Nano building blocks for quantum networks

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With the aim of realizing complex quantum networks, we develop quantum devices based on nanostructures to generate quantum states of light with semiconductor quantum dots, single photon detectors based on superconducting nanowires and on-chip circuits based on waveguides to filter and route light.

The generation of single photons can readily be performed with single quantum dots. We demonstrate a very high single photon purity exceeding 99.99% generated at 795 nm with GaAs quantum dots[1], these quantum emitters also allow for interfacing with atomic ensembles. To enable long distance communication, we are also developing devices based on single InAs quantum dots able to emit at telecom frequencies[2].

Quantum entanglement is an important resource for quantum technologies, we will demonstrate generation of entanglement with quantum dots and discuss the limits to fidelity with the biexciton-exciton cascade[3].

To allow for complex architectures, on-chip integration is desirable. We will demonstrate filtering and routing of single photons with tunable ring resonators on a chip and discuss the scalability of this approach[4].

Generation and manipulation of quantum states of light would be useless without single photon detectors. We are therefore developing high-performance single photon detectors based on superconducting nanowires and will present state-of-the-art performance in terms of detection efficiency and time resolution[5].

References

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