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The Large-Gap Topological Insulator Class Bi_2Se_3 with a Single Dirac Cone on the Surface YUQI XIA, Princeton University, DAVID HSIEH, Massachusetts Institute of Technology, DONG QIAN, Shanghai Jiao Tong University, LEWIS WRAY, ZAHID HASAN, Princeton University — According to recent theories and experiments, strong spin-orbit coupling effects in certain band insulators can give rise to a new phase of quantum matter, the so-called topological insulator, which can exhibit macroscopic entanglement effects. It has been suggested that a topological insulator with a single spin-textured Dirac cone interfaced with a superconductor can form the most elementary unit for performing fault-tolerant quantum computation. Here we present an angle-resolved photoemission spectroscopy study and first- principle theoretical calculation which reveal Bi_2Se_3 as the first observation of such a topological state of matter featuring a single surface Dirac cone. Our results, supported by our theoretical predictions and calculations, demonstrate that undoped compound of this class of materials can serve as the parent matrix compound for the long-sought topological device where in-plane surface carrier transport would have a purely quantum topological origin. Furthermore, our study suggests that the undoped compound reached via n-to-p doping should show topological transport phenomena even at room temperature.

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