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Optical selection rules for electron-hole pair excitation in 3D topological insulators HARI PAUDEL, MICHAEL LEUENBERGER, University 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 helical. Here we consider Weyl interface fermions due to band inversion in narrow-bandgap semiconductors, such as $Pb_{1-x}Sn_xTe$ and $Bi_{1-x}Sb_x$. We determine the optical selection rules of electron-hole pair (EHP) excitation by means of the solutions of the 3D Dirac equation. While EHPs in graphene are generated through intraband transitions, we show that in 3D TI they are generated through both intraband and interband transitions. For their analysis, we calculate explicitly the electric dipole matrix elements by means of bandstructure calculations for $Pb_{1-x}Sn_xTe$. We will introduce a spin helicity operator in 3D TI. Our results are crucial for future opto-spintronic devices based on 3D TI.

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