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An elementary quantum network using robust nuclear spin qubits in diamond NORBERT KALB, ANDREAS REISERER, PETER HUMPHREYS, MACHIEL BLOK, KOEN VAN BEMMELEN, Delft University of Technology, DANIEL TWITCHEN, MATTHEW MARKHAM, Element Six Innovation, TIM TAMINIAU, RONALD HANSON, Delft University of Technology — Quantum registers containing multiple robust qubits can form the nodes of future quantum networks for computation and communication. Information storage within such nodes must be resilient to any type of local operation. Here we demonstrate multiple robust memories by employing five nuclear spins adjacent to a nitrogen-vacancy defect centre in diamond. We characterize the storage of quantum superpositions and their resilience to entangling attempts with the electron spin of the defect centre. The storage fidelity is found to be limited by the probabilistic electron spin reset after failed entangling attempts. Control over multiple memories is then utilized to encode states in decoherence protected subspaces with increased robustness. Furthermore we demonstrate memory control in two optically linked network nodes and characterize the storage capabilities of both memories in terms of the process fidelity with the identity. These results pave the way towards multi-qubit quantum algorithms in a remote network setting.

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