Talk Title /Abstract

Topological phase transitions in $MoTe_2$ Weyl semimetal

Abstract: A Weyl (semi)metal is a new topological state of matter that hosts the condensed matter equivalent of relativistic Weyl fermions. Weyl fermions exist as low-energy electronic excitations at Weyl nodes in three-dimensional momentum space, producing exotic physical properties such as unique surface Fermi arcs and negative magnetoresistance. The topological Weyl state can be realized by breaking either time-reversal or lattice inversion symmetry. A candidate topological Weyl semimetal is the quasi two-dimensional transition metal dichalcogenide $MoTe_2$. The transition to the non-trivial topologically protected crystal state occurs upon cooling from the high temperature 1T' monoclinic phase to the low temperature orthorhombic Td phase. The transition is driven by c-axis layer stacking order around 250 K [9-12]. Upon cooling to the non-centrosymmetric T_d phase, Weyl quasiparticles are expected at characteristic electron and hole band crossings in momentum space. Furthermore, $MoTe_2$ is a candidate topological superconductor in the orthorhombic phase at ambient pressure. In the superconducting state, Fermi arcs are proposed to still exist. The application of pressure can dramatically enhance the superconducting transition temperature from 0.25 up to ~8 K as well as extend the superconducting state over a wide pressure range. Recent studies suggested that while in the superconducting state, a phase transition occurs from the orthorhombic T_d back to the monoclinic 1T' phase under pressure. Using single crystal neutron diffraction, the *pressure-temperature* phase diagram is mapped out and combined with band structure calculations, we elucidate the effects of pressure on the electronic band structure topology. The results provide evidence for a topological state, beyond the T_d-1T' boundary with applied pressure.