Quantum Measurements using Diamond Spins: From Fundamental Tests to Long-Distance Teleportation

Ronald Hanson
Department of Quantum Nanoscience, Kavli Institute of Nanoscience, Delft University of Technology
P.O. Box 5046, 2600 GA Delft, The Netherlands
Author e-mail address: r.hanson@tudelft.nl

Abstract: Spin qubits in diamond provide an excellent platform both for fundamental tests and for realizing extended quantum networks. Here we present our latest results, including the deterministic teleportation over three meters.

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1. Introduction to the style guide, formatting of main text, and page layout
A future Quantum Internet - an optically connected network of small quantum processors - will enable secure information exchange, clustering of quantum computers and blind quantum computing “in the cloud”. Here we present our progress towards scalable quantum networks based on solid-state qubits. We have entangled two electron spin qubits separated by 3 meters, each associated with a nitrogen vacancy center in diamond [1]. The entangled state is generated by a projective quantum measurement on single photons emitted by the qubits.

More recent work focusses on combining this heralded remote entanglement with recently achieved methods for initializing, controlling and entangling nuclear spin qubits near each electron spin [2,3], thus enabling deterministic quantum teleportation and quantum error correction, and paving the road for the implementation of an elementary quantum repeater and distributed quantum computing. At the same time, the “quantum toolbox” developed for these purposes is also used for fundamental tests of quantum measurements such as in violation of Leggett-Garg inequalities with projective measurements [4] and steering a qubit’s trajectory by adaptive partial measurements with feedback [5]. Latest results will be presented.

2. References