复旦大学物理系物质科学报告

Physics Department Colloquium

Valley Physics in 2D Transition Metal Dichalcogenides

Professor Wang Yao

University of Hong Kong

Abstract: The Bloch bands in many crystals have a degenerate set of energy extrema in momentum space known as valleys. For band-edge carriers, the valley index becomes a discrete degree of freedom in addition to spin. In this talk, I will show that, when inversion symmetry is broken in a 2D hexagonal lattice, a pair of valleys which are time-reversal of each other are distinguishable by their opposite values of magnetic moment and Berry curvature. These quantities give rise to circularly-polarized valley optical transition selection rule and valley Hall effect in monolayer group-VI transition metal dichalcogenides (TMDs). The valley optical selection rule makes possible dynamic pumping of valley polarization, and optical generation of excitonic valley coherence. Moreover, we find the electrons and holes at the band edges of monolayer TMDs are described by massive Dirac Fermions with strong spin-valley coupling. In a TMD bilayer with AB-stacking order, this spin-valley coupling manifests as an effective interaction between the layer pseudospin with both the spin and the valley, giving rise to a variety of magnetoelectric effects permitting quantum manipulation of these electronic degrees of freedom. Monolayer TMDs also provide an unprecedented 2D platform to explore the physics of exciton, i.e. bound state of electron and hole pair. I will show that the exceptionally large Coulomb interaction in monolayer TMDs can strongly couple the exciton valley pseudospin to the motion, giving rise to novel strain-tunable Dirac spectra.

Time：2:00 pm, Tuesday, 2014.5.20

Location：Physics Building, Room 221B

(Cookies and coffee are served from 1:30 pm)