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Control of multi-qubit nodes for diamond quantum networks JULIA CRAMER, M. ADRIAAN ROL, NORBERT KALB, Kavli Institute of Nanoscience Delft, VIATCHESLAV V. DOBROVITSKI, Ames Laboratory and Iowa State University, RONALD HANSON, TIM H. TAMINIAU, Kavli Institute of Nanoscience Delft — Quantum networks consisting of multiple connected nodes enable distributed quantum computation and secure quantum communication. Such networks require multi-qubit quantum registers that can be remotely linked. In this work we demonstrate initialization and control of multiple qubits in a nitrogen-vacancy (NV) node in diamond. We use the NV electron spin as an ancillary qubit to detect individual weakly coupled nuclear carbon-13 spins and construct high-fidelity quantum gates [1]. With these gates we show initialization, control and entanglement of multiple nuclear spins. Combined with projective measurements of the NV electron spin [2] and long-range entanglement through optical channels [3] at cryogenic temperatures, this work paves the way for communication between distant quantum nodes via ancillary qubits while preserving complex entangled states in quantum memories within the nodes.

[1] T.H. Taminiau et al., Nature Nanotech. 9, 171 (2014)
[2] L. Robledo et al., Nature 477, 547 (2011)
[3] W. Pfaff et al., Science 345, 532-535 (2014)

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