北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Superconductivity and unconventional density waves in Kagome metal

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Time: 10:00 am, Nov. 8, 2023 (Wednesday)

时间：2023年11月8日 （周三）上午10:00

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

摘要

The transition metal kagome lattice materials host frustrated, correlated and topological quantum states of matter. Recently, a new family of vanadium-based kagome metals, AV_3Sb_5 (A = K, Rb or Cs), with topological band structures has been discovered. These layered compounds are nonmagnetic and undergo charge density wave transitions before developing superconductivity at low temperatures. In this talk, our recent work on the observation of unconventional superconductivity and a pair density wave (PDW) in CsV_3Sb_5 will be presented. By using scanning tunneling microscope/spectroscopy and Josephson scanning tunneling spectroscopy, we find that CsV_3Sb_5 exhibits a V-shaped pairing gap $\Delta \sim 0.5$ meV and is a strong-coupling superconductor ($2\Delta/k_BT_c \sim 5$) that coexists with $4a_0$ unidirectional and $2a_0 \times 2a_0$ charge order. Remarkably, we discover a 3Q PDW accompanied by bidirectional $4a_0/3$ spatial modulations of the superconducting gap, coherence peak and gap depth in the tunneling conductance. We term this novel quantum state a roton PDW associated with an underlying vortex–antivortex lattice that can account for the observed conductance modulations. Probing the electronic states in the vortex halo in an applied magnetic field, in strong field that suppresses superconductivity and in zero field above T_c, reveals that the PDW is a primary state responsible for an emergent pseudogap and intertwined electronic order. Recent progress on the chemically-doped kagome superconductors and new Ti-based kagome superconductors will also be introduced. Our findings show striking analogies and distinctions to the phenomenology of high-T_c cuprate superconductors, and provide groundwork for understanding the microscopic origin of correlated electronic states and superconductivity in kagome metals.

报告人简介

陈辉，中科院物理所副研究员，博士生导师。研究方向为新型拓扑量子材料的原子级精准构筑、物性调控及其微观机理研究。近几年在石墨烯折叠、磁性外尔半金属与笼目超导体的超导及新奇电子态的扫描隧道显微镜研究取得了一系列突破性成果。以（共同）第一作者与（共同）通讯作者在Nature、Science、Nat. Phys.、Nat. Commun.、Adv. Mater.、Angew. Chem.、Int. Ed.、Nano Lett. 和Sci. Bull. 等杂志发表文章20余篇。获国家基金委“优青”资助与2022年中国物理学会胡刚复物理奖（实验技术）等荣誉。