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Coupling superconducting qubits and resonators

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The performance of superconducting qubits has evolved rapidly in recent years, with coherence times now often measured in tens of microseconds. This makes superconducting qubits a promising candidate for a scalable quantum computing architecture and for modeling quantum systems. To realize this potential, consideration must be given to coupling multiple qubits to a system of microwave resonators in a way that balances coherence times, control and readout times, crosstalk, and space constraints. We compare three methods of coupling qubits to resonators: inductive coupling through a shared kinetic inductance with the resonator, capacitive coupling to a voltage antinode, and coupling to a three-dimensional superconducting cavity. We will also present designs and measurements of samples incorporating both inductively and capacitively coupled qubits on the same coplanar resonator. Lastly, we discuss a three-qubit/two-resonator system with one qubit bridging the two resonators that could serve as the building block of a large-scale architecture.