Structural and Electronic Properties of Topological Insulators and Nodal Line Semimetals

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In this presentation, we have briefly discussed our studies on topological insulators and semimetals. In particular, we observed a metal-semiconductor phase transition for the case of a doped topological insulator (Cu doped Bi2Te3) with temperature. This transition originated from the bulk band, whereas the surface state, which is protected by time-reversal symmetry, remained intact even at room temperature as demonstrated by our T-dependent ARPES study. The bulk band is seen to be extremely sensitive to doping. A shift from p-type to n-type in the bulk band can occur if there is a fluctuation in the dopant or if a defect is introduced while the crystal is growing. From the results of the photon energy-dependent ARPES analysis in a nodal line semimetal InBi, we have also seen a Dirac cone like structure. This observation was made in the bulk band of the nodal line semimetal. The discovered structure has interesting analogues in theoretical predictions. The nodal line semimetal demonstrates a number of fascinating properties as well, including the phase transition from semiconductor to metal when a magnetic field is applied to it, along with a very high magneto resistance that is accompanied by carrier compensation. In addition, we visualize the three-dimensional topology of the Fermi surface from the quantum oscillation study and derive several essential parameters, such as effective mass etc.