PhD scholarship at the University of Brest (OPTIMAG lab, France)

Laser polarization microscopy applied to the study of pathologies involving structural and motor proteins

The aim of the PhD, which will begin in October 2019, is the development of a novel optical polarization laser scanning microscope for imaging and quantifying very weak anisotropies (birefringence and dichroism) in biological samples. The applications of this microscope concern biomedical diagnosis, in particular the early diagnosis of liver fibrosis by quantification of fibrillar collagen, but also the assessment of other pathologies involving structures of oriented proteins within supramolecular edifices (striated muscle fibres, mitotic spindle). The new microscope is of major interest because it should also allow imaging the mechanical stress field during cell division in vitro, intracellular trafficking or early embryonic development in the small animal.

The principle of this new microscope will be based on (i) the Mueller microscope recently developed - "Fast spectrally encoded Mueller optical scanning microscopy," Scientific Reports 9, 3972 (2019), (ii) new sensitive polarimetric configurations that will allow imaging different biological structures weakly anisotropic until now invisible without labeling.

The new polarimetric imaging modality will be coupled, within the same microscope, to the polarization-resolved second harmonic generation (SHG) imaging modality. This technique, based on femtosecond pulsed laser scanning microscopy, reveals specifically and without labeling specific structural, motor or functional proteins such as collagen, myosin and microtubules in animals, or amylopectin and cellulose in plants. The SHG modality will provide reference images for the development of the new polarimetric microscope and the interpretation of the images.

In summary, the challenge of this PhD is to develop new concepts of polarimetric imaging in laser scanning microscopy based on the spectral coding of polarization, and to achieve a high polarimetric sensitivity able to reveal, without labeling and at the cell level, structures of biomedical interest.

To carry out this PhD, the OPTIMAG laboratory is looking for a motivated and skilled candidate with a solid background in optics and a particular interest in applied physics and multidisciplinarity. The project will require a mix of optical laboratory work as well as numerical modelling, and development of software for real time display and control. Knowledge in nonlinear optics, and / or microscopy, and / or biophotonics would be appreciated.

Contact: For further information or informal enquiries, please contact Sylvain Rivet (sylvain.rivet@univ-brest.fr), Yann Le Grand (yann.legrand@univ-brest.fr) or Matthieu Dubreuil (matthieu.dubreuil@univ-brest.fr).

Deadline date for applications: 22nd May 2019

Interview in Brest (FRANCE) after application selection: 7th June 2019