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Materials Research Science and Engineering Center

MRSEC SEMINAR SERIES

Magneto-optics in Carbon Nanotubes, Graphene, and Graphite

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Time: 3:00 PM

Location: Microelectronics Research Center, Room 102 A & B

Abstract:

Matter placed in a strong magnetic field provides a fascinating laboratory in which to study exotic quantum phenomena in a highly controllable manner. This talk will summarize our recent findings of novel magnetic properties of carbon nanotubes, graphene, and graphite, probed via high-field magneto-optical spectroscopy. A magnetic field applied parallel to a nanotube introduces an Aharonov-Bohm phase to the electronic wave function, which leads to band gap oscillations, magnetic brightening of dark excitons, and extremely large magnetic susceptibility anisotropy. In graphene, a magnetic field applied perpendicular to the layer results in Landau quantization with non-equal spacings; we highlight a novel situation where *electron* cyclotron resonance appears in the magnetic quantum limit even though the sample is *p*-type. Finally, for graphite, we observe strongly temperature-dependent, asymmetric spectral lines in electronic Raman spectra in magnetic fields up to 45 T applied along the *c*-axis. The magnetic field quantizes the in-plane motion while the out-of-plane motion remains free, effectively reducing the system dimension from three to one. Optically created electron-hole pairs interact with, or "shake up," the one-dimensional Fermi sea in the lowest Landau subbands, resulting in Fermi-edge singularities.