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TIB-VIB JOINT CENTER FOR SYNTHETIC BIOLOGY ADVANCES CHINA-BELGIUM RESEARCH COOPERATION

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Learn more



Signing Ceremony [IMAGE: TIB]

TIB and VIB strengthen synthetic biology partnership with renewed joint center agreement

The Tianjin Institute of Industrial Biotechnology (TIB) of the Chinese Academy of Sciences (CAS) and Belgium's Vlaams Instituut voor Biotechnologie-Flanders Institute of Biotechnology (VIB) renewed their commitment to advancing synthetic biology research through the extension of their Joint Center for Synthetic Biology.

The agreement was signed on December 15, 2025 in Tianjin, China, by Professor Xiang Hua, Director of CAS's TIB, and Dr. Christine Durinx, Managing Director of VIB.

This renewed agreement builds upon the foundational collaboration established in December 2020, which initially focused on yeast synthetic biology and the biosynthesis of plant natural products. Leveraging the success of their previous joint research, talent exchange, and academic outputs, the expanded framework sets a more ambitious agenda for future cooperation.

The upgraded Joint Center will now concentrate on accelerating cutting-edge research and platform technologies within synthetic biology. Expanded research priorities include the study of chassis cell metabolic mechanisms and regulatory networks, pathway design and dynamic regulation, microbial protein and natural product biosynthesis, and the valorization of low-carbon compounds.



Appointment of the Co-Directors [IMAGE: TIB]

During the signing ceremony, Professor Xiang highlighted TIB's leadership in the CAS International Science Program on CO_2 Fixation and Bioconversion (CO_2FIX). He formally presented Professor Kevin Verstrepen, Director of VIB Center for Microbiology, with a certificate as a Distinguished Scientist under the CAS CO_2FIX International Fellowship Initiative, underscoring the depth of this collaborative exchange.

This reinforced partnership aims to foster comprehensive and in-depth cooperation between TIB and VIB. The Joint Center is poised to serve as a high-level platform for Sino-Belgian exchange and innovation in synthetic biology.

Source: Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences



Award Ceremony to Professor Kevin Verstrepen as the CAS CO_2FIX Distinguished Scientist [IMAGE: TIB]

China work permit application guide for foreign nationals

Policy basis

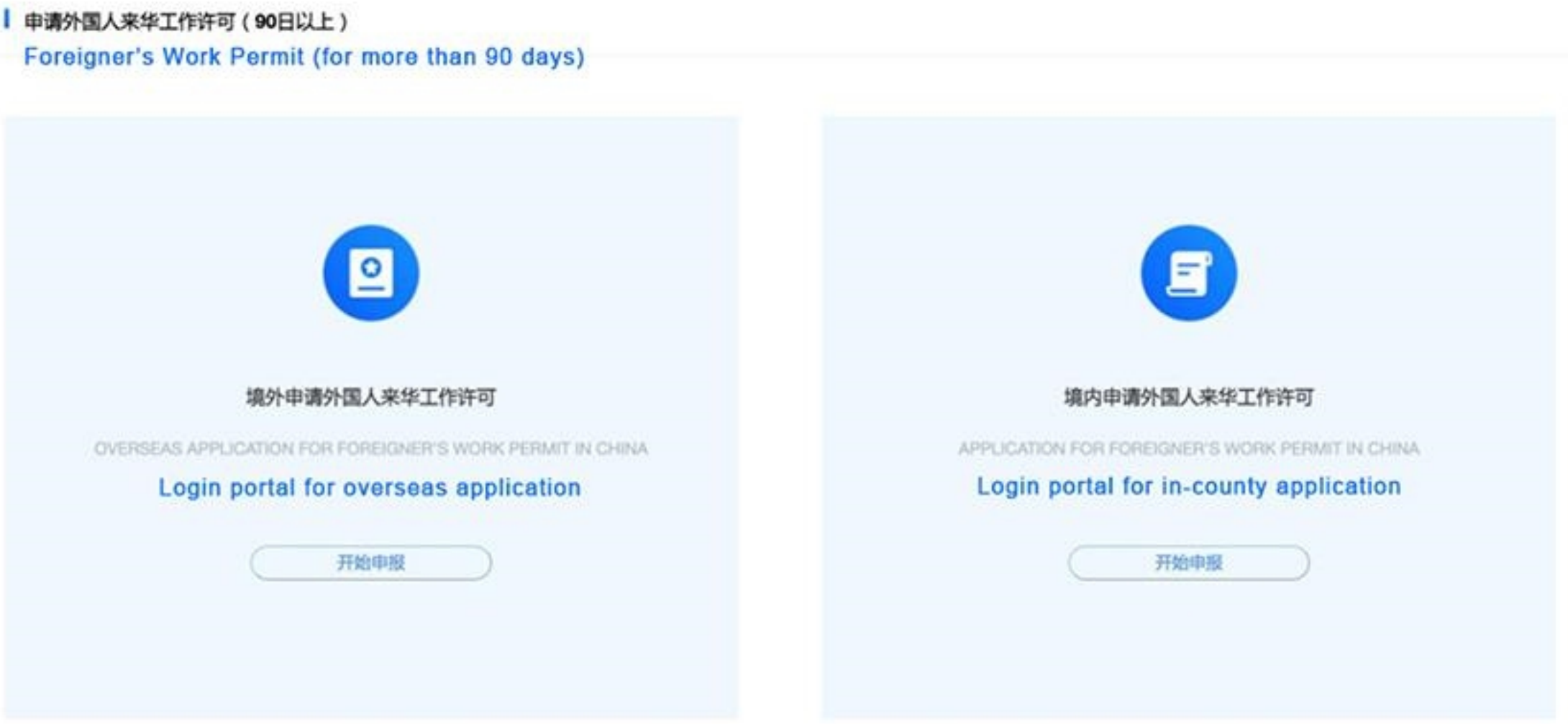
Notice on Issuing the Service Guide to the Foreigner's Work Permit in China (Trial) (No. 36 [2017] State Administration of Foreign Experts Affairs)

