Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Eliminating Leakage Errors in Hyperfine Qubits DANIEL STACK, DAVID HAYES, BRYCE BJORK, ANDREW POTTER, CHARLES BALDWIN, RUSSELL STUTZ, Honeywell Quantum Solutions — Population leakage outside the qubit subspace presents a particularly harmful source of error that cannot be handled by standard error correction methods. Using a trapped Yb^+ ion, we demonstrate an optical pumping scheme to suppress leakage errors in atomic hyperfine qubits. The selection rules and narrow linewidth of a quadrupole transition are used to selectively pump population out of leakage states and back into the qubit subspace. Each pumping cycle reduces the leakage population by a factor of ~ 3, allowing for an exponential suppression in the number of cycles. We use interleaved randomized benchmarking on the qubit subspace to show that this pumping procedure has negligible side-effects on un-leaked qubits, bounding the induced qubit memory error by $\leq 2.0(8) \times 10^{-5}$ per cycle, and qubit population decay to $\leq 1.4(3) \times 10^{-7}$ per cycle. These results clear a major obstacle for implementations of quantum error correction and error mitigation protocols.

Daniel Stack
Honeywell Quantum Solutions

Date submitted: 31 Jan 2020

Electronic form version 1.4