Two-phonon scattering in graphene in the quantum Hall regime

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One of the most distinctive features of graphene is its huge inter-Landau-level splitting in experimentally attainable magnetic fields resulting in the room-temperature quantum Hall effect. We have calculated the longitudinal conductivity due to two-phonon scattering in graphene in a quantizing magnetic field over a broad range of temperatures. The multi-phonon scattering mechanism [1] is known to be negligible for conventional two-dimensional systems under the quantum Hall conditions apart from exotic cases such as magneto-roton dissociation in phonon spectroscopy [2]. However, our calculations show that this mechanism dominates in the high-temperature quantum Hall regime in graphene, since at elevated temperatures the energy of an acoustic phonon with a wavevector comparable to the inverse magnetic length is much smaller than the temperature; therefore, a number of such phonons increases drastically. Single-phonon processes in pristine graphene in this regime remain suppressed due to momentum and energy conservation requirements. We show that the two-phonon scattering mechanism provides a significant error in Hall conductivity measurements, and it is therefore a major obstacle in using graphene as a room-temperature quantum Hall standard of resistance.

[1] V. N. Golovach and M. E. Portnoi, Phys. Rev. B **74**, 085321 (2006).
[2] V. M. Apalkov and M. E. Portnoi, Phys. Rev. B **66**, 121303 (2002).