Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad - 500107

Seminar

Impact of Strong Correlation on Topological Band Properties of different Lattice Systems

Arijit Saha

Institute of Physics, Bhubaneswar

Effects due to strong correlation on bands with non-trivial topology, is an active field of research in modern condensed matter theory. In this talk, first I shall give an introduction to the basic phenomena of topological insulators and strong correlation driven Mott insulators. Then as a first example, I shall discuss in detail the impact of strong correlations on a band topological insulator on the Lieb lattice. The Lieb lattice possesses three bands and with intrinsic spin-orbit coupling λ, supports topologically nontrivial band insulating phases. At half filling the lower band is fully filled, while the upper band is empty. The chemical potential lies in the flat band (FB) located at the middle of the spectrum, thereby stabilizing a flat band insulator. At this filling, we introduce on-site Hubbard interaction U on all sites. Within a slave rotor mean-field theory we show that, in spite of the singular effect of interaction on the FB, the three bands remain stable up to a fairly large critical correlation strength (Uc), creating a correlated flat band insulator. Beyond Uc, there is a sudden transition to a Mott insulating state, where the FB is destroyed due to complete transfer of spectral weight from the FB to the upper and lower bands. We show that all the correlation driven insulating phases host edge modes with linearly dispersing bands along with a FB passing through the Dirac point, exhibiting that the topological nature of the bulk band structure remains intact in the presence of strong correlation. Furthermore, in the limiting case of U introduced only on one sublattice where λ = 0, we show that the Lieb lattice can support mixed edge modes containing contributions from both spinons and electrons, in contrast to purely spinon edge modes arising in the topological Mott insulator. As a second example, I shall briefly discuss how to engineer Metal-Insulator transitions and band topology via external periodic drive in an interacting Triangular lattice.

Tuesday, Feb 4th 2020

4:00 PM (Tea/Coffee at 3:30 PM)

Auditorium, TIFR-H