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High fidelity electron shelving for cw and background free state detection in 171Yb+[1] CONRAD ROMAN, University of California, Los Angeles, ANTHONY RANSFORD, Honeywell Quantum Solutions, THOMAS DELLAERT, PATRICK MCMILLIN, WESLEY CAMPBELL, University of California, Los Angeles — We present a method for improving state detection of $^{171}Yb^{+}$ hyperfine qubits through dissipative shelving of one qubit state to the metastable $^{2}F^{o}_{7/2}$ manifold. Narrowband optical pumping to the $^{2}F^{o}_{7/2}$ state is accomplished on the $^{2}S_{1/2}$ to $^{2}D_{5/2}$ electric quadrupole transition. With an extremely long lifetime ($\sim$ 5 years), shelved population is functionally disconnected from the detection cycle and off resonant effects during fluorescence detection are no longer limiting factors. We improve total state preparation and measurement fidelity in $^{171}Yb^{+}$ to 0.9999. Additionally, the optical separation after electron shelving allows for implementation of a novel background free state detection technique with resonant mode locked laser pulses, increasing the signal to noise during detection by more than two orders of magnitude in the presence of considerable laser scatter.

[1]ARO and NSF

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