Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition : 25.11.2016

Responsable du stage / *internship supervisor*:			
Nom / *name*:	Champenois	Prénom/ *first name* :	Caroline
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Nom du Laboratoire / *laboratory name*: Physique des interactions ioniques et moléculaires			
Code d'identification :UMR 7345	Organisme :CNRS-AMU		
Site Internet / *web site*: http://piim.univ-amu.fr/			
Adresse / *address:* centre universitaire de Saint-Jerome, 13397 Marseille cedex 20			
Lieu du stage / *internship place*: centre universitaire de Saint-Jerome, 13013 Marseille			

Titre du stage / *internship title*: **Advanced Laser Spectroscopy for Space Applications**

The group : Ions trapped in radiofrequency traps are at the heart of our advanced spectroscopy experiments. We develop and apply different protocols and means to study and use stored ions for precision and high-precision spectroscopy applications. Laser stabilisation and light-atom interaction are the fundamental tools for our experiments.

Your project : A double ion trap to test microwave atomic clock performances

Microwave ion clocks designed for deep space navigation have shown a relative stability of few 10-13 over one second. These fluctuations can be lowered down to 10-15 if integrated over one day and there is still room for improvement. Such performances can be reached in a one liter set-up with a double ion trap composed of a quadrupole and a multipole part. The robustness of the set-up all together with the frequency stability led to the development by the Jet Propulsion Laboratory (NASA) of an ion based microwave clock prototype for the Deep Space Network. This device is expected to fly for one year from 2015, to prove its capacities for the long range navigation.

Our work concerns fundamental phenomena in optical or microwave frequency standards. Ultimate performances of such a microwave clock are limited by the 2nd order Doppler effect. We propose a PhD project to experimentally quantify the velocity distribution of the ions in trap segments of different geometry in order to evaluate and control the Doppler contribution and demonstrate the interest of multipole traps for frequency metrology. This is an actual experimental challenge as only indirect measurements have been made so far via the frequency stability of the device.

The project will use laser spectroscopy on the optical clock transition at 729 nm to characterize the second-order Doppler effect, induced by the thermal motion and the rf-driven motion of the trapped ions. Laser excitation along or perpendicular to the trap axis should allow us to compare spectra with and without first order rf-driven motion Doppler effect, in the two different trapping zones. This relies on the use of an ultra-stable laser developed for the excitation of calcium ions on their quadrupole transition at 729 nm (the optical clock transition). This laser is locked onto an ULE cavity for long term stability and now serves as a local optical reference for a frequency comb. Advanced multi-photon coherent excitation processes are also made possible by the simultaneous lock of the three lasers emitting the wave-length implied in the cooling and clock interraction. They will be explored if the training is pursued by a PhD.

Your application : For this project, we are looking for a person who knows about laser and atomic physics and who is motivated for an ambitious experimental project facing frequency metrology challenges for space applications. You will work in a team of researchers with different background. To qualify for the available PhD founding you need to have EU citizenship. Applications should be sent to caroline.champenois [at] univ-amu.fr. Please include a motivation letter, your CV, and a transcript of grades of your most recent diploma.

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : oui**
Si oui, financement de thèse envisagé/ *financial support for the PhD***: financement acquis : DGA-AMU**

Lumière, Matière, Interactions **X**	Lasers, Optique, Matière X	**X**	

*Fiche à transmettre (fichier pdf **obligatoirement**) sur le site http://stages.m*