



Postdoctoral position – September 2022

Multikhi Project – Labex Σ -Lim

Competence: the applicant knows spectroscopy solutions (Raman, multiphoton)

Duration: 1 year (financial support with Labex Σ -Lim) extendable, starting 2022

Dead line for application: end of April 2022

Starting period: September 2022

Supervisors

Optique	Matériaux	Sciences de la vie
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Multikhi project

The detection of infectious or pathogenic agents is one of the priorities for diagnosis and quality control. Depending on the information needed, there exist many possible approaches: microscopic or spectroscopic methods for example. But the multiplication of instrumental solutions complicates the global analysis of the targets and reduces the capacity to correlate the information and to extract an analysis considering all the available data.

The project MultiKHi intends to provide a proof of concept through the implementation of a new nonlinear imaging modality based on broadband CARS (Coherent Anti-Stokes Raman Scattering) spectroscopy, which consists in generating a precise image of the target from a single analysis of the entire CARS spectral response. The added value of this method lies in the extraction of additional information from a CARS spectral region currently considered as a "silent region", and considered as not containing any molecular spectroscopic information. In fact, this area contains indications on the amplitude of the electronic third order optical nonlinearity. The aim is to implement a significant advance in diagnostic methods, by bringing together several optical characterizations within a single instrument.

Role of the postdoctoral researcher

The post-doctoral researcher recruited will be in charge of the technical implementation of the MultiKHi project: he/she will therefore be trained in vibrational spectroscopy, where he/she will be particularly interested in observing various biological samples by CARS spectroscopy. The first mission will be to take control of the available optical analysis systems and explore the CARS responses, especially those from the silent zone. The extraction of the information coming from the silent zone and in particular the electronic third order optical nonlinearity $\chi^{(3)}$ will constitute the main work of this postdoctoral position. Thus, a knowledge of numerical processing of spectral data will be necessary.



To validate the results, it will be necessary to compare the results obtained with more standard solutions: multiphoton microscopy, vibrational Raman imaging, fluorescence imaging, polarimetry.

The hosting laboratories

The post-doctoral fellowship will take place between the laboratories of XLIM, IRCER, CRIBL and the BISCEM technical platform (Limoges). The XLIM laboratory has been developing for many years physical tools dedicated to broadband CARS micro-spectroscopy (M-CARS), but also to multiphoton microscopy (MPM) for the nonlinear characterization of targets coming from various horizons such as inorganic materials for IRCER [1], biomedical targets [2] with a specific interest on B lymphocytes [3, 4].

[1] Z. Rajaofara, P. Leproux, E. Capitaine, H. Kano, T. Hayakawa, P. Thomas, **J.-R. Duclère, V. Couderc**, "Measurement of the third order nonlinear susceptibility of paratellurite single crystal using multiplex CARS," AIP Advances, vol. 9, p. 105301 (2019).

[2] T. Hortholary, **C. Carrion**, E. Chouzenoux, J.-C. Pesquet, **C. Lefort**, "Multiplex-multiphoton microscopy and computational strategy for biomedical imaging", Microscopy Research and Technique, 84 (7), 1553-1562 (2021)

[3] C. Bruzeau, J. Moreau, S. Le Noir, **E. Pinaud**, "Panorama of stepwise involvement of the IgH 3' regulatory region in murine B cells", Adv Immunol. 149:95-114 (2021)

[4] **C. Carrion**, E. Guérin, N. Gachard, A. Le Guyader, S. Giraut, J. Feuillard, « Adult Bone Marrow Three-Dimensional Phenotypic Landscape of B-Cell Differentiation », Cytometry B Clin Cytom., 96 (1), 30-38 (2019).