Ultrafast dynamics of photoexcited Dirac fermions at the surface of topological insulators.

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Abstract

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The surface states of 3D Topological Insulators have been the subject of intensive theoretical and experimental studies after the discovery of their exceptional transport properties [1,2]. Topological order leads to a substantial suppression of back-scattering and to their robust helical spin texture; these conducting edge states are consequently immune to defects and impurities and present a potential interest for novel technological applications. To fully understand all these aspects, a detailed study of the empty electronic states and of the dynamics of excited carriers is essential.

We used time-resolved and angle-resolved photoelectron spectroscopy (TR-ARPES) to study the out-of-equilibrium dynamics of prototype 3D topological insulators of the Bi2Te3 family [4] with femtosecond temporal resolution. Optical excitation in the Dirac cone takes place thanks to interband scattering processes involving the bulk conduction band. The out-of-equilibrium Dirac fermions present a fast thermalization, but also an unusually long relaxation time, which will be discussed in light of the weak electron-phonon coupling of the electronic states in the surface Dirac cone.

M.Z. Hasan, and C.L. Kane, Rev. Mod. Phys., 82, 3045 (2010).

X.-L. Qi, and S.-C. Zhang, Rev. Mod. Phys., 83, 1057 (2011).

M. Hajlaoui, E. Papalazarou, et al. Nano Lett.12, 3532 (2012).

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