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Many-body effects on the optical and magnetic properties of doped graphene sheets.

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I report on the results of our recent investigations of many-body effects in doped graphene sheets. First, we have calculated the first-order interaction corrections to the Drude weight, plasmon dispersion, and optical response of this system. We find that, due to the lack of Galilean invariance, both the plasmon frequency and the Drude weight are enhanced relative to the RPA value. This effect is due to the coupling between the center of mass motion and the pseudo-spin degree of freedom of the massless Dirac fermions. We then apply similar many-body theoretical methods to the calculation of the orbital magnetic susceptibility of a gas of interacting massless Dirac fermions. This susceptibility is zero in the absence of interactions, when the Fermi energy is away from the Dirac point. Our perturbative calculations show that first-order interaction corrections to the orbital magnetic susceptibility are finite and positive. Doped graphene sheets are thus unique systems in which the orbital susceptibility is completely controlled by many-body effects, leading to orbital paramagnetism.

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