

Ultra-compact transportable ULE cavity Masters internship + PhD thesis

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Summary:

We are offering a masters internship position, with possibility of pursuing with a PhD thesis, within the Time and Frequency department at FEMTO-ST. The work will be done within the OHMS (Oscillators, Clocks, Metrology and Systems) team, which is renowned for its work on ultra-stable microwave oscillators, miniature Cs cell atomic clocks, and optical references.

We have developed a first prototype of an ultra-stable, ultra-compact Fabry-Perot cavity, which has achieved a state-of-the art fractional frequency stability of $7.5 \cdot 10^{-15}$ at one second. The optical elements and vacuum chamber are enclosed in a volume of 30 L., and the optical cavity length is only 2.5 cm (see A. Didier *et al.*, Applied Optics 57(22), pp. 6470-6473, 2018). The thermal noise of the cavity is predicted at 10^{-15} , with low temperature and acceleration sensitivities. However, our measurements have shown both higher fractional frequency stability and sensitivities.

Our aim is to upgrade our ultra-compact cavity in order to reach its thermal noise and a low acceleration sensitivity in a transportable setup. A thermal and mechanical re-design will be necessary, as well as a thorough characterization of all technical sensitivities. As a first step, the current acceleration sensitivity will be measured during the Masters internship. The candidate will also be able to measure the acceleration sensitivity of a second cavity, on a cryogenic silicon cavity setup, which will help him/her to familiarize with the tools of optical frequency metrology.

The PhD thesis will be dedicated to the design of the mechanical mount, thermal shielding and spacer of the new cavity, as well as its metrological characterization. The ultra-stable laser will have to be packaged in a low-volume, transportable setup, and all electronics controls will have to be miniaturized using all-digital solutions. The future PhD student will benefit from a high-level environment with a team specialized in time and frequency metrology, optical frequency references, and analog and digital electronics. We are looking for motivated students with a strong background in optics, metrology and control electronics.

For additional information, please visit our webpage:

Group webpage: <http://teams.femto-st.fr/equipe-ohms/>