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Ferromagnetic transition and fluctuation-induced Dzyaloshinskii-Moriya interaction at the surface of three-dimensional topological insulators FLAVIO S. NOGUEIRA, Inst. for Theor. Physics III, Ruhr University Bochum, FERHAT KATMIS, JAGADEESH MOODERA, Department of Physics and Francis Bitter Magnet Laboratory, Massachusetts Institute of Technology, ILYA EREMIN, Inst. for Theor. Physics III, Ruhr University Bochum — A ferromagnetic insulator (FMI) proximate to the surface of a three-dimensional topological insulator (TI) generate a gap in the spectrum of surface Dirac fermions, provided an out-of-plane exchange exists. We study the ferromagnetic transition in TI-FMI structures and show that fluctuations from Dirac fermions induce a Dzyaloshinskii-Moriya (DM) interaction in the effective free energy of the FMI. This DM interaction arises only if the chemical potential is nonzero. Thus, if the proximity effect gaps the Dirac fermions, this means that the Fermi level must be outside the gap in order for a DM term to be induced. We also show that the Curie temperature of the ferromagnetic state at the interface between the TI and FMI is necessarily higher than the bulk Curie temperature of the FMI. This result is corroborated by recent experiments in Bi_2Se_3 -EuS bilayer structures. These results imply an interface critical behavior very different from the bulk FMI.

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