Semiconductor sources of quantum light

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Quantum light is a key ingredient of the emerging second quantum revolution. It is the cornerstone of many applications ranging from quantum computing to quantum networks, offering many degrees of freedom to encode the information. Semiconductor quantum dots are artificial atoms that, over the years, have been shown to be excellent sources of quantum light.
In this talk, I will briefly present the platform and explain how, using the tools of cavity quantum electrodynamics and semi-conductor nano-processing, quantum dots have become close to text-book quantum emitters. They generate single photons at unparalleled efficiency and near perfect quantum purity [1,2] opening the path toward the development of intermediate scale quantum computing [3]. Playing with the spin degree of freedom of a carrier trapped in the quantum dot, we recently unlocked a critical knob for scaling up: the efficient generation of photonic cluster state – chains of entangled photons [4]. Finally, this system also allows us to revisit the fundamentals of light-matter interaction and exploit them to generate entanglement in the photon number basis [5].

References

[1] *Somaschi et al., Nature* **Photonics 10** (5), 340 (2016)
[2] *Thomas et al.,* ***Physical review letters*** *126 (23), 233601 (2021)*
[3] https://cloud.quandela.com/
[4] N. Coste et al., ***Nature Photonics*** *(2023)*
[5] SC Wein et al., ***Nature Photonics*** *16 (5), 374-379 (2022)*

Figures

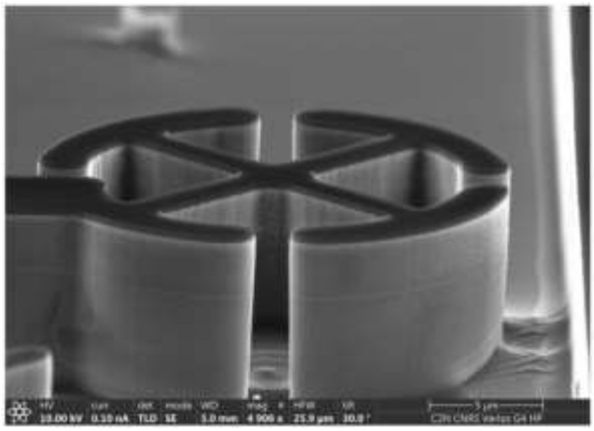

Figure 1: Scanning electron microscope image of a quantum dot-cavity device that we explore as a source of single and entangled photons, as a spin-photon interface as well as a model system to revisit light-matter interaction at the quantum level.

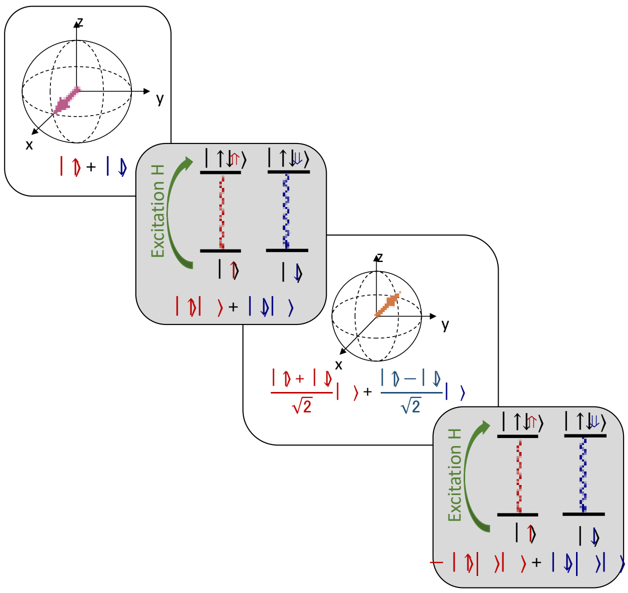

Figure 2: Schematic of the spin-photon-photon entanglement scheme [4].