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Electrostatic control of many-body interactions in graphene: Observation of the effects of doping on the saddle-point exciton KIN FAI MAK, Columbia University, KELIANG HE, Case Western Reserve University, NICK PETRONE, JIM HONE, Columbia University, JIE SHAN, Case Western Reserve University, TONY HEINZ, Columbia University — Significant excitonic effects were recently identified in the optical response of graphene through the asymmetric resonance feature at 4.62 eV in the optical conductivity. The peak, which is red-shifted by nearly 600 meV from the predicted band-to-band transition energy,[1] can be considered as a saddle-point exciton. Here we report a systematic study of this excitonic feature as a function of the doping density, for densities extending up to the metallic regime[2] ($\sim 10^{14} cm^{-2}$). With increasing density of either electrons or holes, the excitonic resonance is found to shift to the red and to become more symmetric in form. These experimental features agree very well with a recent ab-initio GW-Bethe-Salpeter calculation[3] and can be understood as a consequence of enhanced "metallic" screening of the graphene dielectric function.[4] In addition, analysis of the width of the excitonic peak provides information on the quasiparticle lifetime. Mechanisms for the inferred rapid quasiparticle decoherence will be discussed.

[1]Mak et al. Phys. Rev. Lett. 106, 046401, (2011).
[2]Efetov & Kim, Phys. Rev. Lett. 105, 256805, (2010).
[3]Felipe H. da Jornada, J. D., Steven G. Louie. Private communications. (2011).
[4]Hwang, E. H. & Das Sarma, S. Phys. Rev. B 75, 205418

Jie Shan
Case Western Reserve University

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