Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 15/11/2017

Responsable du stage / *internship supervisor*:

Nom / *name*:	LE COQ	Prénom/ *first name* :	YANN
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Nom du Laboratoire / *laboratory name*:

Code d'identification :UMR 8630 Organisme : Observatoire de Paris / CNRS / UPMC

Site Internet / *web site*: http://syrte.obspm.fr/tfc/frequences_optiques/accueil.php

Adresse / *address: 77 avenue Denfert Rochereau 75014 Paris*

Lieu du stage / *internship place*: Observatoire de Paris

Titre du stage / *internship title*: Optical frequency combs and pulse shaping for high precision measurement

Résumé / *summary*

Optical frequency combs (Nobel 2015) use femtosecond lasers to establish a phase-coherent bridge between ultra-stable laser at different wavelength (mid and near IR to visible) and microwave signals. These systems have been demonstrated by the SYRTE team and its collaborators to allow transfer of spectral purity at the 10^{-18} level in the optics domain (Nature Photonics 8,219, 2014), the sub-Hz level in the mid-IR (Nature Photonics 9.456. 2015) and at the zepto-second level in the microwave domain (Nature Photonics 11,44, 2017).

In parallel, femtosecond lasers have seen the development of many applications using pulse shaping (coherent control, ultra-short optical pulses, recompression of pulses, quantum information,…). This technique uses a spatial light modulator to apply a well-controlled amplitude and phase mask in the optical spectrum domain so as to generate a well-controlled optical pulse after recombining the different spectral components. Combining optical frequency combs and pulse shaping is a relatively new domain in the context of ultra-high precision measurements.

The internship will be about using an existing pulse-shaper system with a state-of-the-art erbium-doped fiber based optical frequency comb. In a first period, the intern will be setting up various tools to use the pulse-shaping technique at its best: line by line pulse shaping, genetic algorithm implementation, etc… In a second period, the intern will be using these tools to study the effect of pulse shaping on the opto-electronic pulse detection, where the exact optical pulse dynamics has consequences on the photo-detection process. Optimization of the photo-detection process toward extremely-low microwave phase noise signal generation would be a particularly interesting (scientifically, technologically, and in terms of potential applications) target of these studies. In a third period, if time allows, it may also be possible to begin studies of applications of these techniques to the dissemination of optical timescales, a subject of particular importance toward the future redefinition of time and frequency unit in terms of optical frequency standards, currently planned in the next 10 years.

The intern will interact with several junior and senior members of the Optical frequency group at SYRTE, mostly in English. He/she should show a strong interest for extreme-performance instrumentation (including computer control of complex scientific apparatus), a taste for exploring new scientific territories and the capability to work in a highly international and intellectually challenging environment.

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***: contrat doctoral / other**

Lumière, Matière, Interactions	**OUI**	Lasers, Optique, Matière	**OUI**