1. What is in-country application?

This option allows foreign professionals who are legally residing in China with valid visas or residence permits to obtain work permits without exiting China.

2. How to choose between in-country or overseas application login portals?

Foreign nationals physically present within the People's Republic of China must select the in-country login portal when applying for a work permit. Those outside Chinese territory should use the overseas portal. The foreigner's work permit notification issued for overseas applications will be forwarded to the chosen Chinese embassy/consulate abroad to obtain a Z Visa.



3.Do in-country applications require medical certification?

Yes. Submit either a physical examination record verification certificate, or a health examination certificate issued by Chinese inspection and quarantine authorities within the last six months. Foreigners switching employers are exempt from this requirement.

4. Requirements for foreign workers changing employers in China

To change employers domestically, foreign nationals must retain their original position/occupation and possess a valid work-type residence permit.

Special cases:

a) Expired/canceled permits: Submit a stay visa issued within 30 days

b) Position changes: File under "In-country New Application"

5. Are medical or criminal record checks required for in-country employer changes?

No.

6. Is cancellation required for valid work permits while changing domestic employers?

Yes. A valid foreigner's work permit must be canceled prior to employer transition. The new employment contract's commencement date shall be subsequent to the effective date of cancellation.

7. Supplementary materials for points-based work permit applications

When applying through the points-based system, submit evidence supporting claimed points:

- Salary commitment letter
- Highest academic credential
- Professional license(s)
- Work history verification
- Annual working hours record
- HSK certificate
- Fortune Global 500 employment proof
- Patent documentation

8. What additional materials must be submitted for salary commitment-based applications?

For applications involving salary commitment matters, the employing unit and foreign applicant must submit a salary commitment letter. This document shall include commitments regarding annual/monthly income, tax payment location, etc, affixed with the employer's official seal and signed by the foreign applicant. The template for the salary commitment letter can be obtained by scanning the QR code right:

9. What is the approval timeline for in-country applications?

Pre-approval: Three working days (one working day for Category A high-level foreign talent)

Online acceptance: Within two working days after pre-approval clearance

Note: The acceptance date is excluded from timeline calculations

Formal review: Five working days (fully online process)

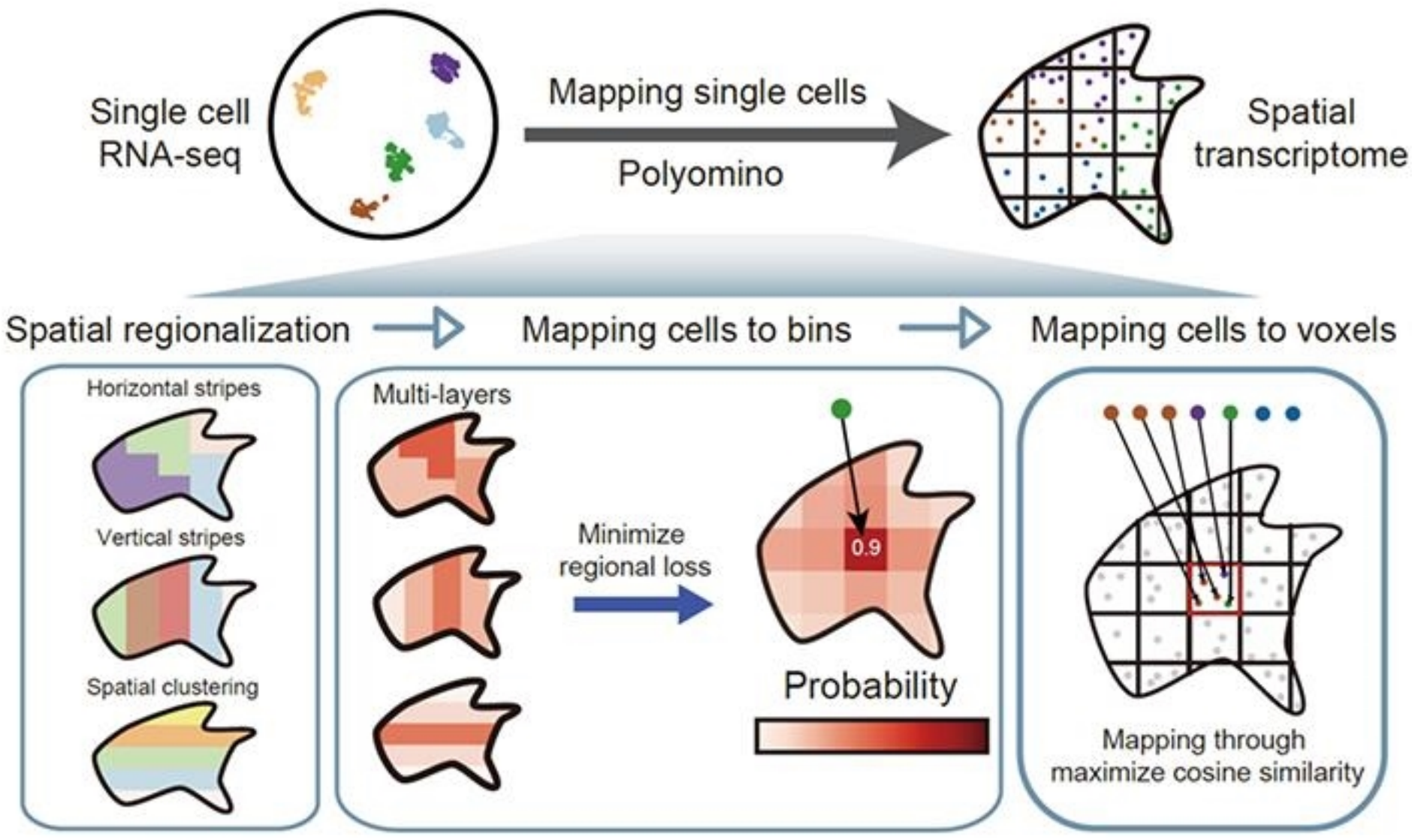
10. When can the work residence permit be processed?

