Plenary Talk PV XI Thu 9:15 Audimax

Relativistic Geodesy with Optical Clocks — •Tanja E. Mehlstäubler — Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig

Time and frequency are the most accurately measurable quantities today. In particular, optical atomic clocks, which have the potential to reach relative frequency inaccuracies as low as 10^{-18} [1,2], open up new fields of fundamental and applied research. The dependence of the atomic frequencies on the gravitational potential makes atomic clocks ideal candidates for the search for deviations in the predictions of Einstein's general relativity, tests of modern unifying theories and the development of new sensors for gravity.

In my talk, I will introduce the concepts of optical clocks and present the current status of international clock development and comparison. Further on, I will discuss the status of some fundamental tests of our standard model by means of high-precision spectroscopy and future applications of time and frequency metrology. Besides further improvement in stability and accuracy of today's best clocks, a large effort is put into increasing the reliability and technological readiness for field missions with compact, portable devices. In the near future, optical clocks are foreseen to contribute together with satellite missions to the precise determination of the Earth's geoid [3] with a height resolution on the *cm*-level.

[1] C.W. Chou, D.B. Hume, J.C.J. Koelemeij, D.J. Wineland, and T. Rosenband: Frequency Comparison of Two High-Accuracy Al^+ Optical Clocks, *Phys. Rev. Lett.* **104**, 070802 (2010).

[2] B. J. Bloom, T. L. Nicholson, J. R. Williams, S.L. Campbell, M. Bishof, X. Zhang, W. Zhang, S. L. Bromley, and J. Ye: An Optical Lattice Clock with Accuracy and Stability at the 10^{-18} Level, arXiv:1309.1137 (2013).

[3] E. Mai: Time, Atomic Clocks, and Relativistic Geodesy, *DGK*, Reihe A, **124** (Beck, München 2013), http://dgk.badw.de/_leadmin/docs/a-124.pdf