executive director of ISTH, said that some European countries and Canada have issued travel warnings for their citizens visiting the U.S., and some international scientific organizations have advised researchers not to go to the U.S. These are the main reasons for the decline. "We are considering whether the U.S. is still a suitable location for hosting such international conferences," said Reiser.

Scholars and academic organizations from multiple countries are now boycotting academic conferences held in

the U.S., opposing and protesting against the discriminatory immigration enforcement policies of the country. In January this year, the Société Mathématique de France announced that it would not participate in the 2026 International Congress of Mathematicians (2026 ICM) being held in Philadelphia. The main reason was that visas and internal security in the U.S. could not be guaranteed.

In March, due to concerns over the U.S. visa policies and the possibility that foreign mathematicians might be harassed, or even violently treated by immigration enforcement agencies, over 2,000 mathematicians, including two Fields Medal winners, jointly signed a protest letter, boycotting the 2026 ICM planned to be held in the U.S., demanding that the International Mathematical Union move the conference out of the U.S.

In fact, since 2025, several academic organizations, such as the International Association for Cognitive Behavioral Therapy (IACBT) and the International Society for Research on Aggression (ISRA), have cancelled their plans to hold conferences in the U.S. or have shown "foresight" by moving academic conferences to other countries.

Skift Meetings, the authoritative media in the conference and event industry, has reported that as scientific groups cancel or change their meeting venues, the status of the U.S. as a host country for academic exchanges declines.

There is no doubt that discriminatory immigration enforcement in the U.S. is seriously undermining international academic exchanges, and the "emigration" of some academic conferences will also weaken the country's status as a major global scientific center. The U.S. government needs to strengthen the supervision of immigration law enforcement agencies and personnel. What they should be offering international scholars is not uncertainty and fear, but safety and respect.

Opinion

Sino-German Auto Cooperation Needs Further Advancement

By LU Zijian

"Traditionally, we have a very strong relationship between China and Germany when it comes to the automotive industry," Hildegard Müller, president of the German Association of the Automotive Industry, told *Science and Technology Daily* in an interview during the recent 2026 Beijing International Automotive Exhibition (Beijing Auto Show).

This was not Müller's first auto show in China. In the past two years, she came to China several times to attend multiple major events like the Beijing Auto Show, Auto Shanghai, and the World New Energy Vehicle Congress in Hainan province in south China.

At these events, she could see "how working together — how cooperation — leads to success, how strengths can be developed together, how we can improve together, how we can meet customer needs, and how an economy can also develop together."

She said that is why the exchange between German and Chinese original equipment manufacturers and suppliers at the Beijing Auto Show was so important. "Because it strengthens products and benefits consumers."

Just days before the Beijing Auto Show started, the German Chamber of Commerce in China published an excerpt from its upcoming *Innovation Report 2026*, detailing three results of the automotive industry section.

According to the report, over the past two years, the share of the surveyed German companies from the automotive industry in China with R&D activities in China that serve both the Chinese and global markets nearly tripled, rising from 12 percent to 33 percent.

Of these companies, 81 percent said localizing their R&D in China has accelerated their development speed compared with Germany; 79 percent also said localized R&D in China has lowered their R&D costs versus costs in Germany.

Müller said German auto makers like BMW, Mercedes-Benz and Volkswagen have certain components that are used globally, as well as other components that are tailored specifically for their customers. "You can truly understand customers and markets only if you're on the ground."

That is why investment and development are carried out here in China — not simply because production might be cheaper or for other factors, but because it allows the companies to respond very specifically to customer needs, Müller said.

For many years, the Chinese and German automotive industries have conducted various forms of cooperation, including corporate partnerships and joint ventures, which provide a solid foundation for developing these initiatives together.

"It is therefore very important to build on these strengths collectively. And to do so, we also need policies and a political framework that continue to make this possible," Müller said.

The German automotive industry is investing heavily in China, aiming to respond very specifically to the needs of Chinese consumers. In doing so, it is also driving economic growth and creating jobs in China, Müller said.

