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Quantum control of a harmonic oscillator using a superconducting qubit

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In quantum information processing, a bit of information is customarily represented using a pair of energy levels acting as a quantum two-level system. As an alternative strategy, one can encode the quantum bits in nonclassical states of harmonic oscillators ("bosonic modes"), while still relying on nonlinear elements for state manipulation and readout. This latter approach presents advantages such as longer coherence times, resource-efficient quantum error correction, and well-understood loss channels. In particular, hosting nonclassical states of light in three-dimensional microwave cavities has emerged as a promising paradigm for continuous-variable quantum computation. In this paradigm, superconducting qubits play the role of "quantum controllers" of the states in these cavities. In this second lecture I will outline this approach and review recent advances, including our own work.

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