Post-doctoral researcher position

FEMTO-ST Institute (CNRS)
Micro-Nano Sciences & Systems Department
15B, avenue des Montboucons, 25030 Besançon, France

Microfabrication and characterization of alkali vapor cells and micro-optical components for miniaturized atomic clocks.

Duration: 1 year, renewable once.

Probing an atomic vapor contained by a mm-scaled cell has allowed the demonstration and the development of a variety of high-sensitivity and high-precision chip-scale atomic devices [1]. Among these instruments, we can in particular mention the miniaturized microwave atomic clocks [2]. These "micro-atomic clocks" relies on a microfabricated buffer-gas-filled alkali cell. They are now commercially available [3, 4] thanks to their high applicative potential resulting from their ability to combine fractional frequency stability in the order of 10^{-10} at 1 s and 10^{-11} at 1 day integration time and strongly reduced volume as well as power consumption (about 15 cm^3 and 150 mW).

Recently, many works have shown the interest of shifting towards optical frequencies, by probing directly in a pure alkali microcell (without buffer gas) an atomic transition instead of a microwave one. [5, 6, 7]. These novel microcell-based optical clocks show much better (2 orders of magnitude) short-term stabilities. Nevertheless, the mid- and long-term stabilities of both microwave and optical miniaturized clocks should still be improved. In this framework, our studies focus on the development of new cell architectures aiming at improving and stabilizing their internal atmosphere while including micro-optical functionalities in order to ease and increase the light-atoms interaction.

Consequently, the present offer concerns the development and characterization of micro-fabricated alkali vapor cells for high performances miniaturized atomic frequency references. Different filling techniques will be studied/optimized, and micro-optical components will be integrated. The candidate will have to be able to characterize the different technological developments, in the context of the long-term performances improvement of microcell-based atomic clocks.

The candidate will integrate the MOSAIC team (https://teams.femto-st.fr/MOSAIC/) at FEMTO-ST Micro Nano Sciences & Systems department (www.femto-st.fr) and will evolve within the "miniaturized clock" project team, made also from people of the OHMS group (http://teams.femto-st.fr/equipe-ohms/) from Time-Frequency department. The project team gathers 3 permanent researchers, 2 post-docs and 2 PhD students.

The candidate must hold a PhD thesis. He (She) should enjoy applied physics sciences. Particular attention will be paid to his (her) experience with **clean-room technologies** (optical and electronic lithography, dry and wet etching, anodic bonding) as well as **optical instrumentation**. He (She) should enjoy team working.

The candidate will participate to 2 projects, funded by the French National Research Agency (ANR ASTRID DGA) and by the National Centre for Space Studies (CNES). He (She) will aim at publishing his (her) work in peer-reviewed journals and will be able to participate to international conferences.

Offer application:

Required diploma: PhD thesis in physics/applied physics/engineering sciences
Expected date of employment: from march 2021 (subject to ZRR allowance)
Contract duration: 1 year, renewable once.
Salary: From 2500 to 3500 € gross salary per month, depending on experience.
Procedure: https://bit.ly/3nBowX3

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Bibliography:

[1] J. Kitching, Appl. Phys. Rev. 5, 031302 (2018)
[2] S. Knappe, MEMS atomic clocks, Comprehensive microsystems, 3, 571-612 (2007).
[3] https://www.microsemi.com/product-directory/clocks-frequency-references/3824-chip-scale-atomic-clock-csac
[4] https://www.syrlinks.com/fr/temps-frequence/horloge-atomique-miniature-mmac/mmac
[5] Z. Newman et al., Optica 6, 5, 580 (2018).
[6] D. Brazhnikov et al., Phys. Rev. A 99, 062508 (2019).
[7] V. Maurice et al., Optics Express 28, 17, 24708 (2020).