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INTERNATIONAL DAY FOR BIOLOGICAL DIVERSITY

ECOLOGICAL CIVILIZATION: BUILDING A SHARED FUTURE FOR ALL LIFE ON EARTH

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Learn more

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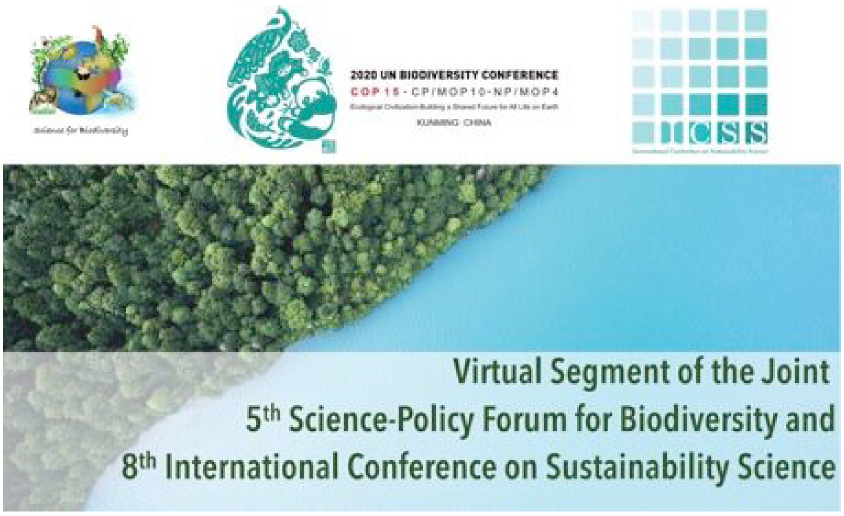
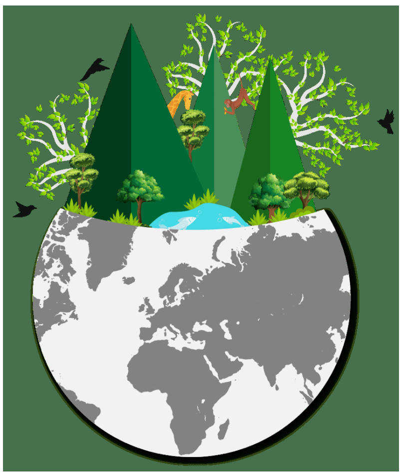
Let science lead the way

The Fifth Science-Policy Forum for Biodiversity with five sessions was held online from April 13 to 23 as the first parallel session of the fifteenth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP 15).

The joint fifth Science-Policy Forum for Biodiversity and the eighth International Conference on Sustainability Science (ICSS 8) aimed to provide a space where scientists, policy makers and other relevant stakeholders could discuss and make recommendations on how science, technology and innovation could contribute to the effective implementation of the post-2020 global biodiversity framework in order to bend the curve of biodiversity loss, obtain positive biodiversity outcomes and foster transformative change towards achieving the 2050 Vision.

In particular, participants discussed options and solutions for facilitating the implementation of the post-2020 global biodiversity framework, including potential nature-based solutions for tackling both biodiversity loss and climate change challenges based on solid scientific knowledge and evidence. They also identified key knowledge gaps and priorities for science-policy research, needs for capacity building and opportunities for increased technical and scientific cooperation.

