Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

" Spontaneous polarization and spin-valley coupling effect in van der Waals group-IV monochalcogenide films"

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Abstract: Spontaneous polarization has long been known in the bulk materials of group-IV monochalcogenides (MX, M = Ge, Sn, Pb; X = S, Se, Te). However, utilizing their polarization is difficult either because of the antiferroelectric stacking (GeSe, SnSe, etc.), or the high conductivity (SnTe, GeTe). In our earlier works, significantly enhanced ferroelectricity was discovered in ultrathin SnTe films grown on graphene substrates, and the mechanism behind is still a mystery [1]. Combining molecular beam epitaxy (MBE), variable temperature scanning tunneling microscopy (VT-STM) and *ab initio* calculations, we have revealed a van der Waals layered phase, which only exists in ultrathin SnTe. The ferroelectric T_c is enhanced from ~100 K in bulk SnTe to over 400 K in ultrathin SnTe. Doping Pb into ultrathin SnTe, we have observed a ferroelectric-paraelectric quantum phase transition. The broken inversion symmetry and strong spin-orbit coupling can induce a band splitting as large as 220 meV at the valence band maximum (VBM) of the monolayer $Pb_{0.5}Sn_{0.5}Te$ film. Such a splitting generates a spin-valley locked band structure, which is promising for the potential valleytronic applications. The selective inter-valley scattering near the VBM has been demonstrated by quasiparticle interference (QPI) technique at low temperature.

[1] K. Chang et al. Discovery of robust in-plane ferroelectricity in atomic-thick SnTe. Science **353**, 274-278 (2016).

12:00pm noon
Tuesday, March 13, 2018
Duboc Room (4-331)

Host: Liang Fu