Ultrafast Carrier Dynamics in 2D- and 3D-Dirac Materials

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In this contribution I will report on recent trARPES results on the relaxation of hot carriers in 2D- and 3D-Dirac cones. In the study of highly oriented pyrolytic graphite (HOPG) we were able to follow different stages in the formation of a Fermi-Dirac distribution in a 2D-Dirac cone within the first 50 fs after excitation with 7 fs pump pulses [1] (see Fig. 1). The data allow discerning processes associated with electron-electron and electron-phonon interaction, which act differently on the energy and momentum relaxation of the nascent carrier distribution [2]. In the 3D-Dirac material Cd_3As_2 the photoexcitation with 840 nm laser pulses results in an indirect population of the Dirac cone from higher-lying states. We observe a depopulation of the Dirac cone taking place on picosecond timescales. In contrast to HOPG the characteristic carrier dynamics is additionally accompanied by a transient band renormalization in the vicinity of the Dirac point.

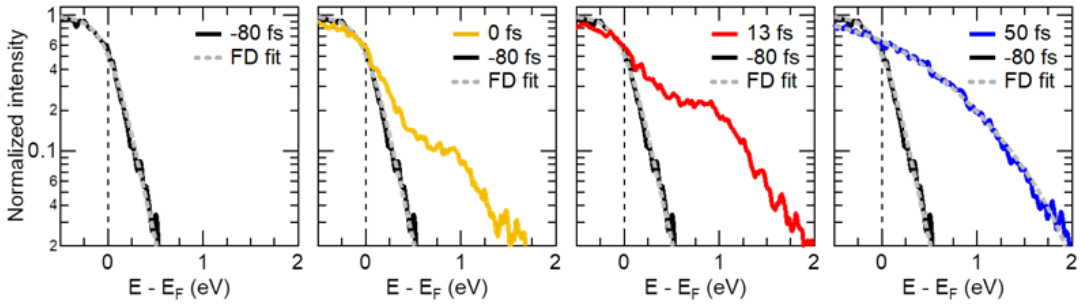

Fig. 1: Formation of a Fermi-Dirac distributed electron gas in HOPG within 50 fs after excitation with 800 nm, 7 fs pump pulses [1].

References:

[1] G. Rohde et al., Phys. Rev. Lett. **121**, 256401 (2018).

[2] E. Malic et al., Appl. Phys. Lett. **101**, 213110 (2012).