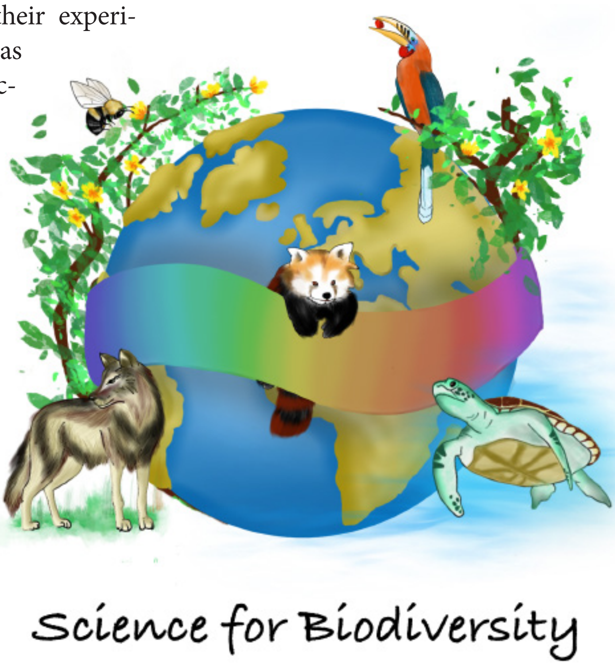


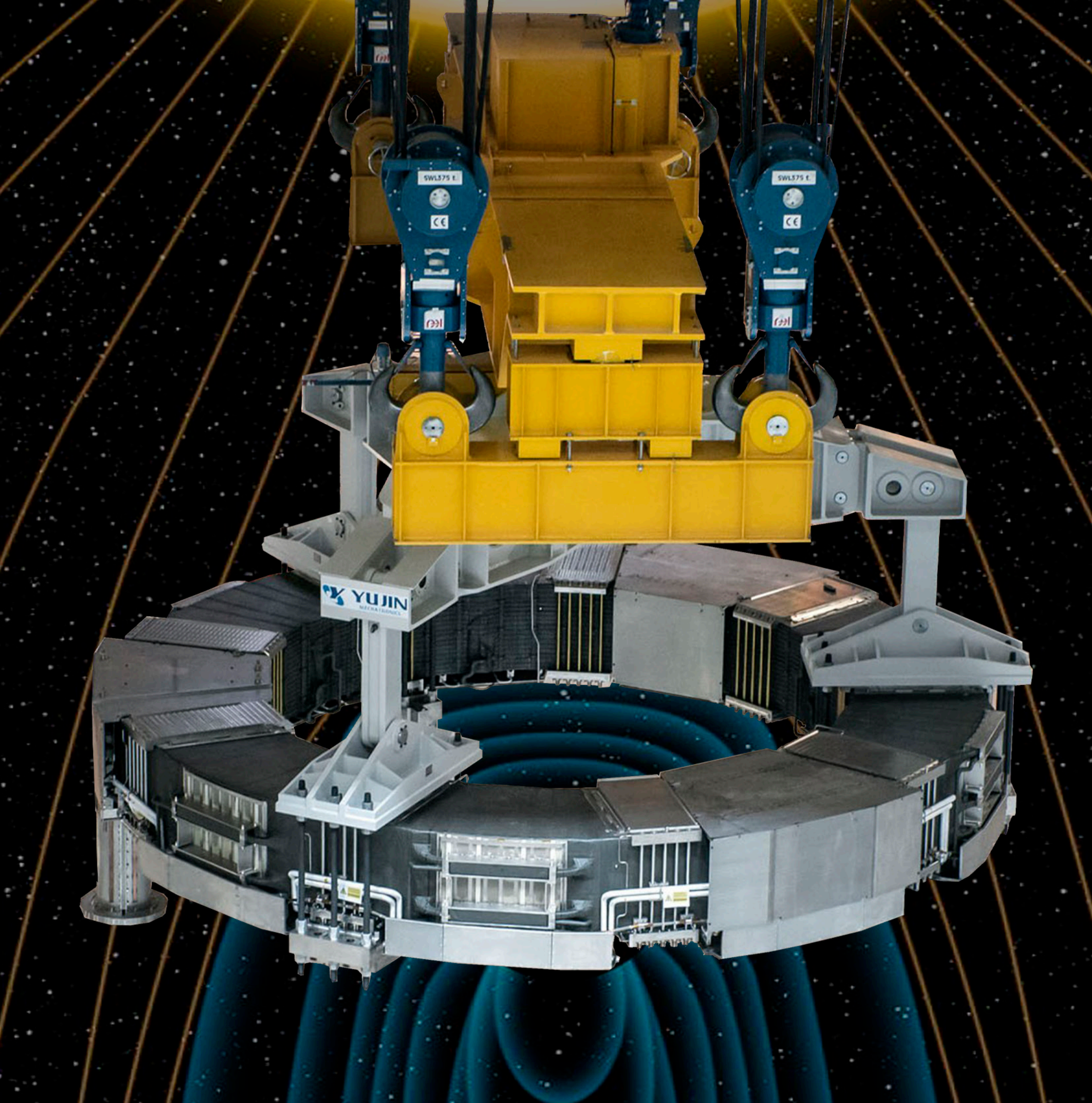


Participants shared their experiences, knowledge, ideas and diverse perspectives on the various subjects. They also showcased innovative solutions and tools that could facilitate the implementation of the post-2020 global biodiversity framework.

The Chinese Academy of Sciences (CAS) was one of the major contributors to the forum. The United Nations Environment Programme-International Ecosystem Management Partnership (UNEP-IEMP), a collaborating center of CAS and UNEP, jointly organized the forum with other partners and led Session 3 on April 19.

Source: Science4biodiversity.org





CHINESE RESEARCHERS CONTRIBUTE DEEPLY TO ITER

Mega-coil completes insertion in the tokamak pit of ITER

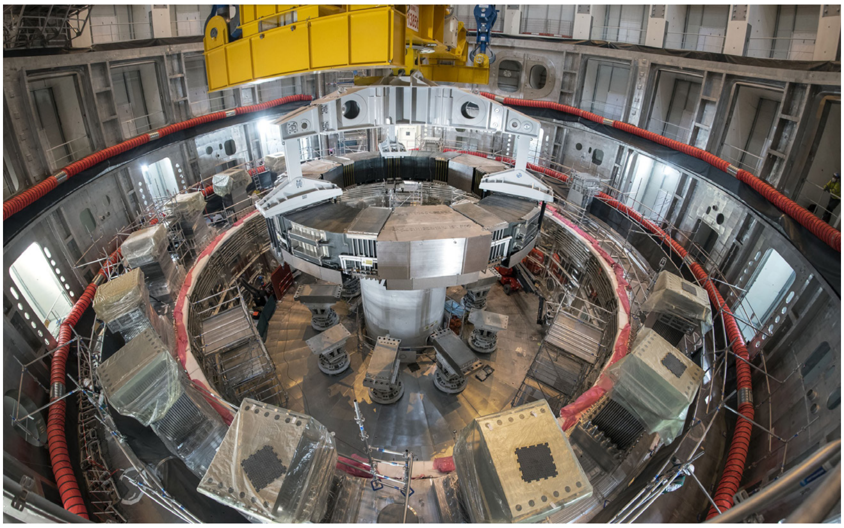
The sixth poloidal field superconducting coil (or PF6 coil), the heaviest of all six superconducting magnet coils of the International Thermonuclear Fusion Experimental Reactor (ITER) project, was successfully installed at the bottom of the tokamak pit at the ITER site in France on April 21 local time. The installation was supervised by Fusion for Energy, marking another international collaboration moment.

