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Search for New Physics with Atomic Clocks

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The precision of atomic clocks improves at a rapid pace: While caesium clocks now reach relative uncertainties of a few 10^{-16}, several optical clocks based on different atoms and ions are now reported with systematic uncertainties in the low 10^{-18} range [1]. The Yb^+ optical clock at PTB has recently reached this uncertainty [2], following Hans Dehmelt's seminal ideas of using a single trapped ion, laser cooling and the observation of quantum jumps as a spectroscopic signal, but based on an unusual reference transition (S-F electric octupole) and special Ramsey interrogation schemes that suppress systematic frequency shifts. The availability of highly precise clocks relying on different quantum systems allows for improved tests of fundamental physics, especially quantitative tests of relativity and searches for violations of the equivalence principle. The strong relativistic contributions to the transition energy and the high electronic angular momentum of the F-state make the Yb^+ optical clock an especially sensitive test case. In comparisons with a ^{87}Sr optical lattice clock at PTB [3] we have performed improved tests for temporal variations of the fine structure constant and the proton-to-electron mass ratio, of coupling of α to gravity in the Solar potential and of violation of Lorentz invariance in the electron sector.

[1] A. D. Ludlow, M. M. Boyd, J. Ye, E. Peik, P. O. Schmidt, Rev. Mod. Phys. 87, 637 (2015)

[2] N. Huntemann, C. Sanner, B. Lipphardt, Chr. Tamm, E. Peik, Phys. Rev. Lett. 116, 063001 (2016)

[3] C. Grebing, A. Al-Masoudi, S. Dörscher, S. Häfner, V. Gerginov,
S. Weyers, B. Lipphardt, F. Riehle, U. Sterr, C. Lisdat, Optica 3, 563 (2016)

Summary

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