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Giant Faraday effect due to Pauli exclusion principle in 3D topological insulators HARI PAUDEL, MICHAEL LEUENBERGER, Univ of Central Florida — Experiments using ARPES, which is based on the photoelectric effect, have shown that the surface states in 3D topological insulators (TI) are gapless. Here we consider Weyl interface fermions due to band inversion in narrow-bandgap semiconductors, such as Pb{1-x}Sn{x}Te. We determine the optical selection rules of electron-hole pair excitation by means of the solutions of the 3D Dirac equation. We calculate explicitly the electric dipole matrix elements by means of bandstructure calculations for Pb{1-x}Sn{x}Te. Using the 3D Dirac equation and bandstructure calculations, we show that the transitions between positive and negative energy solutions, giving rise to electron–hole pairs, obey strict optical selection rules. We apply our results to calculate the Faraday effect due to the Pauli exclusion principle in a pump–probe setup using a 3D TI double interface of a PbTe/Pb{0:31}Sn{0:69}Te/PbTe heterostructure. The Faraday rotation angle exhibits oscillations as a function of probe wavelength and thickness of the heterostructure. The maxima in the Faraday rotation angle are of the order of mrds.

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