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The birth of quantum networks: merging remote entanglement with local multi-qubit control

RONALD HANSON, QuTech and Kavli Institute of Nanoscience, Delft University of Technology

The realization of a highly connected network of qubit registers is a central challenge for quantum information processing and long-distance quantum communication. Diamond spins associated with NV centers are promising building blocks for such a network: they combine a coherent spin-photon interface that has already enabled creation of spin-spin entanglement over 1km [1] with a local register of robust and well-controlled nuclear spin qubits for information processing and error correction [2]. We are now entering a new research stage in which we can exploit these features simultaneously and build multi-qubit networks. I will present our latest results towards the first of such experiments: entanglement distillation between remote quantum network nodes. Finally, I will discuss the challenges and opportunities ahead on the road to large-scale networks of qubit registers for quantum computation and communication. [1] B. Hensen et al., Nature 526, 682 (2015). [2] J. Cramer et al., Nature Communications 7, 11526 (2016)