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Sensing Coulomb impurities with 1/f noise in 3D Topological Insulator SEMONTI BHATTACHARYYA, MITALI BANERJEE, HARIHARAN NHALIL, SUJA ELIZABETH, ARINDAM GHOSH, Indian Institute of Science, Bangalore — Electrical transport in the non-trivial surface states of bulk Topological Insulator (TI) reveal several intriguing properties ranging from bipolar field effect transistor action, weak antilocalization in quantum transport, to the recently discovered quantum anomalous Hall effect. Many of these phenomena depend crucially on the nature of disorder and its screening by the Dirac Fermions at the TI surface. We have carried out a systematic study of low-frequency 1/f noise in $Bi_{1.6}Sb_{0.4}Te_2Se_1$ single crystals, to explore the dominant source of scattering of surface electrons and monitor relative contributions of the surface and bulk channels. Our results reveal that while trapped coulomb impurities at the substrate-TI interface are dominating source of scattering for thin (10 nm) TI, charged crystal disorder contribute strongly in thick TI (110 nm) channels. An unexpected maximum at 25K in noise from thick TI devices indicate scattering of the surface states by a cooperative charge dynamics in the bulk of the TI, possibly associated with the Selenium vacancies. Our experiment demonstrates, for the first time, impact of the bulk charge distribution on the surface state transport in TIs that could be crucial to the implementation of these materials in electronic applications.

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