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2-years post-doctoral position

Quantitative SHG Imaging in Ovarian Cancer-on-Chip.

This project aims to decipher the role of the tumor microenvironment—specifically collagen organization—in therapeutic resistance in high-grade serous ovarian cancer. Collagen organization within the extra-cellular matrix has been indeed recently proposed as a key regulator of tumor immune infiltration.[1, 2] These pioneering works provide however not completely consistent data and are so far limited to qualitative descriptions of collagen assemblies because they use imaging modalities that lack structural content.

Multiphoton microscopy based on second harmonic generation (SHG) is the gold standard technique for 3D characterization of collagen-rich tissues, including in tumors.[3, 4] SHG imaging is done without exogenous labelling and offers a structural specificity to fibrillar collagen types that cannot be reached with any other optical microscope.[3, 5] The group of Marie-Claire Schanne-Klein at LOB has implemented polarization-resolved SHG (pSHG), a non-commercial modality, which further enhances the structural specificity of SHG images by measuring the collagen orientation in every pixel (sub-µm size).[6, 7] pSHG orientation maps then enable the computation of quantitative metrics of disorder with unequalled sensitivity, such as the circular variance of the collagen orientational distribution. [8, 9]

Beyond the characterization of patient tumor biopsies, different tissue models have been developed to provide controlled 3D functional platform to test mechanistic hypotheses. However, most of these models lack a surrounding extra-cellular matrix and associated tumor microenvironment, which strongly limits their clinical relevance. Moreover, it is necessary to use microfluidic to build ovarian cancer models, because of the pathological accumulation of peritoneal fluid, the ascites, which exposes ovarian cancer cells to shear stress. The group led by Dr. Carole Aimé at ENS-Paris develops microfluidic devices based on a “seeding first and insert after” approach ensuring limited constraint for the engineering and cellularization of extra-cellular matrix models before insertion in the chip central chamber. Experiments under flow, with shear stress reproducing the peritoneal cavity, confirmed the prevalence of extra-cellular matrix features in guiding ovarian cancer cell migration.[10]

In this project, pSHG microscopy will be used to quantitatively map the collagen distribution in engineered 3D Ovarian Tumor-on-Chip (OToC) models developed by Carole Aimé at ENS-Paris. The project is divided into four phases. The first step will consist in optimizing pSHG imaging for 3D analyses of these OToCs. Collagen metrics measured in static OToCs will then be compared to recent pSHG data of 2D tumor sections from a cohort of 65 ovarian cancer patients, acquired at LOB in collaboration with A. Leary at Gustave Roussy Cancer Center. The goal will be the identification of collagen disorder metrics that correlate with therapeutic response to guide the design of clinically relevant OToCs. The next step will be to investigate collagen remodeling in these OToCs under patient-derived ascites flow. Finally, synthesis of all results, including clinical and biological data from Gustave Roussy Cancer Center, should provide mechanistic insights into collagen-driven resistance and guide the development of predictive biomarkers and clinically relevant tumor models.

References:

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Position: a 2-year post-doctoral position is open on this project under the supervision of M.C. Schanne-Klein at the Laboratory for Optics and Biosciences. This position will be submitted to a selection procedure by the steering committee of the *Engineering for Health* (E4H) Interdisciplinary Center at Institute Polytechnique de Paris. The postdoctoral candidate will be required to make an oral presentation on Thursday May 21, 2026. See https://www.ip-paris.fr/en/research/interdisciplinary-centers/e4h/call-for-projects/postdoctoral-fellowship for further information

Environment: This project will take place in the "Advanced Microscopies" group at the Laboratory for Optics and Biosciences (LOB), located on the Polytechnique campus in Palaiseau. The LOB is an interdisciplinary laboratory where physicists and biologists collaborate to develop new approaches in optics, computational physics, image analysis, cell and developmental biology and biophysics to study biological systems. This project will be conducted in close collaboration with the group of Carole Aimé at ENS-Paris (OToC, microfluidics) and the group of Alexandra Leary, MD, PhD, at Gustave Roussy Cancer Center (clinical data and patient tissue sections).

Profile: This interdisciplinary project is ideal for a postdoc with a Ph.D. in biophotonics and training in physics, preferably in multiphoton microscopy. The ideal candidate will have a strong interest in biology, as well as skills in experimental microscopy, in the handling of biological tissues, and in bio-image informatics.

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