



Physics/Optics Master Internship

PROPOSITION DE STAGE/ INTERNSHIP PROPOSAL

Laboratory name (internship place): Institut Langevin (1 rue Jussieu 75005 Paris)

Contacts: Pedro Mécé (pedro.mece@espci.fr) and Olivier Thouvenin (olivier.thouvenin@espci.fr)

Internship title : Development of an ultra-sensitive Optical Coherence Tomography for transparent retinal neurons imaging

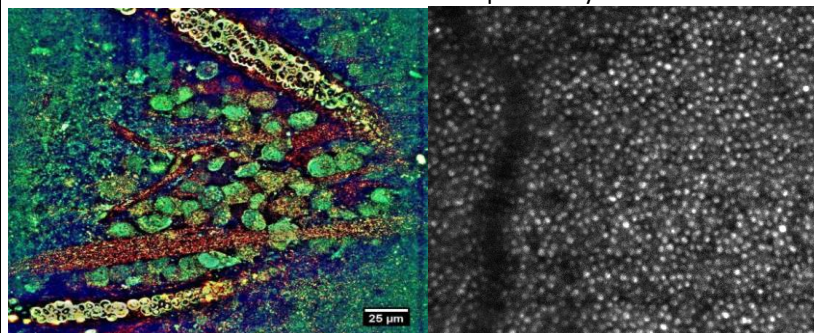
Summary

The retina is part of the central nervous system (CNS). For this reason, several major CNS disorders, such as Alzheimer's disease and Parkinson's disease, occur in the retina and especially in the ganglion cell layer. Due to the optical properties of the eye, the retina is directly accessible to optical imaging with cellular resolution, suggesting that **the eye is a window to the brain and to neurodegenerative diseases**. Despite recent advances in in-vivo retinal imaging, **ganglion cells remain inaccessible for visualisation in the clinical environment**, due to their high optical translucency. This high translucency results in a low amount of backscattered and detected photons (of 1 billion photons sent, only 1 is reflected), generating images dominated by noise.

Recently, our group proposed an optical interference imaging technique, **full-field optical coherence tomography (OCT), which achieves high 3D resolution over a wide field of view**, all in a compact system and therefore suitable for clinical application. This system has recently received **two awards for research excellence from international scientific societies in photonics (SPIE) and ophthalmology (ARVO)**. Despite the high performance of this system in terms of resolution, its sensitivity does not allow the visualisation of ganglion cells.

To overcome this limitation, in this project the intern will work on the **preliminary design and development of a Fourier-domain OCT with optimized illumination/detection geometry** to favor ballistic photons and filter-out multiply scattered photons coming from the retina. Proof of principle studies in vitro and in in-vivo human retina, in collaboration with researchers from **Quinze-Vingts Hospital**, will be performed to validate the new technique.

This work will be carried out in interaction with researchers and a PhD student currently working in this project. To this end, the recruitment of an intern with a good background in physics in general and optics in particular, as well as a marked interest in the interface with ophthalmology or medicine through imaging methods, is desirable. The recruited intern will have the possibility to continue in a PhD program.



Different views of the retina at high resolution ex vivo and lower resolution (photoreceptor) in vivo with FF-OCT technique we developed.

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

Internship duration: 5-6 months (M2 internship)

Qualifications required or desired: The candidate will have initial experience in optics with a taste for microscopy and image processing. Knowledge in biology would be appreciated.