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Resonant excitation of a quantum dot in a photonic wire

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In this poster, we will present our latest experimental results on resonant excitation of a single InAs quantum dot (QD) embedded in a GaAs photonic wire. The system is shown in fig. 1. The QD emits light at a wavelength λ~900 nm. It has been shown to be a very efficient single photon source [1,2]. The wire is an almost perfect waveguide that can collect more than 90% of the photons emitted by the QD. A noteworthy property of these photonic wires is that this performance is maintained over a broadband of 20 nm around the central wavelength of 900 nm. As a consequence, any emitting transition within this range will benefit from this quasi one-dimensional photonic extraction.

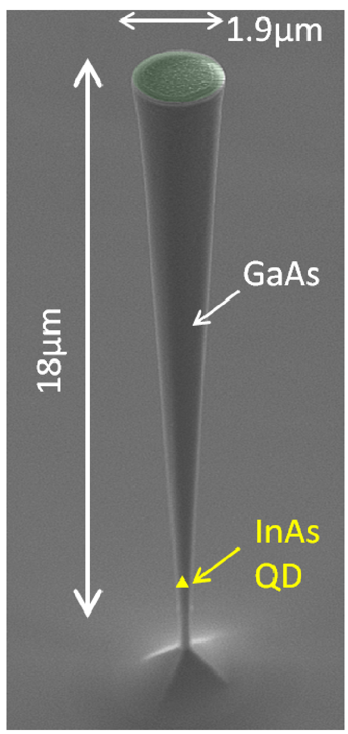

Figure 1. Scanning electron microscope image of a trumpet like photonic wire. The quantum dots are located 1 µm above the basis of the wire.

It turns out that these devices can also be used the other way around to couple a propagating electromagnetic field to a single emitter with an optimal efficiency. In this situation, the probability for the single quantum object to absorb a photon fed into the structure is maximal. One can then take advantage of the strong non-linear behaviour of a two-level system to achieve giant non-linearity at the single photon level [3,4]. This has already been realized with a good efficiency using a resonant photonic structure to enhance the light matter interaction [5-7]. An interesting property of these photonic wires is that their large frequency bandwidth allows two different laser frequencies to be coupled with two different transitions of the quantum dot, while maintaining a very high coupling efficiency. This will enable two-mode nonlinearity at the single photon level in the optical domain, as was already achieved in one-dimensional circuit quantum electrodynamics [8].

We have already observed resonant signatures a single QD in a reflectivity experiment. We will present our on-going work on this topic.

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