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Single trapped indium and barium ion optical frequency standards and a laboratory constraint on the drift of fundamental constants
WILLIAM TRIMBLE, JEFF SHERMAN, WARREN NAGOURNEY, NORVAL FORTSON, University of Washington — Single trappped ions cooled to the Lamb-Dicke regime are spectroscopic systems free of many external perturbations and are therefore attractive as optical frequency standards. We report continued development of single indium ion and barium ion rf Paul-Straubel traps and laser cooling systems. The forbidden ${}^1S_0 \leftrightarrow {}^3P_0$ transition in In^+ at 237 nm has a quality factor of 10^{15} and is immune to ~ 1 Hz quadratic Stark shifts that can limit other systems. In addition, the extraordinarily long $5D_{3/2}$ lifetime ($\tau \sim 80$ s) in a single trapped barium ion yields an electric dipole forbidden 2051 nm $6S_{1/2} \leftrightarrow 5D_{3/2}$ transition with a quality factor of 10^{16}. Further, the odd isotope $^{137}Ba^+$ (I = 3/2) has an excited state with total angular momentum $F' = 0$ so an optical frequency standard based on this transition also avoids significant quadratic Stark shifts. We present our latest experimental probes of these transitions using new low linewidth diode pumped solid state laser systems (a frequency quadrupled non-planar ring oscillator Nd:YAG at 946 nm and a diode pumped Tm,Ho:YLF at 2 μm) and propose a laboratory constraint on fundamental constant drift.

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