北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Imaging and Harnessing the Topological Boundary Modes

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Time: 3:00 pm, Nov.11, 2026 (Wednesday)

时间：2026年11月11日（周三）下午3:00

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Topologically protected edge channels show prospects for quantum devices [1]. In this talk we provide evidence for robust topological helical edge states within a novel topology named three-dimensional (3D) QSHIs. Its topology originates solely from a nonzero spin Chern number for each plane of the crystal and is realized in both bulk α-Bi_4I_4 with trivial symmetry indicators and α-Bi_4Br_4 with inversion Z_4 index. We experimentally observe the edge modes at each type of monolayer and bilayer step of these materials by scanning tunneling microscopy (STM). These edges states are linearly dispersing protected by a large bulk gap spanning E_F, robust against disorders and vertical stacking [2]. Based on these findings, we fabricate helical-edge-state STM tips with these materials, and show how the tunneling of the helical edge state becomes a metrological resource for atomic-scale spin sensing owing to the time-reversal-symmetry paired spin-momentum locking. As a stringent benchmark, we apply this helical tunneling spin probe to the layered altermagnetic material KV_2Se_2O and directly image the defining alternating spin texture in both real and momentum space [3].

[1] S. Phark et al., Nano Futures 9, 032001(2025);

[2] S. Yu et al., Phys. Rev. X 14, 041048 (2024);

[3] Z. Wang et al., Nature (2026). https://doi.org/10.1038/s41586-026-11257-1

About the speaker

Professor Zhenyu Wang obtained his PhD from Institute of Physics, Chinese Academy of Sciences, in 2015. Then he held a postdoctoral appointment at the University of Illinois Urbana-Champaign, before joining the physics faculty at University of Science and Technology of China in 2019. He became a full professor of Physics in 2023. His research interests lie in the realm of quantum materials, including unconventional superconductors, Mott insulators and topological matters. His group uses the tool of STM to unravel the mysteries of these complex systems, and the fundamental goal is to directly visualize their emergent behaviors and manipulate their properties. Now Prof. Wang's lab focuses on STM studies of topological superconductors and moiré superlattice where both electronic interactions and quantum geometry play the vital role in shaping their electronic properties.