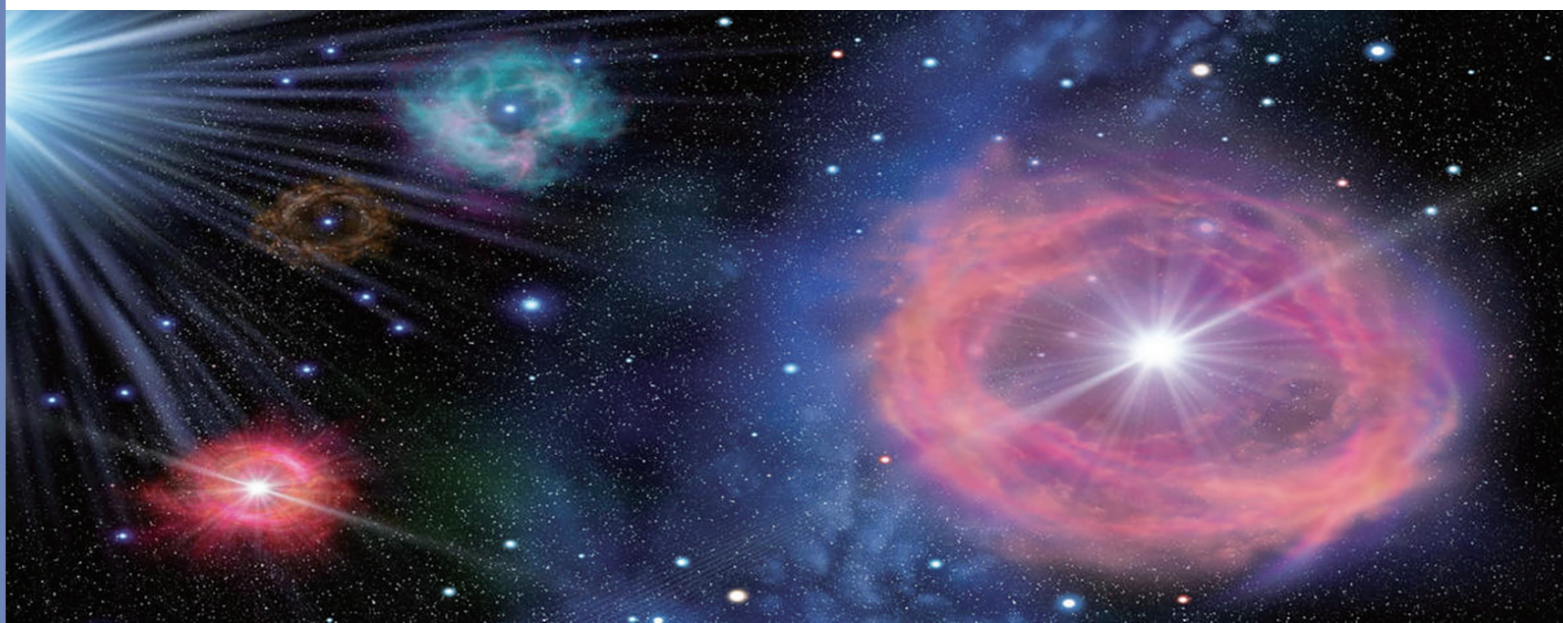
CAS Annual Prizes Granted

On January 16, the Chinese Academy of Sciences (CAS) awarded the winners for its annual prizes, including the Outstanding S&T Achievement Prizes, Young Scientist Prizes, and International S&T Cooperation Prizes. Also granted were the titles of "Scientists of the Year" and the "Research Teams of the Year".

At the ceremony, different awards of the Outstanding S&T Achievement Prizes (OSTAP) were granted. CAS Member CHEN Liquan, researcher from the CAS Institute of Physics, and CAS Member CHEN Xianhui, professor from the University of Science and Technology of China (USTC), both received the Individual Achievement Awards. Four researches such as the "Early formation and evolution of the Milky Way" were granted the Basic Research Awards; five projects, including the "Large-scale compressed

The research on the early formation and evolution of the Milky Way won a Basic Research Award of the Outstanding S&T Achievement Prize. A discovery among those made by the team is the chemical signature of a pair-instability supernova (PISN) found in a Galactic halo star, chemical evidence indicating the legacy from a first-generation star as predicted by numerical simulations. (Image by NAOC)



air energy storage new technology and application", received the Technology Invention Awards; and another five advances, such as the "Black soils-targeted key technologies for mitigating farmland degradation and fertility improvement" received the S&T Breakthrough Awards. The attached list details the OSTAP winners.

