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Emerging weak localization effects on a topological insulator–insulating ferromagnet (Bi_2Se_3-EuS) interface[1]

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A topological insulator (TI) has a full energy gap in the bulk, and possesses gapless Dirac-like surface states. Because of time reversal symmetry, the surface states cannot be back-scattered by non-magnetic impurities [1]. When a thin magnetic layer is applied on the surface, a full insulating gap is opened, and an electric charge close to the surface is predicted to induce an image magnetic monopole [2]. To further elucidate the uniqueness of transport in the surface state of TI materials, and to investigate such predicted interplay with magnetic materials, we studied the interface between a thin film TI (Bi_2Se_3) and an insulating ferromagnet (EuS). While above the Curie temperature (T_C) of the EuS we observed positive magnetoresistance (MR), which is obtainted ubiquitously in similar TI thin films and interpreted as weak antilocalization (WAL) effects [3], below T_C the MR becomes negative near zero field, clearly indicating a proximity effect between the TI and the IF [4]. This phenomenon is consistent with recent theories that predict weak localization (WL) effects in TIs resulted from gap-opening at their surface state Dirac point [5,6].

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