S. N. Bose National Centre for Basic Sciences

Bose Colloquium

21st February 2020

11:30 am

Fermion Hall

"Electronic instabilities in a 'flat' topological band: the case of tin telluride"

Speaker

Professor Vikram Tripathi

Tata Institute of Fundamental research (Mumbai)

Abstract

Flat band systems are an interesting platform for studying electronic instabilities because the resulting enhancement of the density of electronic states enhances the effect of even weak interparticle interactions. Often, the Bloch wavefunctions associated with the flat bands also happen to be topologically nontrivial, which in turn makes it necessary to understand the interplay of topology and correlations. Low carrier density multi-valley systems, topological insulator surfaces, Dirac and Weyl materials, and even Moire systems such as magic angle twisted bilayer graphene are all very exciting systems when viewed from this perspective.

The IV-VI semiconductor SnTe is a topological crystalline insulator (TCI) for a range of Pb doping. Topologically protected surface states with novel electronic dispersions have been found to be present on certain surfaces invariant under reflection symmetry. The topologically protected electron bands on the (001) surface are particularly interesting since they feature Type-II van Hove singularities, accessible at relatively small values of doping. The diverging density of states associated with the two-dimensional Van Hove singularities enhances the possibility of Fermi-surface instabilities on the TCI surface, brought about by weak repulsive interparticle interactions.

Wavefunctions corresponding to electrons in these bands have nontrivial geometric phases that effectively impart a momentum dependence to the interparticle interactions in a given band, that in turn, governs the nature of symmetry breaking and phase competition. We study the effect of repulsive electron interactions on the competition of different electronic phases on the (001) surface when the chemical potential is tuned to the vicinity of the Van Hove singularities. Over a wide region of parameter space of repulsive interactions, we show that a chiral p-wave superconducting phase is favoured. Implications for experiment are discussed.