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Solid state quantum memory using the ^{31}P nuclear spin[1] J.J.L. MORTON, Oxford University, A.M. TYRYSHKIN, S. SHANKAR, Princeton University, A. ARDAVAN, Oxford University, T. SCHENKEL, J.W. AGER, Lawrence Berkley National Lab, S.A. LYON, Prinecton University — Nuclear spins benefit from long coherence times compared to electron spins, but are slow to manipulate and suffer from weak thermal polarisation. A powerful model for quantum computation is thus one in which electron spins are used for processing and readout while nuclear spins are used for storage. Here we demonstrate the coherent transfer of an electron spin superposition to the nuclear spin using a combination of microwave and radiofrequency pulses applied to ^{31}P donors in an isotopically pure ^{28}Si crystal. The state is left in the nuclear spin on a time scale long compared with the electron T_2 and then coherently transferred back to the electron spin, thus demonstrating the ^{31}P nuclear spin as a solid-state quantum memory. The transfer fidelity is about 84% each way, attributed to imperfect rotations which could be corrected using composite pulses [JJL Morton et al. Phys Rev Lett 95, 200501 (2005)]. Varying the time for which the state is stored in the nuclear spin permits the direct measurement of the nuclear spin T_2, which we have studied in the range 6.5 to 10 K.

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Stephen Lyon
Princeton University

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