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Quantum oscillations in a topological insulator Bi-Sb[1]

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It has been elucidated by photoemission that $Bi_{1-x}Sb_x$ alloy in the insulating doping range ($0.07 \leq x \leq 0.22$) is a topological insulator, where an insulating bulk supports an intrinsically metallic surface. However, the relevance of the metallic surface state in the transport properties of $Bi_{1-x}Sb_x$ has been unclear. In high-quality $Bi_{0.91}Sb_{0.09}$ crystals, we observe strong quantum oscillations bearing a clear 2D character, which gives compelling evidence that a 2D electron system is responsible for the metallic transport observed in nominally-insulating $Bi_{0.91}Sb_{0.09}$ [A. A. Taskin and Y. Ando, Phys. Rev. B **80**, 085303 (2009)]. A puzzling aspect of our finding is that the amplitude of the 2D quantum oscillations is orders of magnitude larger than what is naively expected for the surface electrons, possibly pointing to a novel physics of helical Dirac fermions. For a higher doping of $x = 0.17$, we obtain an even more puzzling result that the quantum oscillations present a very unusual angular dependence that defies any conventional interpretations in terms of Fermi surfaces. We are trying to understand it by invoking novel conduction channels in topological insulators. Work in collaboration with A. A. Taskin.

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