Master 2 research internship in Integrated Structural & Cell Biology in Grenoble

Supervisor(s):
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Host laboratory:
LPCV, Cytomorpholab
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Title of the M2 research internship:
Analysis of the actomyosin cytoskeleton dynamics coupled to traction force during endothelial cell chiral rotation

Project summary:
Asymmetry is a universal and conserved parameter encountered in nature, playing both a role in the organization of galaxies, chemical molecules, and the development of organs and organisms. Understanding how this characteristic emerges from an originally symmetrical condition is thus a major scientific goal in numerous domains, including Biology.
In this context, our project focuses on the emergence of the spontaneous left-right asymmetry, also known as chirality, among endothelial cells. It is manifested by the apparition of a chiral rotation (biased in a specific direction) when cells are confined on micropatterned surfaces. Interestingly, we recently highlighted the importance of forces produced and transmitted by the actin cytoskeleton in the expression of the chiral phenotype of these cells. Indeed, our preliminary results demonstrate the existence of a « force optimum » corresponding to the existence of a stable chiral bias in this population. When this equilibrium is shifted by modulating contractility (use of chemical inhibitors or soft substrates), both the rotation and bias are impaired, leading to either a reinforcement of the bias or to its complete reversion. In order to understand the functional link between the organization and dynamics of the actomyosin cytoskeleton and cell contractility, we are measuring traction forces exerted on the underlying substrate but also at cell-cell contacts during the establishment of chiral rotation. In this context, we are looking for a master student possessing a strong expertise in image analysis and programming to perform a deep characterization of the chiral rotation of cells and their cytoskeleton in correlation with the measured traction forces. The objective of this traineeship will be to use preexisting analysis tools (dynamic characterization of protein fluxes and forces at the adhesion and cell-cell junction) and to integrate them in a pipeline allowing the study of the interconnexion of the different parameters followed.

Keywords:
cytoskeleton dynamics, traction force, cell chirality

Relevant publications of the team:
Kollimada S, Senger F, Vignaud T, Théry M*, Blanchoin L*, Kurzawa L* (2021) Stress fibers are embedded in a contractile cortical network, MBoC. * = corresponding authors

Vignaud T, Copos C, Leterrier C, Toro-Nahuelpan M, Tseng Q, Mahamid J, Blanchoin L, Mogilner A, Théry M*, Kurzawa L* (2020) Stress fibers are embedded in a contractile cortical network, Nature Materials.

Senger F, Pitaval A, Ennomani H, Kurzawa L, Blanchoin L, Théry M (2019) Spatial integration of mechanical forces by α-actinin establishes actin network symmetry. J Cell Sci.

Kurzawa L*, Balland M, (2019) Lost in mechanobiology, what's next?: Missing tools related to the physics of the system. Biol Cell.

Kurzawa L, Vianay B, Senger F, Vignaud T, Blanchoin L (2017) Dissipation of contractile forces: the missing piece in cell mechanics, Mol Biol Cell.

Martiel JL, Leal A, Kurzawa L, Balland M, Wang I, Vignaud T, Tseng Q, Thery M (2015), Measurement of cell traction forces with ImageJ, Methods in Cell Biology.