This magnet is also known as the “divertor coil.” Its main function is to create the null field point that allows the removal of helium ash from plasma.

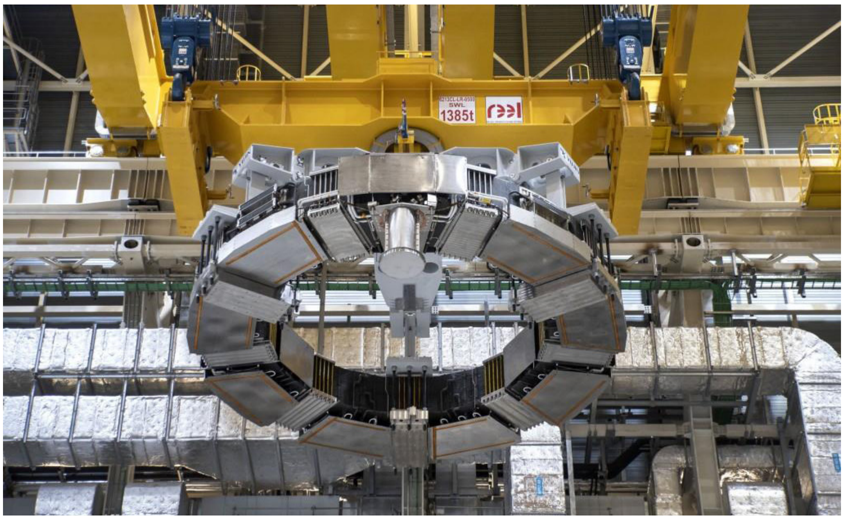
The magnet consists of nine twin-shaped winding pancakes and a series of supporting accessories, each measuring 11.2 meters in diameters and weighing roughly 400 metric tons (heavier than two Boeing 747 airplanes). The profile accuracy of the PF6 coil is strictly controlled within ±1.5mm after winding.

A team of experienced engineers from the Institute of Plasma Physics, Hefei Institutes of Physical Science (ASIPP, HFIPS) worked on-site to help position this equipment in the correct place. As one of the contractors of ITER, ASIPP has sent many groups of experts overseas in the past few years, contributing their knowledge and effort to the ambitious international scientific project.

According to Alessandro Bonito-Oliva, the Magnets Programme Manager at the European Domestic Agency’s Fusion for Energy, the project is a “collective achievement of Europe and China, working together with the ITER Organization to manufacture a first-of-a-kind component that presented a number of technical and organizational challenges.”



The sixth poloidal field superconducting coil successfully sits at the bottom of the tokamak pit. [IMAGE: ITER ORGANIZATION]



The PF6 is the heaviest of all six superconducting magnet coils of ITER. [IMAGE: ITER ORGANIZATION]

The PF6 coil was manufactured in China by ASIPP. In March 2020, the coil was transported to Cadarache, France where ITER is located. The coil arrived in June after a sea journey of more than three months.

Source: Hefei Institutes of Physical Science, Chinese Academy of Sciences

Major progress achieved in improving the oxidation resistance of Ni-28W-6Cr for molten salt reactors

Recently, the alloy research team of the Shanghai Institute of Applied Physics (SINAP) of the Chinese Academy of Sciences (CAS) made important progress in researching high-temperature oxidation resistance of Ni-28W-6Cr alloy, and proposed an approach to improve it by doping to hinder the oxygen vacancy-mediated oxidation. The research result entitled "An approach to improve the oxidation resistance of a Ni-28W-6Cr alloy by hindering the oxygen vacancy-mediated oxidation" was published in *Corrosion Science*. The first author is PhD student Liu Shulin; Professor Ye Xiangxi, Professor Zhou Xingtai, and Dr. Ming Chen (from the Shanghai Institute of Ceramics, CAS) are the co-corresponding authors.

The reliability of structural materials in aggressive environments is a paramount safety and economic concern for developing new-generation energy systems. For molten salt reactors, the structural alloys are exposed to both high-temperature air and molten salts. Because oxide-forming elements (Cr, Al, Si, etc.) are easily attacked by molten salts, and refractory elements (Ni, W, Mo) are immune to molten salts, Ni-base superalloys developed for molten salts powered energy system are rich in Mo, W and have low content of Cr to keep proper oxidation resistance. In the pursuit of energy efficiency, the temperature of these energy systems continues to increase. The proportion of solid solute strengthening refractory metals, such as W and Mo, in the superalloys constantly rises to improve their mechanical performance at elevated temperatures, which is harmful to their high-temperature oxidation resistance. For example, Ni-28W-6Cr alloys, developed by SINAP, have been considered one of the potential advanced structural materials for molten fluoride salt techniques due to their excellent high-temperature mechanical performance and resistance to corrosion by molten salts. However, the previous work showed that the oxidation resistance of Ni-xW-6Cr alloy deteriorates dramatically when the content of W reaches above 25 wt.%, because the excessive W can prevent the formation of compact $NiCr_2O_4$ oxide scales. The loose inner oxide scale of $NiWO_4$ with a large number of oxygen vacancies provides paths for the inward diffusion of oxygen (*Corros. Sci.*, 149 (2019) 87-99).