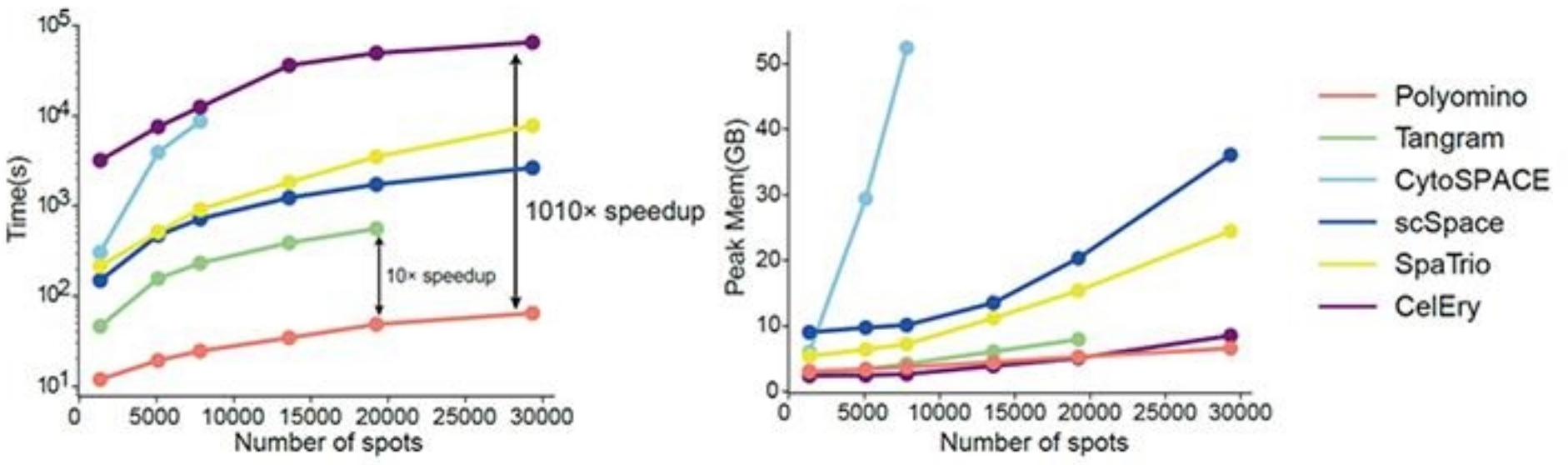
Upon approval of the in-country application, the following documents must be printed from the system:

- *Work permit notification for foreigners*
- *Administrative licensing decision*

Applicants must then visit immigration authorities to apply for the work residence permit for foreigners in China. (Inquiry hotline: 12367)

Source: Beijing Overseas Talents Center





Polyomino's multi-level region-allocation strategy enables single-cell spatial localization while substantially improving computational efficiency

[IMAGE: PROFESSOR CHEN'S TEAM]

Polyomino: A high-precision single-cell and spatial omics integration algorithm

On October 22, 2025, *Genome Research* published online a paper from Professor Chen Jiekai's laboratory at the Guangzhou Institutes of Biomedicine and Health (GIBH) of the Chinese Academy of Sciences (CAS), entitled "Polyomino reconstructs spatial transcriptomic profiles with single-cell resolution via region-allocation method". The paper was selected as the cover article for issue 11 of *Genome Research*. The study introduces a spatial integration algorithm, Polyomino, which efficiently and accurately reconstructs spatial transcriptomic maps at single-cell resolution.

Cells in living organisms do not exist in isolation. They communicate with each other according to their spatial positions to form intricate tissues and organs. Spatial transcriptomics is a key technology for revealing this cellular blueprint and has advanced rapidly in recent years. However, existing methods for integrating single-cell and spatial datasets often struggle to balance speed and accuracy when confronted with data at the scale of millions of cells, due to computational demands and noise.

