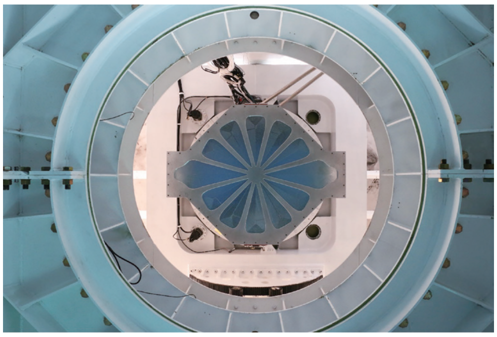
## INFOCUS | Listening to Echoes of Big Bang



(Image Credit: AliCPT Collaboration)

According to Inflation theory, a violent expansion in the wake of the Big Bang that stretched the spacetime from an extremely condense point to a cosmological scale, could have established the initial conditions that determined the subsequent evolution of our universe, sowing the seeds for the universe's large-scale structure, like galaxy clusters. This very inflation could have also triggered the first ripples in our cosmos, the primordial gravitational waves (PGWs). Therefore, listening to such echoes of the Big Bang, we might better understand the early cosmos and its subsequent evolution.

Also a fossil relic from the universe's infancy, the cosmic microwave background (CMB) has undergone the influence from the PGWs, and carries invaluable information about the infant universe. Searching for their signals hence could greatly help us unravel a serial of mysteries, including dark matter distribution, nature of dark energy, and shape of the universe.

Designed to detect primordial gravitational waves by measuring the B-mode polarization of CMB radiation, the Ali CMB Polarization Telescope (AliCPT) is coming into operation.

Detecting such extremely faint signals is a monumental challenge — This quest is often likened to searching for a needle in a cosmic haystack, or discerning a single, subtle ripple across a vast ocean from an immense distance. Turn to page 213 to known how a seemingly impossible mission is unfolding.



## HIGHLIGHT |Einstein Demonstrated Wrong Again — in an Interference Experiment Loyally Replicating His Idea of a Movable Slit

Chinese physicists are sealing the UN International Year of Quantum Science and Technology (IYQ) with an experiment to help close the classic debate between Albert Einstein and Niels Bohr on quantum uncertainty.

To rebut Bohr, Einstein designed a Gedankenexperiment (thought experiment in German), adding to the classic Young's double-slit interference experiment a movable slit as an observer. He argued that while the passing photon could give the movable slit a momentum, the latter would respond with a recoil. This recoil, if measured precisely enough, would also predict the photon's future path as well as position on the wall. This meant, both the momentum and the position of the photon  a quantum particle  could be measured simultaneously, violating Bohr's interpretation of quantum uncertainty.

This movable slit, however, is so challenging to realize that it remained a conceptual idea for a long time. Now Profs. CHEN Mingcheng, LU Chaoyang, PAN Jianwei from the University of Science and Technology of China (USTC) and their colleagues directly replicate this idea in a real-life experiment – demonstrating that Einstein was wrong. (DOI: 10.1103/93zb-lws3)

Find more detail in page 217 of this issue.

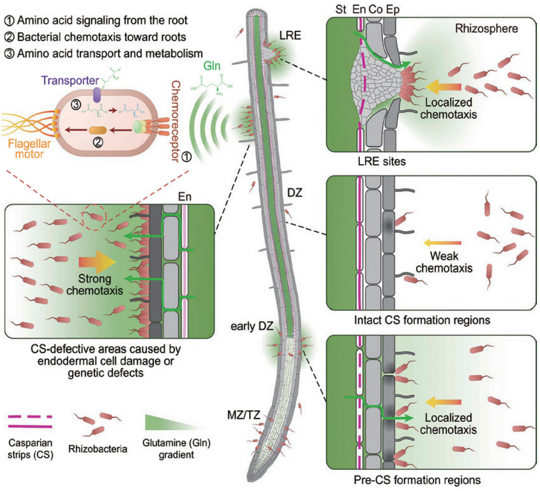
## HIGHLIGHT | A Serendipitous Rediscovery May End Chemistry's Most Dangerous Routine

Sometimes breakthroughs arise not from solving a problem but from seeing value in failure. When Dr. ZHANG Xiaheng's team at the Hangzhou Institute for Advanced Study, University of Chinese Academy of Sciences, tried to weaken aromatic C–N bonds using conventional methods, every path failed—until nitric acid treatment unexpectedly produced *N*-nitroamines, crystalline compounds known since 1893 but long dismissed as curiosities.

Published in *Nature* (October 27, 2025), ZHANG's method unveils a deaminative functionalization that bypasses the 140 years of explosive diazonium intermediates of the classic Sandmeyer reaction (1884). The reaction allows direct formation of diverse C–X (C–Br, C–Cl, C–I, C–F, C–N, C–S, C–Se, C–O) and even C–C bonds under mild, scalable conditions (up to kilogram scale, 90% yield).

Beyond safety, the method works across electronic variations where traditional routes largely fail, integrates seamlessly with metal-catalyzed couplings, and turns aromatic amines into programmable handles for late-stage diversification. For an industry long dependent on a hazardous routine, this is not just elegant science—it's a blueprint for safer, more efficient pharmaceutical manufacturing. For further insights, please refer to page 220.

