Strong coupling between a microwave photon and a singlet-triplet qubit

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Spin qubits offer a promising approach towards scalable quantum computing due to their long coherence time, small size, and fast gate operation times [1]. The combination with circuit quantum-electrodynamics could enable interconnectivity between distant qubits by using superconducting resonators as quantum buses, as is standard for superconducting qubits [2]. A promising way to couple the spin degree of a qubit to microwave photons of a superconducting resonator is by exploiting electron-dipole spin resonance which relies on spin-orbit interaction. This simplifies the devices architecture, since it does not require micromagnets [3-5].
In contrast to previous work, we are making use of the intrinsic spin-orbit interaction of zincblende InAs nanowires (NW) [6]. We use NWs that contain a built-in crystal-phase defined double quantum dot (DQD), where the tunnel barriers are grown in wurtzite crystal structure [7]. The DQD is coupled to a high quality, magnetic field resilient resonator [8]. To maximize the photon-qubit interaction [9] we use a high-impedance resonator with an impedance of ~2 kΩ. We investigate the hybrid DQD-resonator system and observe the formation of a singlet-triplet qubit. We reach the strong coupling limit between the singlet-triplet qubit and a single photon stored in the resonator.

References

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Figures

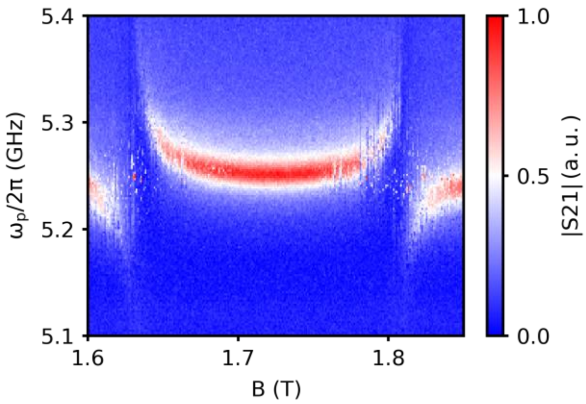

Figure 1: Resonator transmission as function of the magnetic field and the probe frequency revealing an anti-crossing between a resonator and a singlet-triplet qubit hosted in a semiconducting NW QD.