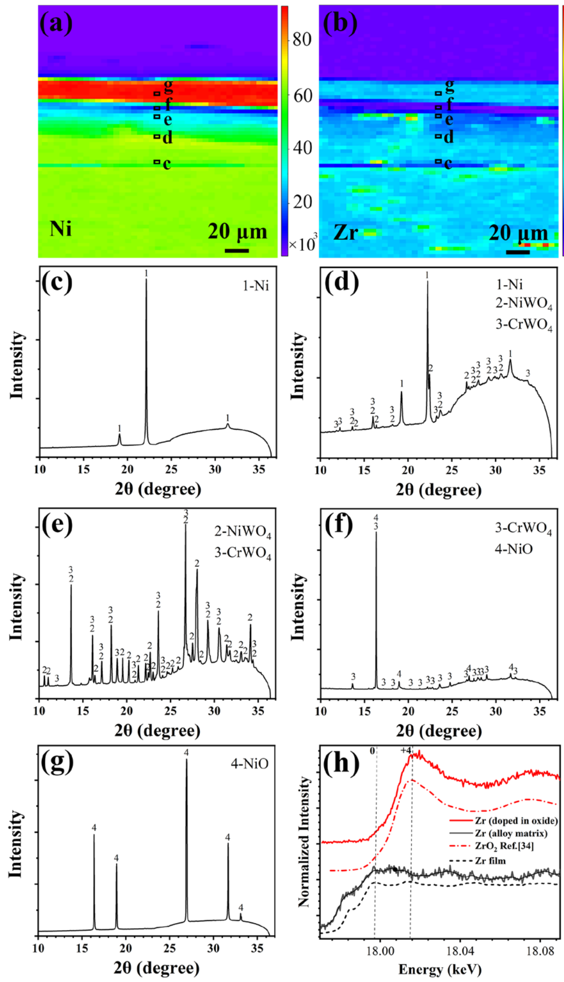


Fig. 1 μ-XRF mapping of Ni (a) and Zr (b) in the Ni-28W-6Cr-0.2Zr alloy cross section; (c) - (g) are the μ-XRD patterns; (h) μ-XANES spectra (×1000) of Zr in the oxide scale and alloy matrix of Ni-28W-6Cr-0.2Zr. [IMAGES: SHANGHAI INSTITUTE OF APPLIED PHYSICS, CHINESE ACADEMY OF SCIENCES]

Hindering the formation of oxygen vacancies in the inner oxide scales may be an effective approach to improving the high-temperature oxidation resistance of Ni-28W-6Cr alloys.

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$NiWO_4$ is a common oxide scale in the W-bearing Ni-based superalloys. The valence states of Ni, W and O in $NiWO_4$ are +2, +6 and -2 respectively, and the oxygen vacancies are +2-charged. If a +2-charged nickel atom in $NiWO_4$ is replaced by a dopant with a higher valence, such as +4 dopant, the dopant will carry an extra +2 charge compared to Ni, and is expected to inhibit the formation of +2-charged oxygen vacancies or repel them, thus hindering their diffusion. Following the above idea, i.e., doping a high valence metal element into the oxides to hinder the formation of oxygen vacancies, the alloy research team recently added Zr into the Ni-28W-6Cr alloy to improve its oxidation resistance. The results showed that the oxidation resistance of the Ni-28W-6Cr alloy was significantly enhanced with the Zr addition. The thickness of the inner oxide scales in the Ni-28W-6Cr (the main component is $NiWO_4$) significantly decreases accordingly. The oxide scales were analyzed by using a combination of synchrotron radiation-based micro X-ray fluorescence (μ-XRF), micro XRD (μ-XRD), and micro X-ray absorption near edge structure (μ-XANES) (Fig. 1). No Zr oxide (ZrO_2) was detected in all the oxide scales of Zr-bearing Ni-28W-6Cr alloy, and Zr charged +4 prefers to segregate in the inner $NiWO_4$. DFT calculations showed that Zr tends to replace Ni in the $NiWO_4$, rather than W, or locate at the interstitial site (Fig. 2b). Then, the defect formation energy of Zr_{Ni} (Zr in Ni sites) and oxygen vacancy V_O with a variation of Fermi energy was calculated. In the *p*-type or neutral region, both Zr_{Ni} and V_O tend to be ionized and Zr_{Ni} owns lower formation energy than V_O. As Zr_{Ni} donates electrons to the system, the Fermi energy tends to shift to the *n*-type region, which increases the formation energy of V_O (Fig. 2c-d). Therefore, the Zr dopants in the $NiWO_4$ could significantly reduce the concentration of oxygen vacancy, which leads to the reduction of oxygen transport channels and thus enhances the oxygen resistance of the alloys.

