Plenary Talk PV VIII Wed 12:10 Audimax

Quantum Nano-Optics — •Jelena Vuckovic — Stanford University

By embedding a single quantum emitter inside a nanoresonator that strongly localizes optical field, it is possible to achieve a very strong light-matter interaction. The strength of this interaction is characterized by the coherent emitter-field coupling strength (g), which increases with reduction in the optical mode volume and which also sets the limit on the operational speed of such a system. While in systems consisting of a single neutral atom coupled to a cavity maximum $g/(2\pi) = 20$ MHz has been demonstrated, quantum dots inside photonic crystal cavities have reached $g/(2\pi) = 40$ GHz. Such a quantum dot-nanocavity platform has also been employed in a series of quantum and nonlinear optics experiments at the single or few photons level, that are of importance for applications ranging from all optical computing and optical interconnects, to bio-sensors and quantum repeaters.

Considering that the speed of each of these elements is ultimately limited by g, it is worthwhile building structures that localize light into volumes even smaller than those of photonic crystal cavities (typically on the order of a cubic optical wavelength). In nano-metallic and metamaterials cavities, light can be squeezed into volumes that are a few orders of magnitude times smaller than those of photonic crystal cavities, opening a new field of quantum metaphotonics. As an example, a silver nano-cavity was used to demonstrate a strong interaction with a single quantum dot, with coherent coupling strengths exceeding 100GHz.