Single photon generation and non-linearity with a semiconductor quantum dot.

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In a semiconductor quantum dot, the Coulomb interaction between carriers results in a strong anharmonicity of the energy levels. This non-linearity is widely used to generate single photons on demand. It has also been recently explored to implement single photon routers. Both these applications requires to implement a highly efficient single photon-single quantum dot interface, so as to collect every photon emitted by the quantum dot or, symmetrically, so that every photon sent on the device interacts with the quantum dot. In this talk, I will present our recent progresses in this research line.

By deterministically coupling a single quantum dot to the optical mode of a micropillar cavity, we implement a highly efficient single quantum dot-single photon interface. We demonstrate the fabrication of ultrabright sources of indistinguishable single photons with a record brightness of 79% collected photon per pulse. The indistinguishability of the emitted photons varies with the excitation conditions and can reach values as high as 92% [1–3]. Symmetrically, we show that such devices can be used to demonstrate optical non-linearities at the level of only few incident photons [4]. When a single spin is inserted in the quantum dot, the polarization of a photon sent on the device can be rotated by $\pm 6^{\circ}$ depending on the single spin state [5].

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