- INTERNSHIP PROPOSAL

Laboratory name: Laboratoire Matière et Systèmes Complexes
CNRS identification code: UMR 7057
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Internship location: Laboratoire MSC
10 rue Alice Domon et Léonie Duquet
75013 PARIS
Thesis possibility after internship: YES

Mechanobiology of nematic-like tissues

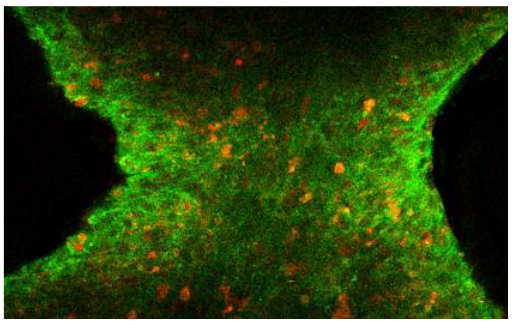
The proposed internship is situated within the realm of mechanobiology, a discipline that investigates the role of mechanical forces generated by cells in the formation, organization, and functioning of biological tissues. Specifically, this internship focuses on studying nematic-like tissues, such as muscle tissues, and their response to physical constraints.

Forces generated by cells play a crucial role in shaping and functioning biological tissues, particularly in the formation of muscle tissues. Understanding the impact of physical constraints on muscle cell differentiation is essential for comprehending muscular pathologies. Recently, our team has developed an innovative approach based on the use of magnetic nanoparticles [1,2,3,4]. These nanoparticles render cells magnetic, enabling remote stimulation using a magnet, promoting the formation of controlled multicellular aggregates in size, shape, and content, as well as their deformation to study mechanical properties [5] or influence cell fate [2].

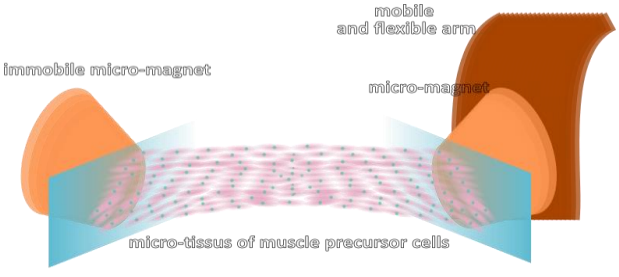
The internship project aims to investigate the self-generated forces in artificial muscle-like tissues formed by muscle precursor cells exhibiting nematic behavior. By utilizing micro-magnets, we can align these cells and fuse them, thereby creating micro-tissues. These micro-tissues generate internal forces that we aim to characterize and comprehend.

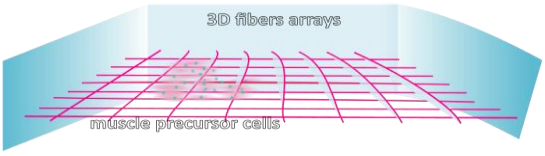
The intern will participate in the design and utilization of new dedicated experimental setups. Initially, they will measure macroscopic forces using flexible arms to assess forces created by the micro-tissues. Subsequently, they will explore microscopic forces using an architecture of reconstituted flexible fibers to analyze forces developed during cell fusion.

The project will shed light on the interplay between mechanical force generation and muscle cell differentiation within these artificial micro-tissues. Moreover, the internship can be extended into a doctoral thesis, encompassing the study of optogenetically induced electrical stresses on these micro-tissues.



Myoblasts precursors cells stretched between two micro-magnets





This internship offers an opportunity to engage in cutting-edge interdisciplinary research in mechanobiology, combining techniques from cell biology, physics, and engineering. It also serves as an excellent foundation for pursuing a Ph.D. in this exciting field.

This is a synergistic project that will benefit from a collaborative network with important interactions with the Cochin Institute and the Curie Institute. It will use a variety of techniques including two-photon microscopy, mechanical manipulation, magnetic forces, cell biology and AI imaging treatment.

The Laboratory Complex Systems (MSC-UMR7057) in Paris is a renowned interdisciplinary research center, with expertise both in life science, physics, chemistry and technology. Do not hesitate to contact us.

[1] F. Mazuel et al. *Phys. Rev. Lett* (2015)
[2] V. Du et al. *Nat. Comm.* (2017)
[3] G. Mary et al. *Cancers* (2022)
[4] I. Nagle et al. *Front. Cell Dev. Biol.* (2022)
[5] I. Nagle et al. *Elife* (2022)