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Spin Generation Via Bulk Spin Current in Three Dimensional Topological Insulators XINGYUE PENG, University of California, Davis - Physics Department — To date, charge transport and spin generation in three-dimensional topological insulators (3D TIs) are primarily modeled as a single-surface phenomenon. We propose a new mechanism of spin generation where the role of the insulating yet topologically non-trivial bulk becomes explicit: an external electric field creates a transverse pure spin current through the bulk of a 3D TI, which transports spins between the top and bottom surfaces and leads to spin accumulation on both. The surface spin density and charge current are then proportional to the spin relaxation time, which for a sufficiently high disorder level can be extended by nonmagnetic scattering analogous to the Dyakonov-Perel spin relaxation mechanism. This new spin generation mechanism suggests a distinct and practical strategy for the enhancement of surface spin polarization by increasing nonmagnetic impurity concentration. Numerical results obtained by coherent potential approximation (CPA) based on a 4-band lattice model confirm that this spin generation mechanism originates from the unique topological connection of the top and bottom surfaces and is absent in other two dimensional systems such as graphene, even though they possess a similar Dirac cone-type dispersion.

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