MONTANA STATE UNIVERSITY | College of LETTERS & SCIENCE

Physics Colloquium

April 8, 2025
4:10 – 5:00 PM
Roberts 101

New Spectroscopic Probes of Emergent Phenomena in Correlated Quantum Materials

Dipanjan Chaudhuri
University of Illinois Urbana-Champaign

Abstract:

Quantum materials display emergent phenomena such as superconductivity, magnetism, and topological phases, with promising applications in energy storage, computation, sensing, and communication. Understanding the microscopic origins of these phenomena and manipulating them to engineer new functionalities is a key focus in condensed matter physics. The characteristic energy scale associated with elementary excitations and collective modes in quantum materials lie in the low-energy regime ~0.02-25 THz (0.1-100 meV). In this talk, I will introduce novel spectroscopic probes to study the low-energy electrodynamic response of correlated quantum phases – THz 2D coherent spectroscopy that measures higher-order electronic susceptibilities, and inelastic electron scattering that extends our measurements to finite momentum transfer. These methods offer qualitatively new insights into the emergent phenomena in quantum materials. I will highlight our recent discovery of the exceptional THz nonlinearity in the normal state of high-Tc cuprate superconductors and use it to understand the energy relaxation and dynamics in interacting metallic phases [1]. Furthermore, I will present the first measurements of energy and momentum dependent charge susceptibility in a charge-density wave material ErTe3, revealing a divergent response predicted by Alan Heeger in 1979 but never previously observed in experiments [2].

Host: Anton Vorontsov

**** Refreshments served in the Barnard Hall second floor atrium at 3:45 PM ****