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Disorder-induced dimensionality transition and non-local transport in Sb_2Te_3 thin films[1] INNA KORZHOVSKA, The City University of New York, Graduate Center, SHIHUA ZHAO, LUKAS ZHAO, ZHIYI CHEN, LIA KRUSIN-ELBAUM, The City College of New York, SIMONE RAOUX, Helmholtz-Zentrum, Berlin, GHIDEWON AREFE, Columbia University in the City of New York — We examine the effects of disorder on local and non-local charge transport in thin (20-50 nm) films of topological insulator (TI) Sb_2Te_3, where a very large range of structural disorder is obtained by a suitable annealing protocol. The films were patterned in H- and Π- shaped structures of various sizes, and the response of each structure was then recorded as a function of disorder. Under strong disorder, the non-local response is found to be strong. Remarkably, we find that highly disordered films also exhibit a nontrivial magnetic response. With decreasing disorder W the non-local signal is progressively reduced and disappears concurrently with the magnetic response. This occurs at the level of disorder W_t at which magnetoconductance (MC) changes its character from a 3D positive MC state to a 2D WAL (weak antilocalization) negative MC state, characteristic of TIs. The 3D positive MC suggests that for $W > W_t$, MC is controlled by disorder-driven spin correlations (rather than orbital effects). We explore the connection of non-local transport to helical edges and discuss our findings in the context of recently proposed spin-memory effects in disordered systems.

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