Multimodal optical microscopy to characterize multiscale biomechanical properties of connective tissues

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Context - Mainly composed of fibrillar collagen, highly organized at different hierarchical scales, connective tissues (cartilage, skin, bone, vocal folds…) provide structural scaffold to many organs and determine the micro-environment properties influencing cell adhesion and migration. Despite common constituents, these tissues present widely different mechanical behaviors and functions. While it exists extensive literature dealing with the mechanical characterization of individual collagen fibrils and with the assessment of tissues' macroscopic response, the interplay between these scales is left obscure, mostly due to the lack of appropriate techniques to probe them simultaneously. Yet, deciphering the complex role of collagen organization in determining macroscopic biomechanical properties is of utmost interest since they play an intricate role in physio-pathological behavior of connective tissues.

Objective – In this context, the aim of the research project is to implement a multimodal imaging platform, coupling Second Harmonic Generation, Raman and Brillouin microscopy, compatible with simultaneous mechanical assay, to probe the multiscale morpho-mechanical properties of connective tissues. Combined with advance image analysis algorithm, this will enable to **characterize and quantify the collagen architecture and viscoelastic properties at sub-micron scale**. Upon operational, this instrument will be validated on **mouse vocal folds** by probing and quantifying collagen architecture in the different layers, from epithelium to the *vocalis* muscle, through the *lamina propria*. Ultimately, this project will provide new insights into the complex morpho-functional relationship in any connective tissues and will provide a framework to analyse patho-physiological behaviour (scarring, carcinomas, genetic disease…).

Environment - This project will take place in the Nano-BioMicroscopy team at **LP2N** (**Institut d'Optique d'Aquitaine**). The team works at the crossroads between nanoscience, optics and bio-imaging to design and study innovative nanostructures and to investigate complex biological system at the nanoscale. In particular, the group has a well-known expertise in infrared imaging, super-resolution microscopy and single particle tracking.

Profile - This project is **primarily experimental** and involves aspects of nonlinear microscopy (femtosecond laser alignment, image acquisition), data analysis (ImageJ /Python/ Matlab) and basic tissue preparation. We are seeking for candidate with a background in **physics/experimental optics** and a strong motivation to work in an **interdisciplinary environment**. Notion in optical microscopy, nonlinear optics, programming (Python) and image/signal processing would be an asset.

Three-years doctoral contract is available with **ANR funding** (project: ''HaBIm''). To apply, please send a **CV**, a **motivation letter**, your **transcripts**, and at least one **reference letter** to Stéphane Bancelin (stephane.bancelin@cnrs.fr).