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Combining high-impedance resonators with crystal-phase defined double quantum dots

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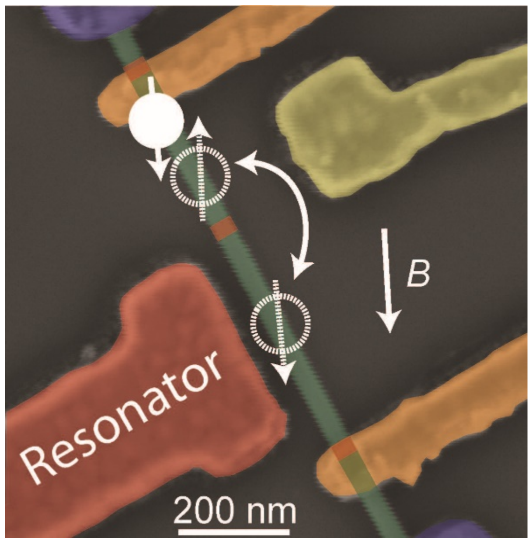

Spin qubits in semiconductors are promising contenders for realizing scalable quantum computers because of their small footprint, long coherence times and fast gate operations. Typically, entangling gates between spin qubits are short range, limiting the scale-up towards larger quantum processors. In circuit quantum electrodynamics (QED), on the other hand, superconducting qubits are routinely interconnected with each other exploiting resonators as quantum buses. Implementing circuit QED techniques in the context of electron spin qubits is challenging and recent advances rely on micromagnets.

Here, we present a different approach based on intrinsic spin-orbit interaction that is naturally present in zinc-blende InAs nanowires and provides large coupling to the spin. The used nanowires feature a double-quantum dot (DQD) that is defined by epitaxial crystal-phase tunnel barriers, tremendously simplifying the device architecture. We integrate these DQDs in a magnetic-field resilient, high-impedance circuit QED architecture. Investigating the hybrid DQD-resonator system, we find clear indications of a coherent coupling between a singlet-triplet qubit formed in the DQD and a single photon in the resonator with an electron spin-photon coupling strength of 114 ± 9 MHz exceeding previous values by an order of magnitude.