

Master 2: *International Centre for Fundamental Physics* **INTERNSHIP PROPOSAL**

Laboratory name: Institut Fresnel

CNRS identification code: UMR 7249

Internship director's surname: Thomas CHAIGNE

e-mail: thomas.chaigne@fresnel.fr

Phone number: 0413945475

Web page: <https://www.fresnel.fr/perso/chaigne/> www.fresnel.fr/spip

Internship location: Institut Fresnel, Marseille

Thesis possibility after internship: YES

Funding: NO (but likely via ED application)

Photoacoustic imaging of neuronal activity in mice

Research program: The study of large scale neuronal circuits throughout the brain is currently one of the biggest challenge in neurobiology. Non invasive imaging of neuronal activity with single cell resolution is however currently limited to shallow depths, due to prominent light scattering beyond one millimeter. Photoacoustic imaging, a fascinating technique relying on ultrasound generation upon the absorption of a light pulse, has been developed to overcome this issue, enabling to probe optical absorption contrast at large depths in biological tissue. The project aims at developing an *all-optical photoacoustic imaging* setup to non-invasively *access neuronal activity at large depths (≥ 2 mm) in the mouse brain*.

To provide a sufficient detection bandwidth and hence achieve quasi cellular resolution, the *acoustic field will be optically detected* using custom-made Fabry-Pérot cavities. Wide-field interrogation strategies will be investigated to yield the high temporal resolution required for neuronal activity imaging. High-end compressive sensing techniques will be used for image reconstruction. We will apply these techniques to image neuronal activity (via calcium) in mice.

Collaborations: As dealing with advanced optical fabrication and neurobiology, this project will be carried out in close collaboration with other groups from Marseille ([RCMO group](#) at Fresnel Institute, [Cossart group](#) at [Inmed](#)).

Requirements

Candidates with a strong background in physics and optics are encouraged to apply. As this project is tightly linked to its applications in biology, the candidates are expected to have a strong interest for neuroscience and biology.

Programming skills are essential (Matlab or Python), as well as a certain taste for tinkering. As they will be evolving in an international environment, the candidates must be fluent in English, and exhibit excellent communications capabilities (written and spoken).

Host lab

The project will be carried out at the [Fresnel Institute](#) in Marseille, within the [MOSAIC group](#). Gathering more than 40 people from around the world, this interdisciplinary group is working at the crossroad of physics and biology.