"Probing Quantum Materials with Scanning Tunneling Microscopy"

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Engineering 100

Abstract

Quantum information science and engineering (QISE) have experienced rapid advancements over the past decade, offering the potential to revolutionize human society entering the quantum age. The foundation of QISE lies the study of quantum materials – systems that provide reliable ways to manipulate the fragile quantum states for information processing.

In this talk, I will present our recent investigations of quantum materials using scanning tunneling microscopy (STM), which focus on topological superconductor (TSC) candidates and magnetic materials. Specifically, I will discuss our work on 2M-WS2, a promising TSC candidate relevant to topological quantum computing, and our exploration of magnetism near the quantum limit, which is central to realizing quantum magnetic devices.

Our studies employ STM and spin-polarized STM (SPSTM) to probe the electronic and magnetic properties of the quantum materials at the atomic scale. Highlights include the phase change patterning on TSC (2M WS_2) toward Majorana zero mode braiding, magnetic domain manipulations in centrosymmetric materials (Fe_3GeTe_2). In addition, our efforts in understanding Eu-based systems (Eu, Eu-Si, and $EuAl_4$) will be added to illustrate ways surface science can contribute to the research in quantum materials.

Biography

TeYu Chien is a Professor in the Department of Physics & Astronomy at the University of Wyoming. He earned his bachelor's degree from National Taiwan Normal University in 2001 and his Ph.D. in Physics from the University of Tennessee, Knoxville in 2009, focusing on electron–phonon coupling studied with angle-resolved photoemission spectroscopy. From 2009 to 2011, he was a postdoctoral researcher at Argonne National Laboratory, where he developed cross-sectional scanning tunneling microscopy for probing complex oxide interfaces. He then worked as a postdoctoral researcher at Northwestern University from 2011 to 2013, studying graphene functionalization. Chien joined the University of Wyoming as an Assistant Professor in 2013, was promoted to Associate Professor in 2019, and became a Full Professor in 2024. His research group specializes in using scanning tunneling microscopy (STM) and related surface physics techniques to investigate quantum, magnetic, topological, energy, and high-entropy materials.