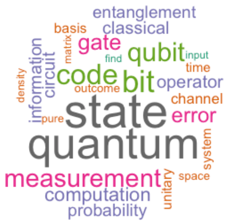

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Colloquium: Adventures in quantum optimization with noisy qubits

Wednesday, 6 December 2017 16:00 (1 hour)

Quantum information processing holds great promise, yet large-scale, general purpose "universal" quantum computers capable of solving hard problems are not yet available despite 20+ years of immense worldwide effort. However, special purpose quantum information processors, such as the quantum simulators originally envisioned by Feynman, appear to be within reach. Another type of special purpose quantum information processor is a quantum annealer, designed to speed up the solution to classical optimization problems. In October 2011 USC and Lockheed-Martin jointly founded a quantum computing center housing a commercial quantum annealer built by D-Wave Systems. Starting with 108 qubits, two generations later the current processor at USC has 1098 qubits, and the latest generation deployed elsewhere already has close to 2048 qubits. These processors use superconducting flux qubits to try to find the ground states of Ising spin-glass problems with as many spins as qubits, an NP-hard problem with numerous applications. There has been much controversy surrounding the D-Wave processors, concerning whether they are sufficiently quantum to offer any advantage over classical computing. After introducing quantum annealing I will survey the work we have done to test the D-Wave processors for quantum effects, to test for quantum enhancements by benchmarking against highly optimized classical algorithms, and to perform error correction.

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