In 2024, the Academy adjusted the prize arrangement and set four different awards under the Outstanding S&T Achievement Prizes with different emphases. The Individual Achievement Awards honor the scientists who have long been dedicated to the explorations on the S&T frontiers and have scored important innovative achievements. The Basic Research Awards recognize the important science discoveries and original innovations in the field of fundamental science and applied research. The S&T Invention Awards are set to encourage scientists engaging in applied science research and technological development to make invention of high-value intellectual property and remarkably benefit the society with economic, social and ecological efficiency via the applications of their inventions. The S&T breakthrough Awards aim to encourage scientists to tackle crucial hardcore technological issues and play a key role in answering important strategic demands of the nation.

The Young Scientist Prizes aim to award the junior S&T workers who have made outstanding contributions in S&T innovation. Under this prize, two awards are arranged to promote excellence in basic research and engineering technology. At the ceremony, a total of 10 young scientists received the awards for their excellence in basic research, and another 10 for their outstanding contributions to engineering technology.

The titles of the "Scientists of the Year" and the "Teams of the Year" are set to recognize the outstanding scientists and research teams who have made important contributions.

At the event, winners for the CAS Prize for International S&T Cooperation were also announced. This prize awards foreign scientists and S&T management experts who have played a key role in S&T cooperation with CAS.

Winners of Outstanding S&T Achievement Prizes

Individual Achievement Awards

CHEN Liquan, Institute of Physics

Prof. CHEN Liquan, a CAS Member, is a pioneer trailblazer and visionary leader to China's lithium battery industry. He has devoted himself to the research and advancement of lithium battery since 1976, playing a pivotal role in establishing the research of Solid-State Ionics in China. Through unwavering dedication, CHEN spearheaded groundbreaking researches and revolutionized the technological landscape of lithium battery sector in China. His major achievements include the successful demonstration of the first all-solid-state lithium metal battery in China, the proposal and commercialization of high-capacity silicon-carbon anode materials, and the innovation of multiple cathode materials. CHEN's contributions have laid the foundation and paved the way for the continuous evolution of China's lithium battery industry.

CHEN's foresight was instrumental in the establishment of China's first pilot production line for cylindrical lithium-ion batteries, which later prompted him to initiate and foster several leading companies, including CATL, now the global leader in the lithium-ion battery market. His visionary leadership not only nurtured China's lithium battery industry from its infancy but also elevated China to a position of global prominence in the field. Beyond that, in recent years, CHEN has emerged as the most prominent advocate for next-generation all-solid-state batteries and sodium-ion batteries. Such efforts have been pivotal in securing China's leadership in future competition by enabling large-scale production and application of both solid-state lithium-ion battery and sodium battery ahead of the rest of the world. He has made outstanding achievements and contributions in the fields of secondary lithium batteries and energy conversion devices.

CHEN Xianhui, University of Science and Technology of China

Prof. CHEN Xianhui, a CAS Member, has been committed to the exploration of new quantum materials and the emergent physics thereof. He made key contributions in the field of iron-based superconductors by discovering the first iron pnictides whose transition temperature breaks the McMillan limit under ambient pressure, thus establishing iron-based superconductors as a new class of high-temperature superconductors, and uncovered several key physical properties such as the coexistence of superconductivity and magnetism. He discovered a series of important high-temperature superconductors in layered iron-selenium-based materials, and developed a new field-effect transistor with solid ion conductor to achieve the electric-field control of quantum phase transition in various superconductors. He contributed to the developments of two-dimensional black phosphorus field-effect-transistor devices in which ultrahigh mobility and a comprehensive control of the bandgap are achieved. This breakthrough significantly advanced the development of two-dimensional semiconductor materials. CHEN has continuously made groundbreaking contributions in the frontier fields of quantum materials, including

Kagome superconductors, interface superconductivity, and magnetic topological insulators. His pioneering work has laid a solid physical foundation for the technological advancement of quantum materials, driving the development of cutting-edge research in quantum materials.

Basic Research Awards

Early formation and evolution of the Milky Way

By ZHAO Gang, XING Qianfan, YAN Hongliang, CHEN Yuqin and SHI Jianrong
From the National Astronomical Observatories, CAS

Using the data from LAMOST, the research team has undertaken systematic inquiries into the cutting-edge field of the early formation and evolution of the Milky Way, and achieved original breakthroughs. The team identified the chemical signature of a pair-instability supernova (PISN) resulting from the evolution of a first-generation very massive star, opening up a new direction for the study of the Milky Way's initial mass function at the massive end. The team also proposed a novel approach for identifying accretion remnants using stellar orbital parameters and unique chemical tags, and provided observational evidence of dwarf galaxies accreted by the Milky Way in orbital and chemical spaces, respectively. The team discovered that lithium-rich stars are primarily red clump stars that have undergone helium flashes, and proposed that helium flashes are a universal new mechanism for lithium production, which reshaped the theory of lithium formation and evolution. These research findings have unveiled key physical processes in the early formation and evolution of the Milky Way, having a significant impact on frontier research of the Milky Way.

