Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

$^{133}Ba^+$: a new ion qubit. JUSTIN CHRISTENSEN, DAVID HUCUL, WESLEY CAMPBELL, ERIC HUDSON, Univ of California - Los Angeles
— $^{133}Ba^+$ combines many of the advantages of commonly used trapped ion qubits. $^{133}Ba^+$ has a nuclear spin 1/2, allowing for a robust hyperfine qubit with simple state preparation and readout. The existence of long-lived metastable D-states and a lack of low-lying F-states simplifies shelving, which will allow high fidelity state detection. The visible wavelength optical transitions enable the use of high-power lasers, low-loss fibers, high quantum efficiency detectors, and other optical technologies developed for visible wavelength light. Furthermore, background-free qubit readout, where the readout is insensitive to laser scatter, is possible in $^{133}Ba^+$, and simplifies its use in small ion traps and the study of ions near surfaces. We report progress on realizing this qubit. We load barium ions into an ion trap using thermal ionization from a platinum ribbon. We experimentally demonstrate the isotopic purification of large numbers of barium ions using laser heating and cooling along with mass filtering to produce isotopically pure chains of any naturally-occurring barium isotope. This purification process has allowed us to laser cool rare, naturally-occurring barium isotopes $^{132}Ba^+$ and $^{130}Ba^+$, and we report the isotope shifts from $^{138}Ba^+$ of the $P_{1/2}$ to $D_{3/2}$ transitions near 650 nm for the first time. In addition, we have developed an ion gun to produce high luminosity ion beams with adjustable mean kinetic energy by combining a surface ionization source and ion optics.

Justin Christensen
Univ of California - Los Angeles

Date submitted: 29 Jan 2017 Electronic form version 1.4