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Demonstration of an optical qubit in $^{137}Ba^{+}$ ions THOMAS NOEL, MATT DIETRICH, NATHAN KURZ, GANG SHU, BORIS BLINOV — We present a demonstration of an optical qubit in $^{137}Ba^{+}$ ions. Isotope-selective ion loading, qubit state preparation, single-qubit rotation, and qubit state readout have been achieved with high fidelity. An infrared fiber laser at 1762 nm coherently drives the narrow $6S_{1/2}$-$5D_{5/2}$ quadrupole transition, which has a natural line width of about 33 mHz. A Rabi frequency of 55 kHz has been achieved with about 5 mW of laser power, and a qubit coherence time of about 200 μs was observed. To accomplish this, we developed a novel microcontroller-based lock servo and modulation scheme for stabilization of the fiber laser. Using this laser we have also demonstrated an efficient adiabatic passage population transfer, which makes possible high fidelity readout of the ground state hyperfine and Zeeman qubits in $^{137}Ba^{+}$.

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