A Quantum Network Node based on the Tin-Vacancy Center in Diamond

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Quantum networks will unlock key applications like distributed quantum computation and secure communication [1].
A functional quantum network node requires an efficient photonic interface that allows for the generation of remote entanglement as well as a stationary qubit with coupled memory qubits.
Tin-vacancy (SnV) centers in diamonds have become a prime candidate for such nodes due to their intrinsic efficiency, their integration capabilities and their access to and control of memory qubits [2-5].
Here, we report on the advances of building a fully functional quantum network node based on SnV centers. The SnV center is embedded in a nanophotonic waveguide (Figure 1) with tapered-fiber optical I/O. The spin state is controlled via microwaves with gate fidelities exceeding 98%.
A key metric for the quality of the photonic interface is the visibility of the photons created from different SnV centers. This metric directly impacts the achieveable fidelity of entangled states.
We perform a spin-state-selective two-photon quantum interference experiment with pulsed resonant excitation with two SnV centers. This sequence is compatible with remote entanglement protocols.
From first experiments we find a raw visibility of *V = 0.68(7)* which improves upon stricter thresholding to *V = 0.87(8)* (Figure 2). These results show that the SnV center is capable of emitting highly indistinguishable photons, with a clear path to further improvement.
This last missing ingredient completes the set of capabilities needed for a full quantum node, and paves the way towards first quantum entanglement experiments between SnV center quantum network nodes.

References

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Figures

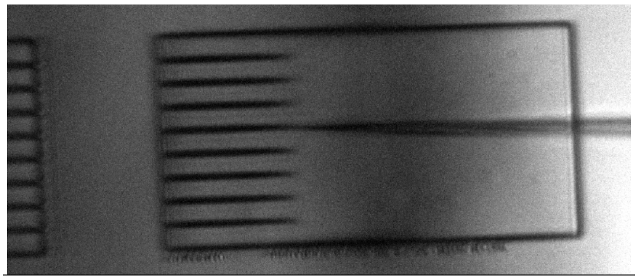

Figure 1: Nanophotonic diamond waveguides with SnV centers accessed via tapered fibers. The shadow is cast by a bondwire for microwave delivery.

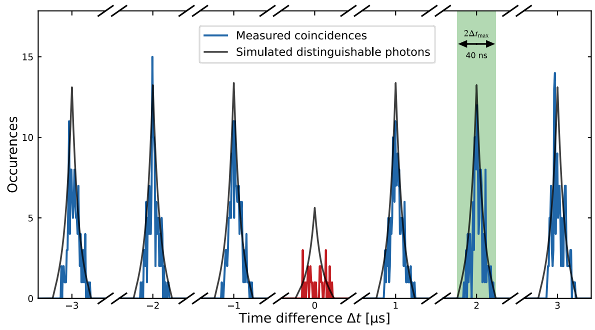

Figure 2: Two-photon quantum interference of two SnV centers. Blue/red data show measured coincidences as a function of their time difference, black lines are theoretically expected coincidences for fully distinguishable photons. The clear deviation in the center time bin shows quantum inference.