Physics Colloquium

Giti Khodaparast

Department of Physics, Virginia Tech University

Magneto-Optical and Ultrafast Optical Phenomena in Multi-functional Materials

Magneto-optical and time resolved spectroscopy are extremely powerful tools and have provided crucial information on matter, its properties, structure, and dynamics. The confinement of electrons in nanostructured materials or in a strong magnetic field can result in fascinating phenomena for quantum optics and condensed matter physics, in which electronic states can be designed and controlled. My group, using state-of-the-art spectroscopic techniques, studies magneto-optical and ultrafast optical phenomena in several important materials systems. Ultrafast optical spectroscopy can provide insight into fundamental microscopic interactions, dynamics and the coupling of several degrees of freedom. In this talk examples in the area of ferromagnetic semiconductors and multiferroic materials, will be presented. Both static and dynamical material properties are being investigated from the macroscopic to microscopic nanoscale response, across multiple length and time scales combining time-resolved far-field and local probe spectroscopy. Specifically, we use ultrafast optical spectroscopy to gain insight into the microscopic interactions that determine the macroscopic material properties. Our studies will provide insight into the fundamental interactions among the many coupled degrees of freedom (electrons, holes, phonons, electronic and nuclear spin, etc.) in our systems [1,2].

[1] B. A. Magill, K-D Park, Y. Zhou, A. Chopra, Maurya, S. Priya, M. B. Raschke, A. Belyanin, C. J. Stanton, G. A. Khodaparast "Ultrafast Anisotropic Optical Response and Coherent Acoustic Phonon Generation in Polycrystalline $BaTiO_3$-$BiFeO_3$", Energy Harvesting and Systems. Volume 3, Issue 3, Pages 229–236, April (2016).

[2] 21- M. Bhowmick, T. R. Merritt, and G. A. Khodaparast, Bruce W. Wessels Stephen A. McGill, D. Saha, X. Pan, G. D. Sanders, and C. J. Stanton, (2012) "Time-resolved differential transmission in MOVPE-grown ferromagnetic InMnAs" Phys. Rev. B 85, 125313 (2012).

*Professor **Giti Khodaparast** is an associate professor of physics at Virginia Tech. The focus of her research activities has been to utilize and enhance the importance and power of magneto-optical spectroscopy to explore quantum coherence, correlations, and many-body effects in several materials systems that can play important roles in developing concepts for the next generation of devices or shed lights on the underlying interactions at the nanoscale. She has established modern experimental techniques including femtosecond time resolved optical, magneto-optical, nonlinear spectroscopy, and magnet-transport, at the physics department. In addition, she has established strong national and international collaborations with large research facilities including the National High Magnetic Field Laboratory in Florida, and the Megagauss Laboratory in Kashiwa, Japan. She is the recipient of both the NSF career and the AFOSR young investigator awards.*

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