



清华大学高等研究院

Institute for Advanced Study, Tsinghua University

学术报告

Title: Exotic response of topological insulators

Speaker: Zhou Li (RIKEN)

Time: 10:00am, Tuesday, April 17, 2018

Venue: Conference Hall 322, Science Building, Tsinghua University

Abstract

The 2016 Nobel prize in Physics was awarded to topological phase transitions and topological phases of matter. The story begins in 1980s in the search of an explanation of the quantization of Hall conductivity (TKNN formula) found by Klaus von Klitzing. Also in the earlier study of vortex and anti-vortex states, a topological phase transition (BKT transition) was identified. We use the Green's function technique and Kubo formula to study the spectral function, density of states, optical and magneto-optical conductivity in topological insulators and valleytronic materials. Quasiparticles in those materials can be described by the Dirac equation in which the gamma matrices can have Dirac representation, Weyl representation and also Majorana representation. In 1+1D and 3+1D the chirality can be defined while in 2+1D no definition of chirality can be found but the valley degree of freedom plays a similar role. In general the Kubo formula can also be generalized to study nonlinear response to the external driving electro-magnetic field E or B . One example was given in our study of the nonlinear magneto-optical conductivity for topological insulators in which the particle-hole asymmetry can generate chiral absorption of left and right circularly polarized light. Recently we study the nonlinear response (frequency up- and down-conversion) to an electric field E and found an unusual way to generate a DC current from frequency down-conversion. This may bring novel nonlinear thermoelectric functionalities (e.g. thermal energy harvesting) in the far-infrared region. Recently in a magic-angle twisted bilayer graphene (superlattice), two dimensional flat-band state was generated. We have studied the time evolution of the flat-band state in a one-dimensional disordered system. We found a de-localization together with diffusive transport induced by a type of Gaussian correlated disorders.