

Abstract Submitted  
for the DAMOP14 Meeting of  
The American Physical Society

**Ytterbium optical lattice clock with  $10^{-18}$  level characterization**

NATHANIEL PHILLIPS, JEFF SHERMAN, KYLE BELOY, NIST - Boulder, NATHAN HINKLEY, NIST - Boulder and Dept. of Physics, University of Colorado, MARCO SCHIOPPO, CHRIS OATES, ANDREW LUDLOW, NIST - Boulder — A recent comparison of two ytterbium-based optical lattice clocks at NIST demonstrated record stability of 1.6 parts in  $10^{18}$  after 25,000s averaging. We report on measurements of the two primary systematic effects that shift the ultra-narrow clock transition, towards a reduction of the clock uncertainty to the  $10^{-18}$  level. Uncertainty stemming from the blackbody radiation (BBR) shift is largely due to imprecise knowledge of the thermal environment surrounding the atoms. We detail the construction and operation of an in-vacuum, thermally-regulated radiation shield, which permits laser cooling and trapping while enabling an absolute temperature measurement with  $< 20$  mK precision. Additionally, while operation of the optical lattice at the magic wavelength ( $\lambda_m$ ) cancels the scalar Stark shift (since both clock states shift equally), higher-order vector and two-photon hyperpolarizability shifts remain. To evaluate these effects, as well as the polarizability away from  $\lambda_m$ , we implement a lattice buildup cavity around the atoms. The resulting twenty-fold enhancement of the lattice intensity provides a significant lever arm for precise measurement of these effects.

Nathaniel Phillips  
NIST - Boulder

Date submitted: 31 Jan 2014

Electronic form version 1.4