Contribution ID: **138** Type: **Invited**

# Probing Interactions and Dynamics in Single- and Few-Layer Graphene by Optical Spectroscopy

*Monday, 23 July 2012 09:15 (25 minutes)*

Tony F. Heinz

Departments of Physics and Electrical Engineering
Columbia University, New York, NY 10027

The optical conductivity of graphene provides a sensitive probe not only of the basic band structure, but also of various interactions in the system. In this talk, we will discuss three recent directions that highlight these possibilities.

(1) Probing electron-electron interactions. While the optical conductivity of graphene at low photon energies (~1 eV) conforms well to band structure calculations, at higher photon energies, we observe strong deviations. The existence of a pronounced peak around 4.5 eV is predicted within a single-particle picture. The strongly asymmetrical shape of the peak, however, can be understood only within the picture excitonic corrections, notably in the form of a saddle point exciton. The optical conductivity thus provides a direct indication of the strong many-body electronic interactions in graphene. The effect of carrier screening, as probed by changing the carrier density through electrostatic gating, on these interactions will be discussed.

(2) Probing interlayer interactions. The interactions between different layers define the low-energy band structure of few-layer graphene. We have examined the band structure through measurements of the infrared conductivity, emphasizing particularly the role of stacking order - Bernal (ABA) and rhombohedral (ABC) – in few-layer graphene samples. The influence of perpendicular static electric fields on the band structure is shown to depend critically on stacking order.

(3) Probing electron-phonon interactions. The infrared conductivity also permits probing of C-C stretching (G-mode) vibrations of appropriate symmetry in few-layer graphene. We show the existence of strong coupling between these discrete modes and the electronic absorption continuum. The line shape of the modes depends strongly on the electronic structure and varies with layer thickness and stacking order.

**Primary author:** HEINZ, Tony (Columbia University)

**Presenter:** HEINZ, Tony (Columbia University)

**Session Classification:** Graphene I

**Track Classification:** Graphene