Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Webinar

Transport study of the Localization behavior and magnetic proximity effect in three dimensional topological insulator Bi_2Se_3

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Topological insulators (TI) belong to the new group of quantum materials with insulating bulk and conducting surface states that are robust against back-scattering and protected by time-reversal symmetry (TRS). The charge transport mechanism in topological surface states (TSSs) is often probed by measuring the weak anti-localization (WAL) response. However, weak localization (WL) contribution from the bulk states is also known to coexist which is often ignored in the analysis. In this talk, I will show the necessity of considering bulk response in the WAL study of a TI, Bi_2Se_3. Additional mechanisms, such as anisotropic magnetoconductance (AMC) and disorder driven decoupling of TSSs will also be shown. In the second half, I will describe how proximity of such a TSS with a magnetic insulator (MI) can break the TRS and open an exchange-gap (EG) at the Dirac point which leads to the exploration of various exotic quantum effects. The proximity effect of an MI, EuS, will be demonstrated to affect the WAL response of Bi_2Se_3 film. Importantly, gate- and magnetic field cooling modulated magnetism at Bi_2Se_3/EuS interface is observed that establishes the presence of charge carrier mediated RKKY interactions across such interface. Further, study of planar Hall and magnetoresistance (MR) of the Bi_2Se_3/EuS devices has revealed an unconventional step-like behavior that may arises from the interaction of inverse proximity effect (IPE) induced interfacial spin-textures and the conduction electrons of Bi_2Se_3.

References:

[1] J. Phys.: Condens. Matter 33, 465601 (2021)
[2] npj Quantum Materials 5, 64 (2020)

Friday, Jan 14th 2022

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