Toward High Fidelity Quantum Networks - Silicon Vacancy Centers in Diamond

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Quantum networks combine high security with the ability to scale up the number of qubits, which is essential for large-scale quantum information processing. These networks have nodes that store quantum data. Entanglement can be used to connect these nodes and enable quantum communication. Silicon-vacancy (SiV) color centers in diamond are promising components of optically coupled quantum processors. These solid-state emitters provide an effective optical interface and exhibit protective inversion symmetry. As a result, it is feasible to incorporate them into nanophotonic structures. The entanglement between spin- and photonic qubits can be generated using this approach. Coherent interactions between nuclear spins and the SiV require ultra-low temperatures and strong currents that simultaneously generate radio-frequency fields. Here we present a platform integrating superconducting coils with nanophotonic structures for operation at millikelvin temperatures.

References

[1] C. T. Nguyen et al., "Quantum Network Nodes Based on Diamond Qubits with an Efficient Nanophotonic Interface ". Phys. Rev. Lett. 123, 183602 (2019).
[2] M.K. Bhaskar et al., "Experimental demonstration of memory-enhanced quantum communication". Nature 580, 60–64 (2020).
[3] P.-J. Stas et al., "Robust multi-qubit quantum network node with integrated error detection" Science 378, 557 (2022).

Figures

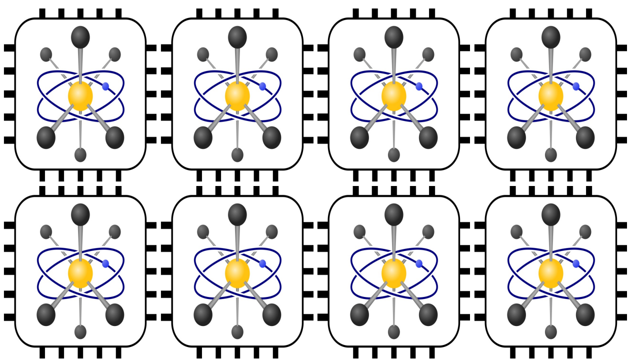

Figure 1: Schematic of a quantum network with SiV-centers as nodes. Connecting the color centers are photons distributing the entanglement.