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Symmetry tests with clocks

Friday 2 September 2022 09:00 (30 minutes)

We use frequency comparisons between highly accurate optical clocks for tests of fundamental principles. In particular, the 171Yb+ optical clock based on an electric octupole transition between the S-ground state and the lowest excited F-level (radiative lifetime 1.58 yr) provides a favorable combination of low systematic uncertainty and high sensitivity to relativistic effects and potential new physics. Using this system we have established improved limits for violations of Lorentz invariance in the electron sector and for violations of local position invariance, including the presently most stringent limits for temporal variations of the fine structure constant and the electron-proton mass ratio [1]. I will give an outlook on the development of a 229Th nuclear optical clock that will open new perspectives for fundamental tests in the domain of nuclear physics [2].
[1] R. Lange, N. Huntemann, J. M. Rahm, C. Sanner, H. Shao, B. Lipphardt, Chr. Tamm, S. Weyers, and E. Peik, "Improved limits for violations of local position invariance from atomic clock comparisons", Phys. Rev. Lett. 126, 011102 (2021).
[2] E. Peik, T. Schumm, M. Safronova, A. Palffy, J. Weitenberg, P.G. Thirolf, „Nuclear clocks for testing fundamental physics", Quantum Sci. Technol. 6, 034002 (2021).

Scientific topic

Symmetries

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