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Photo-galvanic effect in Bi_2Se_3 thin films with ionic liquid gating[1]

YU PAN, ANTHONY RICHARDELLA, JOON SUE LEE, THOMAS FLANAGAN, NITIN SAMARTH, Department of Physics, Penn State University — A key challenge in three dimensional (3D) topological insulators (TIs) is to reveal the helical spin-polarized surface states via electrical transport measurements. A recent study [Nature Nanotech. **7**, 96 (2012)] showed that circularly polarized light can be used to generate and control photocurrents in the 3D TI Bi_2Se_3, even at photon energies that are well above the bulk band gap. Symmetry considerations suggest that this "photo-galvanic effect" arises purely from photo-currents induced in the surface Dirac states. To gain insights into this phenomenon, we have carried out systematic measurements of the photo-galvanic effect in electrically gated MBE-grown Bi_2Se_3 thin films of varying thickness. By using an ionic liquid as an optically transparent gate, we map out the behavior of the photo-galvanic effect as a function of Fermi energy over a temperature range 5 K $\leq T \leq$ 300 K.

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