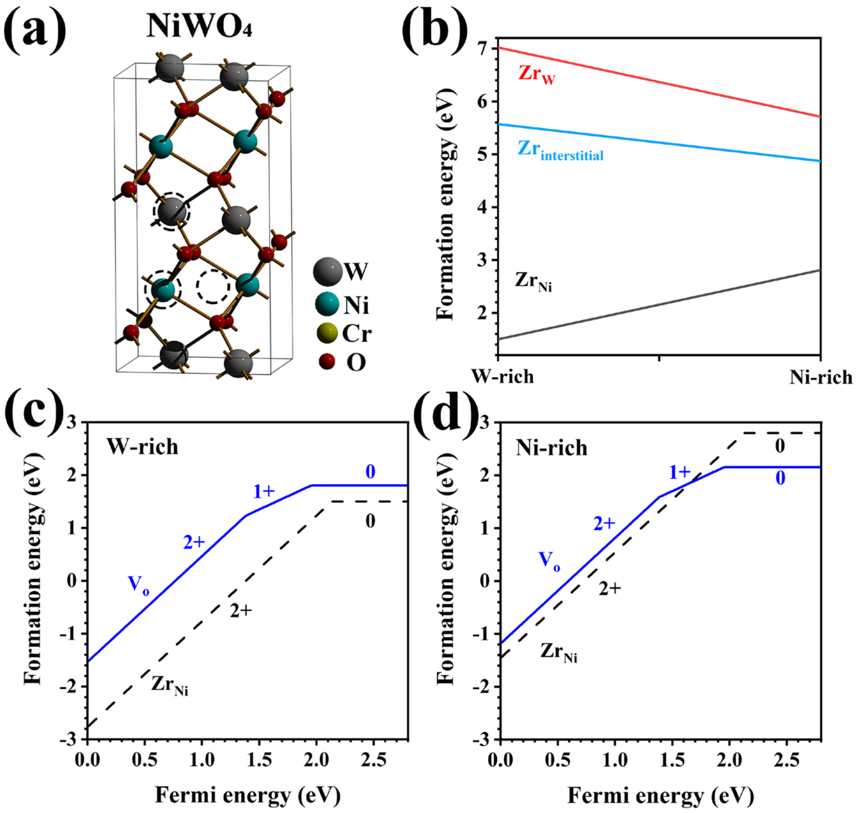

Fig. 2 (a) Crystal Structure of $NiWO_4$; (b) The defect formation energy of Zr_{Ni} (Ni site), Zr_W (W site) and $Zr_{interstitial}$ (interstitial site) as a function of chemical potential. Images (c) and (d) denote the defect formation energy of Zr_{Ni} and V_O (oxygen vacancy) as a function of Fermi energy under W- and Ni-rich conditions, respectively. [IMAGES: SHANGHAI INSTITUTE OF APPLIED PHYSICS, CHINESE ACADEMY OF SCIENCES]

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Source: Shanghai Institute of Applied Physics (SINAP), Chinese Academy of Sciences

Understanding the architecture of plant immune system

Plants have evolved a two-layered immune system to protect themselves against diverse pathogens, including bacteria, fungi and oomycetes. The first layer of the immune system is the immunity triggered upon recognition of pathogen-associated molecular patterns (PAMPs) via cell surface-localized pattern recognition receptors (PRRs), and is called pattern-triggered immunity (PTI). The second layer of plant immunity is triggered by activation of intracellular immune receptors, nucleotide-binding and leucine-rich repeat proteins (NLR), through direct or indirect recognition of pathogen effectors, and is known as effector-triggered immunity (ETI). A large number of previous studies show that PTI and ETI have significant differences in signaling initiation and early transduction events, and consequently have traditionally been considered to act independently. However, the relationship between the two pathways was not clear, a knowledge gap in a full understanding of plant immunity.

On March 11, 2021, the prestigious international journal *Nature* published a research article from Dr. Xin Xiufang's group at the CAS Center for Excellence in Molecular Plant Sciences (CEMPS), entitled "Pattern-recognition receptors are required for NLR-mediated plant immunity". In this work, the authors described the functional association between the two primary immune pathways, PTI and ETI, in plants.

The study shows that PRR mutants, which lack PTI signaling, are surprisingly also compromised in ETI responses. They found that PTI pathway activation is crucial for ETI-associated reactive oxygen species (ROS) production. ETI-triggered ROS production is mainly mediated by RBOHD, a NADPH oxidase. Interestingly, the authors found that ETI can significantly upregulate the mRNA and protein level of RBOHD in a PTI independent manner, but the full activation of RBOHD during ETI depends on PTI signaling. Therefore, the PTI and ETI pathways work together to regulate RBOHD and produce ROS. Furthermore, the authors found that ETI strongly upregulates the transcript and protein levels of many key signaling components of PTI. The study demonstrates the exquisite synergistic mechanism between PTI and ETI pathways and that PTI is actually an indispensable component of ETI. It provides a new perspective for understanding the plant immune system. Meanwhile, it explains the long-observed puzzle of largely overlapping downstream outputs between PTI and ETI and suggests new strategies of improving plant resistance to numerous diseases by integrating the two pathways.

