Seminar of Luis A. JAUREGUI

Director of the Irvine Quantum Materials Center, UCI

14:00 Monday, August 31st, 2026 IJL 4-A014

Engineering Topological and Interaction-Driven Quantum Phases in $HfTe_5$

Quantum materials can host electronic states that do not exist in ordinary solids, many of which are topological and protected by symmetry. In this seminar, I will present $HfTe_5$, a layered van der Waals material whose electronic structure can be tuned in situ to access multiple topological and interaction-driven phases.

By applying uniaxial strain, we drive a transition between weak and strong topological insulating states, producing a nearly three-order-of-magnitude increase in resistance and a crossover to surface-state-dominated transport. In the weak topological phase, a magnetic field generates a sequence of Landau levels and one-dimensional Weyl-like modes. At low carrier density, strong Coulomb interactions stabilize a spin-triplet excitonic insulator that we recently discovered. In the strong topological phase, this condensate appears at lower fields and can be tuned through isotope-controlled electron–phonon coupling.

When thinned below ~100 nm, $HfTe_5$ becomes increasingly surface dominated and exhibits new correlated behavior, providing a clean platform to study the interplay of topology, dimensionality, and interactions.

In summary, $HfTe_5$ offers an exceptional opportunity to control topological phase transitions, interaction-driven condensates, and symmetry-protected boundary transport within a single material system. Its tunability and rich phase diagram make it a promising platform for spin-based electronics and topologically robust quantum devices.

Biosketch: **Luis A. Jauregui** is an Associate Professor of Physics and Astronomy at the University of California, Irvine (UCI) and Director of the Irvine Quantum Materials Center. He earned his Ph.D. from Purdue University, where his research focused on electron and phonon transport in graphene and topological nanostructures and where he received the Intel Ph.D. Fellowship and Purdue Research Foundation Fellowship. He subsequently joined Harvard University as a postdoctoral fellow, investigating the optical and electronic properties of van der Waals heterostructures.

Jauregui joined UCI in 2019 and was promoted to Associate Professor in 2026. He leads an interdisciplinary research program at the intersection of condensed-matter physics, materials science, and engineering, with an emphasis on the discovery, synthesis, and integration of quantum materials into novel device architectures. His research spans graphene, topological materials, superconductivity, van der Waals heterostructures, light–matter interactions, phonon polaritons, excitonic phenomena, and quantum sensing. His work has been recognized with several honors, including the NSF CAREER Award in 2022 and the Scialog Fellow in Quantum Matter and Information in 2025.

Séminaire organisé dans le cadre du programme interdisciplinaire MAT-PULSE