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Current distribution in a two-dimensional topological insulator

XIAOQIAN DANG, JOHN BURTON, EVGENY TSYMBAL, Univ of Nebraska - Lincoln — Topological insulator (TI) is a bulk insulator with spin-dependent surface (edge) states that are protected by time-reversal symmetry. This property makes TIs very interesting for potential application in electronic devices. Here we report on theoretical investigations of transport properties of a model two-dimensional (2D) TI where the conductance is controlled by the topologically protected edge states. We utilize the tight-binding form of the Bernevig-Hughes-Zhang model [1] and employ the Landauer-Büttiker formalism to explore the transport properties in the presence of impurities. Using the Green's function technique we calculate the current distribution for states within the bulk band gap of the 2D TI. Interestingly, in absence of impurities we find that the current density decays into the bulk in an oscillatory fashion reflecting an oscillatory decay pattern of the local density of states as predicted from the complex band structure. [2] Non-magnetic impurities disturb this picture and lead to a complex spatial distribution of current; however, the net transmission along the edge is conserved and remains a spin conductance quantum as expected from general considerations.

[1] B. A. Bernevig *et al.*, *Science*, **314**, 1757 (2006).
[2] X. Dang *et al.*, Phys. Rev. B **90**,155370 (2014).

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