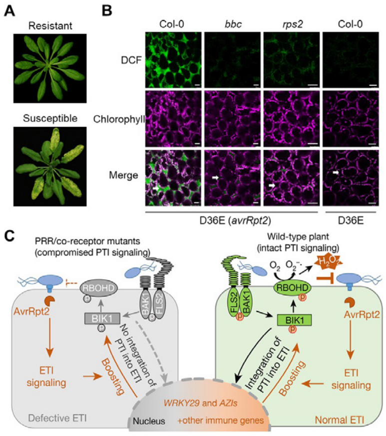

Fig. Main findings in the article. A, The phenotypes of resistant and susceptible plants after bacterial infection; B, The ROS production in plants treated by different bacteria Wild-type Col-0 plants treatment with D36E(*avrRpt2*) strain can activate both PTI and ETI. *bbc*, PTI mutants. Green fluorescence indicates ROS, and purple fluorescence represents autofluorescence of chloroplasts; C, A model depicting the findings from this study, showing PTI as a key component of ETI In wild-type plants (right), RPS2 activation leads to protein accumulation of key PTI components, including BIK1 and RBOHD, and potentiation of PTI-associated genes such as *WRKY29* and *AZIs*. PRR/co-receptors are required to fully activate ROBHD (by phosphorylation) to generate robust ROS and normal ETI. In the absence of PRR/co-receptors (left), although NLR activation still induces PTI components, many of these components, such as BIK1 and RBOHD, are inactive, leading to lack of ROS production and defective ETI. Mutated (that is, FLS2 and BAK1) or inactive (that is, RBOHD and BIK1) proteins are colored gray and active proteins are in green. [IMAGE: CAS CENTER FOR EXCELLENCE IN MOLECULAR PLANT SCIENCES/INSTITUTE OF PLANT PHYSIOLOGY AND ECOLOGY]

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Source: Chinese Academy of Sciences Center for Excellence in Molecular Plant Sciences (CEMPS)


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Scientists review global significance of biodiversity science in China

China is a mega-diverse country with great biodiversity and a high proportion of endemic species. For decades, rapid progress has been made in the studies of Chinese biodiversity science in quantity and quality.

Scientists from the Institute of Botany of the Chinese Academy of Sciences (IBCAS), together with a number of domestic and international collaborators, recently reviewed the important events and studies affecting the development of China's biodiversity research, and discussed the limitations and key areas for future biodiversity research in China from a global perspective.

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China to jointly build SKA radio telescope

China has approved joining a convention on establishing the Square Kilometer Array (SKA), with the decision passed at the 28th session of the Standing Committee of the 13th National People's Congress, the top legislature, on April 29.

The move will contribute to research into radio astronomy, basic physics and information science, as well as solving major scientific problems.

The SKA will be the world's largest radio telescope array, with a much higher sensitivity and survey speed than any other radio instrument so far developed.

It will not be a single telescope, but rather a network of thousands of radio antennas of varying types and sizes, located at several sites in Western Australia and Southern Africa.

The SKA will be jointly funded, built and run by more than 10 countries, with China being one of the seven founding members and a signatory to the SKA Observatory Convention which was signed in 2019.

The construction of the SKA is scheduled to begin in July. The first phase of the SKA, accounting for 10 percent of its full scale, will be put into use in 2028.

Scientists will use the super telescope to study the evolution of the universe, understand the nature of gravity, explore the origins of life and the origins of cosmic magnetic fields, and search for extraterrestrial civilization.

Source: Xinhua

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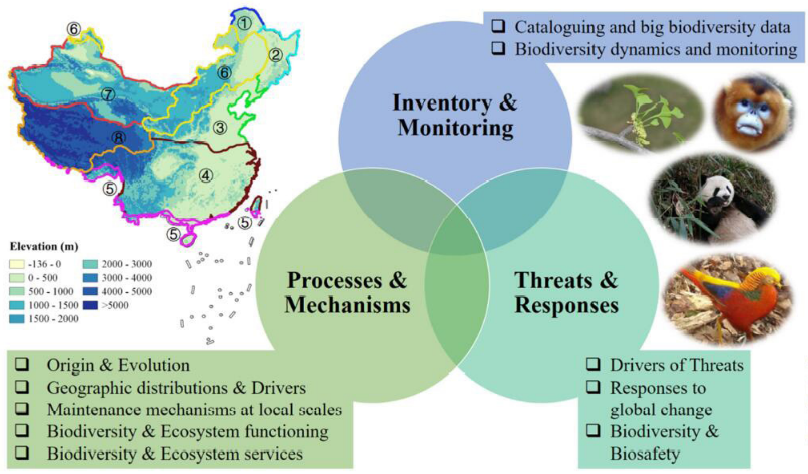

China's biodiversity science has made progress on ten topics in three areas.
[IMAGE: INSTITUTE OF BOTANY, CHINESE ACADEMY OF SCIENCES]

The following three aspects of research were identified for future work: biodiversity inventory and monitoring, origin and maintenance mechanisms of biodiversity and threats to biodiversity and responses to global change.

Priority topics for future biodiversity research in China, such as the ecology and biogeography of the Qinghai-Tibet Plateau and adjacent areas, the impact of human activities on subtropical forest biodiversity and marine biodiversity, and scientific support for biodiversity conservation and ecological civilization construction were also established.

Future strategies were also proposed. They include translating advanced biodiversity science into practice for biodiversity conservation, strengthening capacity building and application of advanced technology and expanding international collaborations.

In October 2021, the 15th meeting of the Conference of the Parties to the Convention on Biological Diversity will be held in China. "It is of great significance to summarize and review the research progress of China's biodiversity science at this time," said Professor Ma Keping from IBCAS.

Source: Institute of Botany, Chinese Academy of Sciences

Mushrooms, Yunnan and COP 15: protecting biodiversity

When I finished my PhD in Cape Town, South Africa, I decided to take one year off to travel and rock climb in Asia, not realizing how that decision would influence my future. Towards the end of my year of travels I came to Kunming, Southwest China's Yunnan Province, for the purpose of rock climbing, and during that trip I was introduced to Professor Xu Jianchu who subsequently offered me a job and suggested I begin my professional career with his team at the Kunming Institute of Botany (KIB), Chinese Academy of Sciences (CAS). I saw the opportunity for what it was and readily agreed, and settled in to life in Yunnan. It is now 11 years later and I feel like it is still just the beginning of things to come.

