Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Proximity-induced global time-reversal symmetry (TRS) breaking and enhanced surface ferromagnetism mediated by Dirac fermions in bilayers of magnetic topological insulators (TIs) C.-C. CHEN, M. L. TEAGUE, W. FAN, N.-C. YEH, Dept. of Physics, Caltech, Pasadena, CA 91125, L. HE, X. KOU, M. LANG, K.-L. WANG, Dept. of Elec. Eng., UCLA, Los Angeles, CA 90095 — Proximity-induced magnetic effects on the surface Dirac spectra of TIs are investigated by scanning tunneling spectroscopic (STS) studies of bilayer structures consisting of an undoped TI layer Bi$_2$Se$_3$ and (Bi$_{1-x}$Sb$_x$)$_2$Te$_3$ on top of a Cr-doped, magnetic TI of 6 quintuple-layer (QL) thickness. For all samples with the top layer thinner than 4-QL, a surface gap $\Delta$ opens up below $T_{c}^{2D}$, much higher than the bulk Curie temperature $T_{c}^{3D}$ derived from the anomalous Hall resistance. The temperature ($T$) evolution of $\Delta$ shows an initial increase below $T_{c}^{2D}$, followed by a ‘dip’ near $T_{X}$, and then rises again, reaching maximum at $T \ll T_{c}^{3D}$. The gap is spatially inhomogeneous, and its average value and spatial homogeneity at low $T$ increases with applied magnetic field $H$ and Cr-doping level $x$. The appearance of massive Dirac spectra below $T_{c}^{2D}$ is the result of global TRS breaking in the surface state of TIs. The non-monotonic $T$-dependence of $\Delta$ and the finding of $T_{c}^{2D} \gg T_{c}^{3D}$ may be attributed to proximity magnetism induced by a 3D contribution from the bulk magnetism that dominates at low $T$, and a 2D contribution from the RKKY interaction mediated by surface Dirac fermions, which dominates at $T_{c}^{3D} \ll T_{X} < T < T_{c}^{2D}$ and can significantly enhance the surface magnetism due to the long wavelengths of Dirac fermions. 1C.-C. Chen et al., New J. Phys. (2015); arXiv:1506.06841

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Date submitted: 06 Nov 2015
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