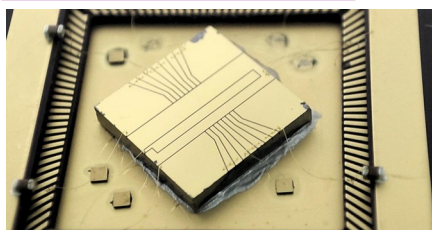


POST-DOC OFFER



Development of an ion trapping chip for time and frequency metrology

Laboratory : FEMTO-ST – Time and Frequency Department – Besançon, France.

Summary:

We are looking for an experienced AMO experimentalist with a background in ion trapping and/or microfabrication of ion trapping chips to join our compact optical clock project. We are currently developing an optical clock based on the Yb^+ 435.5 nm transition frequency, with a target fractional frequency stability below 10^{-14} at 1 s and < 500 L volume. The apparatus is based on a surface-electrode trap similar to those traditionally used in QIP experiments [1-3], with a high ion-to-electrode distance to reduce the impact of anomalous heating. We have developed a custom microfabricated chip based on doped Si electrodes etched on a SiO_2 insulating layer.

The present offer aims for the local production of an improved version of this microfabricated chip, which will reduce the heating and energy dissipation of the trapping electrodes. The microfabrication process will be developed jointly with the MN2S department, with the objective of making the device compatible with future integration of optical waveguides. The scientific objectives of the project are directly in line with the FEMTO-ST institute know-how, combining micro-manufacturing and high metrological performance.

This post-doc will be a first step towards the realization of a silicon-based ion trapping chip with integrated Silicon nitride (SiN) optical waveguides (WGs) and gratings. It will aim at optical frequency metrology applications, with the possibility of individual addressing of multiple ions. The realization process and fabrication philosophy will also make it compatible with quantum information processing (QIP) and on-chip optical addressing of individual-qubits. There is a strong demand for robust, compact and even transportable ion traps, for use in QIP, atomic clocks or other quantum sensors. Within this context, surface-electrodes (SE) ion traps, which offer the ability to trap multiple ions, manipulate single ions and enable ion shuttling with scalability, are a highly promising technology. Such traps rely on a 2D electrodes architecture, easily compatible with standard cleanroom processes.

In summary, during this post-doc, the candidate will have the opportunity to:

- finalize the design, supervise the microfabrication and characterize a SE ion trap with doped Si electrodes on a borosilicate substrate;
- initiate the design of a next-generation trapping chip with embedded waveguides and grating outcouplers.

The candidate will join the OHMS team of the Time-Frequency department of FEMTO-ST. The clock is being developed within the OHMS team (Oscillators, Clocks, Metrology and Systems). Among other works, the OHMS teams develops ultra-stable Fabry-Perot cavities, Cs cell CPT atomic clocks, as well as cryogenic sapphire oscillators. The candidate will have the opportunity to work in a high-level environment in an internationally recognized time and frequency metrology laboratory, benefiting from high-end metrological

characterization equipment and know-how. The team is a first-circle member of the French metrology network FIRST-TF, and a member of the REFIMEVE+ project, which physically links our institute to the SYRTE laboratory in Paris

The candidate must have a major interest in high-precision measurements, present skills in optics, electronics and instrumentation. The knowledge of mechanical design and fundamental physics is a real asset. He or she will evolve within a team made up of researchers, engineers and technicians, and will have the support of the electronic, mechanical and IT departments of the FEMTO-ST Institute and the OSCILLATOR-IMP infrastructure of excellence, dedicated to time & frequency metrology. The candidate will present their work at international conferences and will aim to have their work published in international journals.

Offer details

Prerequisites: PhD in Physics or Applied Physics

Desired skills:

Preference will be given to candidates with experience in ion trapping and microfabrication. Other useful skills include:

- Atom laser cooling and trapping
- Optics and guided optics
- Frequency metrology.

Contract duration: 1 year

Salary: approximately 2100 € net

Application Process: Send CV, cover letter and at least 1 reference letter to the email address below.

Contact

Adresse :

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FEMTO-ST

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References

[1] Compact Yb⁺ optical atomic clock project: design principle and current status, C. Lacroûte *et al.*, *J. Phys.: Conf. Ser.* 723(1), 012025, 2016.

[2] Heating rate measurement and characterization of a prototype surface-electrode trap for optical frequency metrology, T. Lauprêtre *et al.*, *App. Phys. B* 129:37, 2023.

[3] Preliminary characterization of a surface electrode Paul trap for frequency metrology, J. Madunic *et al.*, *Journal of Phys.: Conf. Ser.* 2889 012013, 2024.