



School of Physics & Microelectronics, Zhengzhou University

Location

School of Physics & Microelectronics, Zhengzhou University,
Zhengzhou 450052, China

Futher Information: <http://www5.zzu.edu.cn/wuli/>

Overview

School of Physics and Microelectronics of Zhengzhou University was founded in 1995, and its predecessor was the former Department of Physics of Zhengzhou University that was founded in 1956. The founder of this school is Prof. Bingquan Huo, a famous physicist on high-energy physics and cosmic ray physics of China. Currently, the school has 220 staffs, including 1 academician of Chinese Academy of Sciences, 2 Distinguished Professors of Changjiang Scholars, 1 winner of National Fund for Distinguished Young Scholar, 39 professors, 44 associate professors, and 82 assistant professors.

The school now has postdoctoral station of Physics, first-level doctoral program of Physics, second-level doctoral program of Materials Physics and Chemistry; and provides 3 first-level master programs: Physics, Nuclear Science and Technology, and Instrument Science and Technology; 3 second-level master programs: Biophysics, Materials Physics and Chemistry, and Physical Electronics; and 5 undergraduate programs: Physics, Applied Physics, Electronic Information Science and Technology,

Electronic Science and Technology, and Observation and Control Techniques and Instrument. The school has about 1200 undergraduate students and over 400 postgraduate students.

Currently, the school aims to explore the frontiers of basic physics, resolve the strategical challenges of the country, and contribute to the economic and social progress of Henan Province. The research outputs of the school have been improved greatly in recent years. In the future, the school will strengthen its basic and technological research, and try to make the school an important base for both education and research of physics. You are cordially welcome to join us to upgrade your value and we will try to provide competitive startup kits and comfortable working and living conditions.

Key Contact

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Research Foci

- **Cosmology and Gravity:** Discovering the evolution and the large scale structures of our universe, especially the studying of the predictions of the baryogenesis mechanisms, the electroweak, QCD phase transitions in the early universe and related gravitational wave emissions, studying the properties of various



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dark matter candidates and their direct/indirect detections from underground/satellite experiments, testing the predictions of inflationary cosmology and the non-singular cosmology, studying the dark energy models and the modified theories of gravity.

- **Particle Physics and Quantum Field Theory:** Studying the mass generation and electroweak symmetry breaking mechanisms in the standard model, testing new interactions and discovering new particles for the new physics models and the Grand Unified Theory, studying the hadronic spectra and 3D internal structures of hadrons with pQCD and appropriate factorization scheme, analyzing the data of hadron transitions and decays from the BESIII, Belle II, JUNO experiments.
- **Quantum Information Science:** Being mainly engaged in quantum computing and high-fidelity quantum logic design based on neutral Rydberg atoms, experimental design of quantum information and theoretical study of quantum precision measurement based on ultra-cold calcium ion quantum system, theoretical research on photon blocking and hybrid quantum optical system based on optomechanical system, and the construction of high fidelity nonadiabatic geometric quantum logic gate.
- **Incoherent Digital Imaging Fundamentals and Applications:** Aiming at reducing the complexity of the holographic imaging systems, improving the spatial resolution and computational efficiency of the systems, we try to develop new incoherent digital imaging systems, more efficient reconstruction algorithms, and novel imaging theories. As a promising three-dimensional imaging technology, we are also interested in solving practical engineering problems related to biological imaging and other fields.
- **Diamond Optoelectronic Materials and Devices Group:** Focusing on the large-scale synthesis of high-quality diamond materials and explores their promising applications in the optoelectronic devices. Based on the investigation of the nucleation and growth mechanisms, synthesis conditions and control parameters of high-quality diamond single/poly-crystals, through the devices design, micro-nano fabrications, surface modification/functionalization, combined with the theoretical calculations and simulations, we aim to develop high-performance diamond-based optoelectronic devices.
- **Computational Physics and Quantum Materials:** Focusing on developing new computational algorithms including time-dependent density functional theory (TD-DFT) for computational simulations of exotic physics in low dimensional systems, such as the growth mechanism and electronic structures of nanoclusters, diamond quantum dots, and single-atomic-thick two-dimensional materials. Especially, underlying the microscopic mechanism of ultrafast carrier dynamics in plasmon-mediated photocatalysis at the single molecular level, the physics and quantum behaviors of vacancies in diamond nanocrystals and quantum dots, the dissipation of both electronic and phonon excitations in tribology of nanomaterials are of our major projects for design of quantum

functional materials.

- **Quantum Structures and Quantum Energy:** Focusing on transition-metal oxide heterostructures, metal nano-structures, and halide perovskites. The microstructures and novel properties of the quantum structures were revealed by advanced techniques, such as scanning transmission electron microscopy and synchrotron radiation techniques. The physical properties of structure, magnetism, optical and electrical properties manipulated by external fields were also investigated. Their applications, especially for quantum energy, such as electrical catalysis, photocatalysis, and solar energy cells, were investigated.
- **Nanomaterial Physics and Nanodevices:** Focusing on solving the key scientific problems including the advanced and controllable preparation technologies, the high-density interface physics, the group effect and collaborative mechanism of massive nanostructure systems, the properties of high-quality nanoheterojunctions characterizing by complicated interface structures, as well as their applications in building high-performance light-emitting diodes (LEDs), photodetectors (PDs) and solar cells based on silicon or other novel optoelectronic materials such as perovskites and two-dimensional semiconductors.
- **Negative Thermal Expansion (NTE):** Focusing on the abnormal phenomenon of thermal contraction and the physics behind, related materials and applications. The group explores the origins of NTE associated with optical and acoustic phonons, spins, oxygen vacancies and phase transitions, and aims to develop novel materials with excellent NTE in a wide temperature range including room temperature and without hygroscopicity. A linear scaling law is presented for design NTE materials with desired phase transition temperatures. The concepts of average atomic volume and averaged effective electronegativity are proposed for speed-up the design of NTE materials.
- **Alloy Materials and Metal Physics:** Developing new Al alloys and heat- or radiation-resistant alloys. Based on our developed electrolytic alloying theory, Al alloys containing Zr, Ti, Sc, and Er are investigated. Using the mixed effects of electric, magnetic and temperature fields during electrolyzing and the following structure heredity, Al alloys with improved properties and relatively low costs can be massively produced. Combining the alloying element addition and cold/hot working, novel heat- or radiation-resistant (high-entropy) alloys are studied.
- **Nanomaterials for Energy Application:** Developing energy conversion and storage devices based on nanomaterials to utilize the solar, chemical, and mechanical energy, including solar cells, light-emitting diodes (LEDs), lithium-ion batteries, and triboelectric nanogenerators, for applications in wearable sensors, micro/nano power sources and high-performance light sources, etc. Our interdisciplinary researches offer various sustainable energy supply solutions and boost the development for the next generation electronic devices.