Discovery of novel effects in metals at extremely-fine grain sizes

By LI Xiuyan, XU Wei, ZHANG Baobing and LUO Zhaoping
From the Institute of Metal Research, CAS

The research group has focused on the structures and properties of metals with extremely fine grains. Utilizing independently developed extreme deformation equipment and technology, they have refined the grains of various metals to below ten nanometers and discovered the spontaneous grain boundary relaxation, anomalous phase transformations and Schwarz crystal structure. Their discovery of Schwarz crystal structure reveals that, when the grains are small enough, the polycrystals evolve into a metastable state where the grain boundaries are three-dimensional minimal-interfaces, instead of transforming into amorphous. Schwarz crystal exhibits a strength in the vicinity of the theoretical value – a high-level stability close to the equilibrium melting point, and extremely low diffusion coefficients. Based on these effects, new superalloys, aluminum alloys, and wear-resistant rollers have been developed, and some of them have been applied in industry.

Multi-timescale environmental evolution of Mars

By CHEN Ling, LIU Jianjun, ZHANG Jinhai, QIN Xiaoguang and DU Aimin,
From the Institute of Geology and Geophysics, CAS, and the National Astronomical Observatories, CAS

The research group has carried out interdisciplinary studies on major frontier issues regarding Martian environment evolution, achieving significant breakthroughs in the research field

of multi-scale aqueous activity on Mars. They developed innovative methods of weak-signal extraction and high-resolution imaging for planetary radar exploration. Using these methods, for the first time they revealed fine subsurface structural layering and lateral variations, uncovering a long history of aqueous activity and long-timescale environmental changes on Mars.

The group was also the first to discover key evidence of liquid water on the dune surface of Martian low-latitude regions, and revealed short-term environmental changes characterized by alternating aeolian and aqueous activities. These findings open up a new direction for studying aqueous activity on Martian dunes.

Furthermore, the group developed independently a high-precision Mars rover magnetometer and a novel data calibration method, achieving the first ground magnetic survey on Mars. Their findings show that significant magnetic field changes and the weak magnetic field are essential to maintain Martian long-term aqueous activity.

These achievements have refreshed our understanding of Martian aqueous activity and provide original insights into the long-term evolution of paleomagnetic field and paleoenvironment on Mars.

The mechanisms of light sensation in regulating life processes

By XUE Tian, MA Yuqian, ZHANG Mei, MENG Jianjun and SHI Yiming
From the University of Science and Technology of China

The research team has made a series of groundbreaking achievements focused on the scientific theme of "the mechanisms of light sensation in regulating life processes". In mechanisms of light regulation in physiological functions, the team was the first to uncover and elucidate the molecular and neural circuit mechanisms through which light sensation early in life influences synaptic development in the brain. They also revealed the neurophysiological processes by which light stimuli regulate systemic glucose metabolism and how nighttime light pollution induces negative emotional states. In terms of human eye development, aging, and vision restoration, the team deciphered the mechanisms of human retinal development and aging, highlighting the essential role of specific glial cells in macular formation and functional maintenance. They developed innovative technologies for vision restoration and enhancement, and established a gene-editing-based vision restoration technique and developed a gene therapy drug for macular degeneration, which has been approved for Phase I clinical trials. These findings have opened new frontiers and established a pioneering research field focused on "light sensation in regulating life processes".

Technology Invention Awards

Large-scale compressed air energy storage new technology and application

By CHEN Haisheng, XU Yujie, LI Wen, ZHU Yangli, ZUO Zhitao and WANG Liang
From the Institute of Engineering Thermophysics, CAS

The research team has invented an advanced compressed air energy storage system (CAES) that does not utilize fossil fuels or rely on geographical conditions. For the first time, they proposed the design theory of "process correspondence — parameter matching", breaking through the technology of full condition design and regulation. The team has broken through the technology of wide operating range compressor and high-load expander, and invented multiple models of com-

pressors of wide operating range and expanders of high load. The team has broken through the technology of supercritical heat/cool storage thermal exchangers, and invented novel structural heat/cool storage and exchange devices powered with "internal insulation and external pressure-bearing" and "multi-process compact structure" technologies. The team has constructed the world's first 10 MW, 100 MW, and 300 MW demonstration systems, with performance repeatedly setting international records. The team has produced a cluster of high-value patents, incubated the world's first unicorn enterprise in this field, and achieved significant economic benefits.

