北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Geometric Rashba Control of Polar Pairing: When Crystal Geometry, Spin-Orbit Coupling, and Soft Polar Modes Conspire at Oxide Interfaces

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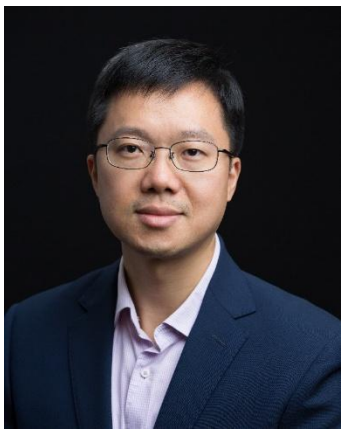

Time: 3:00 pm, May 28, 2026 (Thursday)

时间：2026年5月28日（周四）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

Two-dimensional superconductivity at $LaAlO_3/KTaO_3$ interfaces presents a striking puzzle: the transition temperature depends quasi-linearly on the crystallographic orientation of the interface, rising from identically zero at the pristine (100) face to roughly 2.2 K at the (111) face. No comparable anisotropy is seen in the closely related $LaAlO_3/SrTiO_3$ system. What makes $KTaO_3$ so sensitive to geometry?

In this talk, I will describe a minimal theoretical framework in which three ingredients conspire to produce the effect. First, the built-in interfacial electric field aligns polar nanoregions whose overdamped amplitude fluctuations supply a soft, low-energy bosonic glue. Second, cutting the crystal at an angle tilts the conduction orbitals and rigorously generates a dynamic Rashba electron-boson coupling that grows with the sine of the tilt angle. Third, the strong atomic spin-orbit coupling of tantalum amplifies this channel by more than an order of magnitude relative to the lighter titanium in $SrTiO_3$.

Solving the resulting strong-coupling Eliashberg equations, I show that the Coulomb repulsion threshold combined with intrinsic non-linearity maps the quadratic geometric input into an extended quasi-linear transition-temperature curve, in quantitative agreement with experiment. The framework also predicts a mixed-parity gap structure and a sizable oxygen isotope effect as distinguishing experimental fingerprints.

About the speaker

Yi Zhou is a professor at Institute of Physics, Chinese Academy of Sciences. He received his B.S. degree and Ph. D. in physics from Tsinghua University in 1998 and 2004 respectively. After postdoctoral journey, he became a faculty member in Zhejiang University in 2009 and moved to current position in 2019. His main research interests include quantum many-particle physics and theoretical condensed matter physics.