

PHYSICS DEPARTMENT

COLLOQUIUM

“Shedding new light on graphene, semiconductors, and high temperature superconductors using polarized infrared magneto-spectroscopy”

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10:50am – 12:20pm

Abstract: By measuring the change in the polarization of transmitted/reflected infrared light in the presence of a magnetic field, infrared Hall studies have provided new insights into a variety of interesting materials including high temperature superconductors, magnetic semiconductors, and graphene. Even a conventional two-dimensional electron gas formed at a GaAs/AlGaAs heterojunction recently has shown unexpected behavior in the infrared Hall effect. In this talk I will discuss recent cyclotron resonance (CR) measurements in GaAs and graphene. In the GaAs/AlGaAs heterojunction, we observe remnants of dc quantum Hall effect plateaus in the optical regime where THz photons (~ 10 meV) are being resonantly absorbed in inter-Landau-level transitions. Although plateaus in the THz Hall conductivity have been predicted theoretically by Morimoto et al. (PRL 2009), this is a remarkable and surprising experimental result for such a well-studied system, where CR measurements have been made for decades without observing these plateaus at the resonance. In epitaxial graphene, we observe a rich and complex CR structure in the mid-infrared (~ 100 meV), with over 18 CR features from 0-5T. By using Fourier transform Kerr spectroscopy we are able to separate and identify CR from graphene multilayers with various stacking orders and thicknesses. Moreover, from the identification of the layers present and their measured fundamental band parameters we are able to use these results to better understand previously unexplained CR features in far-infrared (0.1 meV - 87 meV) transmission measurements performed on the same sample. I will also discuss new work using infrared polarization-sensitive measurements to explore symmetry breaking in the pseudogap state of cuprate high temperature superconductors. (This work is supported by NSF-DMR1006078 and NSF-DMR1410599.)