Emission control technologies for diesel vehicles

By HE Hong, YU Yunbo, SHAN Wenpo, SHAN Yulong, HE Guangzhi and LIAN Zhihua
From the Research Center for Eco-Environmental Science, CAS and the Institute of Urban Environment, CAS

Meeting the national major needs for diesel vehicle emission control, the research group established the technical route for the synergistic reduction of pollutants and carbon emissions from diesel vehicles in China, proposed the design principles of NH_3-SCR (selective catalytic reduction of NO_x) catalysts, and developed high-efficiency V-based catalysts with oligomeric vanadium species and aluminum-rich Cu-based small-pore zeolite catalysts. They developed diesel vehicle emission aftertreatment systems that meet the V and VI emissions standards of China, building industrialization technology systems with comprehensive and independent intellectual property rights. Moreover, they constructed the whole chain innovation system that spans principle-based technology, process -based technology to industrial application, significantly benefiting the society and the economy. The research group played a key role in the iterative upgrades of China's diesel vehicle emission standards and synergistic reduction of pollutants and carbon emissions from diesel vehicles, making outstanding contributions to the leapfrog development of the diesel vehicle emission control technologies in China.

Key technologies for industrialization of high-performance poly (lactic acid)

By CHEN Xuesi, BIAN Xinchao, PANG Xuan, LIU Yanlong, ZHANG Bao and SUN Hai
From the Changchun Institute of Applied Chemistry, CAS

The research team has invented conjugated coordination and intramolecular multi-nuclear synergistic catalysis technologies, increasing the yield of lactide (LA) to 98% and enhancing the catalytic activity of polymerization reaction by 133 times. They have overcome challenges in constant-temperature field control and steady-state continuous polymerization technologies, achieving an optical purity of 99.7% for LA and enabling the rapid continuous polymerization of poly (lactic acid) (PLA). The team has also developed crystallization-guided chain extension and branching modification technologies, raising the melting point of fully stereoregular crystalline PLA-modified resin to 254 °C, the Vicat softening temperature to 214 °C, and the elongation at break to 400%. They have developed PLA composite mulching films with adjustable lifespans. Furthermore, they established the first domestic production line for PLA with an annual capacity of 10,000 tons and the first for medical-grade PLA with a capacity of 10 tons per year. Eight PLA-based products, including ultra-high-strength absorbable bone screws and bone plates, have received Class III medical device registration certificates in China.

Black soils-targeted key technologies for mitigating farmland degradation and fertility improvement

By ZHANG Jiabao, JIANG Ming, JIA Zhongjun, LIANG Zhengwei, ZOU Wenxiu, ZHANG Xingyi, ZHANG Lili, LIANG Aizhen, GUAN Yixin and LIU Huanjun
From the Northeast Institute of Geography and Agroecology, CAS, the Institute of Soil Science, CAS, and the Institute of Applied Ecology, CAS

The research team focused on the conservation and utilization of black soils and conducted trans-disciplinary collaborative research in order to implement national strategy for food security. The team effort has led to successful development of an integrated space-air-ground system for monitoring and assessing the degradation of black soils, clarification of soil degradation processes, elucidation of the mechanisms underlying the construction of fertile plough horizon, and the advanced technologies for the targeted improvement of the internal stability for soil fertility. Their key accomplishments include the first 10-m high-resolution map of black soil organic matter in China and the first "White Paper on Black Soils in China"; the restoration technologies for gully-destructed arable land and integrated anti-erosion technologies for slopes and gullies; and the trans-disciplinary models with regionally appropriate farming systems such as "Lishu Model 2.0", "Longjiang Model" and "Da'an Model", as well as their large-scale demonstration and promotion. These key techniques and models have been incorporated into the Implementation Plan for the National Black Soil Protection Project, empowering the national key task of black soil conservation and utilization, and making important contributions to ensuring national food security.

Large scale cryogenic plant and its demonstration in helium extraction project

By LIU Liqiang, GONG Linghui, LI Zhengyu, PENG Nan, WU Jihao, XIE Xiujuan, ZHOU Gang, HU Zhongjun, ZHANG Yu and WANG Bingming
From the Technical Institute of Physics and Chemistry, CAS

The research team has broken through a series of key technologies in large-scale cryogenic refrigeration, such as helium turbine expansion with gas-bearing, and so on. The first large-scale helium liquefier for industrial use with a capacity of 300 L/h, the first 5 ton/day hydrogen liquefaction plant and the first superfluid helium cryo-plant with a capacity of 500W@2K in China have been developed. The helium liquefier with the ISO liquid helium tank container were applied in the first large-scale helium extraction project in China. The full industrial chain of "domestic gas source, domestic equipment and domestic liquid helium" has been built, improving the self-sufficiency of helium and ensuring the safety of strategic helium resources in China. Their large-scale hydrogen liquefier technology has helped the nation achieve complete independent control of large-scale hydrogen liquefaction in aerospace engineering and clean energy fields. The super-fluid helium cryo-plant has achieved a breakthrough in the kilowatt-level cryogenic refrigeration technology for this temperature zone in China, which will strongly guarantee the healthy development of large scientific facilities.