HQOC

HARVARD Quantum Optics Center

ITAMP

Institute for Theoretical Atomic Molecular and Optical Physics

Joint Quantum Sciences Seminar

Wednesday | Apr. 3 | 4:00 pm
Jefferson 250

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"Shining a (Bright) Light on the Very Small"

Extensive research in Nano-optics over the last decade has made possible controlling optical fields on the nanometer scale. Such concentration of light, well below the limit of diffraction opens plenty of new routes towards enhanced interaction with tiny amounts of matter down to the single molecule/atom level. In this talk we will present our recent advances in enhanced light-matter interaction on the nanometer scale and their applications to quantum optics.

We first discuss the controlled electromagnetic coupling of single to few quantum emitters with plasmonic nano-antennas. For this purpose, we developed a fabrication technique that enables accurate positioning of said quantum dot(s) at a predefined location of the antenna. Our experiments first show that the antenna can be designed to efficiently control the emission properties of the quantum emitters. Using the same technique, we also demonstrate that a single qdot can be used to probe the optical near field of the antenna.

In the second part of the talk we discuss a different approach in which light is used to trap and manipulate a single nanodiamond containing a single nitrogen vacancy. We demonstrate both translational and angular control of the trapped NV and discuss applications to vectorial magnetometry and mapping of the electromagnetic local density of states.

The final part of the talk presents our recent advances in optomechanics. We optically trap a single nanoparticle in high vacuum and cool its three spatial degrees of freedom by means of active parametric feedback. Using a single laser beam for both trapping and cooling we demonstrate a temperature compression ratio of four orders of magnitude. The absence of a clamping mechanism provides robust decoupling from the heat bath and eliminates the requirement of cryogenic precooling. The small size and mass of the nanoparticle yield both high resonance frequencies and quality factors along with low recoil heating, which are essential conditions for ground state cooling and for low decoherence.

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Student Presentation TBD

Student Presentation will begin at 4:00 PM
Guest Presentation will begin at 4:30 PM
Refreshments will be provided