Magnetotransport measurements for detection of Dirac fermions in topological insulators

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Abstract

Topological insulators (TIs) are materials that are insulating in their bulk but present metallic states on their surface. This is the simplest definition for a complex quantum effect that results from strong spin-orbit coupling that changes the topological order of the material. The metallic states host spin-polarized currents composed of Dirac fermions flowing on the topological surface states (TSS). The TSS of TIs are protected by time-reversal symmetry (their physics is independent of whether time is flowing backward or forward). Some years ago, a new class of materials called topological crystalline insulators (TCIs) were discovered, where the TSS are protected by crystal symmetries. Both TIs and TCIs are part of a wider group called quantum materials in which the quantum-mechanical effects fundamentally alter properties of the material leading to new states of condensed matter. In the particular case of TIs and TCIs, the potential to application in quantum computation and spintronic is enormous. Prior to the application in development of new technologies, however, the detection of Dirac Fermions via electrical transport measurements is mandatory [1].

The detection of Dirac fermions in TIs via transport measurements represents a big challenge for experimentalist. The main reason is that the TIs are not really insulators but mostly highly degenerates narrow-gap semiconductors, which leads to a massive contribution from bulk states to electrical transport. In this talk, the results of magnetotransport measurements performed on Bi_2Te_3 and SnTe nano-structures will be presented. The investigation will involve the analysis of Shubnikov-de Haas oscillations in SnTe structures [2] and weak anti-localization effect in Bi_2Te_2 nano films providing a full description of the important parameters that characterize the electrical transport in these materials.

References

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