ID de Contribution: **56** Type: **Invited talk**

Comparing a mercury optical lattice clock with microwave and optical frequency standard

lundi 22 février 2016 11:40 (20 minutes)

Neutral mercury is a promising candidate to build an optical lattice clock thanks to several favorable atomic properties. Its high vapor pressure at room temperature suppresses the need for an oven and thus reduces temperature gradients on the experimental setup. Furthermore, the $^1S_0 - {}^3P_0$ ultranarrow clock transition is very weakly coupled to static and thermal radiation fields easing the efforts needed to control the blackbody radiation shift, one of the limiting factors in almost all the other optical clocks.

Additionally, ^{199}Hg has a simple structure with spin ½ for which tensor component of light shift is null and vector component can be exactly canceled when alternatively interrogating the two spin states. Finally, the $^3P_1$ state used for laser cooling has a 1.3 MHz linewidth yielding Doppler limited temperatures as low as 30μK. This allows for direct loading in the magic wavelength optical lattice from a single stage MOT.
In spite of these advantages, a big challenge lies in the need for adequate (narrow-linewidth, tunable$\cdots$) cw laser sources in the UV region of the spectrum at 254, 362 and 266 nm respectively for cooling, trapping and probing the mercury atoms.

In this talk, after briefly presenting a new evaluation of the systematics of our Hg clock down to 1.6×10^{-16} of relative uncertainty, we will report the first direct measurement of the Hg/Rb frequency ratio, and, to our knowledge, the best absolute frequency measurement of the Hg clock transition via comparison with FO2-Cs down to an uncertainty of 4×10^{-16}, close to the limit of the fountain and about 30 times better than the last measurement reported by our group [1]. Finally, we will report a direct optical to optical measurement of the Hg/Sr frequency ratio with an uncertainty of 1.8×10^{-16}. Our value is in good agreement, within the stated 1σ uncertainties, with the value reported in [2]. To the best of our knowledge, no other frequency ratio has been measured in different labs with an uncertainty below that of the SI second. These kinds of comparisons are essential in assessing the reliability of optical frequency standards as candidates for a redefinition of the SI second, as well as for tests of the variation of fundamental constants.

[1] J. J. McFerran, L. Yi, S. Mejri, S. Di Manno, W. Zhang, J. Guéna, Y. Le Coq, and S. Bize, Phys. Rev. Lett., vol. 108, 183004, 2012.

[2] K. Yamanaka, N. Ohmae, I. Ushijima, M. Takamoto, and H. Katori, Phys. Rev. Lett., vol. 114, 230801, 2015.

Auteur principal: DE-SARLO, Luigi

Co-auteurs: NICOLODI, Daniele; BOOKJANS, Eva (Observatoire de Paris); GUÉNA, Jocelyne; LODEWYCK, Jérôme; FAVIER, Maxime; ABGRALL, Michel; TYUMENEV, Rinat; M. LE TARGAT, Rodolphe (LNE-SYRTE); M. BILICKI, Slawomir (LNE-SYRTE, Observatoire de Paris); BIZE, Sébastien; LECOQ, Yann

Orateur: DE-SARLO, Luigi

Classification de Session: Session 1