"We also invite the Chinese automotive industry to come to Germany or Europe, including establishing production bases, and to become part of the production network in the same way that the German automotive industry is currently doing in China," she said.

Hi-Tech

AOE: An Open Space Orbital Data Ecosystem

By LI Linxu

With the accelerated deployment of Low Earth Orbit (LEO) satellite constellations and the rise in space debris, space traffic management has become a pressing reality.

"Without independent orbital data, it's like driving with someone else's map — you could face a 'network blackout' at any moment," said Kang Ruiqing, chairman of CreatUnion, highlighting the industry's predicament.

Drawing on its 22 years of expertise, CreatUnion is engaged in research and development of the AOE (ADS Orbital Elements) ecosystem. AOE leverages an observation network comprising 30 ground stations and 108 space-based satellites. By integrating international orbital data, it effectively fills the gap in China's commercial space object data.

"AOE is an all-process independent orbital dataset covering core functions such as orbital visualization and monitoring," Kang said.

By building a full-link technical framework, AOE ensures total orbital coverage during data acquisition. Its optimized algorithms improve accuracy in tracking space debris. Furthermore, it provides exclusive photometric data.

To consolidate its market position, CreatUnion has developed a dedicated AOE chip and applied for more than 130 patents to protect its core IP.

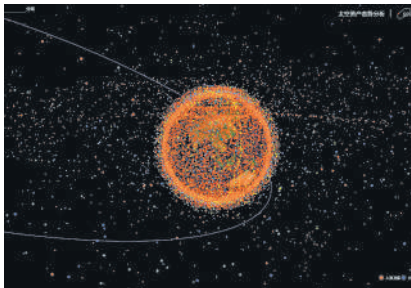
In the commercial sector, AOE offers multiple download options. Users can access data simply by logging onto the SpaceMapper. The system has secured

several data service contracts for two consecutive years.

Leveraging AOE, the company has recently launched the Global University Satellite Alliance Constellation initiative. The initiative aims to launch 300 satellites over the next six years, making them accessible to 100 universities. Several universities have already signed agreements to co-build joint laboratories.

"We will advance three key initiatives in the future," Kang stated. "We will optimize the precision and update efficiency of AOE, drive the integration of AOE with cutting-edge technologies such as AI and laser communication, and expand industry-academia-research collaboration to build an ecosystem of talent, technology, and data."

"Our goal is to make space safer and flight more reliable," Kang said. With AOE at its core, the company will build a comprehensive orbit data ecosystem, cultivate the commercial space field, and offer the world an alternative choice for space data.



A simulation of space environment based on the orbital data of CreatUnion. (COURTESY PHOTO)

Time to Industrialize Chip-scale Atomic Clocks

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A leak just 10 times larger would double power consumption and cripple performance.

Initial attempts using standard welding furnaces failed to achieve the necessary vacuum. "Each unit is expensive, and we could only make one or two a week, most ending up as scrap," said Liu, pointing to a pile of failed units. After six months of inconsistent results, the team abandoned off-the-shelf tools and co-developed a custom vacuum welder with a motion mechanism. This meant conquering three major challenges: precision alignment under extreme heat, controlling solder splash, and optimizing heating curves.

The R&D team worked in harsh conditions — a vacant factory in Dax-

ing, Beijing, with summer temperatures over 40°C and winter cold so severe it numbed their hands. A single weld required 20+ hours of continuous monitoring, with teams working in shifts to adjust parameters. In July 2020, after four years of effort, the reliable vacuum seal was finally achieved, turning an experimental possibility into an engineering reality ready for production.

Building a production line

Despite a working product, manual production was unsustainable. Ten technicians using tweezers under microscopes could produce only 200-300 units per year, far short of the thousands needed for national projects. "A major advantage of CSACs is mass production," said Liang Xiaopeng, chairman of Huaxin. "We had to build a line."

