Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage

Date de la proposition : 10/10/2017

Responsable du stage / *internship supervisor*:

Nom / *name*: JOFFRE Prénom/ *first name* : Manuel

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Nom du Laboratoire / *laboratory name*: Laboratoire d'Optique et Biosciences

Code d'identification : LOB – UMR7645 Organisme : Ecole Polytechnique-CNRS-INSERM

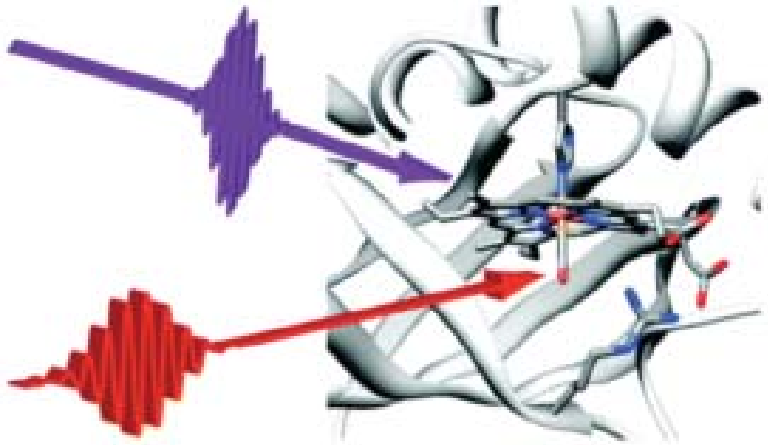
Site Internet / *web site*: http://www.lob.polytechnique.fr

Adresse / *address:* Ecole Polytechnique, 91128 Palaiseau

Lieu du stage / *internship place*: LOB, Ecole Polytechnique

Titre du stage / *internship title*: Femtosecond spectroscopy from picosecond to millisecond timescales

Résumé / *summary*



Laboratoire d'Optique et Biosciences benefits from a cross-disciplinary environment where physicists and biologists work together in order to address relevant issues in biology through the development of new optical methods, based for example on femtosecond lasers and nonlinear optics. In this context, the host team is more particularly developing femtosecond spectroscopy in the mid-infrared (mid-IR) and visible spectral domains in order to control and probe biomolecules such as hemoproteins [1-3]. The available experimental setups consist of a 1-kHz femtosecond mid-IR pulses source, relying on an amplified Titanium:Sapphire laser system pumping two nonlinear stages, and of a 5-MHz chirped-pulse femtosecond oscillator pumping a tunable optical parametric amplifier.

This internship project is based on a method we have recently developed for performing femtosecond spectroscopy using two different femtosecond lasers, the first one (pump) triggering a biochemical reaction and the second one (probe) being used to analyze the system response. The advantage of using two electronically-controlled lasers is that the time delay between the pump and probe pulses can be controlled at will from picosecond to millisecond timescales [4]. The purpose of the project is to apply this new method combined with mid-IR spectroscopy to monitor the motion of a carbon-monoxide ligand inside a hemoprotein over the entire biologically-relevant timescale.

[1] L. Antonucci, A. Bonvalet, X. Solinas, M.R. Jones, M.H. Vos, M. Joffre, *Arbitrary-detuning asynchronous optical sampling pump-probe spectroscopy of bacterial reaction centers*, Opt. Lett. **38**, 3322-3324 (2013)

[2] C. Falvo, L. Daniault, T. Vieille, V. Kemlin, J.-C. Lambry, C. Meier, M.H. Vos, A. Bonvalet, M. Joffre, *Ultrafast Dynamics of Carboxy-Hemoglobin: Two-Dimensional Infrared Spectroscopy Experiments and Simulations*, J. Phys. Chem. Lett. **6**, 2216-2222 (2015)

[3] V. Kemlin, A. Bonvalet, L. Daniault, M. Joffre, *Transient two-dimensional infrared spectroscopy in a vibrational ladder*, J. Phys. Chem. Lett. **7**, 3377-3382 (2016)

[4] X. Solinas, L. Antonucci, A. Bonvalet, M. Joffre, *Multiscale control and rapid scanning of time delays ranging from picosecond to millisecond*, Opt. Express **25**, 17811 (2017)

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***: Ecole Doctorale Interfaces**

Lumière, Matière, Interactions	**x**	Lasers, Optique, Matière	**x**