武汉物数所理论交叉学术交流系列报告
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Multi-dimensional snapshots of many-body quantum dynamics: from atoms to 2D semiconductors

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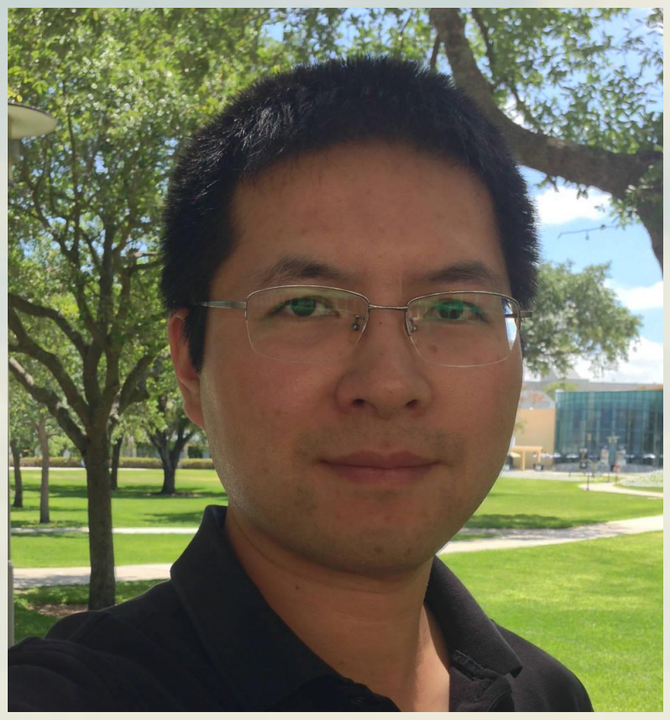
About the lecturer:



Hebin Li, received his BS degree from Wuhan University in 1997-2001, and his PhD degree from Texas A&M University in 2004-2010. After his graduation, he continued his research with Prof. Steven Cundiff in JILA, University of Colorado and National Institute of Standards and Technology as an associate researcher from 2010 to 2013. Since then, he is an Associate Professor at Department of Physics, Florida International University in Miami.

During his PhD and research career till now, he has been engaged in the research on the dynamic process and coherent regulation of the interaction between laser field and atoms, the dynamic process and coherent regulation of the interaction between laser field and semiconductor nanostructures (quantum well, atomic-level two-dimensional system, etc.), and the technology and application of multidimensional ultra-fast Fourier transform spectroscopy.

Abstract:

Many-body interaction and correlation 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 quantum dynamics is essential for many problems in cold atoms/molecules, optical atomic clocks, semiconductors, and photosynthesis.

In this presentation, I will introduce the idea of optical two-dimensional coherent spectroscopy (2DCS) and its experimental implementations in our lab. I will then talk about its applications in studying many-body interaction and dynamics in atoms and semiconducting 2D materials. In atomic vapors, double-quantum 2DCS provides an extremely sensitive and background-free detection to dipole-dipole interactions. The resulting 2D spectra reveal effects of dipole-dipole interactions at a mean interatomic distance of micrometers, confirming the long-range nature of dipole-dipole interaction. The technique can also be extended to multi-quantum coherent spectroscopy to provide direct evidence of multiple-atom correlated states (Dicke states) up to 7 atoms. Besides atomic vapors, optical multi-dimensional coherent spectroscopy is also a powerful tool for studying many-body dynamics and coupling in semiconductor nanomaterials. I will present several applications in semiconducting 2D materials, where unique information about the carrier dynamics can be obtained from 2D spectra.

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