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Relativity and Al^+ Optical Clocks[1] CHIN-WEN CHOU, DAVID B. HUME, DAVID J. WINELAND, TILL ROSENBAND, Time and Frequency Division, National Institute of Standards and Technology, Boulder, Colorado 80305 — We have constructed an optical clock based on quantum logic spectroscopy of an Al+ ion that has a fractional frequency inaccuracy of 8.6×10^{-18}. The frequency of the $^1S_0 \leftrightarrow {}^3P_0$ clock transition is compared to that of a previously constructed Al^+ optical clock with a statistical measurement uncertainty of 7.0×10^{-18}. The two clocks exhibit a relative stability of $2.8 \times 10^{-15} \tau^{-1/2}$, and a fractional frequency difference of -1.8×10^{-17}, consistent with the accuracy limit of the older clock. By comparing the frequencies of the clocks, we have observed relativistic effects, such as time dilation due to velocities less than 10 m/s and the gravitational red shift from a 0.33 m height change of one of the clocks.

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