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STM and STS studies of electronic states near macroscopic defects in topological insulators[1]

ZHANYBEK ALPICHSHEV, Stanford University

Bi_2Te_3 and Bi_2Se_3 have been argued recently to be three-dimensional (3D) topological insulators (TI), exhibiting a bulk gap and a single, non-degenerate Dirac fermion surface band topologically protected by time-reversal symmetry. In this talk we will discuss the physics of topological insulators. We will show that Scanning tunneling spectroscopy (STS) studies on high-quality Bi_2Te_3 and Bi_2Se_3 crystals exhibit perfect correspondence to ARPES data, hence enabling identification of different regimes measured in the local density of states (LDOS). Unique to Bi_2Te_3, we will discuss observations of oscillations of LDOS near a step. Within the main part of the surface band we found that the oscillations are strongly damped, supporting the hypothesis of topological protection. At higher energies, as the surface band becomes concave, oscillations appear which disperse with a particular wave-vector that results from an unconventional hexagonal warping term in the surface-state-band Hamiltonian [1]. For both systems, a bound state was observed in the bulk gap region that runs parallel to the edge of the defect and is bound to it at some characteristic distance. An expression that fits the data, and provides further insight into the general topological properties of the electronic structure of the surface band near strong structural defects, can be obtained using the full three-dimensional Hamiltonian of the system.

[1] Zhanybek Alpichshev, J. G. Analytis, J.-H. Chu, I. R. Fisher, Y. L. Chen, Z. X. Shen, A. Fang, and A. Kapitulnik *Phys. Rev. Lett.* **104** 016401 (2010)

[1]In collaboration with J. G. Analytis, J.-H. Chu, I. R. Fisher, Y. L. Chen, Z. X. Shen, A. Fang, and A. Kapitulnik.