INTERNSHIP PROPOSAL

Laboratory name: Matière et Systèmes Complexes
CNRS identification code: UMR 7057
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Thesis possibility after internship: YES type of funding: ED 564

Early muscle differentiation under geometric and mechanical constraints

The forces applied to or generated by cells play a crucial role in the formation and function of biological tissues, which is particularly obvious in the case of skeletal muscle. The aim of the internship is to explore the combined effect of geometric and mechanical constraints on the early differentiation of muscle cells. During the differentiation of skeletal muscle, progenitor cells called myoblasts stop proliferating, elongate and fuse to form myotubes that will mature in muscle fibres. In this project we will first explore the question of the role of shape in skeletal muscle differentiation. Elongation will be applied either "passively", by plating cells on elongated adhesive micropatterns (see Figure), or "actively", by plating cells on an elastomeric substrate which will be stretched (see Figure), or by combining both. Various differentiation markers will be monitored using fluorescence microscopy (membrane potential, localisation of transcription co-factor YAP, myogenin). We will then add mechanical stimulation by progressive or cyclic stretching of the substrate and seek to characterize the better shape and mechanical stimulation pattern that accelerate or optimize differentiation.

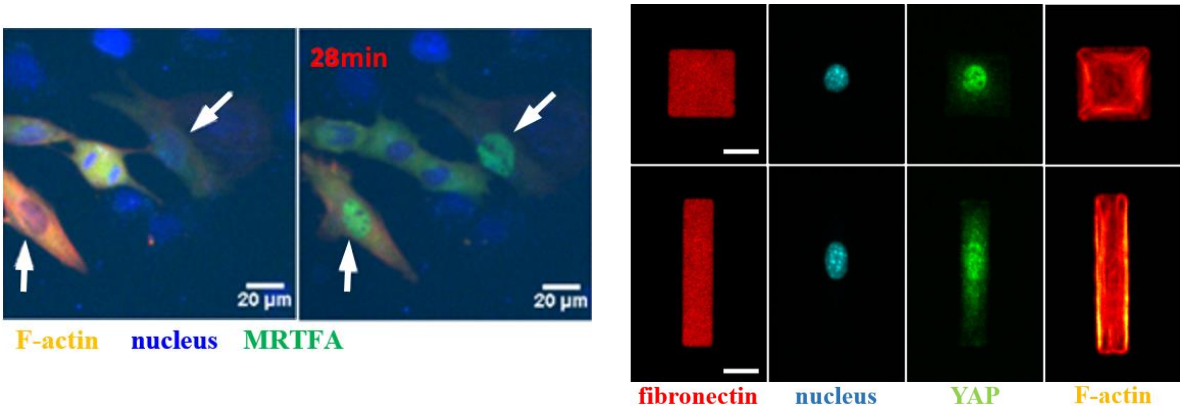

***Figure**: Left: Under the application of a global stretch, the transcription co-factor MRTFA enters the nucleus of the two myoblasts pointed by arrows [1]. Right: Myoblasts cultured on adhesive micro-patterns (in red: adhesive protein fibronectin) that determine their shape and size. The transcription co-factor YAP is more nuclear in square than in rectangle cells [2].*
In the two series of images, the nuclei of the cells appear in blue, the actin filaments in orange fire, and the transcription co-factors in green. scale bars: 20µm

The project will take place at the Laboratory Complex Matter and Systems in Paris, a renowned interdisciplinary research centre with expertise in physics, life science, chemistry and technology. The project is developed in close collaboration with a network of biology laboratories (Institut Cochin, Institut Jacques Monod, Epigenetics and Cell Fate).

[1] L. Montel et al. *PLoS One* (2019)
[2] D. Pereira et al. *Sci. Rep.* (2020)

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: NO Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: NO