The research team adapted the image-analysis concept of regions of interest (ROIs) and developed a multi-level region-allocation strategy to place cells spatially. Rather than assigning cells directly as in conventional approaches, Polyomino first partitions the spatial data into an array of tiles and constrains cell localization using multi-level regional cues (such as horizontal/vertical bands and spatial clustering). Fine-scale matching is then performed within each tile. This two-stage design dramatically reduces computational cost and improves robustness to common noise sources such as cell-segmentation errors and imbalance in cell-type proportions.

In a series of evaluations on both simulated and real data, Polyomino demonstrated outstanding performance:

a) High computational efficiency: Integrating roughly 15,000 single cells with nearly 20,000 spatial spots required only 141 seconds, 10 to 1,000 times faster than existing algorithms. Polyomino is currently the only method capable of integrating million-scale cells in a single run.

b) Accuracy and robustness: The method maintained high accuracy under various noise scenarios (e.g., segmentation errors, proportion biases). In validations using mouse embryos and cerebral cortex samples, Polyomino accurately reconstructed spatial distributions of cells.

c) Broad applicability: In analyses of colorectal cancer liver metastasis tissues, Polyomino revealed spatially distinct subpopulations of conventional dendritic cells (cDCs) between tumor and peritumoral regions and identified immune signaling networks associated with angiogenesis, offering new insights into the tumor microenvironment.

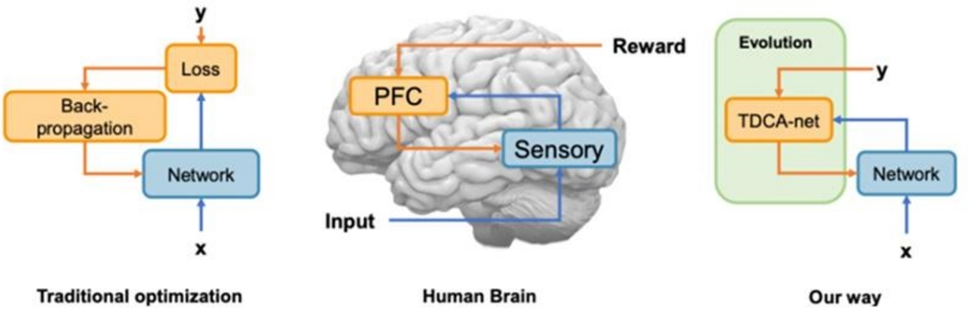
Overall, Polyomino overcomes computational bottlenecks in large-scale data integration and provides a higher-resolution tool for studying tissue development, disease mechanisms, and potential clinical applications. The authors anticipate that, as single-cell and spatial omics datasets continue to grow, Polyomino will become an important methodological foundation for building comprehensive cellular atlases and for dissecting organogenesis and pathological changes.

Dr. Cai Quanyou, Associate Investigator Lin Lihui from CAS's GIBH, and Dr. Liu Xin from Guangdong Second Normal College are listed as co-first authors. Professor Chen Jiekai and Associate Investigator Lin Lihui are co-corresponding authors.

This work was financially supported by the National Key R&D Program of China, the National Natural Science Foundation of China, a Major Project of Guangzhou National Laboratory, the Science and Technology Planning Project of Guangdong Province, China, and the Health@InnoHK Program launched by the Innovation Technology Commission of the Hong Kong SAR, P.R. China.

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Chinese Academy of Sciences

Source: Guangzhou Institutes of Biomedicine and Health, Chinese Academy of Sciences



Comparison of different learning approaches: traditional optimization, biological brains, and our TDCA network approach. [IMAGE: CEBSIT]

New brain-inspired learning framework: AI can learn without loss functions or backpropagation

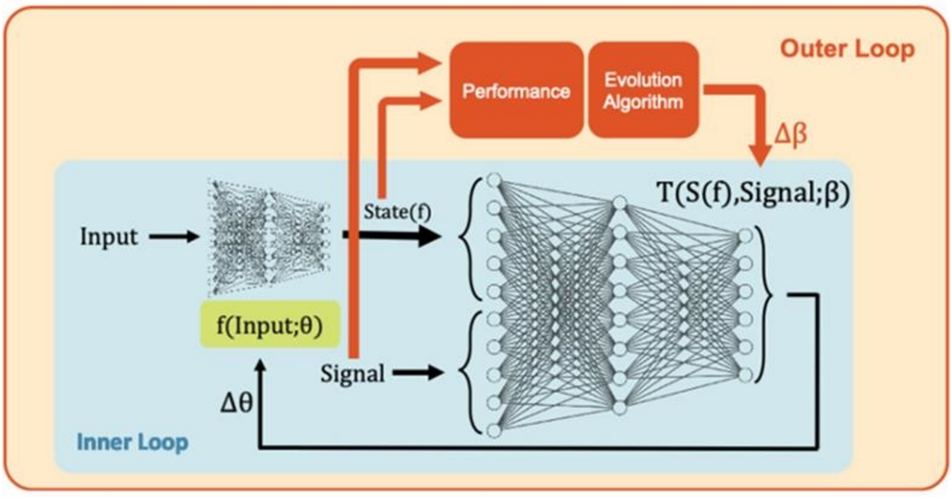
A research team led by Wang Zuoren from the Institute of Neuroscience, Center for Excellence in Brain Science and Intelligence Technology (CEBSIT) of the Chinese Academy of Sciences (CAS), in collaboration with Liu Chenglin from the Institute of Automation, Chinese Academy of Sciences (CAS), has proposed a fundamentally new learning paradigm inspired by the biological brain.

