From solid-state quantum emitters to photonic quantum computers

Recent progress in the field of semiconductor quantum dots has recently enabled the fabrication of single-photon sources which are bright, pure and indistinguishable [1]. By placing dots in micropillar optical cavities, we maximise the probability that photons are emitted into a single output mode as well as improving the quantum properties of the emission. Furthermore, by trapping a single electron or hole inside the quantum dots, we can use the same technology to deterministically entangle spins and photons [2], which we have leveraged to generate streams of photons which are sequentially entangled to one another [3].

This versatile platform is now reaching a level of maturity which will enable many technologies of the 2nd quantum revolution, including quantum computing. In this talk, I will present Quandela's approach to emitter-based single-photon sources, describe how they are being put to use in the first European photonic quantum computer available on the cloud [4], and give some perspective on future quantum processing unit architectures based on spins and photons [5].

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[4] N. Maring *et al.*, Nat. Photon. **18**, 603 (2024). https://doi.org/10.1038/s41566-024-01403-4

[5] G. de Gliniasty *et al.*, Quantum **8**, 1423 (2024). https://doi.org/10.22331/q-2024-07-24-1423