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M3Or3C-04 [Invited]: Superconducting Qubit Control with Single Flux Quantum Pulses in A Multichip Module

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Superconducting qubits are an attractive candidate for building quantum information processors. However, existing control techniques do not scale well to large multi-qubit arrays. A promising candidate for scalable control is the Single Flux Quantum (SFQ) digital logic family. In an initial single-chip implementation, the fidelity of SFQ-based qubit gates was limited by quasiparticle (QP) poisoning of the qubit. QP excitations created from the operation of the SFQ circuitry can be a source of decoherence and temporal instability in the qubit. In order to suppress QP poisoning, we have developed a multi-chip module with an SFQ driver on a classical control chip that is flip-chip coupled to a superconducting qubit on a separate quantum chip. We demonstrate SFQ-based coherent control of a transmon in this multi-chip module. In addition, we characterize the QP poisoning in these structures and compare with earlier measurements on single-chip implementations of SFQ-based qubit control. We discuss strategies for further mitigation of QP poisoning.

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