With no domestic reference to follow, the team designed everything from scratch. The smallest physical part is just 0.2 mm (two hair-widths), requiring micron-level precision systems. Many automation equipment vendors were unable to help due to the difficulty of the task. Moreover, to automate the manual process, materials and workflows had to be completely redesigned.

To overcome these challenges, Huaxin collaborated with the Institute of Physics at the Chinese Academy of Sciences, leveraging their semiconductor equipment and micronano processing capabilities. Through iterative testing, they locked in optimal process parameters.

By continuously refining equipment and processes, the team pushed the production yield above 98 percent.

Sci-tech Labs Promote Global Development Initiative

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The foundation also added a prefabricated modular classroom to serve as a sci-tech lab for each of the two programs in Malaysia and Togo. With a shorter construction cycle and reduced resource waste, this type of prefabricated modular classroom employs high-efficiency and eco-friendly materials to lower both building energy consumption and the carbon footprint of transportation. Renewable resource facilities like photovoltaic panels further decrease carbon emissions and reliance on traditional energy.

"Our approach to this project is not

only to ensure its successful completion on the ground, but also to make it a sustainable process that truly empowers local people with the skills to help themselves," Li said.

The foundation invited the headmaster of Phiawath Secondary School to visit Shenzhen and the school signed a friendly cooperation agreement with Shenzhen Hongling Middle School.

The donors in this project also share the philosophy that public welfare assistance is not merely a one-off donation of items. When teachers and students at SJKC Nan Kai in Kuala Lumpur, encountered problems while using the

robots, the donor offered technical support.

It is worth noting that all donations came from enterprises, and most of them are in Shenzhen. The city has a large cluster of tech enterprises and abundant tech products, which can provide strong support for improving people's livelihoods. "I've summarized this model of donation as 'sourced from the public and used for the benefit of the public,'" Li said.

Although there are challenges while implementing the sci-tech lab project, Li is proud to be able to mobilize private-sector resources to promote people-

to-people bonds within the framework of GDI through small but meaningful projects that benefit people.

The projects in Laos and Papua New Guinea have been included in the Achievements Pool of the Global Development Project Pool maintained by China International Development Cooperation Agency, while the projects in Malaysia and Togo have been included in the Incubation Pool.

Li said the next step is to launch initiatives in Thailand and the United Arab Emirates, continuing to promote the development of science and technology education within the GDI framework.

A French Engineer's Railway Dream: From Nanjing to Europe

Dialogue

By LONG Yun & ZHANG Jianing

While speaking with *Science and Technology Daily*, Adrien Peulvast, a French railway signaling engineer, reached into his pocket, pulled out his business card, and slid it across the table. It read: SilkRail, the name of his company.

Peulvast has spent over two decades in railway signaling research. He holds multiple international safety certifications and was once the youngest member of the Institution of Railway Signal Engineers. But rather than rest on his credentials, he has taken a new path. Today, his four-year-old startup in Nanjing in east China builds AI-powered tools that test train control systems.

From robots to railways
Peulvast's interest in his research field started early. "When I was young, I wanted to work in robotics and automation," he said. After university, he joined a railway company almost by chance. "It suited me well. I enjoyed the heavy industry, the complex systems that last for decades, the computers, and the rigorous processes."

One of his early projects, the UK's High Speed 1, the country's first high-speed railway, has now been running for two decades. "It has carried billions of passengers without any problems," he said. "I am proud to have contributed to a system that remains in daily use two decades later."

He also worked on China's Shijiazhuang-Taiyuan high-speed line, which opened in northern China in 2009. "Seeing a system operate reliably for decades gives you a sense of fulfillment."

At the start of his career, the CENELEC safety standards — European electrotechnical standards — were just emerging. He subsequently gained experience in Sweden, Spain, and China, and witnessed how common standards enable cross-border cooperation. "When you speak with Chinese engineering teams, everyone uses the same technical language. That is remarkably powerful."



Adrien Peulvast. (COURTESY PHOTO)

A sleepless night that changed everything

That technical language became the foundation of his own company. The idea for SilkRail's an important product, an AI-powered testing tool that shortens a typical test cycle from 30 days to just seven, came from a project with China Railway Signal & Communication (CRSC).

