

Auger scattering in massless Dirac and Kane materials

Wednesday, 6 July 2022 11:00 (45)

We present an overview that sheds light into the carrier dynamics of in Landau-quantized Dirac and Kane systems, namely graphene and mercury cadmium telluride (MCT). The non-equidistant Landau-ladder makes these materials highly attractive for realizing the old dream of the semiconductor physics community to fabricate a Landau-level laser. For a recent review on this topic, see Ref. [1]. In such a laser, stimulated emission is achieved between a pair of Landau levels and the emission wavelength can be tuned by the strength of the magnetic field. In graphene, we found evidence for strong Auger scattering for the lowest allowed transitions $LL_{-1} \rightarrow LL_0$ and $LL_0 \rightarrow LL_1$ [2]. These energetically degenerate transitions can be distinguished by applying circularly polarized radiation of opposite polarization. In this configuration, Auger scattering can cause depletion of the LL_0 level even though it is optically pumped at the same time. Recently, we have investigated the $LL_{-2} \rightarrow LL_1$ and $LL_{-1} \rightarrow LL_2$ transition under strong optical pumping. This transition is a candidate for the lasing transition for a Landau-level laser. We observed non-equilibrium carrier distributions by selective pumping before thermalization occurred. MCT, on the other hand, is even more attractive because of much longer relaxation times [3]. They are on the ns scale while in graphene thermalization occurs on a timescale of a few ps. The reason for the longer timescale is the different Landau ladder due to spin splitting.

References:

- [1] E. Gornik, G. Strasser und K. Unterrainer, *Nature Photonics* **15**, 875 (2021).
- [2] M. Mittendorff, F. Wendler, E. Malic, A. Knorr, M. Orlita, M. Potemski, C. Berger, W. A. de Heer, H. Schneider, M. Helm und S. Winnerl, *Nature Physics* **11**, (2015).
- [3] D. B. But, M. Mittendorff, C. Consejo, F. Teppe, N. N. Mikhailov, S. A. Dvoretiskii, C. Faugeras, S. Winnerl, M. Helm, W. Knap, M. Potemski und M. Orlita, *Nature Photonics* **13**, 783 (2019).

Primary author(s) : Dr WINNERL, Stephan (Helmholtz-Zentrum Dresden-Rossendorf)

Presenter(s) : Dr WINNERL, Stephan (Helmholtz-Zentrum Dresden-Rossendorf)

Session Classification : Wed 06/07 Morning 2/ change at 11 o'clock keynote1 J.M Klopff / Abstract ID