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Taking Control of Superconducting Qubits[1]

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One of the fundamental challenges in quantum information processing is to sustain coherence over a time interval practical for performing a computation or simulation. Until recently, boosting coherence has involved hardware development to minimize coupling to a dissipative environment which typically transforms a quantum superposition into a classical state. In the domain of superconducting circuits, the development of robust quantum-noise-limited microwave amplifiers and quantum bits with lifetimes in excess of 100 microseconds has enabled the use of bath engineering to actively suppress decoherence. In particular, we have been able to tailor the dissipative environment, either via measurement or control pulses, to stabilize quantum superposition states and coherent oscillations indefinitely, generate entanglement, and maintain a pure quantum state by real-time tracking. Future directions for improving measurement efficiency and architectures for on-chip measurement in a multi-qubit setting will also be discussed.

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