Hybrid quantum systems: Outsourcing superconducting qubits

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Abstract

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. Work is supported by grants from AFOSR, ARO, DOE and NSF.

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