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Quantum register based on individual electronic and nuclear spin qubits in diamond EMRE TOGAN, M. V. GURUDEV DUTT, LILY CHILDRESS, LIANG JIANG, JERONIMO MAZE, Department of Physics, Harvard University, FEDOR JELEZKO, Physikalisches Institut, Universitat Stuttgart, PHILIP HEMMER, Department of Electrical and Computer Engineering, Texas A & M University, MIKHAIL LUKIN, Department of Physics, Harvard University — We describe a technique that makes use of coherent manipulation of an individual electron spin and individual nuclear spins in its environment to create a controllable quantum register composed of a few quantum bits (qubits). Using optical and microwave radiation to control an electron spin associated with the Nitrogen-Vacancy (NV) color center in diamond, we demonstrate robust initialization of a two-qubit register at room temperature and transfer of arbitrary quantum states between electron and nuclear spin qubits. We further show that nuclear spin qubits can be well isolated from the electron spin, even during optical polarization and measurement of the electronic state. Finally, we observe coherent interactions between individual nuclear spin qubits, and demonstrate that they have excellent coherence properties. These registers can be used as a basis for scalable, optically coupled quantum information systems.

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