Spécialité de Master « Optique, Matière, Plasmas »

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

Proposition de stage

Date de la proposition : 9 Décembre 2014

Responsable du stage *: Valentina EMILIANI*

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Nom du Laboratoire / *laboratory name*: **Laboratoire de Neurophotonique**

Code d'identification : UMR 8250 Organisme : CNRS/Paris 5

Site Internet / *web site*: neurophotonics.parisdescartes.cnrs.fr

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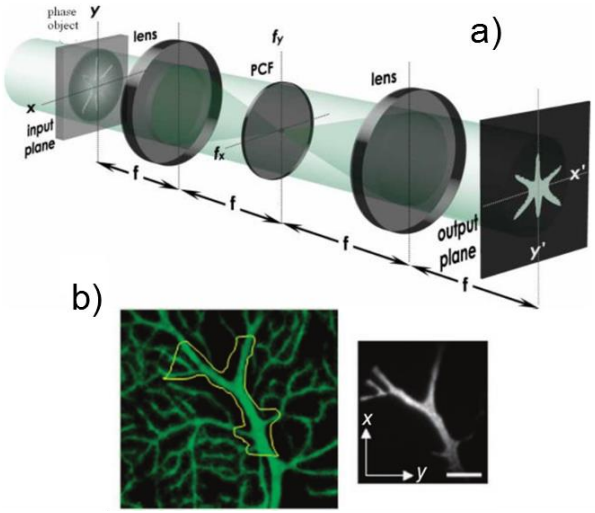
Wavefront shaping for functional imaging of neuronal structures

The ability to perturb and manipulate the flow of excitation and inhibition, enabled by a rapidly developing repertoire of optogenetic actuators, is essential for elucidating causal relationships between neural circuit activity and function. Optogenetic tools have spurred a parallel revolution in optical technology to realize their full potential for brain circuit interrogation, specifically through the development of methods for light patterning. An ideal light delivery method should be: efficient, robust to scattering, span multiple spatial scales, and feature high spatial (micron) and temporal (millisecond) resolution.

The Neurophotonic laboratory is pioneer in the development of optical techniques based on wave front engineering that permit reaching all these requirements through a 3D sculpting of the laser spot. These techniques include the Generalized Phase contrast (GPC) method, an interferometric technique based on the phase modulation of a laser beam with a spatial light modulator (1,2). When combined with temporal focusing GPC permits to precisely illuminate with micrometer precision single cells or single cellular structures (dendrites, axons, dendritic spines).

The internship will be dedicated to the application of GPC combined with temporal focusing of femtosecond laser beams, as a tool to improve imaging of neuronal structures.

In particular, the student will be involved in the extension of these techniques to generate patterns of graded intensity and pattern comprising multiple shapes placed on different planes.



a) Scheme of a GPC interferometer.
b) Target pattern (left) and experimental intensity distribution (right) of a GPC laser beam.

Successively (during the PhD) the student will work side-by-side with the neurophysiologists of the laboratory to apply these techniques to measure the propagation of electrical signals along neuronal dendrites and axons in mouse brain slices.

(1) Glückstad, J., *Phase contrast image synthesis*. Opt. Commun. 1996, 130, pp. 225–230.
(2) Papagiakoumou, E., et al., *Scanless two-photon excitation of channelrhodopsin-2.* Nature Methods, 2010. 7(10): pp. 848-54.

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : yes**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: Ecole doctorale/ Contrats**

Lasers, Optique, Matière	**X**	Lumière, Matière, Interactions	**X**
Plasmas : de l'espace au laboratoire			