## **HIGHLIGHT** | Root's Border Control: How Plants Use Glutamine Leaks to Shape their Microbial World




**(Graphic: Tsai et al., 2025)**

A team of researchers from the Chinese Academy of Sciences and collaborating European institutions has uncovered a precise mechanism by which plants manage their underground allies. Published in *Science* on October 2, 2025, the study reveals that plant roots leak the amino acid glutamine through microscopic, transient breaches in their internal barrier—the endodermis—to attract and nourish specific soil bacteria. These "nutrient beacons" guide microbial colonization at defined root zones, such as sites of lateral root emergence, effectively allowing plants to map and seed their own microbiome.

This discovery illuminates a previously hidden layer of root-microbe communication, offering new avenues for microbiome-informed crop breeding and sustainable soil management. For further insights, please refer to page 227. 

## **IN DEPTH** | From Editors to Architects: The Dawn of AI-Designed Agriculture

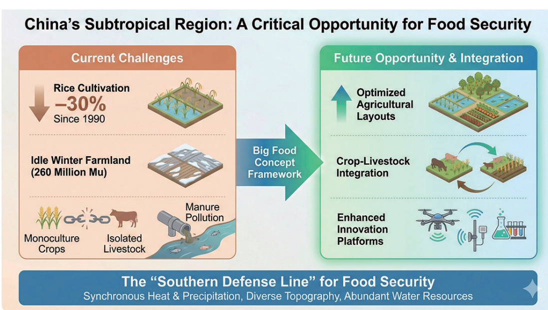
For decades, crop breeding was about "hunting" for the right traits in nature. Even with CRISPR, we were often limited to fixing genetic typos. But in vision is a paradigm shift: We are not just editing plant genomes; we are architecting them.

A new wave of breakthroughs, achieved by Dr. GAO Caixia's team and her collaborators, demonstrates how the convergence of Artificial Intelligence (to predict what to edit), Biotechnology (to perform the edit), and High-Throughput Phenotyping (to verify the result) is one step closer to shattering the old ceilings.

The future granary might not be just about higher yields; it could be more about "designing" food systems that are climate-resilient and nutritionally complete. For further insights, please refer to page 231.

## **PERSPECTIVE** | China's Subtropics: Taking up Challenges for Food Security

China's subtropical region is a powerhouse of agricultural abundance, contributing 40% of the nation's grain and over 54% of its meat production. Yet, this vital "southern defense line" faces mounting pressures from resource inefficiency, disconnected crop-livestock systems, and underutilized mountainous terrain. In a compelling perspective, researchers led by Dr. CHEN Hongsong from the Institute of Subtropical Agriculture, Chinese Academy of Sciences, propose to embrace the "Big Food Concept"—a framework that integrates efficient resource



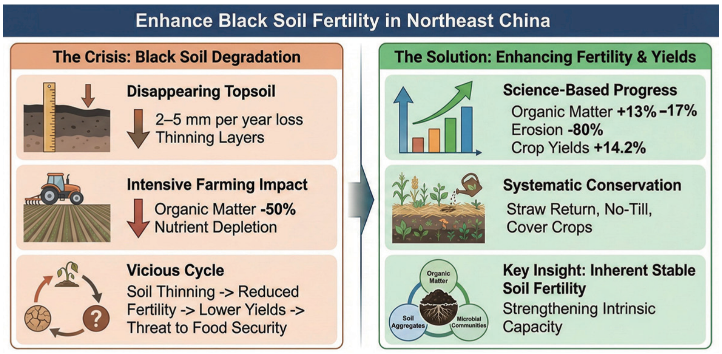

**(Illustration generated with AI)**

utilization with ecological conservation through optimized agricultural layouts, crop-livestock integration, and enhanced innovation platforms.

As climate pressures mount in northern grain-producing areas, the subtropical region's unique advantages—synchronous heat and precipitation, diverse topography, and abundant water resources—make it a vital "southern defense line" for food security.

For further insights, please refer to page 238.

## **ARTICLE** | Awakening the Black Soil: A Strategy for Renewal




(Illustration generated with AI)

Did you know that one of the world's four major black soil regions is disappearing at 2–5 mm per year?

Northeast China's 36 million hectares of black soil produce one-quarter of the nation's grain output, but decades of intensive farming have created a crisis: topsoil thinning, organic matter declining by 50% in some areas, and a vicious cycle of degradation threatening food security.

How do we reverse this trend without compromising yields? Spearheaded by CAS Member ZHANG Jiabao from the Institute of Soil Science, Chinese Academy of Sciences (CAS), and researchers from the Northeast Institute of Geography and Agroecology, CAS, the joint team unveils a breakthrough theory of "enhancing inherent stable soil fertility". By deploying locally adapted conservation models like the "Lishu Model 2.0" and "Longjiang Model," the team achieved stunning results: boosting soil organic matter by 13%–17% and slashing erosion by over 80%. This study offers a robust scientific blueprint for protecting the nation's "Black Soil Granary".

For further insights, please refer to page 246.