The findings were published in the journal *Neurocomputing* on December 5, 2025, under the title: "Towards Biologically Plausible DNN Optimization: Replacing Backpropagation and Loss Functions with a Top-Down Credit Assignment Network".

The study demonstrates — for the first time — that a biologically inspired Top-Down Credit Assignment Network (TDCA-net) can simultaneously replace loss functions and backpropagation in deep learning. Across a wide range of non-convex optimization, vision, reinforcement learning, and robotic control tasks, TDCA-net achieves faster convergence, higher stability, better generalization, and reduced computational cost, offering a promising new route toward next-generation brain-like AI.

For decades, the success of artificial intelligence has relied on the classical training recipe of explicitly defined loss functions plus backpropagation. Yet a long-standing question persists: the human brain does not use backpropagation — so how does it learn so efficiently? And can artificial systems learn effectively without it? In neuroscience, studies show that the brain lacks: explicit numerical loss functions, precise gradient-based error propagation, and symmetric, layer-by-layer credit assignment pathways. Instead, top-down regulatory signals originating from high-level cognitive areas — such as the prefrontal cortex and cingulate cortex—appear to play a central role in guiding learning throughout the cortex. This suggests that biological learning may rely on an endogenous, top-down modulation mechanism fundamentally different from artificial backpropagation.

Motivated by these insights, the authors propose a framework consists of two components: 1) a bottom-level task network, responsible for performing the actual task; 2) a top-down credit assignment network, responsible for generating learning signals. Unlike traditional methods that compute gradients through an explicit loss function and backpropagation, the TDCA-network directly generates the signals used to update the task-network parameters, entirely replacing both the loss function and the backpropagation process. By mimicking the hierarchical control structure of the human brain, TDCA-network provides a learning mechanism that is structurally more aligned with biological cognition.



Schematic diagram of the top-down learning framework. [IMAGE: CEBSIT]

The research team validated the TDCA-network on a wide range of representative tasks: 1) Non-convex optimization, where standard algorithms often become trapped in local minima; 2) Image classification, including MNIST and Fashion-MNIST; 3) Reinforcement learning, including CartPole, Pendulum, BipedalWalker, and MetaWorld robotic tasks. Across these tasks, TDCA exhibited several key advantages: 1) Much faster convergence and greater ability to escape local minima; 2) Stronger robustness to initialization and hyperparameter choices; 3) Improved generalization and transferability to new tasks; 4) Overall better performance than backpropagation-based training and multiple biologically plausible learning baselines.

Notably, in reinforcement learning and robotic control, a single TDCA top-down module can guide learning across multiple distinct tasks — resembling the brain's ability to apply general learning strategies across contexts. The TDCA-network framework represents an important step toward bridging deep learning and biological learning mechanisms. Its broader implications include: 1) providing a new training paradigm for next-generation neuromorphic and brain-inspired AI systems; 2) offering a low-power, hardware-friendly learning mechanism suitable for intelligent chips; 3) supplying a computational model for understanding real neural credit assignment; 4) enabling more efficient learning strategies for robots and reinforcement learning systems.

In the long run, TDCA opens a promising pathway toward artificial systems that learn more like the brain — without explicit losses, without backpropagation, and with more flexible, generalizable strategies.

Dr. Chen Jianhui is the first author of this paper. Professor Wang Zuoren and Professor Liu Chenglin are the corresponding authors, and Professor Yang Tianming has made significant contributions to the paper.

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Source: Center for Excellence in Brain Science and Intelligence Technology, Institute of Neuroscience, Chinese Academy of Sciences

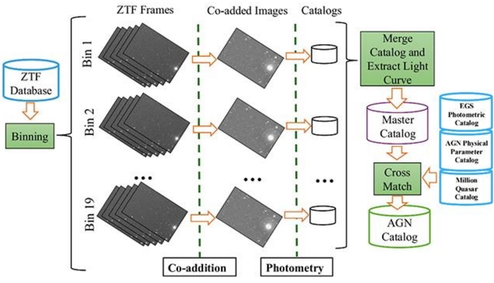


Figure 1. Data processing workflow. [IMAGE: SHAO]

Significant progress in optimizing active galactic nucleus light curves achieved

A joint research team from the Early Universe and High-Redshift Galaxy Group at the Shanghai Astronomical Observatory (SHAO) of the Chinese Academy of Sciences (CAS), and the Optical-Infrared Observational Research Group at Sun Yat-sen University (SYSU), has recently made significant progress in improving the quality of long-term light curves for Active Galactic Nuclei (AGNs). By stacking multi-epoch images from the Zwicky Transient Facility (ZTF), the team has effectively enhanced the signal-to-noise ratio (SNR) of the observational data, enabling high-quality reconstruction of AGN light curves that were previously inaccessible due to their intrinsic faintness. This advancement reveals long-term variability and color-evolution characteristics with unprecedented clarity, providing critical observational constraints for probing the physical mechanisms and accretion dynamics of AGN central engines.

