Topological Insulator with Dislocation Lines

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We report our recent study[1] on protected gapless surface states in a weak topological insulator. We propose a workable model for describing dislocation lines introduced into a three-dimensional topological insulator. We show how fragile surface Dirac cones of a weak topological insulator evolve into protected gapless helical modes confined to the vicinity of dislocation line. We demonstrate that surface Dirac cones of a topological insulator (either strong or weak) acquire a finite-size energy gap, when the surface is deformed into a cylinder penetrating the otherwise surface-less system. This reveals that the topological stability of protected 1D modes stems from this finite-size energy gap associated with the spin Berry phase. The latter has been a subject of much theoretical attention in the context of peculiar Aharonov-Bohm oscillations observed recently in a system of strong topological insulator.

[1]K.-I. Imura, Y. Takane, A. Tanaka, arXiv:1103.1430.