QuanTalks

IISc Quantum Technology Initiative (IQTI) Seminar Series

Title

Multidimensional sensing and spectroscopy with quantum light: from IR to XUV

Speaker

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Date & Time

Wednesday, 19th October 2022, 5 PM (IST)

Venue

Physics Department Auditorium, IISc

Meeting Link

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Abstract: The progress in quantum optics utilizes a unique photon state configuration for engineering of the ultimate light-matter interactions with relatively simple material systems. It results in a broad range of photonic applications including radiation sources, quantum communication, information, computing and nanotechnology. The development of the ultrafast multidimensional nonlinear spectroscopy that has been enabled by progress in ultrafast optical technology provides a unique tool for probing complex molecules, semiconductors, nanomaterials by classical light fields. I will show how new quantum phenomena in complex systems can be studied and controlled using advances in both quantum optics and nonlinear spectroscopy. In particular, I investigate how to probe, control, and image the dynamics of these complex systems using quantum light and reveal the material information, which is not accessible by conventional classical photonics tools. In the second part of the talk, I will discuss a novel method for monitoring electronic coherences using ultrafast spectroscopy and create quantum states of light in high harmonic regime. This method is based on the time-domain high-order harmonic spectroscopy where a coherent superposition of the electronic states is first prepared by the strong optical laser pulse using a three-step mechanism introduced by Lewenstein and Corkum. The coherent dynamics can then be probed by the higher order harmonics generated by the delayed probe pulse. The main advantage of the method is that only optical (non-X-ray) laser is needed. In addition, a semi-perturbative model based on the Liouville space super operator approach is developed for the bookkeeping of the different orders of the nonlinear response for the high-order harmonic generation using multiple pulses. Coherence between bound electronic states is monitored in the harmonic spectra from both the first and the second order responses. The nature of the multi-wave mixing in high harmonic regime allow to modify the statistics of light and give rise of quantum squeezing between higher harmonics suitable for higher signal-to-noise ratio measurements of electronic properties in multi-eV range.

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Biography: Konstantin E. Dorfman was born in Russia. He completed his B.S. degree in Physics from Nizhny Novgorod State University, Russia, in 2006. In 2009 he completed his Ph.D. degree at Texas A&M University. From 2009 to 2015 he worked as a postdoctoral scholar at Princeton University, Texas A&M University, University of California, Irvine, and a staff scientist in Singapore Agency for Science, Technology and Research (A*STAR). Dr. Dorfman is currently a Zijiang Endowed young professor of physics at State Key Laboratory of Precision Spectroscopy, East China Normal University, Shanghai. His scientific interests include atomic, molecular, optical, and chemical physics, quantum and nonlinear optics and photonics, X-ray optics, ultrafast phenomena, and quantum thermodynamics. Dr. Dorfman published over 70 research articles in scientific journals including high impact publications in Review of Modern Physics, PNAS, PRL, Nature Communications, JACS, Chemical Reviews, Accounts of Chemical Research.

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