Tata Institute of Fundamental Research
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Seminar

Transport study of the localisation behaviour 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-localisation (WAL) response. However, weak localisation (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 surface states' finite thickness, anisotropic magnetoconductance (AMC) and disorder driven decoupling of TSSs will also be shown. In the second half, the proximity effect of a magnetic insulator, EuS, on the WAL response of Bi_2Se_3 film will be shown. Such a magnetic proximity effect can potentially break the time reversal symmetry at the interface and open up an exchange gap at the Dirac point of TSS. Importantly, gate- and magnetic field cooling modulated magnetism at Bi_2Se_3/EuS interface is also 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 behaviour that may arise 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)

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6:30 PM

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