David Hume
(Universität Heidelberg)

The NIST Al^+ Optical Clocks

In recent years, the development of atomic clocks that operate at optical frequencies (~ 1 x 10^{15} Hz) has led to significant improvements in stability and accuracy over their microwave counterparts. Two optical clocks based on a narrow ultraviolet resonance in $^{27}Al^+$ have been built at NIST in Boulder, Colorado. These clocks are unique in that they rely on techniques developed in the context of trapped-ion quantum computing. In this talk, I will describe the operation of the Al^+ optical clocks and review a series of experiments that demonstrate their performance. In one experiment we measure time dilation due to relative velocities below 5 m/s. In another experiment we observe the gravitational red shift due to a height change of only 33 cm.

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Universität Ulm, Raum 45.2.304 (Uni West)
Albert-Einstein-Allee 45, 89081 Ulm

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