GaAs Quantum Dots for Quantum Networking

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Nowadays, the majority of quantum optics experiments involving semiconductor-based quantum emitters are performed with Stranksi-Krastanow InGaAs quantum dots (QDs). This material system has been instrumental in the fabrication of near-optimal single photon sources and it is considered to be an "established choice". However, the performances of InGaAs QDs as sources of entangled photons have not yet reached the levels required for quantum networking.
In this talk, I will focus on a system that has received limited attention so far: GaAs QDs grown via droplet etching/epitaxy. After a brief introduction on the general properties of these QDs, I will show how they can be easily integrated onto semiconductor-piezoelectric devices capable of reshaping their emission properties [1, 2]. Then, I will demonstrate that under two-photon resonant excitation GaAs QDs can generate pure single photons [3], and highly indistinguishable entangled photon-pairs [4, 5] with concurrence larger than 97% [6]. Finally, I will present our first advanced quantum optics experiments performed with these QDs: I will show quantum teleportation using single and entangled photons emitted by the very same QD [7], and discuss two-photon interference experiments performed with two QDs located in different cryostats [8]. A discussion on future perspectives will conclude the talk.

References

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