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Science and Technology Daily

VOL.6-NO.239 MAY 9-10, 2026

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.

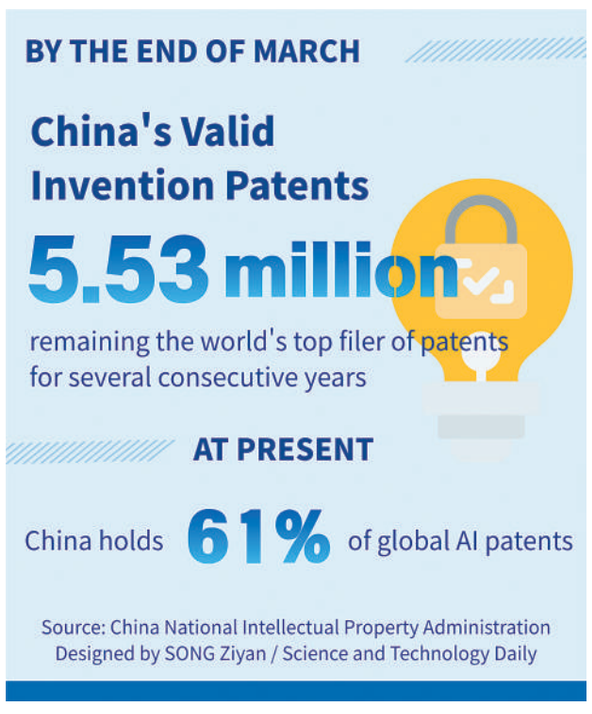
Xi emphasized the need to strengthen overall planning and top-level design to optimize the systematic layout of basic research.

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***

New Graphic



WECHAT ACCOUNT E-PAPER

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 cm^3 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 cm^3 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***

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 Yian

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)

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