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RPA Theory of Carrier Correlations in Graphene YAFIS BARLAS, TAMI PEREG-BARNEA, University of Texas at Austin, MARCO POLINI, Scuola Normale Superiore di Pisa, ALLAN MACDONALD, University of Texas at Austin
— We have applied RPA theory to examine some consequences of electronic correlations in doped and undoped graphene. The full wavevector and complex-frequency dependent polarization bubble was evaluated using dimensional regularization in the absence of doping and adding the appropriate carrier-scattering and Pauli-blocking corrections in doped systems. We have evaluated the RPA correlation energy as a function of charge and spin density by integrating the dynamically screened Coulomb interaction along the imaginary axis and from this have extracted the compressibility, and the spin and valley susceptibilties. We have also evaluated the frequency and wavevector dependent self-energy and used this to extract the doping dependence of velocity renormalization and the quasiparticle spectral weight at the Fermi energy. The accuracy of RPA theory applied to graphene will be critically discussed.

Yafis Barlas
University of Texas at Austin

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