TOPICAL REVIEW — Celebrating 30 Years of *Chinese Physics B*

Editorial: Celebrating the 30 Wonderful Year Journey of *Chinese Physics B*

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The year 2022 marks the 30th anniversary of *Chinese Physics B*. This editorial provides a brief history of the journal and introduces the anniversary theme collection comprising over 30 invited reviews and perspective articles from renowned scholars in various branches of physics.

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Chinese Physics B, sponsored by the Chinese Physical Society and Institute of Physics, Chinese Academy of Sciences, was launched in 1992, under the title *Acta Physica Sinica* (*Overseas Edition*). Just as the founding Editor-in-Chief, Professor Zuqia Huang, wrote in the foreword, "*It is a new sister journal of the existing Chinese journal Acta Physica Sinica, launched to accelerate the dissemination of important activities of Chinese physicists in the fields of theoretical and experimental physics, so as to promote the scientific intercourse between native and foreign scholars*." The overseas edition and its sister Chinese edition share the same editorial board. However, the submissions and publications are independent. Soon after its foundation, *Acta Physica Sinica* (*Overseas Edition*) was indexed in the Science Citation Index in 1994. In the early days of its publication, it published many achievements of the older generation of outstanding physicists in China. Prof. C. N. Yang's recommendation of *Acta Physica Sinica* (*Overseas Edition*) and its sister Chinese edition in 1999 elucidated, "*These two journals can be regarded as the best representatives of the physics periodicals ever published in China. Their influence on promoting the international academic exchange cannot be neglected*." In the year 2000, to avoid confusion with the Chinese edition, *Acta Physica Sinica* (*Overseas Edition*) was renamed *Chinese Physics.* Since then, the number of articles published increased from about 100 articles in 2000 to 648 articles in 2007. To promote the serialization of journals sponsored by the Chinese Physics Society, the journal title was changed for the second time to *Chinese Physics B* (CPB) in 2008. With the increased government investment in physics research, and the corresponding increase in the number of physics researchers and students in China, the number of submissions and publications continues to grow substantially. Since 2015, CPB has become the physics journal with the highest number of publications, the highest total citations, and the widest readership in China.

On the journal's 30th anniversary, we have organized this special collection, comprising more than 30 review and perspective articles, providing readers with cutting-edge advancements in several areas of physics research conducted in China. Each author was carefully selected by the editorial board for their respected academic achievements.

In the condensed matter physics domain, we have collected 12 articles covering a wide range of condensed matter physics from theoretical and computational condensed matter physics to experimental condensed matter physics. For instance, Zhao and Weng review the background and recent progress of Mott physics based on a weakly-coupled mutual Chern–Simons gauge fields representation, which describes a non-Fermi liquid parent phase. The antiferromagnetically ordered phase, superconducting phase, and the Femi liquid phase may be regarded as the low temperature instabilities of such a parent state at different doping regimes.[1] Pan *et al*. summarize recent developments in model design and computation solutions based on quantum Monte Carlo approaches for a few representative quantum many-body systems, including non-Fermi-liquid and SYK quantum critical metals, magic angle twisted bilayer graphene, and other moiré superlattices.[2] Xu *et al*. review recent computational studies on magnetism and ferroelectricity. In particular, a new first principles method is presented for computing the linear magnetoelectric coupling tensor without applying an external field.[3] Du and Wang present recent progress in magnetic skyrmions, from both theoretical and experimental aspects, with an outlook of the fundamental challenges in device applications in spintronics.[4] In experimental condensed matter physics, Li *et al*. present an overview of recent scan-

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ning tunneling microscopy (STM) studies on the Majorana zero modes in iron-based superconductors.[5] Chen *et al*. review the recent progress of the superconductivity, non-trivial surface and unconventional density waves in vanadium-based kagome materials AV_3Sb_5. In particular, they discuss the competition between superconductivity and charge density waves under different conditions of pressure, chemical doping, thickness, and strains.[6] Shi *et al*. focus on recent advances in quasi-2D superconductors in the bulk phase using an organic molecular electrochemical intercalation method, resulting in enhanced superconductivity and emergent pseudogap behavior.[7] He briefly introduces several techniques based on molecular beam epitaxy growth on pre-patterned substrates which enable them to directly prepare in-plane nanostructures and heterostructures in ultrahigh vacuum.[8] Zhang *et al*. summarize recent STM advances on the spin- and/or valley-polarized states induced by individual atomic scale defects in graphene, including single-atom vacancies, dopants and chemisorption.[9] Lin *et al*. present recent progress on emergent van der Waals magnetic compounds and their potential applications in magnetism-related devices.[10] Han *et al*. retrospect the history of microelectronics, spintronics, and magnonics, which will help to envision emerging research fields for development of spintronics and magnonics beyond micro-electronics.[11] Xu *et al*. overview several methods of preparing various 2D materials, including recent progress and applications of III-nitrides for optoelectronic devices.[12]

