THE UNIVERSITY OF CHICAGO

Computational and Applied Mathematics
Student Seminar

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Optimizing Readout and Gate Pulses in a Coupled Heavy Fluxonium System

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Jones Laboratory, Room 303

ABSTRACT

Capacitively shunted, heavy-fluxonium qubits are promising for future applications in superconducting quantum processors. Its small level splitting results in long coherence times, while its large anharmonicity allows us to perform fast gates on the order of a few nanoseconds[1]. However, because its logical qubit states have a frequency less than the thermal energy scale, the qubit is in thermal equilibrium, making direct initialization to the ground state difficult. We demonstrate improved readout by optimizing the fluxonium level structure to give enhanced qubit state-dependent frequency shifts, achieving increased readout fidelity without sacrificing coherence times. In addition, we employ a newly developed FPGA-based readout system[2] to perform active reset using real-time feedback, cooling the qubit below 2mK. Furthermore, fluxonium qubits rely on novel flux-tuning control pulses to achieve arbitrary gate control. Such gate pulses can be optimized given knowledge of the qubit and coupler parameters[3], and a brief introduction over the methods needed for such a design will be presented, along with the most recent coherence measurements.

[1] H. Zhang et al., Phys. Rev. X 011010 (2021)
[2] L. Stefanazzi et al., Rev. Sci. Inst. 93.044709 (2022)
[3] Propson et al., Phys. Rev. App. 17.014036 (2021)