Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Origin of helical spin texture of topological phase transition family materials $\mathbf{TlBi(Se_{1-x}S_x)_2}$ JUSTIN WAUGH, YUE CAO, University of Colorado at Boulder, KOJI MIYAMOTO, TAICHI OKUDA, Hiroshima Synchrotron Radiation Center, CHETAN DHITAL, STEPHEN WILSON, Boston College, DANIEL DESSAU, University of Colorado at Boulder — The unique helically spin-polarized metallic surface states of topological insulators are believed to arise from an odd number of band inversions per unit cell. It is believed that the band inversion in the family of compounds $TlBi(Se_{1-x}S_x)_2$ can be removed by replacing Se by S, removing the spin-polarized surface states. Using spin and angle-resolved photoemission spectroscopy we here show that even on the gapped non-topological "trivial" side of the phase transition (x=0.7), Dirac-like helical spin polarization still exist, as well as small but finite gaps on the topological side of the phase transition (x=0.3). Additional spin helicity inversions are also present in the bulk bands of both samples. We consider various explanations for this effect, including a superposition of domains, massive Dirac states due to thin domains, and Rashba spin orbit splitting at the surfaces.

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Date submitted: 12 Dec 2012 Electronic form version 1.4