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Experimental Analysis of Weak Anti-localization in Topological Insulator Thin Films JISOO MOON, NAMRATA BANSAL, MATTHEW BRAHLEK, NIKESH KOIRALA, SEONGSHIK OH, Rutgers, State University of New Jersey — The weak anti-localization (WAL) effect, seen as a sharp cusp in resistance vs magnetic field at small fields, is quantified by the Hikami-Larkin-Nagaoka (HLN) formalism that yields information about the effective number of 2D conducting channels in terms of the parameter A. In thin-film Bi_2Se_3, A has a typical value of 1, even if the ideal value is 2 that occurs if top and bottom surfaces are decoupled. We show that this is due to bulk being metallic. On depleting the bulk carriers, the value of A increases to 2, though only if the film is thick enough. In the ultra-thin regime, $<$6 nm, a gap is formed at the Dirac point; A remains 1 if the Fermi level is away from Dirac point and into the conduction band, and only drops to 0 when Fermi level is tuned into the Dirac gap, though this occurs only for thin films with high mobility. In case of highly disordered films with poor carrier mobilities, the value of A can change from 1 to 0 as the film thickness is reduced, even if the Fermi level is away from Dirac gap. We provide a coherent picture of how A evolves depending on disorder, bulk properties and film thickness.

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