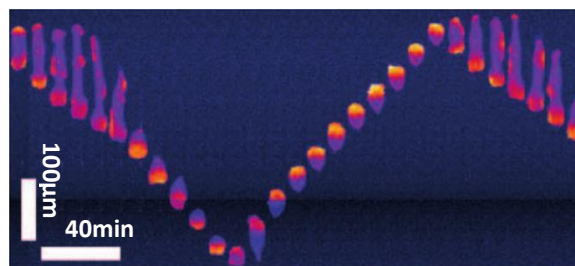


Dynamical control of cell migration: interplay between internal polarity and substrate-deposited footprint.

M2 internship (2027) leading to a funded PhD – ANR project Petit PouCell – J. d'Alessandro, IJM, Paris

Context. Cell motility is a ubiquitous phenomenon throughout the life of animals. From a physical point of view, cells behave as polar self-propelled particles, driven by asymmetries of their cytoskeletal activity. We also discovered recently that epithelial cells deposit a footprint on their way, which in turn feeds back on cell polarity to act as an external self-attracting cue. The objective of the PhD is to understand two aspects of cell polarity: (1) how its peculiar dynamics may arise from the interconnection of several layers of intracellular chemical and mechanical activities: Rho-GTPases, cortex contractility, actin protrusions, substrate adhesion, but also organelle position, trafficking... (2) how those dynamics integrate external signals provided by cellular footprint.



Kymograph of an MDCK cell moving along a 1d track. It expresses a fluorescent reporter of protrusive activity and bounces on the edges of its own footprint.

Methods. We perform standardised cell migration experiments based on live videomicroscopy to extract quantitative, biologically meaningful information amenable to physical modelling and interpretation: activity fields (see figure), traction forces, cell edge motion... To that end, epithelial (MDCK) cells are seeded on 1d micropatterned tracks, which can be “conditioned” (ie covered with footprint) beforehand. We may also control processes at a subcellular scale with optogenetics. The project also includes the use of data-driven modelling approaches developed by our collaborators.

M2 internship. The student will characterise a new conditioning method as a mean to learn the full existing pipeline: substrate preparation, cell culture and imaging, data analysis. Then they will set-up the imaging of various polarity markers and characterise their dynamics.

Environment. Institut Jacques Monod is a large biology institute, offering rich scientific life and common infrastructure, including imaging and proteomics facilities. The student will be under the supervision of Joseph d'Alessandro and benefit from the multidisciplinary expertise of the Cell Adhesion and Mechanics team, ranging from cell biology to physics and material sciences. The student will have the opportunity to broaden her/his scope by actively hitting their road through our collaborator network.

Candidate profile. Strong background (M2 level) in physics (soft matter, complex or dynamical systems) and/or cell biology expected. Notions of coding (Matlab/Python/ImageJ) will be a plus. The project is *mainly experimental* but entails advanced data analysis. The student should be willing to learn various aspects of the project and to work in an interdisciplinary team.

Internship setting. Standard stipend. 4-6 months internship starting in winter/spring 2027.

Application. Please send your CV, available university record and short cover letter to Joseph d'Alessandro – joseph.dalessandro@ijm.fr