Terahertz response of graphene is governed by basic thermodynamics

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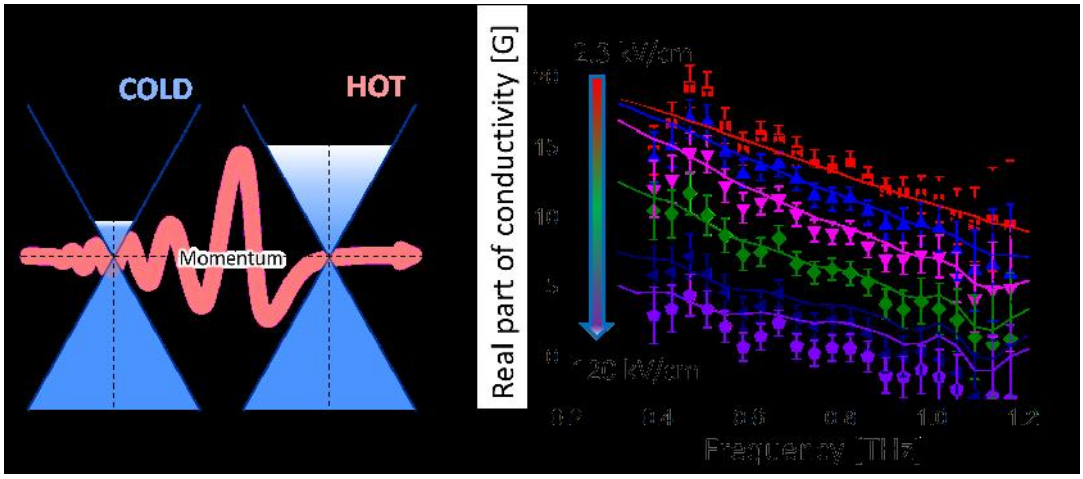
In this presentation we will show, that the terahertz linear, non-linear and photo-conductivity of graphene [1–3] can be accurately described within a simple picture, in which the free carrier population of graphene act as thermalized electron gas in or out of equilibrium with graphene lattice. Within this simple thermodynamic picture, the electron population quasi-instantaneously increases its temperature by absorbing the energy of driving THz electric field or incident photon, and at the same time cools down via a time-retarded, few picosecond-long process of phonon emission. The asymmetry in electron heating and cooling dynamics leads to the heat accumulation in the electron population of graphene, concomitantly lowering the chemical potential for hotter electrons, and thereby reducing the intraband conductivity of graphene – an effect crucially important for understanding of ultrafast graphene transistors, photodetectors and other ultra-high speed graphene-based electronic devices.



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