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Many-body interactions in graphene and graphite via infrared magnetospectroscopy

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The electronic band structures of graphene and graphite exhibit unusual low-energy dispersion relation, radically different from the parabolic bands common to conventional two-dimensional semiconductors. Most interestingly, the charge carriers in graphitic systems mimic relativistic, massless Dirac particles, leading to intriguing new phenomena. In this talk, I focus on infrared optical studies of graphene and graphite in high magnetic fields (up to 35 T). In particular, we resolved resonances between hole Landau levels and electron Landau levels (intraband transitions), as well as resonances between hole and electron Landau levels (interband transitions). We argue that many-body correlations of massless Dirac Fermions, considering electron-electron, electron-phonon and electron-plasmon interactions, contribute considerably to our experimental results. Our work suggests that rich interacting physics exists in graphitic materials, which may have profound implications in future optoelectronics.

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