Joint CQSE and CASTS Seminar

2020
Mar. 13, Friday

TIME Mar. 13, 2020, 2:30~3:30pm
TITLE High-fidelity two-qubit controlled-Z gates for direct-coupling superconducting transmon qubits
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Abstract

Superconducting transmon qubits are promising candidates for realizing quantum computation. The architecture of direct-coupling transmons with tunable qubit frequencies has the advantage of shorter two-qubit gate time, but has the disadvantage of reduced coherence time. For this architecture, the experimentally measured infidelity of a two-qubit controlled-Z (CZ) gate with gate time of 40 ns is 6×10-3, limited by decoherence, control error, and state leakage. We construct single smooth flux pulses by optimal control to recover the control error and to suppress the leakage error to 3×10-5 for a CZ gate with realistic system parameters. We further characterize the decoherence mechanisms of the CZ gate from experiments, including slow dephasing noise (flux noise) with 1/f spectrum, fast dephasing noise with white noise spectrum, and Markovian relaxation noise. To minimize decoherence effects from Markovian fast dephasing and relaxation noises, we reduce the CZ gate time to 15 ns and keep the same state leakage level by means of optimal control. The decoherence error from characterized 1/f flux noise can be minimized to 3×10-5 by our robust control method.