I soon learned that the decision to stay and work at KIB was a good one. The facilities, funding, and opportunities for research, under the umbrella of CAS, were, and still are, unequalled. I was able to build a research team and start running research programs far quicker than I could have hoped for had I stayed in South Africa. Based on this I soon had a good team of young scientists working with me on the topic of soil ecology and fungal biogeography, and I was able to establish myself within the field of mycology quite quickly.

When I first came to Yunnan, I had no idea about the biodiversity found within this province, and had no appreciation for how many different kinds of fungi and more specifically, mushrooms, can be found within this region. Initially my research was on broader topics related to sustainable agriculture and agroforestry systems, but I quickly shifted focus to work exclusively on fungi, with a special interest and passion for mushrooms.

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As most of you know, Yunnan is world famous for its edible mushrooms; nowhere else on the planet can you find so many different kinds of mushrooms in such a small geographical location. And this richness is also reflected in the diversity of other life forms found here, whether mammals, plants, and insects. Yunnan and the surrounding region is truly a natural scientist's dream location for research.

With funding from the National Natural Sciences Foundation of China (NSFC) and from CAS, I began researching the diversity and biogeography of fungi in Yunnan, but after a few years I wanted to see how the results I was getting in Yunnan compared to the surrounding regions.

And so I began to conduct similar research in Thailand, Myanmar, Laos, and India. Studying the different kinds of fungi found in different forest types and land-use systems of these countries was an amazing opportunity to really grasp how the distribution ranges of fungi shift across the region, and how diversity changes based on the local environment.

I also realized that to better understand the diversity and use of mushrooms at the regional level, it is important to engage local communities and learn about traditional knowledge systems, and how this knowledge differs across the region. By including research relating to traditional knowledge, we began to appreciate just how much the people of Yunnan know about mushrooms! And, in comparison, how little other communities in other parts of the region know.

Based on the knowledge gaps shown by some communities, and

with funding from CAS, my team and I began a training program in some remote villages in Myanmar, teaching local communities how to safely use wild harvested mushrooms, and how to sustainably grow certain species of mushrooms.

This work provided a range of benefits, one of which was additional income and food supply for rural households, and started to give value to the surrounding forests. Communities quickly learned that by conserving the forests, they could generate an income from the forest products, and that healthy forests were more productive than disturbed ones. Thus, in small part, we could contribute towards biodiversity conservation in these remote areas.

So far my team and I have discovered and described more than 1,000 new species of fungi. This is quite an amazing achievement (and I give full credit to my team), as even a single species requires many hours of lab work and manuscript preparation in order to be registered as new, but it also reflects how much is still waiting to be discovered in this region.

Added to that, if you think about it, each of those new species has potential for application. They could contain new chemicals for cancer treatment, or enzymes that can degrade plastics, or anti-pathogenic properties to fight off fungal or bacterial infections; the list goes on and on.

The potential application and benefits for so many new discoveries is enormous and may take decades to be fully documented. We are finding new species each day we study specimens in the lab, so it may be a never-ending task ahead of us!

I only work on one small topic within the field of biodiversity science, yet, within that small field I have come to realize just how diverse life in this region is. So when I step back and think about all the other scientists working in this region, and all the other life forms being studied, and the new species being discovered and, perhaps more importantly, awaiting discovery, I am convinced this is the place to be conducting biodiversity science.

I think Kunming is the perfect location for such an important meeting as COP 15. COP 15 is a critical meeting; it is a time for intergovernmental bodies to assess the past 10-year plan, noting the successes and shortcomings, and laying out the all-important strategy for the next 10 years, which may prove to be the most crucial 10 years for our planet. We are at a tipping point and it will take a concerted effort from individuals all the way through to governments if we are to bring about a positive, and necessary, change in biodiversity conservation.

Source: Kunming Institute of Botany, Chinese Academy of Sciences

USTC realizes coherent storage of light over 1 hour

Remote quantum distribution on the ground is limited because of the loss of photons in optical fibers. One solution for remote quantum communication lies in quantum memories: photons are stored in the long-lived quantum memory (quantum flash drive) and then quantum information is transmitted by transportation of the quantum memory flash drive. Given the speed of aircraft and high-speed trains, it is critical to increase the storage time of the quantum memories to the order of hours.

In a new study published in *Nature Communications*, a research team led by Professor Li Chuanfeng and Professor Zhou Zongquan from the University of Science and Technology of China (USTC) of the Chinese Academy of Sciences (CAS) extended the storage time of the optical memories to over one hour. It broke the record of one minute achieved by German researchers in 2013, and is a great stride towards the application of quantum memories.

In the attempt to achieve optical storage in a zero-first-order-Zeeman (ZEFOZ) magnetic field, the complicated and unknown energy level structures in both the ground and excited states have challenged researchers for a long time. Recently, researchers used the spin Hamiltonians to predict the level structures. However, an error may occur in the theoretical prediction.

To overcome the problem, researchers from USTC adopted the spin wave atomic frequency comb (AFC) protocol in a ZEFOZ field, namely the ZEFOZ-AFC method, successfully implementing long-lived storage of light signals.

Dynamical decoupling (DD) was used to protect the spin coherence and extend the storage time. The coherent nature of this device is verified by implementing a time-bin-like interference experiment after 1h storage with fidelity of 96.4 percent. The result showed the great storage capacity of the coherent light and its potential in quantum memories.

