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

Many body interaction and correlation in atomic vapors

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Many body interaction and correlation in an atomic ensemble are fundamental in understanding collective and emergent phenomena that cannot be understood by a simple extrapolation of the microscopic laws of a few particles. Experimentally confirmed understanding of many body interaction and correlation in atoms is essential for many problems in cold atoms/molecules, optical atomic clock, semiconductors, and photosynthesis.

The dipole-dipole interaction has been studied mainly in cold atoms by using photoassociation spectroscopy. On the other hand, rich structural and dynamic information about dipole-dipole interactions can be found in atomic vapors at room or higher temperatures. Compared to cold atoms, a thermalized atomic vapor provides a broader range of mean interatomic separation and more atoms for experiments. Thermal motion also introduced many-body effects and dynamics that may not present in cold atoms and may be shared by natural processes in chemical and biologic systems. Experiments with thermalized atoms complements studies in cold atoms/molecules for a full understanding of many body interaction and correlation.

I will present our studies of many-body interaction and correlation in potassium and rubidium atomic vapors by using a novel ultrafast spectroscopic technique – two dimensional coherent spectroscopy. This technique provides an extremely sensitive and background-free detection of interatomic dipole-dipole interactions even in a dilute gas that is usually considered an ideal gas. Our results reveal effects of dipole-dipole interactions at a mean interatomic distance of micrometers, confirming the long-range nature of dipole-dipole interaction. The spectra also provide direct evidence of multiple-atom correlated states (Dicke states) up to 4 atoms.

Hebin Li is currently an assistant professor in the Department of Physics at Florida International University. He received his B.S. in physics from Wuhan University in 2001, and his Ph.D. in physics from Texas A&M University in 2010. Before joining the faculty at FIU in 2013, he worked as a Postdoctoral Research Associate at JILA, a joint institute of the National Institute of Standards and Technology (NIST) and the University of Colorado at Boulder. He is interested in many-body quantum systems consisting of interacting atoms, molecules and electrons. He develops and uses techniques and ideas in ultrafast spectroscopy and quantum optics to probe and manipulate quantum dynamics of such systems.