Quantum Feedback in a Superconducting Qubit

Associate Professor, Irfan Siddiqi
Department of Physics - University of California, Berkeley

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ABSTRACT:
A dissipative environment usually transforms a quantum superposition into a classical state. Recent advances in superconducting circuits--the development of robust quantum-noise-limited microwave amplifiers and quantum bits with lifetimes in excess of 100µs--have enabled the use of feedback to actively suppress decoherence. Our experimental architecture is based on a superconducting quantum bit coupled to a readout cavity. By applying microwave pulses, we modify the spectrum of quantum fluctuations experienced by the qubit to autonomously cool the system to any coherent superposition of ground and excited states. We also perform weak measurement of the qubit state to implement continuous quantum feedback. Using this technique to counteract measurement induced backaction, we demonstrate Rabi oscillations which persist indefinitely. These experiments suggest the plausibility of high fidelity measurement as a means to generate entanglement and implement error correction.

BIOGRAPHY:
Irfan Siddiqi is an experimental condensed matter physicist whose research focuses on the quantum mechanical properties of nanoscale electrical circuits at microwave frequencies and cryogenic temperatures. He is a faculty member at UC Berkeley. Dr. Siddiqi received his PhD from Yale University in 2002 and his A.B. degree from Harvard in 1997. Currently, he is investigating superconducting qubits and developing novel superconducting amplifiers which operate near the quantum limit of sensitivity.

For additional info contact Prof. Jing Xu jxu8@ucmerced.edu