M1/M2 internship proposal for 2024-2025

Perturbation of lymphoid tissue and cells function

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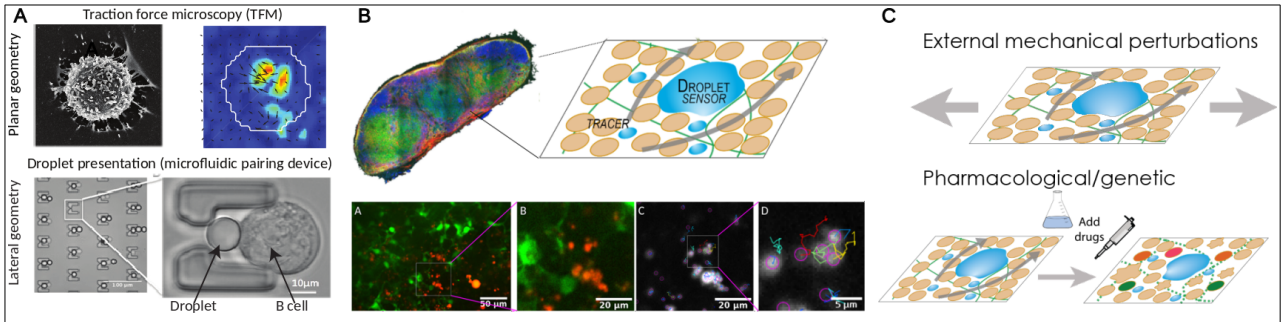
https://institutcochin.fr/projets-recherche/perturbations-mecaniques-synapse-immunologique
Open for PhD: Yes

Context: Communication between cells in organs can be perturbed by external flows, contractions and cell motility. We are interested in understanding how mechanics impacts cell-cell communication when mounting an immune response, a process call immune synapse. In particular we study how B cell react when they interact with an antigen the first time. In recent publications, we setup *in vitro* systems to measure cell response in 2D[1]and 3D[2,3]. We are currently setting up observations *ex vivo* in live tissue.

Internship: This internship offers a flexible and dynamic opportunity to explore the intersection of microfluidics, cellular mechanics, and immunology. Depending on your interests, the project can take different directions, including:

1. Microfluidics for Immune Cell Mechanics: Investigate how primary B cells respond to the formation of an immune synapse in 2D and 3D by exploring forces, polarization, and cytoskeleton rearrangement in planar (on gels) and lateral (microfluidic trapping devices) geometries
2. Ex-vivo Lymph Node Models: Mimic cell-antigen interactions on lymph node slices, characterizing tissue mechanics using AFM and micro-rheology, with the option to design a micro-fabricated chamber for long-term observation.
3. Mechanical Stimulation of Tissues: Develop a device to stretch and compress tissues, examining its effects on gene expression through bulk RNAseq.



(A) Planar and 3D antigen presentation assay for force measurement and polarization dynamics: Traction force microscopy and microfluidic pairing device). (B) Experimental setup ex vivo: in lymph node slices we will study the flows and stresses through motion and deformation of soft lipid droplets (Bottom: trajectories of individual droplets (in red) in living lymph node slices of tissue). (C) Different possible perturbations of the mechanical properties of live lymph node slice tissue: physical stretching or pharmacological treatment.

Skills required: You need to like quantitative approaches, working at the bench (with biological samples), microscopy, image analysis and interdisciplinary research. Knowledge of image analysis/ ImageJ/ coding (Python/ Matlab) is strongly appreciated but not mandatory.

Applicants should send their CV and a motivation letter to paolo.pierobon@inserm.fr.

1 Kumari et al, Nat. Comm. 2019 https://www.nature.com/articles/s41467-019-10751-7
2 Pineau et al, eLife 2022 https://elifesciences.org/articles/78330 https://doi.org/10.1016/j.crmeth.2022.100335
3 Pinon et al, Cell Rep. Meth. 2022 https://www.cell.com/cell-reports-methods/pdf/S2667-2375(22)00232-6.pdf