Post-doc position at Institut Langevin

In vivo acousto-optic imaging with a rare-earth crystal-based high resolution filter

LABEX WIFI

ESPCI Paris - PSL

ESPCI Paris is a major institution of higher education (a French "Grande École d'ingénieurs"), an internationally renowned research center (6 Nobel Prizes), and a fertile ground of innovation for industry (3 start-ups created/year). ESPCI is a highly multidisciplinary environment with teaching and research in physics, chemistry and biology.

Institut Langevin and Acousto-optic team

Institut Langevin is a joint research unit between ESPCI Paris and CNRS. It combines fundamental research, applied research and start-up creation in a very multidisciplinary approach. The research at Langevin focuses on a broad spectrum of waves: mechanical waves (acoustic, elastic, seismic), electromagnetic waves (radiofrequency, microwave terahertz) and optical waves (infrared and visible).

The acousto-optic team explores multiwave imaging techniques combining light and ultrasound to image defects deeply buried in scattering media. Over the last decade they have focused on various detection methods based on holography, using photorefractive crystals, gain media or digital holography [J.-B. Laudereau, *et al.*, Journal of biophotonics 8, 429 (2015)]. They have also proposed original ultrasound excitation sequences boosting the imaging sensitivity [M. Bocoum et al., Appl. Opt. 58, 1933 (2019)]. They have tied strong collaborations with researchers from BIOMAPS (CEA, Orsay) and UTCBS (Paris) providing expertise in ultrasound techniques, animal tumor models, and ethics issues.

Project

The main goal of the IVRE project is to realize an optical image with sub-mm resolution, deep (>1cm) inside *in-vivo* biological tissue, in order to help tumor or cyst medical diagnosis. It can also be useful for neuronal imaging and deep-tissue oxygenation monitoring.

The acousto-optic imaging technique has strong potentialities in that perspective, but to this day there has been no in-vivo demonstration yet, due to the intrinsic sensitivity of interferometric methods to speckle decorrelation.

This project aims at performing in-vivo imaging in small animals (murine models), using the Spectral Holeburning (SHB) detection technique [C. Venet et al., Optics Letters 43, 3993 (2018)]. This technique consists in creating a narrow transparency window in the absorption profile of a photosensitive crystal. This way the relevant photons tagged by the ultrasound wave are filtered from the background photons, making this technique robust to phase fluctuations inevitable when dealing with in-vivo studies.

The *in-vivo* demonstration is an experimental challenge because it requires combined expertise on spectroscopic properties of the photosensitive crystal, handling cryogenic equipment, designing original excitation sequences with an echograph, and animal manipulation according to a validated protocol. All the building blocks of this demanding setup are well mastered by the team and their collaborators. The successful candidate will join a highly multidisciplinary team, with experience spanning optics, ultrasound techniques,

and biology, and will work on gathering these technological bricks to produce a major scientific achievement in the medical imaging domain.

Job location
The experimental setup is located within the UTCBS facility (4 avenue de l'Observatoire, 75006 Paris, France), allowing access to animal models. The postdoc candidate will also spend some time at Institut Langevin (1 rue Jussieu, 75005 Paris, France) for group meetings and discussions.

Requirements
We are seeking a highly motivated Post-Doc with experience in optics, and an interest in medical imaging. Experience in light-matter interaction, cryogenics or ultrasound techniques is appreciated. Flexibility, autonomy, the ability to work in a highly multidisciplinary team and good interpersonal skills are essential.

Starting date : ASAP (beginning of 2021)
Duration: 1 year

Correspondence (CV + cover letter) to be addressed to:
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