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Hybrid quantum systems: Outsourcing superconducting qubits[1]

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Superconducting qubits offer excellent prospects for manipulating quantum information, with good qubit lifetimes, high fidelity single- and two-qubit gates, and straightforward scalability (admittedly with multi-dimensional interconnect challenges). One interesting route for experimental development is the exploration of hybrid systems, i.e. coupling superconducting qubits to other systems. I will report on our group's efforts to develop approaches that will allow interfacing superconducting qubits in a quantum-coherent fashion to spin defects in solids, to optomechanical devices, and to resonant nanomechanical structures. The longer term goals of these efforts include transferring quantum states between different qubit systems; generating and receiving "flying" acoustic phonon-based as well as optical photon-based qubits; and ultimately developing systems that can be used for quantum memory, quantum computation and quantum communication, the last in both the microwave and fiber telecommunications bands.

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