This study expands the optical storage time from the order of minutes to the order of hours. It meets the basic requirements of the optical storage lifetime for quantum memories. Through optimizing the storage efficiency and signal-to-noise ratios (SNR), researchers can expect to transmit quantum information by classical carriers in a new quantum channel.

Source: University of Science and Technology of China, Chinese Academy of Sciences

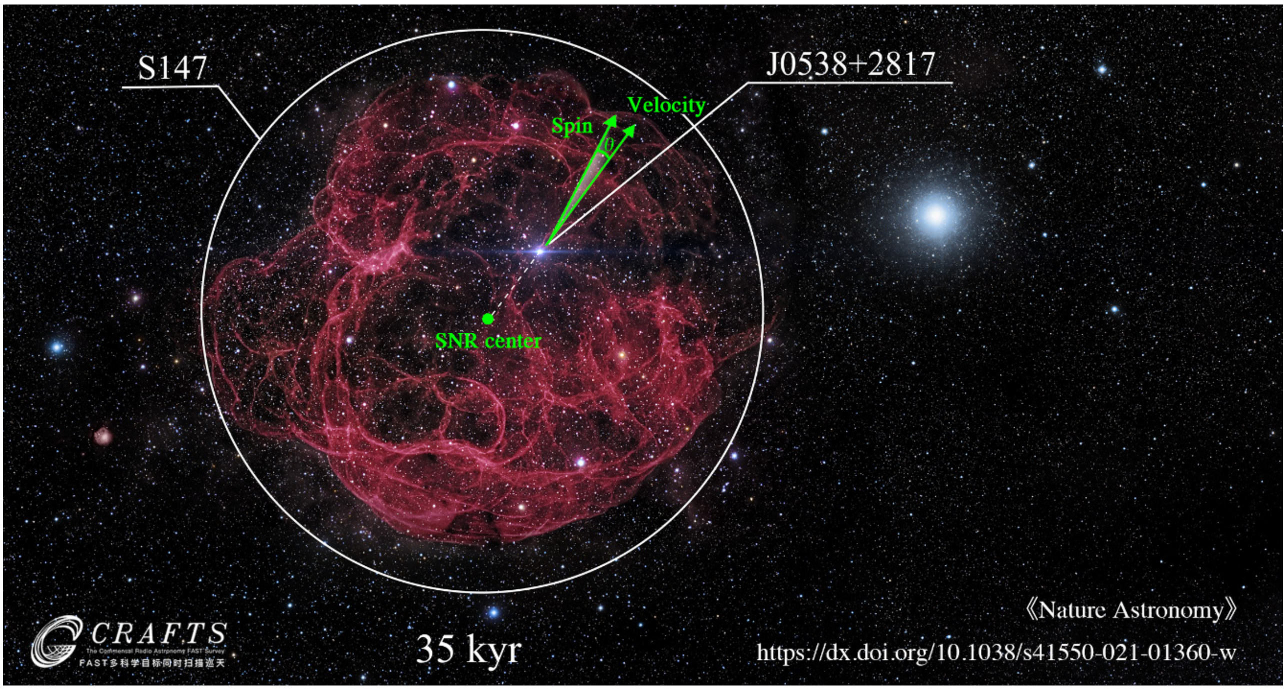

Illustration of supernova remnant S147 and pulsar J0538+2817 [IMAGE: NAOC]

FAST detects 3D spin-velocity alignment in a pulsar

Pulsars — another name for fast-spinning neutron stars — originate from the imploded cores of massive dying stars through supernova explosion.

Now, more than 50 years after the discovery of pulsars and confirmation of their association with supernova explosions, the origin of the initial spin and velocity of pulsars is finally beginning to be understood.

Based on observations from the Five-hundred-meter Aperture Spherical radio Telescope (FAST), Dr. Yao Jumei, a member of a team led by Dr. Li Di from the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC), found the first evidence for three-dimensional (3D) spin-velocity alignment in pulsars.

The study was published in *Nature Astronomy* on May 6, and marks the beginning of in-depth pulsar research with FAST.

For decades, scientists have found observational evidence for spin-velocity alignment in young pulsars. The relationship thus revealed between pulsars' spin axis and spatial velocity vectors, however, has largely been restricted to a 2D sky plane perpendicular to the line of sight, due to difficulty in constraining radial velocity.

Focusing on PSR J0538+2817 in the supernova remnant (SNR) S147 and using the scintillation technique, Dr. Yao obtained its radial location with respect to the SNR boundary and its radial velocity for the first time. "Then we got the 3D velocity by combining the transverse velocity measured by Very Long Baseline Interferometers," said Dr. Yao. The polarization analysis resulted in the direction of the 3D spin axis. The best fit angle between these two vectors was found to be about 10 degrees, which is the first such measurement in 3D.

FAST is currently the world's most sensitive single aperture radio telescope. "This represents a tour-de-force in pulsar data analysis. Through FAST observation, our team has accomplished more detections, which promise to further help reveal the origin of pulsar spin-kick," said Dr. Li, chief scientist of FAST and one of the corresponding authors of the study.

This work was supported by the International Partnership Program of the Chinese Academy of Sciences (CAS).

Major collaborators include those from the Xinjiang Astronomical Observatory of CAS, the Australia Telescope National Facility, the University of California, the Max Planck Institute for Radio Astronomy, and Oberlin College.

Source: National Astronomical Observatories, Chinese Academy of Sciences