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Quantum computation - spins inside

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Abstract

Quantum computation has captivated the minds of many for almost two decades. For much of that time, it was seen mostly as an extremely interesting scientific problem. In the last few years, we have entered a new phase as the belief has grown that a large-scale quantum computer can actually be built. Quantum bits encoded in the spin state of individual electrons in silicon quantum dot arrays, have emerged as a highly promising direction. In this talk, I will present our vision of a large-scale spin-based quantum processor, and ongoing work to realize this vision. This includes two-qubit gate fidelities of more than 99.5%, universal control of up to six qubits, and the coherent coupling of spin qubits at a distance. Finally, in close collaboration with Intel, we have fabricated and measured quantum dots using all-optical lithography on 300 mm wafer, using industry-standard processing, demonstrating excellent qubit performance. When combined, the progress along these various fronts can lead the way to scalable networks of high-fidelity spin qubit registers for computation and simulation.