

High-precision atomic spectroscopy and searches for variation of fundamental constants

T.M. Fortier, N. Ashby, J.C. Bergquist, M.J. Delaney, S.A. Diddams, T.P. Heavner,
L. Hollberg, W.M. Itano, S.R. Jefferts, K. Kim, F. Levi, L.Lorini, W.H. Oskay,
T.E. Parker, J.E. Stalnaker

*National Institute of Standards and Technology, Time and Frequency Division,
MS 847 Boulder CO 80305*

fortier@boulder.nist.gov

We will present the results of recent clock comparisons at NIST that have allowed for limits to be placed on possible time variation of the fine structure constant and on local position invariance [1]. In particular, we will discuss measurements of the frequency ratio of the $^{199}\text{Hg}^+$ optical transition at 282 nm [2] to the ground state hyperfine splitting in ^{133}Cs at $\sim 9.192\text{GHz}$ [3]. Analysis of the time record for these measurements, taken over six years at NIST, in conjunction with results of the frequency ratio of $^{171}\text{Yb}^+$ to ^{133}Cs , at the PTB, [4] has allowed us to obtain coupled constraints on the fractional time variation of the fine structure constant α and $\mu_{\text{Cs}}/\mu_{\text{B}}$ at a level of 10^{-15} per year.

References:

- [1] T.M. Fortier, N. Ashby, J.C. Bergquist, et al. PRL **98**, 070801 (2007)
- [2] U. Tanaka, J.C. Bergquist, S. Bize, S.A. Diddams, R.E. Drullinger, L. Hollberg, W.M. Itano, C.E. Tanner, D.J. Wineland, IEEE T. Instrum. Meas. **52**, 245 (2003).
- [3] T.P. Heavner, S.R. Jefferts, E.A. Donley, J.H. Shirley, and T.E. Parker, Metrologia **42**, 411 (2005).
- [4] C.Tamm, B. Lipphardt, H. Schnatz, et al., IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT **56**, 601 (2007)