

Abstract Submitted
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Weak antilocalization in HgTe quantum wells and topological surface states: Massive versus massless Dirac fermions¹

EWELINA HANKIEWICZ, GRIGORY TKACHOV, Wuerzburg University — HgTe quantum wells and surfaces of three-dimensional topological insulators support Dirac fermions with a single-valley band dispersion. In this work we conduct a comparative theoretical study of the weak antilocalization in HgTe quantum wells (QWs) and topological surface states. The difference between these two single-valley systems comes from a finite band gap (effective Dirac mass) in HgTe quantum wells in contrast to gapless (massless) surface states in topological insulators. The finite effective Dirac mass implies a broken internal symmetry, leading to suppression of the weak antilocalization in HgTe quantum wells and transition to the weak localization regime as a function of the gap or carrier density. In particular, we show how the difference in the behavior of the weak localization corrections for HgTe QWs allows to distinguish topological versus normal insulators. Further for the topological surface states we predict specific weak-antilocalization magnetoconductivity in a parallel magnetic field due to their exponential decay in the bulk. The relevant experiments will be discussed.

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Ewelina Hankiewicz
Wuerzburg University

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