Impurities in Topological Insulators

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Topological insulators are narrow-band semiconductors with band inversion generated by strong spin-orbit coupling. They are distinguished from the ordinary band insulators according to the Z2 invariant classification of the band insulators that respect time-reversal symmetry. The variation of the Z2 invariant at their boundaries will lead to the topologically protected edge or surface states with the gapless Dirac energy spectrum. Imperfections, such as impurity, vacancy, and disorder, are inevitably present in topological insulators. Owing to the time-reversal symmetry, an exciting feature of topological insulator is that its boundary states are expected to be topologically protected against weak nonmagnetic impurities or disorders. This provoked much interest on the single impurity problem in a topological insulator. In this talk, the speaker will introduce a series of solutions of the bound states induced by impurities in topological insulators and superconductors. The impurities can be classified as the topological and non-topological ones. Conventional defects and impurities can induce a series of in-gap bound states while topological defects such as domain walls, vortex lines and magnetic monopoles may produce the bound states of zero energy which are robust against geometry deformation and disorders in the materials. In topological superconductors, these zero energy bound states are Majorana fermions.

References

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