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The spectral function and quasiparticle dynamics of graphene thin films[1]

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Graphene, a single layer of carbon atoms arranged in a simple honeycomb lattice, is the building block of graphite, fullerenes, and carbon nanotubes and has fascinating electronic properties deriving from the effectively massless, relativistic behavior of its charge carriers. The study of many-body interactions among these carriers is of interest owing to their contribution to superconductivity in these systems. I will report synthesis of graphene thin films (1-4 layers) grown on SiC and the evolution of their band structure using angle-resolved photoemission spectroscopy (ARPES). We determined the spectral function for graphene as a function of doping, which encodes the many-body interactions among the quasiparticles in the system—namely the charge and vibrational excitations. Our measurements show that the bands around the Dirac crossing point are heavily renormalized by electron-electron, electron-plasmon, and electron-phonon coupling, showing that these interactions must be considered on an equal footing in attempts to understand the quasiparticle dynamics in graphene and related systems. At very high doping (comparable to graphite intercalation compounds (GICs)) renormalization of the carrier mass near E_F becomes significant for electrons moving in certain directions, supporting the importance of electron-phonon coupling in superconductivity in GICs.

[1]Work done in collaboration with A. Bostwick, T. Ohta, J. L. McChesney (LBNL), Th. Seyller (U. Erlangen), K. Horn (Fritz Haber Institute).