Ultrafast Electron Kinetics in Graphene

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Graphene is an ideal structure to study the efficiency of different carrier relaxation channels in a two-dimensional system: Its linear energy dispersion and the vanishing bandgap allow scattering processes, which are suppressed in conventional semiconductors.

Here, we present self-consistent calculations of the coupled carrier and phonon dynamics based on a time resolved second order Born-approximation. This approach allows to track the way of optically excited carriers toward equilibrium - resolved in time-, momentum-, and angle - in theory and corresponding experiments (Helmholtz-Zentrum Dresden-Rossendorf; RWTH Aachen; Max Born Institute Berlin).

In particular, our calculations predict a significant contribution stemming from Auger processes. Inverse Auger recombination leads to a considerable carrier multiplication – in spite of the directly competing phonon-induced processes. Unique signatures of Auger processes can be identified in pump-probe experiments on pristine graphene and in a magnetic field.