- INTERNSHIP PROPOSAL

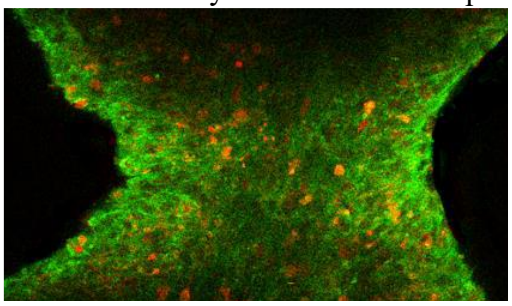
Laboratory name: Laboratoire Matière et Systèmes Complexes
CNRS identification code: UMR 7057
Internship director'surname: Myriam REFFAY
e-mail: myriam.reffay@u-paris.fr Phone number: 01.57.27.70.29
Web page: https://mreffay-research.fr
Internship location: Laboratoire MSC 10 rue Alice Domon et Léonie Duquet 75013 PARIS
Thesis possibility after internship: YES

Exploring Muscle Cell Differentiation in 3D Under Mechanical Constraint with Magnetic Cell Manipulation

The proposed internship is situated within the realm of mechanobiology, 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]. We are excited to offer a Master's internship opportunity to investigate muscle cell differentiation in a 3D environment under mechanical constraints. This project aims to use magnetic nanoparticles to render cells magnetic, enabling remote manipulation. The magnetized cells can be organized using opposing magnets to create purely cellular 3D tissues. The project explores the potential for applying various mechanical stimuli to these micro-tissues. A key research question is whether the type of muscle fibers can be controlled through stimulus manipulation.

This internship provides a unique platform to delve into the intriguing field of muscle cell differentiation in a 3D context using innovative magnetic manipulation. The selected candidate will work closely with our interdisciplinary research team and gain hands-on experience in cell culture, nanoparticle manipulation, and cell imaging. The project will shed light on the interplay between mechanical force generation and muscle cell differentiation within these artificial micro-tissues using rainbow cells whose myosin types are labelled with different colors. 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. 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 is a synergistic project that will benefit from a collaborative network with important interactions with the Cochin Institute. 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)