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Robust Two-Qubit Gates for Donors in Silicon Controlled by Hyperfine Interactions[1] RACHPON KALRA, ARNE LAUCHT, CHARLES D. HILL, ANDREA MORELLO, Centre for Quantum Computation and Communication Technology, Australia, CENTRE FOR QUANTUM COMPUTATION AND COMMUNICATION TECHNOLOGY, AUSTRALIA TEAM — The electron spin of a single atom in silicon is an excellent candidate for the building-block of a quantum computer. Recent breakthrough experiments have shown an individual phosphorus impurity atom can be used to store and elaborate one bit of quantum information. To continue along this exciting path, it is necessary to couple multiple phosphorus atoms in a controllable way and demonstrate quantum logic operations between pairs of qubits. This was thought to require exquisite control of their mutual interaction, and atomically-precise placement of the spins. Our work shows that the nuclei, to which the electrons are bound, can be exploited to enable a logic operation based on selective resonant excitation. This operation has the enormous advantage that the inter-qubit interaction does not require any modification. Our calculations show that high-fidelity operations can be performed while tolerating a rather wide range of distances between atoms. This drastically reduces the demands posed on device fabrication, paving the way forward for large-scale quantum-information processing in silicon.

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