Quantum Electrodynamics with Quantum Dots in Photonic Nanostructures

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Abstract

2D photonic crystal membranes fabricated in GaAs containing InGaAs quantum dots have in recent years proven to be a very successful platform for all-solid-state quantum optics experiments. In a photonic crystal, the light-matter interaction strength can be tailored, i.e. either enhanced or suppressed by controlling the lattice constant of the structure. We will present experimental results on how highly efficient single-photon sources can be constructed by coupling single quantum dots to a photonic crystal waveguide exploring slow light [1]. The role of disorder in the form of fabrication imperfections is explored and found to lead to Anderson localization of light enabling cavity quantum electrodynamics by exploiting disorder as a way to enhance light-matter interactions [2]. We finally demonstrate that the mesoscopic character of quantum dot emitters implies that the traditional point-dipole description of light-matter interaction may break down in plasmonic nanostructures [3] providing a new way to strongly interface photons with matter.