The research is jointly led by Zheng Zhenya's team at SHAO and Ma Bin's team at SYSU. The results have been published in the *Astrophysical Journal Supplement Series* with the title "Optimizing Long-term Variability of Active Galactic Nucleus Light Curves. I. A Case Study with ZTF Observations in the EGS Field".

Variability is a typical observational characteristic of AGNs. Analyzing their light curves is a key diagnostic tool for investigating the accretion physics of the central supermassive black holes. However, for low-luminosity AGNs and high-redshift AGNs, the limited depth of single-epoch observations leads to issues such as large photometric errors, sparse sampling, or even undetectable variability in their light curves, limiting the variability study of these objects.

To overcome these observational challenges, the research team proposed an innovative forward-modeling data-processing strategy. Rather than post-processing existing light curves, the approach begins with the raw imaging data: single-epoch exposures are binned and stacked following the temporal sequence of observations (Figure 1). This procedure effectively integrates multiple short exposures, improving the detection limit by approximately 2.0–2.5 magnitudes. While sacrificing short-timescale variability, the method robustly preserves long-term variability on month-to-year scales, making it particularly suitable for AGN variability study.

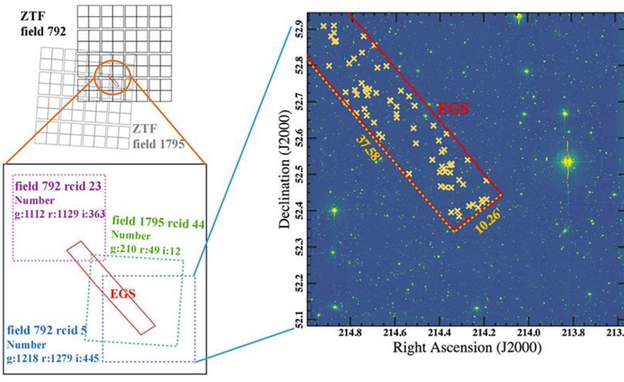


Figure 2. Schematic diagram of the overlapping region between ZTF and the EGS field. Left panel: Coverage of the EGS field by three ZTF CCD-quadrants and statistics of observation counts per band (2018-2024). Right panel: Overlap region between the selected CCD-quadrant (blue area) and the EGS field (red outlined area, approx. 10.2' × 37.5'). Yellow "×" marks represent the 73 AGN sample extracted in this study. [IMAGE: SHAO]

Applying this method to the ZTF observations in the Extended Groth Strip (EGS) field (Figure 2), the team successfully constructed high-quality light curves for 73 AGNs. Compared with traditional ZTF data products, the improvements of the new method are mainly reflected in: (1) For AGNs with strong variability, the method substantially enhances photometric precision while retaining the original long-term trends; (2) for AGNs with faint signals, the technique suppresses noise contamination and clearly reveals variability features that were previously indistinguishable; (3) for objects with brightness near or below the single-exposure detection threshold, the method recovers meaningful variability signals, extending the accessible AGN sample to fainter regimes (Figure 3).

Based on these improved light curves, the team further analyzed color evolution and found that 56 of the 73 AGNs (77 percent) exhibit a significant "bluer-when-brighter" trend, consistent with thermal fluctuations in the inner accretion disk as the dominant mechanism of long-term optical variability.

Corresponding author Zheng Zhenya noted: "In optical variability studies of supermassive black holes and binary black hole systems, light-curve quality is often the main bottleneck in extracting reliable physical parameters. By co-adding multiple short-exposure images, we significantly improve detection depth and SNR, enabling systematic acquisition of high-quality light curves for low-luminosity AGNs that were previously beyond reach. This provides a solid data foundation for studying accretion processes and long-term evolutionary behaviors of AGN central engines."

Corresponding author Ma Bin added: "Our next step is to develop automated data reduction pipelines to extend this method across other ZTF fields and to systematically build a high-precision optical light-curve dataset for low-luminosity AGNs. This will offer essential observational support for understanding black hole growth and evolution in the early universe. The technical framework is also highly scalable and will serve as a methodological reference for processing deep-field observations from the Multi-Channel Imager (MCI) onboard the China Space Station Telescope (CSST), thereby enhancing the scientific returns of CSST-MCI in time-domain astronomy."

