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Quasiparticle properties in graphene[1]

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The quasiparticle properties in both single layer and bilayer graphene are presented. We study the electron self-energy as well as the quasiparticle spectral function in graphene, taking into account electron-electron interaction in the leading order dynamically screened Coulomb coupling and electron-impurity interaction associated with quenched disorder. Our calculation of the self-energy provides the basis for calculating all one-electron properties of graphene. We provide analytical and numerical results for quasiparticle renormalization in graphene. Comparison with existing angle-resolved photoemission spectroscopy measurements shows broad qualitative and semiquantitative agreement between theory and experiment, for both the momentum-distribution and energy-distribution curves in the measured spectra. We also present the inelastic quasiparticle scattering rate and the carrier mean free path for energetic hot electrons as a function of carrier energy, density, and temperature, including both electron-electron and electron-phonon interactions. Our results are directly applicable to device structures where ballistic transport is relevant with inelastic scattering dominating over elastic scattering.

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