"We had an idea: to automate the testing process," Peulvast said. "During the day, they explained their requirements. Through the night, we developed the solution."

His wife Zhang Yu, who handles commercial and translation work for SilkRail, filled in the details. "We did not sleep at all that night," she said. "I translated the Chinese technical data, the requirements. He wrote the code. Within a week, we had a working prototype."

The client was impressed and that initial success led to a formal partnership. SilkRail signed a contract and built the full software incrementally, using an agile approach. "Now the client uses it on many railway lines," Peulvast said. "You simply launch the tool, and it runs the tests automatically."

The company name, SilkRail, reflects a broad ambition. "My dream is that one day we will see trains bearing

the SilkRail logo running from China to Europe," he said. "A bridge between two continents."

China's high-speed miracle and the road ahead

That dream is rooted in Peulvast's deep respect for what China has already achieved. Asked about the country's greatest high-speed rail accomplishment, he pointed to the scale and speed of deployment. "More than seventy percent of cities are connected. Trains run at 350 kilometers per hour — the fastest in the world. To have built such a vast network in such a short period of time is remarkable. Taking the train in China is convenient, comfortable, and punctual."

He also noted a key difference between China and Europe. "In Europe, trains cross multiple national borders, so we need a system that functions everywhere. China is a single country, so the technical specifications can be unified. That is very powerful. Every time you build a new line, you know exactly what needs to be done, and every team speaks the same technical language." Looking ahead, the biggest challenge is no longer construction but maintenance.

On the future of railway signaling, Peulvast sees two critical areas. One is the data format. "Our company is the first Chinese member of the

RailML consortium. If everyone uses the same data format, we can share data and make train systems more predictable and efficient."

The other is AI reliability. "When you ask AI for an answer, it is not always accurate. The challenge is to ensure that AI-generated answers are reliable enough to analyze systems and solve problems effectively. The models are getting better, and we are learning to use them."

A home in Nanjing

For Peulvast, China is not just a place to do business. It is home. Moving to Nanjing in late 2020 during the pandemic was not an easy decision. "It was a difficult time everywhere," he recalled. "We had to choose: return to France, go somewhere else, or stay in China."

They stayed. "I never had any doubt about settling in China," he said. He had already traveled to China many times before, starting in 2007. "I knew what it was like. The support we received from the local government in Nanjing made the decision easier."

Peulvast and Zhang Yu highlighted both the practical and lifestyle benefits of living in Nanjing. Nanjing is one of China's largest rail hubs, offering convenient transportation. It also has a green environment, which they appreciate.

Their two children attend local Chinese schools. "Our daughter writes Chinese characters very well," Zhang Yu said. "She wants to become a cultural ambassador between China and France. That is her dream."

Having witnessed China's rapid technological transformation and having participated in it through his own work, Science and Technology Daily asked Peulvast to sum up the country's tech development. He offered four words: "Fast. Giant. Flexible. Smart."

After a brief pause, he added a fifth: "Cooperation. China is remarkably open and excels at working with others."

For now, Peulvast continues to write test scripts and run through the forests of Nanjing, hoping that one day a train bearing his company's name will cross the Eurasian continent.

ZHANG Heyan from *International Talent Magazine* also contributed to this article.

Overseas Echoes

Chinese Embassy in U.S. Hosts Open House with Sci-tech Exhibition

By SUN Xueping & ZHONG Ping

The Chinese Embassy in the U.S. hosted an open house on May 2, featuring a science and technology exhibition titled "Innovate Together: Science & Technology for a Shared Tomorrow."

The exhibition was built on a popular format from previous years, using panels, models, videos, and hands-on experiences to present the outcomes of U.S.-China sci-tech cooperation and China's own innovation drive. It underscored China's commitment to open, win-win collaboration in science and technology and its contribution to the global innovation system.

