Comparison of Two Single-Ion Optical Clocks

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The single-ion mercury optical clock at NIST, Boulder has been the world's most accurate atomic clock for several years. Recently, we built a new type of optical clock that relies on quantum logic techniques to probe a single aluminum ion. Both frequency standards have fractional systematic uncertainties below 3×10^{-17}. This allows us to measure their frequency ratio (see Fig. 1) with an uncertainty of 5×10^{-17}, making this ratio the best known constant of nature[1]. By looking for changes of the ratio, we can search for changes of the fine-structure constant α. Preliminary results indicate that presently

$$\dot{\alpha}/\alpha = (-1.6 \pm 2.3) \times 10^{-17}/\text{year},$$

which is consistent with no change.

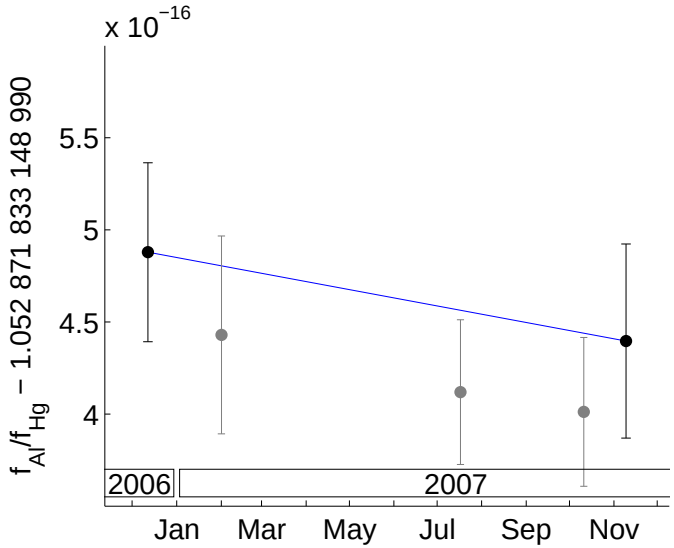

Figure 1: *History of frequency ratio measurements grouped by month. The line connects the first point to the last one with a slope of* $(-5.3 \pm 7.9) \times 10^{-17}$*/ year.*

[1] T. Rosenband *et al.*, *Science* **319**, 1808 (2008)