**Bi$_2$Se$_3$ and Bismuth: A comparison of transport in topological and trivial materials**

ANTHONY RICHARDELLA, Penn State University, MICHEL VAN MAASAKKERS, Eindhoven University of Technology, DUMING ZHANG, JOON SUE LEE, NITIN SAMARTH, Penn State University — The simple surface state structure of Bi$_2$Se$_3$ has made it one of the most promising materials for harnessing transport through topologically protected surface states. Identifying unambiguous signatures of transport through these states is difficult however due to residual bulk conductivity and the formation of 2D electron gases near the surface due to band bending. As in bulk bismuth these non-topological states are subject to strong-spin orbit coupling. Very thin films of bismuth are predicted to be 2D topological insulators and thus are interesting themselves for a topological to non-topological transition as a function of thickness. Analysis of signatures such as weak anti-localization and linear magnetoresistance are compared between high quality MBE grown films of these materials to determine what can and cannot be ascribed to transport through protected surface states.

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