SYFC 1: Variations of Fundamental Constants I

Time: Monday 14:00–16:00 Location: A 001

Invited Talk SYFC 1.1 Mo 14:00 A 001

Fundamental constants, gravitation and cosmology — •Jean-Philippe Uzan — Institut d'Astrophysique de Paris, 98 bis bd Arago, 75014 Paris (France)

The tests of the constancy of fundamental constants is a test of Einstein equivalence principle, and thus of general relativity. This talk will summarize the links between the constants and general relativity and higlights the necessity of such tests focusing on cosmology. Some new results concerning the effects of the variations of fundamental constants on stellar evolution will also be mentioned.

Invited Talk SYFC 1.2 Mo 14:30 A 001

Molecular hydrogen in the lab and in the early universe; search for varying mu — •Wim Ubachs — Laser Centre VU University, Amsterdam, Netherlands

Variation of the proton-to-electron mass ratio (mu) can be assessed by comparing spectra obtained at zero redshift (in the laboratory) and similar spectra at high red-shift observed at large telescopes equipped with high-resolution spectrographs. We have performed accurate calibration measurements of H_2 and HD lines by laser-based and Fourier-transform spectroscopic methods to result in accuracies of 5×10^{-9}. Recently we made observations of a single object, the J2123 absorbing cloud at z=2.05 via the Keck-Hires system (Hawaii) and the VLT-UVES system (Paranal Chili) to derive a new constraint on a possible variation of mu. The analysis includes, for the first time, also lines of the deuterated HD molecule besides H_2.

Invited Talk SYFC 1.3 Mo 15:00 A 001

Stability of the proton-to-electron mass ratio tested with molecular spectroscopy using an optical link to frequency reference — •Anne Amy-Klein[1], Alexander Shelkovnikov[1,3], Robert J. Butcher[1,4], Olivier Lopez[1], Christophe Daussy[1], Haifeng Jiang[2], Fabien Kéfélian[1], Giorgio Santarelli[2], and Christian Chardonnet[1] — [1]LPL, CNRS, Université Paris 13, Villetaneuse, France — [2]LNE-SYRTE, Observatoire de Paris, CNRS, UPMC, France — [3]Lebedev Physical Institute, Moscow, Russia — [4]The Cavendish Laboratory, Cambridge, UK

Time and frequency metrology has experienced a lot of developments since ten years leading to the possibility of many fundamental tests of physics, as, for example, the search for a temporal variation of fundamental constants. However these tests are limited to macroscopic resonators or atomic systems while molecular systems are still difficult to probe with a high sensitivity, since experiments on molecules lacks of absolute frequency measurements set-ups. In that context, we have developed an optical link between our lab and the LNE-SYRTE, which allows us to benefit from their frequency references. Using this link, we performed the first experimental comparison of a molecular clock to an atomic clock, which gives a direct line to the proton-to-electron mass ratio stability. Recently, we extended the frequency dissemination technique to non-dedicated fibers of the telecommunication network simultaneously carrying digital data from the Internet traffic. This is very challenging for the development of transcontinental atomic and molecular clocks comparisons.

Invited Talk SYFC 1.4 Mo 15:30 A 001

Optical clocks with trapped ions and the search for variations of fundamental constants — •Ekkehard Peik — Physikalisch-Technische Bundesanstalt, 38116 Braunschweig

Optical clocks with laser-cooled trapped ions have now reached an accuracy that surpasses those of the best atomic clocks in the microwave domain. The comparison of different optical transition frequencies over time can be used in a laboratory search for a possible time dependence of the fine structure constant α. We investigate two reference transitions with very low natural linewidths that are promising candidates for precise clocks and also offer high sensitivity to variations of α: the electric octupole transition at 467 nm in $^{171}Yb^{+}$ and the optical nuclear transition at about 7.6 eV in $^{229}Th^{3+}$.