Quantum interference theory of magnetoresistance in topological materials

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Abstract

Topological insulator and semimetal have attracted much attention and witnessed impressive theoretical and experimental breakthroughs in the past decades. Recently, an intriguing magnetic field- driven crossover from positive to negative magnetoresistance (MR) has been widely observed in variety of topological materials, where a notch-shaped longitudinal MR appears in the vicinity of the zero magnetic field and turns into a negative MR when the magnetic field exceeds some critical value. The origin of the notch at small field is not completely understood and may arise from quantum interference effect or the Zeeman energy. The large negative longitudinal MR at higher field is commonly attributed to the chiral anomaly and regarded as a crucial transport signature for Weyl fermions but some other mechanisms are also proposed. In this talk, I will introduce a quantum interference theory for magnetoresistance in topological materials. Strong competition between weak localization and weak anti-localization is uncovered in the massive and massless Dirac particles in topological materials, in which the conduction bands and the valence bands are strongly coupled. This will be revealed through the non-monotonic behaviors of magnetoresistance in these materials.

References:

1.H. W. Wang, B. Fu & S. Q. Shen, Anomalous temperature dependence of quantum correction to the conductivity of magnetic topological insulators, (2019) arXiv.: 1909.09297

2.B. Fu, H. W. Wang & S. Q. Shen, Quantum interference theory of magnetoresistance in Dirac materials, Phys. Rev. Lett. 122, 246601 (2019)/arXiv: 1901.00965

3.H. Z. Lu & S. Q. Shen, Weak anti-localization and localization in disordered and interacting Weyl semimetals, Phys. Rev. B 92, 035203 (2015)

4.H. Z. Lu & S. Q. Shen, Competition between weak localization and anti-localization in topological surface states, Phys. Rev. Lett. 107, 076801 (2011)

About the Speaker

Professor Shun-Qing Shen is a professor of physics in Department of Physics, The University of Hong Kong. He is an expert in the field of condensed matter physics, distinguished for his research works on topological insulator, transport theory of topological materials, spintronics of semiconductors, quantum magnetism and orbital physics in transition metal oxides, and novel quantum states of condensed matters. He proposed topological Anderson insulator, spin transverse force, resonant spin Hall effect and theory of phase separation in colossal magnetoresistive (CMR) materials. He developed the theory of weak localization and weak antilocalization in Dirac electrons in the surface states and topological materials. He has published a single-authored monograph, Topological Insulators (Springer, 1st ed., 2012; 2nd ed., 2017), which is the first book on the topic.

Professor Shen received his BS, MS, and Ph()]TJETQq0.000000547 0 571.2 817.8 reW*nBT/F9 9.48 Tf1 0 0 1 204.19 87.408 Tm0 g0 G9( )]TJE