Physics Colloquium, University of South Florida
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☞*Refreshment available* ☜

Ultrafast Optics of Graphene and Graphene Multilayers

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Graphene is being widely investigated for both its remarkable electronic and optical properties. Graphene is of course famous for the unique properties arising partly from being atomically thin, but there are also many interesting phenomena and new applications opened up by the exploration of layered graphene structures. This talk will present an experimental program in ultrafast spectroscopy of graphene, and discuss how unusual properties of graphene and multilayer structures built of graphene can be revealed through optical and THz-domain spectroscopy. I will discuss femtosecond mid-infrared spectroscopy as an approach to studying the dynamics of hot electrons, their interactions with acoustic phonons, and the materials properties of multilayer epitaxial graphene. I will then discuss our extensions of mid-infrared studies to coherent control of optically generated ballistic currents in graphene. In addition to demonstrating the generation of THz radiation via coherently controlled currents, we have shown that the polarization dependence can reveal the presence of coupling between layers in multilayer epitaxial graphene. Furthermore, we have shown that a consequence of the "relativistic" band structure of graphene is that electron-electron scattering can relax a current (unlike the situation in normal parabolic-band semiconductors). Time-domain THz spectroscopy also reveals new aspects of interlayer interactions in multilayer systems, such as thermal coupling via carrier Coulomb interactions. Multilayers of graphene separated by dielectric layers can also provide new opportunities: I discuss how hyperbolic metamaterials may be constructed based on such structures, and how novel ultrasensitive ultrabroadband photodetectors may be made.