Internship proposal - M2

Laboratory: Institut Langevin (1 rue Jussieu, 75005, Paris)
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Internship title:

Exploring Spatial Coherence in Cellular-Resolution Retinal Imaging with Full-Field OCT.

Context: The retina, as part of the central nervous system (CNS), is affected by several major CNS disorders, including Alzheimer's and Parkinson's diseases, which often manifest in the ganglion cell layer. Due to the optical properties of the eye, the retina is directly accessible to optical imaging at a cellular resolution, making it a promising "window" into the brain and its neurodegenerative diseases.

Despite recent advancements in in-vivo retinal imaging, ganglion cells remain challenging to visualize in a clinical setting because of their high optical translucency. This leads to a low number of backscattered photons—of 1 billion photons sent, only 1 is reflected—resulting in noisy images.

Recently, our group has developed a novel optical imaging technique for cellular-resolution retinal imaging: Full-Field Optical Coherence Tomography (FF-OCT). This compact system achieves high resolution by utilizing spatially incoherent illumination, which acts as a virtual confocal pinhole, doubling resolution and improving robustness to ocular aberrations. However, despite its high resolution, FF-OCT's sensitivity is insufficient for imaging ganglion cells. Indeed, the virtual confocal pinhole rejects aberrated photons, reducing sensitivity and making ganglion cells inaccessible.

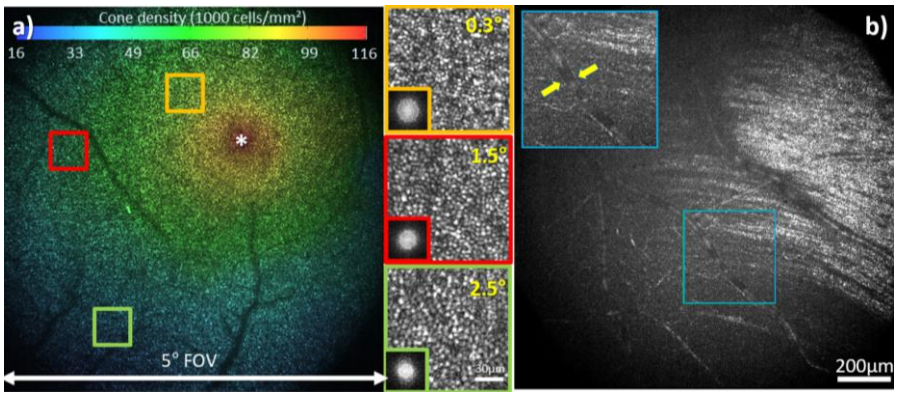

Fig.1: A) Photoreceptors and B) retinal nerve fiber layer (ganglion cell's axons) imaging using FFOCT device. The color is coding photoreceptor density.

Internship objectives:

The main objectives of this internship are:

1. To develop an experimental method to tune the spatial coherence of the light source.
2. To assess the imaging performance of the FF-OCT setup by measuring the lateral resolution and the signal-to-noise ratio (SNR).
3. To study the impact of ocular aberrations and spatial coherence on FF-OCT imaging performance.

This work will involve close collaboration with researchers and a PhD student currently engaged in this project. The ideal candidate will have a strong background in physics, particularly optics, and a keen interest in the intersection of imaging technology and ophthalmology or medicine.

Internship duration: **M2**: 5-6 months

Possibility to continue in a PhD program: Yes.

How to apply? Interested applicants should send a **motivation letter** and a **CV** including the names of two references.