Second order weak topological insulator in a nanowire geometry.

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Recently proposed second order topological insulators [1] are characterized by a bulk gap in the band structure and also possess gapped surface states. The protected gapless modes may appear at the hinge connecting two surface boundaries with opposite gap in the spectrum. The simplest realization of such scenario is a topological insulator crystal subject to external magnetic field, which penetrates adjacent faces pointing inwards and outwards.

We model the crystal on a simple cubic lattice with a tight binding model and we introduce anisotropy in one direction (z-direction). This allows us to obtain different phases of strong and weak topological insulators. We consider hinges between different faces in a nanowire geometry, where the number and presence of boundary Dirac nodes depends on crystal phase and surface orientation.

We assume presence of strong Zeeman coupling to the magnetic field, which induces a gap in the spectrum of surface states and results in creation of the hinge states. In particular, we discuss the conditions for magnetic field strength, orientation and finite size effects, which allow for the formation of hinge states. The results are illustrated mainly with numerical calculations, and we also provide some analytical estimates.

[1] J. Langbehn, Y. Peng, L. Trifunovic, F. von Oppen, and P. W. Brouwer, Phys. Rev. Lett. **119**, 246401 (2017).