CONDENSED MATTER SCIENCES SEMINAR

Professor Khandker Quader

Kent State University

Host

Dr Vladimir Dobrosavljevic

Title

All the 'Buzz' about the Nickelates: A DMFT Perspective

Friday, February 20th, 2026

3rd Floor – B333

15:00-16:00

Abstract

Superconducting nickelates have garnered tremendous interest in hopes of a better understanding of unconventional superconductors. Observation of superconductivity across several platforms under varying conditions, such as, doping, pressure or biaxial strain at ambient pressure have created a distinct 'buzz' in the field. Among these are the infinite-layer systems, the Ruddlesden-Popper (RP) series and hybrid structure compounds. To understand the many-body normal state from which superconductivity emerges, it is important to ascertain the nature and role of correlations in these materials. Large-scale first-principle computational approaches, such as embedded dynamical mean field theory (eDMFT) can be valuable for obtaining the correlated ground and excited states of d- and f-electron systems such as these.

I will first present an overview of the various platforms of nickelates of current interest. Then, I will give a simple picture of what underlies the eDMFT approach. Following this, I will discuss our recent charge self-consistent DFT+ DMFT work on some of the nickelate systems, namely, RP bi-layer nickelate under compressive strain; and undoped and doped infinite-layer nickelates. In bi-layer nickelates, in contrast with DFT and DFT+U studies, at the strain where superconductivity has been observed, we find the emergence of an extra Fermi surface sheet associated with a flat Ni-d band, driven by dynamical correlations. This is consistent with recent ARPES results, and may have implications for superconductivity. In the case of undoped infinite-layer nickelate, we propose a correlation-temperature (U-T) phase diagram, showing low-T Fermi liquid phase of screened nickel d-electron moments. At non-zero doping, our study, across a range of temperature, reveals possible Ni site-selective behavior in quasiparticle scattering rates obtained at various doping levels.