Abstract Submitted
for the DAMOP09 Meeting of
The American Physical Society

Experimental Progress on the NIST $^{27}Al^+$ Optical Clock CHIN-WEN CHOU, DAVID B. HUME, JEROEN C.J. KOELEMEIJ[1], TILL ROSENBAND, JAMES C. BERGQUIST, DAVE J. WINELAND, National Institute of Standards and Technology — A recent measurement of the frequency ratio between single-ion optical clocks based on $^{27}Al^+$ and $^{199}Hg^+$ at NIST showed a combined statistical and systematic uncertainty of 5.2×10^{-17}[1]. Here we report progress on improving both the accuracy and stability of the $^{27}Al^+$ optical clock. We have developed a new trap and laser systems that enable the use of $^{25}Mg^+$ for sympathetic cooling and clock-state detection of $^{27}Al^+$. These developments should reduce time-dilation shifts caused by harmonic motion of the ions and thus lower the dominant systematic uncertainty below 10^{-17}. In the new clock apparatus we have demonstrated spectroscopy of the $^{27}Al^+$ $^1S_0$ to $^3P_0$ transition with a quality factor of $Q = 3.5 \times 10^{14}$ and simultaneously a contrast approaching unity. In addition, we have developed techniques for the sympathetic laser cooling and quantum logic spectroscopy of multiple aluminum ions with the goal of further improving measurement stability [2]. *supported by ONR and NIST [1] T. Rosenband et al., Science **319**, 1808 (2008) [2] D. B. Hume et al., Phys. Rev. Lett. **99**, 120502 (2007)

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Date submitted: 27 Jan 2009 Electronic form version 1.4