Photonically Connected Nuclear Spin Microprocessors

Donika Imeri
Timo Eikelmann, Mara Brinkmann, Konstantin Beck, Rikhav Shah, Ralf Riedinger

Zentrum für Optische Quantentechnologien, Universität Hamburg, 22761 Hamburg, Germany
The Hamburg Centre for Ultrafast Imaging, 22761 Hamburg, Germany

dimeri@physnet.uni-hamburg.de

Silicon Vacancy (SiV) color centers in diamond show potential for improving quantum communication systems. SiVs exhibit atom-like optical transitions, enabling high-fidelity interfaces between photons and a long-lived electron spin. The inversion symmetry of the SiV protects its optical transition from electrical noise, allowing integration into nanophotonic cavity QED structures. However, SiV color centers require operation at low temperatures and high radiofrequency fields to manipulate the nuclear spins.

In this work, we present a platform that integrates nuclear magnetic resonance coils with nanophotonic structures designed to operate at millikelvin temperatures, thereby facilitating advances in quantum networks using SiV-based systems.

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).