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Gate-Tunable Quantum Corrections in Topological Insulator/ Insulating Ferromagnet Heterostructures JOON SUE LEE, ANTHONY RICHARDELLA, ROBBIE FRALEIGH, CHAO-XING LIU, NITIN SAMARTH, Dept. of Physics, Penn State University, University Park, PA 16802 — Heterostructures that interface a topological insulator (TI) and an insulating ferromagnet (IFM) are of current interest for potential spintronics applications, as well as for fundamental explorations of quantum phenomena resulting from broken time reversal symmetry (TRS). Since angle resolved photoemission spectroscopy cannot directly probe the modified topological surface state at the buried interface between a TI and an IFM, we use the quantum corrections to the magneto-conductance (MC) as a possible probe of broken TRS. We report systematic studies of the quantum corrections by varying temperature and chemical potential in $(Bi,Sb)_2Te_2Se$/ $Ga_{1-x}Mn_xAs$/ InP (111)A heterostructures grown by molecular beam epitaxy. We select the $Ga_{1-x}Mn_xAs$ composition to yield a conductivity of orders of magnitude lower than the TI, with a ferromagnetic Curie temperature of $16 \sim 40$ K. At fixed chemical potential, we observe a crossover from negative MC (weak anti localization) to positive MC (weak localization) as the temperature is lowered. A similar crossover is observed when the chemical potential is electrically tuned using a top gate. The results are interpreted in terms of the opening of a gap at the Dirac point. Funded by ONR and DARPA.

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