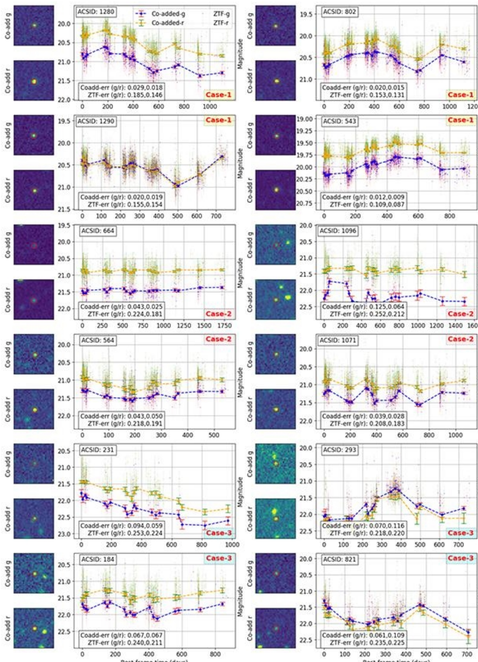
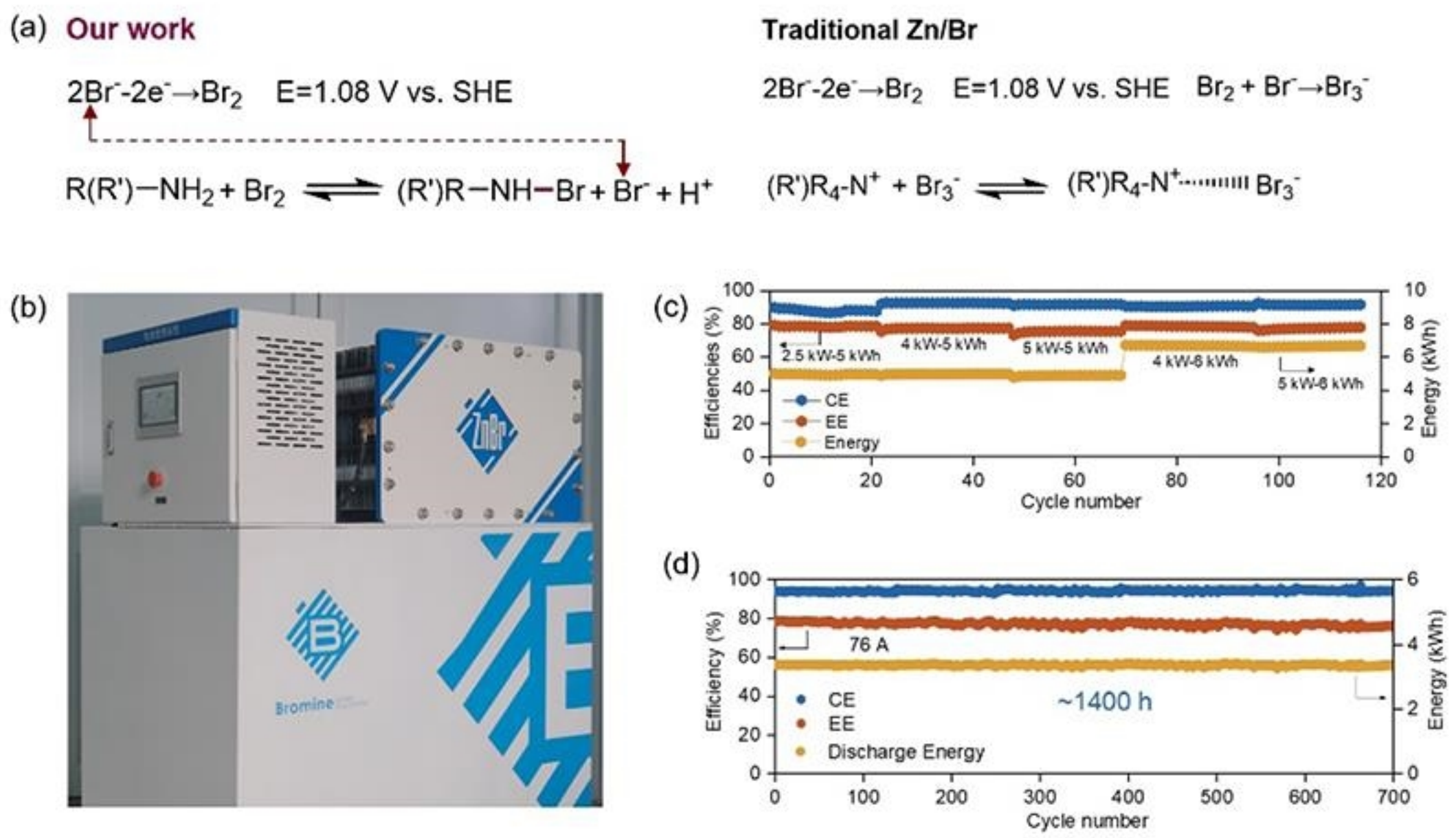


Figure 3. Comparison of light curves from the stacking method and traditional ZTF data, highlighting the performance advantages of the new method in three typical scenarios. [IMAGE: SHAO]

The first author of the paper is Lin Jiaqi, a PhD candidate jointly supported by SYSU and SHAO. The corresponding authors are Zheng Zhenya and Ma Bin. This work is supported by the National Key R&D Program of China, the China-Chile Joint Research Fund, the China Manned Space Program, and other projects.

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Source: Shanghai Astronomical Observatory, Chinese Academy of Sciences



The principle and battery verification of the novel bromine-based two-electron transfer reaction system [IMAGE: XIE CONGXIN AND XU YUE]

Researchers develop new system for high-energy-density, long-life, multi-electron transfer bromine-based flow batteries

Bromine-based flow batteries operate through the redox reaction between bromide ions and elemental bromine, offering advantages such as abundant resources, high redox potential, and good solubility. However, the substantial bromine generated during the charging process can corrode battery components, shorten cycle life, and increase system costs. Although traditional bromine complexing agents can alleviate corrosion to some extent, they often induce phase separation, compromising electrolyte homogeneity and adding complexity to the system.

In a recent study published in *Nature Energy*, a research team led by Professor Li Xianfeng from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) developed a novel bromine-based two-electron transfer reaction system and applied it to a zinc-bromine flow battery. This study demonstrates both the proof of concept and the system-scale up of a long-life zinc-bromine flow battery.