The "China-U.S. Sci-Tech Cooperation and China's Sci-Tech Innovation" section detailed their practical collaboration in agriculture, public health, clean energy, and high-energy physics. Highlights included hybrid rice cooperation to bolster food security, a folic acid intervention program that reduced birth defect rates, and the work of the China-U.S. Clean Energy Research Center in advancing green and low-carbon development.

Additionally, panels introducing the International Science and Technology Cooperation Initiative and the Initiative on International Cooperation in Open Science illustrated China's advocacy for an open, fair, equitable, and non-discriminatory approach to global scientific cooperation. They also demonstrated China's readiness to join other nations in tackling shared development challenges.

The model display area featured replicas of major Chinese scientific achievements: the Five-hundred-meter Aperture Spherical radio Telescope (FAST), the Jiangmen Underground Neutrino Observatory (JUNO), the High-Intensity Heavy-Ion Accelerator Facility, the Fendouzhe deep-sea

manned submersible, and the Tiangong space station.

Many visitors lingered in the area, having in-depth conversations with the embassy's science and technology staff. English-language videos on China's open sci-tech cooperation, its women scientists, and major facilities such as FAST and JUNO were also played on a loop, giving American audiences an insight into the latest progress in China's science and technology development and its open cooperation practices.

For the first time, the exhibition introduced a regional innovation section, with northwestern Shaanxi Province as the guest of honor. The Shaanxi exhibition highlighted the province's achievements and international cooperation in aerospace, advanced manufacturing, and AI through panels, models, and interactive experiences.

A BYD model car demonstrated the growth of the new-energy vehicle industry, and an AI-powered chess robot drew many participants. The arrangement enriched the exhibition and offered the American public a window into the scientific and technological development at China's local level.

The embassy's science and technology staff talked with visitors on topics such as sci-tech cooperation, innovation policies, and future developments. Many attendees said they walked away with a fuller, more nuanced understanding of China's innovation system and its vision for open collaboration.

Dai Gang, the embassy's minister counselor for science and technology, said the exhibition vividly demonstrated the openness and inclusiveness of China's sci-tech innovation. It helped Americans better understand China's technological progress and played a positive role in promoting bilateral sci-tech exchanges and cooperation.



Visitors have in-depth conversations with the embassy's science and technology staff. (COURTESY PHOTO)

Why Xuelong 2 Explores the Antarctic Deep Freeze in Southern Hemisphere's Winter

Science Outreach

By BI Wenting & BI Weizi

On March 27 — the second day of comprehensive station operations during the 2026 Autumn Joint Voyage to Prydz Bay, part of China's 42nd Antarctic Expedition — force 12 gale winds, whipping up blowing snow, raged across the Davis Sea Polynya.

As the side hatch of China's newest icebreaking vessel Xuelong 2's Moon Pool workshop slowly opened, expedition members successively deployed a vertical net, a particulate matter profiling system, and a Conductivity-Temperature-Depth profiler to probe the mysteries of the Southern Ocean (Antarctic Ocean) in autumn.

Why conduct research during autumn and winter?

Given such severe climatic conditions during autumn and winter, why does the Xuelong 2 venture deep into the Southern Ocean to reach Antarctica's Prydz Bay? Chen Jianfang, a researcher serving as the deputy leader of China's 42nd Antarctic Expedition and chief scientist of this Joint Voyage, explained that China has conduct-

ed oceanic surveys in Prydz Bay for over 30 years. However, in the past — constrained by sea conditions, weather, and technological limitations — these surveys could only be carried out during the summer months; consequently, international scientific understanding of this region during the autumn and winter seasons remains extremely limited.

The successful completion of the first Joint Voyage to the Ross Sea — undertaken during China's 41st Antarctic Expedition in November 2024 — provided invaluable experience for the current Joint Voyage to Prydz Bay. During the autumn and winter seasons, the biosphere of the Antarctic marginal seas remains active. Mesoplankton, krill, and Antarctic silverfish larvae constitute the primary biological components of this ecosystem; influenced by deep convection and their own migratory behavior, these organisms migrate from the shallow layers down into the deep ocean.

