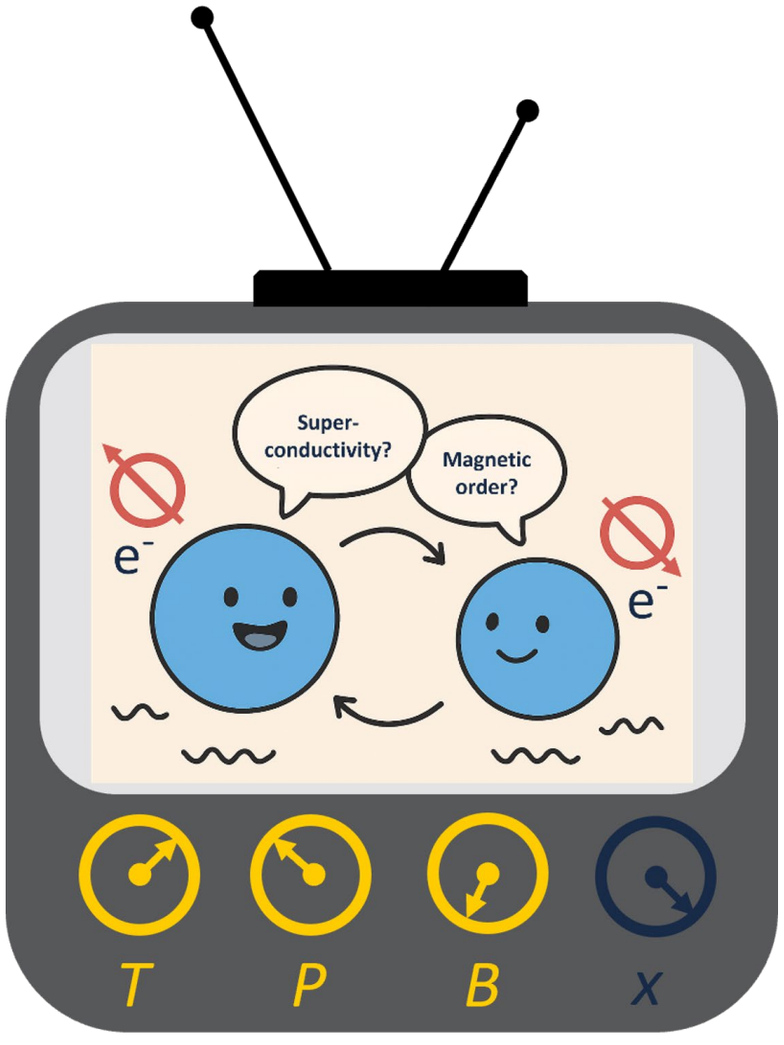
Physics Colloquium

Dr. Yuhang Deng, University of California San Diego

Correlated electron materials at extreme conditions

ABSTRACT

Correlated electron materials built from lanthanides, actinides, and transition metals host a remarkable variety of emergent phenomena, including unconventional superconductivity, exotic magnetism, heavy-fermion behavior, and topological states. These phenomena arise when strong electronic correlations and large spin–orbit coupling compete and cooperate, often producing complex states that can be delicately tuned by temperature, pressure, magnetic field, or chemical substitution. In this talk, I will present our efforts to probe such materials under extreme conditions of high pressure and intense magnetic fields. Using diamond anvil cells, versatile devices that enable electrical, magnetic, and optical measurements at high pressures, together with complementary high magnetic field techniques, we explore how these control parameters reshape quantum phases. Highlights include pressure-induced metallization and suppression of a magnetically ordered conducting surface state in FeSi, structural and valence transitions/changes in UTe_2 under compression, the evolution of multiple superconducting states in $U_{1-x}Th_xTe_2$ under high fields, and the coexistence of magnetic order and density-wave order in lanthanide-substituted nickelates. Our results illustrate how pressure, magnetic field, and composition can tip the balance in correlated electron systems, offering new insights into the fundamental mechanisms driving correlated and topological quantum phases.



3:00-4:00 p.m., Friday, October 3rd, 2025

In-person in McLane Hall 162