Researchers proposed an innovative bromine two-electron transfer reaction by introducing amine compounds as bromine scavengers into the electrolyte. They discovered that the bromine (Br_2) generated during the electrochemical reaction could be converted into brominated amine compounds, reducing the concentration of Br_2 in the solution to an ultra-low level of approximately 7 mM. Unlike the traditional single-electron transfer reaction from bromide ions to Br_2, this new reaction enables a two-electron transfer from bromide ions to brominated amine compounds, increasing the battery's energy density. Simultaneously, the ultra-low Br_2 concentration substantially reduces electrolyte corrosivity, extending battery life.

Furthermore, researchers applied this novel reaction to zinc-bromine flow batteries. Due to the extremely low Br_2 concentration in the electrolyte, the long-term stable operation was achieved by assembling a single battery using a conventional non-fluorinated ion exchange membrane (SPEEK), thereby reducing battery costs. In a 5 kW system scale-up test, the battery operated stably for over 700 cycles under a current density of 40 mA cm^{-2}, achieving an energy efficiency above 78 percent. With the drastically reduced Br_2 concentration, no corrosion was observed in key materials — including current collectors, electrodes, and membranes — either before or after cycling.

"Our study provides a novel approach to the design of long-life bromine-based flow batteries and lays the foundation for the further application and promotion of zinc-bromine flow batteries," said Professor Li.

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Dalian Institute of Chemical Physics,
Chinese Academy of Sciences

Source: Dalian Institute of Chemical Physics, Chinese Academy of Sciences



My postdoc experience of learning and discovering more

During my stay at the Northwest Institute of Eco-Environment and Resources (NIEER) of the Chinese Academy of Sciences (CAS), I learned a lot from the renowned resident scientists about several phenomena of environmental science, and particularly about climate change and global warming. The group I worked with was very diverse, energetic, and friendly so I was able to polish my skills and enhance my learning process. My regular interaction with them during weekly meetings and laboratory work provided me the opportunity to stay informed about the research in different domains (phenomena taking place in the cryospheric environment, water balance, atmosphere science, air and water pollution such as micro-plastic and mercury). The research atmosphere at NIEER is very good and the diverse research domains make it more attractive for high-quality research. The laboratories are of high level, well-equipped, and provide every facility on time to the researchers. The teachers and technical staff are very cooperative and I learned a great deal from their expertise. The regular interaction of professors with their group members is a very encouraging factor that not only enhances the learning of group members but also helps in the production of high-quality research findings. By working in such a research-friendly environment I gained a lot.



My stay in NIEER provided me a very fertile platform where I published many papers about different topics in well-reputed journals and several more are in process. Besides, during my stay in China, I came across a very remarkable use of science for development. It includes artificial snowfall in Gansu, rapid development in health, agriculture, and other technologies that seem like dreams elsewhere but happen in reality here. Moreover, I got the chance to visit many cities and learned more about the culture, food, and, more importantly, development on the local level. By participating in workshops and conferences, I learned about the geographical and geological importance of several cities and their development in science and technologies.

Our institute provides a high-standard living environment. The interaction with the institute administration was very friendly and they provided us with every basic facility in a satisfactory way. Being a foreigner, it is very easy to live in China; the locals are very friendly and the atmosphere is very attractive and provides so many opportunities. Overall, my experience was very positive and I found NIEER and China had become my second home.

Source: Wasim Sajjad,
Northwest Institute of Eco-Environment and Resources,
Chinese Academy of Sciences

China's "artificial sun" experiment finds way to break fusion plasma density limit

Researchers have identified a method to surpass the plasma density limit in experiments with the Experimental Advanced Superconducting Tokamak (EAST), known as the "artificial sun", providing a crucial physical basis for high-density operation in magnetic confinement fusion devices.

This research was conducted collaboratively by the Institute of Plasma Physics at the Hefei Institutes of Physical Science under the Chinese Academy of Sciences (CAS), Huazhong University of Science and Technology, and Aix-Marseille University in France, among other institutions. The findings were published in the journal *Science Advances* on Friday.

A tokamak is a toroidal device that employs magnetic confinement to achieve controlled nuclear fusion. It resembles a helical "magnetic racetrack", effectively confining high-temperature plasma to promote fusion reactions. Plasma density, a crucial parameter affecting tokamak performance, directly impacts the rate of fusion reactions.

Historically, researchers have acknowledged that plasma density has an upper limit. When this limit is reached, the plasma becomes unstable, escapes magnetic confinement, and releases substantial energy onto the device's inner walls, thereby jeopardizing operational safety.

While long-term international fusion research has indicated that the physical processes triggering the density limit occur at the plasma-wall boundary region, the underlying mechanisms have remained unclear.

In this study, the Chinese research team developed a self-organized plasma-wall interaction theoretical model. Through this model, they identified the critical role of radiation instability induced by boundary impurities in triggering the density limit, thereby elucidating the underlying mechanism.

Building on this theoretical insight, researchers experimentally controlled the plasma to exceed the density limit and successfully guided it into a new "density-free zone".

These results mark the first experimental confirmation of such a zone in tokamaks. This innovative work not only provides key insights into understanding the density limit but also establishes an important physical basis for high-density operation in tokamaks, according to the scientists.

Source: Xinhua

