Chez Pierre

Presents ...

Monday, February 13, 2023

12:00pm Noon

Duboc Room – 4-331

Chez Pierre Seminar

Yong-Baek Kim, University of Toronto

"Quantum Spin Liquids and Criticality in Multipolar Materials"

Multipolar quantum materials possess local moments carrying higher-rank quadrupolar or octupolar moments. These higher-rank multipolar moments arise due to strong spin-orbit coupling and local symmetry of the crystal-electric-field environment. In magnetic insulators, the interaction between multipolar local moments on frustrated lattices may promote novel quantum spin liquids. In heavy fermion systems, the interaction between multipolar local moments and conduction electrons may lead to unusual non-Fermi liquids and quantum criticality. In this talk, we first discuss a novel quantum spin ice state, a three-dimensional quantum spin liquid with emergent gauge field, that may have been realized in $Ce_2Zr_2O_7$ and $Ce_2Sn_2O_7$, where Ce^{3+} ions carry dipolar-octupolar moments. We present a theoretical analysis of possible quantum spin ice states in this system and compare the theoretical results of dynamical spin structure factors with recent neutron scattering experiments. Next, we present a theoretical model to describe the unusual Kondo effect and quantum criticality in $Ce_3Pd_{20}Si_6$, where Ce^{3+} moments carry a plethora of dipolar, quadrupolar, and octupolar moments. We show that two consecutive Kondo-destruction-type phase transitions can occur with the corresponding Fermi surface reconstructions. We compare these results with existing experiments and suggest future ultrasound experiments for the detection of emergent quantum critical behaviors.