Title:

Nonequilibrium electron-phonon dynamics

Abstract:

Electron-phonon interaction is an old yet evergreen problem in condensed matter physics. It is closely related to many quantum states we are concerned with, such as superconductivity, charge density waves, and polarons. It also profoundly affects, or often accompanies, critical phenomena such as the formation of excitonic insulators and metal-insulator transitions. An ultrafast laser pulse can reshape the potential energy surface and thus the coupling in the excited states, and may open up a new avenue of ultrafast coherent control of quantum phases and topological orders. However, theoretical approaches often fail to capture the coupled dynamics of the non-thermal excited carriers and the nonequilibrium lattice order.

In this talk, I will introduce how light-induced coherent phonons can cause a quasi-static lattice distortion and result in a Lifshitz transition in a nodal-line semimetal. We also demonstrate how the laser energy can shift the quasi-equilibrium lattice structure towards opposite directions, thus engineering the electronic structure via different regimes. Moreover, I will discuss our recent discovery on how nonequilibrium electron-phonon interaction can interact with the spin degree of freedom, causing ultrafast demagnetization and excitation of chiral phonons in a monolayer ferromagnet.