Asymmetric Transport in Topological Insulators

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Abstract

Asymmetric transport along interfaces separating insulating bulks has been observed and shown to be robust to perturbations in many settings. This surprising robustness has a topological origin. The talk proposes a classification of elliptic partial differential operators modeling such systems by means of confining domains walls. This defines a first topological invariant as the index of a Fredholm operator computed explicitly by a Fedosov-Hormander formula. We also characterize asymmetric transport by a physical observable, an edge conductivity, itself naturally associated to a second topological invariant whose calculation is less direct. We present a general bulk-edge correspondence stating that the two invariants in fact agree. The theory is illustrated on several examples of applications in bilayer graphene models, geophysical models, and three-dimensional higher-order topological insulators.