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Precise Control of Qubit Frequencies in a Superconducting Quantum Processor[1] CORA BARRETT, Wellesley College — Quantum computers can solve certain problems that are deemed impossible on classical machines. The building block of our superconducting quantum processors is a tunable transmon qubit (quantum bit), which is composed of a capacitor and two Josephson junctions in a SQUID (superconducting quantum interference device) loop. To perform calculations, we need to be able to control the qubits with a high degree of precision. One critical property of a tunable transmon qubit is its transition frequency, which is controlled by changing the magnetic flux through its SQUID loop via a flux line. We need to compensate for the cross-talk from the flux lines targeting other qubits, so that we can control each qubit individually. Due to the number of measurements required, calibrating the flux cross-talk for the entire processor is a time-consuming process (˜18 hours for a 3x3 qubit array). We use statistical analysis to determine the minimum number of measurements needed to control the qubit frequencies with less than 0.01% error. We use the results of these simulations to design a faster and more accurate calibration protocol. Decreasing the calibration time will bring larger quantum processor sizes within experimental reach.

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