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New forms of superconductivity and magnetism in a doped topological insulator L. ANDREW WRAY, Lawrence Berkeley National Lab, SUYANG XU, Princeton University, HSIN LIN, Northeastern University, M. ZAHID HASAN, Princeton University — Topological insulators achieve a phase of matter characterized by the quantum topology of electron kinetics rather than by broken symmetries. The topological insulator state gives rise to spin-helical surface states that dramatically alter the surface physics and allow new phenomena in the presence of purturbations such as superconductivity and magnetism. We have used angle resolved photoemission spectroscopy to map electron dynamics at the surface of a topological insulator in the presence of magnetic surface ions and with doping compositions that superconduct. Our measurements establish that bulk Cu-doped $Cu_{0.12}Bi_2Se_3$ realizes a new form of superconductivity (Wray et al, Nat. Phys. 6, 855 (2010)) and is likely to host localized non-Abelian Majorana fermions on the crystal surface. We observe that surface-deposited ions lead to the formation of new topoligically-derived surface Dirac bands, and our data suggest that magnetic moments of deposited Fe undergo a phase transition to align along the out-of-plane axis (arXiv:1009.6216).

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