ANDREAS MULLER 'Quantum Optics with Semiconductor Quantum Dots'

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Seminar, November 30, 2009, 12:00. Seminar Room

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Semiconductor quantum dots are discrete atom-like quantum entities on a chip that can strongly interact with light and could serve as building blocks of single and entangled photon sources, quantum repeaters, and quantum information processors. However, the solid-state environment imposes constraints that are different from those typically encountered in the spectroscopy of trapped atoms or ions in free space. Thus innovative approaches need to be developed for efficiently interfacing and optically manipulating the quantum states of these solid-state "artificial atoms".

In this talk I will describe our most recent progress in this direction. I will first report our successful measurements of resonance fluorescence from a single quantum dot using a waveguide-based orthogonal excitation/detection geometry in order to overcome background laser scattering. For the fist time, we access both the weak (elastic) scattering regime as well as the nonlinear (inelastic) regime characterized by oscillations in the correlation functions and the spectral Mollow triplet. Secondly I will describe a novel approach to coupling single quantum dots to an optical microcavity based on a micromirror that is external to the semiconductor sample. This open cavity is fully tunable spectrally with a piezo actuator and a single dot can be conveniently positioned at the cavity-field antinode. Fabricating the micromirror at the tip of a fiber permits direct collection into a well-defined detection mode. This may allow us to efficiently interface quantum dot/cavity systems with each other, as well as with completely different, unrelated quantum entities, such as entangled photon pairs generated from parametric downconversion.

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Hosted by Prof. Maciej Lewenstein