In energy materials and devices, we have collected five articles covering DFT-based energy materials design, as well as batteries and solar cells. We start with a perspective article by Kang and co-authors. They discuss advances and challenges in density-functional theory calculations which provide accurate simulation towards accelerated energy materials design, followed by examples leading to the discovery of new energy materials for photovoltaic, photocatalytic, thermoelectric, and battery applications.[13] Hou *et al*. summarize fundamental investigations of the anionic redox reaction (ARR) mechanism and the latest exploration of cathode materials of sodium-ion batteries.[14] Gan *et al*. on the other hand present a brief review on lithium-ion batteries with a particular focus on safety issues based on quasi-solid-state battery design principles.[15] Yu *et al*. present a brief account of recent progress in inverted perovskite solar cells with a detailed discussion on interfacial engineering towards high power conversion efficiency.[16] Suo *et al*. present a review article that introduces progress in Pt and Pt-based oxygen reduction reaction (ORR) electrocatalysis for proton exchange membrane fuel cells.[17]

In atomic, molecular and optical physics, we have collected six review articles by leading scientists in the field. Li *et al*. summarize determination of the three-dimensional equilibrium geometry of molecules and molecular clusters through reconstruction by fragments momenta method, and also show how dissociation dynamics on the complex potential energy surface can be tracked in real-time with the ultrafast laser-induced Coulomb explosion imaging technique.[18] Ma *et al*. review twenty-year studies on atomic structure and collision dynamics with highly charged ions (HCIs) based on heavy ion storage rings and electron ion beam traps, and propose some new and interesting topics for cutting-edge research employing HCIs in current and future large-scale accelerator facilities around the world.[19] He *et al*. outline recent progress in attosecond pulse generation and attosecond spectroscopy capable of recording ultrafast movies of nuclear and electronic dynamics with unprecedented temporal and spatial resolution.[20] Liu and co-authors summarize recent research progress on momentum-space polarization fields and singularities in two-dimensional photonic-crystal slabs, with a particular focus on their unique optical properties and potential applications in photonics.[21] Chen and Li present a brief review of progress in topological photonics in gyromagnetic photonic crystal systems, which will surely motivate further interest in scientific and technological applications.[22] Yao *et al*. summarize recent progress in perovskite oxide thin-film deposition by state-of-the-art pulsed laser deposition. They also highlight recent work on probing symmetry breaking at the surface/interface/interior and weak coupling among nanoscale ferroelectric domains using optical second harmonic generation spectroscopy.[23]

In quantum science and technology, we introduce two excellent review articles. Xu and Fan review progress on multiqubit state generation, the quantum computational advantage, and simulating the physics of quantum many-body systems. Perspectives towards the noisy intermediate-quantum processors are also presented.[24] Qin *et al*. present a comprehensive introduction to quantum error mitigation which is fundamentally important for realistic quantum computing technology.[25]

In plasma physics, we have also assembled two excellent review articles. Liu and co-authors review recent progress in the fundamental study of radio-frequency (RF) plasmas, covering both fundamental principles and applications,[26] while Lu and co-authors[27] focus on recent progress on collisionless magnetic reconnection in the magnetotail, magnetopause and magnetosheath based on *in-situ* observations from satellites as well as kinetic simulations, and describe new physics beyond the standard model of collisionless magnetic reconnection.

In statistics mechanics, Wang and Huang present prominent studies on hydrodynamic metamaterials in porous media, non-porous media, creeping flows, and non-creeping flows from several perspectives.[28] Ding *et al*. give a critical review of progress in thermal diodes and transistors, especially in the classical regime, followed by a brief introduction on new

developing research directions such as topological phononics and quantum phononics.[29] In high pressure physics, Zhuang and Hu review the electronic conductivity and metallization of iron oxides under high-pressure conditions found in Earth's deep interiors.[30] In biophysics, Wang *et al*. give an overview of single molecule methodologies for physical biology, with a particular focus on protein machinery.[31] In acoustics, Wang *et al*. present a comprehensive review on the exciting new direction of controlling acoustic orbital angular momentum with artificial structures, covering recent advances in the generation, manipulation, and application of acoustic orbital angular momentum based on acoustic metasurfaces.[32]

We hope readers will enjoy this outstanding collection of achievements in Chinese physics.

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