

Condensed Matter Physics Seminar Series

Supercurrent Diodes and their Applications in Quantum Computing

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A supercurrent diode is a superconductor where electric current flows more easily in one direction than the other. This effect is closely tied to the symmetry of the superconducting state and has exciting applications in quantum computing. First, they provide evidence for unconventional quantum states that could lead to robust quantum bits (qubits), potentially extending the lifespan of quantum information. Our research on supercurrent diodes in iron-based superconductors has revealed special symmetries representative of these topological quantum states. Second, supercurrent diodes, akin to semiconductor diodes, offer practical applications in cryogenic electronics, which are crucial for controlling quantum computers at extremely low temperatures. By strategically designing the symmetry of superconducting heterostructures with multiferroic materials, our latest breakthrough involves a supercurrent diode that can withstand strong magnetic fields, meeting industrial standards for the first time. These advancements in supercurrent diode research and low-dimensional superconducting heterostructures hold significant implications for developing powerful quantum computers.

Dr. Hung-Yu Yang is a postdoctoral researcher at the University of California, Los Angeles. He received his B.S. in Physics from National Tsing Hua University, and Ph.D. in Physics from Boston College. He has authored and co-authored over 20 research papers in high-quality peer-reviewed journals, including Nature Materials, Nature Communications, Physical Review Letters, Physical Review B, etc. He actively serves the scientific community as an APS Career Mentoring Fellow, lead abstract sorter, invited speaker, and session chair for APS March Meeting, and reviewer for international journals and government funding agencies. His research focuses on engineering topological quantum states by combining electronic band topology, magnetism, and superconductivity. His work aims to advance our understanding of quantum materials and pave the way for new quantum technologies, such as robust quantum computers and cryogenic electronic devices.

**Friday, February 21st at 10am
4-330 PAB**