Prydz Bay is a quintessential example of an Antarctic marginal sea, where the Antarctic Bottom Water is formed. As one of the densest and coldest water masses globally, Antarctic Bottom Water covers 40 percent of the world's deep-sea regions and plays a pivotal role in global thermohaline circulation and climate regulation. Furthermore,

key species within the Antarctic ecosystem — such as krill, fish, seals, and seabirds — breed, live, and overwinter in this environment.

Chen noted that conducting research in Prydz Bay during the autumn and winter seasons serves multiple purposes: it not only helps fill gaps in seasonal survey data for the region but also facilitates a deeper understanding of the formation mechanisms of Antarctic Bottom Water, allows for the assessment of carbon sink intensity, and enables the investigation of the overwintering processes of key biological species.

Anchoring at the "birthplace" of Antarctic Sea ice

To achieve the above scientific objectives, the selection of a representative study area is of paramount importance. Within the vast expanse of Prydz Bay, numerous "ice factories" — known as polynyas — are scattered across the water. Among these, the Davis Polynya and the Mackenzie Polynya open water have been designated as the primary focus for the current expedition.

Wang Shuoren, assistant leader of China's 42nd Antarctic Expedition, explained that a polynya refers to a relatively open area of water that appears amidst dense sea ice during the autumn and winter months. During this period, atmospheric temperatures drop

significantly below the temperature of the seawater; this drastic temperature differential causes the ocean to release heat into the atmosphere, thereby triggering the formation of new ice.

However, katabatic winds — descending from the high elevations of the ice sheet like a colossal hairdryer — sweep the newly formed ice away from the sea surface, leaving exposed water that continues to freeze. Alternatively, driven by upwelling currents, warmer deep-sea water may rise to the surface, inhibiting ice formation or even melting existing sea ice.

Through this continuous cycle, polynyas emerge as the regions within Antarctica with the highest volume and efficiency of ice production, serving simultaneously as natural laboratories for the study of sea ice formation. Traditional Antarctic expeditions have historically focused on the summer season; however, with regard to Antarctic sea ice production and the formation of bottom water, summer is precisely the most "quiescent" period. Autumn, conversely, constitutes the critical window during which the Southern Ocean transitions from open water to a frozen state — and so represents the optimal opportunity to unlock the core mysteries surrounding the "polynya-deep convection-bottom water" nexus.

Advancing Basic Research to Solidify Foundation for China's Strength in Science, Technology

From page 1

Xi noted that it is essential to integrate the development of education, science and technology, and talent, make comprehensive efforts in cultivating, introducing, and utilizing talent, and expand the talent pool for basic research.

He advocated carrying forward the spirit of scientists, promoting science popularization, and stimulating the imagination and curiosity of young people, so that pursuing basic research becomes their lifelong aspiration.

Xi stressed the need to strengthen support for basic research, and called for gradually increasing the share of funds for basic research and establishing a mechanism of diversified inputs.

He also called for a systematic approach to developing major sci-tech infrastructure, the advancement of intelligent research platform systems, and the improvement of a categorized evaluation system tailored to the characteristics of basic research.

Efforts should be made to enhance the working and living conditions of those engaged in basic research, foster an open, inclusive and failure-tolerant

innovation environment, and strengthen research integrity, Xi said.

He called for actively integrating into the global innovation network, deepening international exchanges and cooperation in basic research, jointly tackling major scientific issues such as climate change, energy and environment, as well as life and health, and actively participating in global sci-tech governance.

Cai Qi, a member of the Standing Committee of the Political Bureau of the CPC Central Committee and director of the General Office of the CPC Central Committee, attended the symposium.

Ding Xuexiang, a member of the Standing Committee of the Political Bureau of the CPC Central Committee and Chinese vice premier, presided over the symposium.

Ding called for greater confidence and resolve, as well as more practical measures and actions, to comprehensively strengthen basic research, enhance original innovation capabilities, and strive for a high level of self-reliance and strength in science and technology.

Source: XINHUA