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Mechanical control of a single nuclear spin in diamond

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Nuclear spins interact weakly with their environment and therefore exhibit long coherence times. This has led to their use as memory qubits in quantum information platforms, where they are controlled via electromagnetic waves. Scaling up such platforms comes with challenges in terms of power efficiency, as well as cross-talk between devices. Here, we demonstrate coherent control of a single nuclear spin using surface acoustic waves. We use mechanically driven Ramsey and spin-echo sequences to show that the nuclear spin retains its excellent coherence properties. We estimate that this approach requires 2–3 orders of magnitude less power than more conventional control methods. Furthermore, this technique is scalable because of the possibility of guiding acoustic waves and reduced cross-talk between different acoustic channels. This work demonstrates the use of mechanical waves for complex quantum control sequences, offers an advantageous alternative to the standard electromagnetic control of nuclear spins, and opens prospects for incorporating nuclear spins in mechanically interfaced hybrid quantum architectures.

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