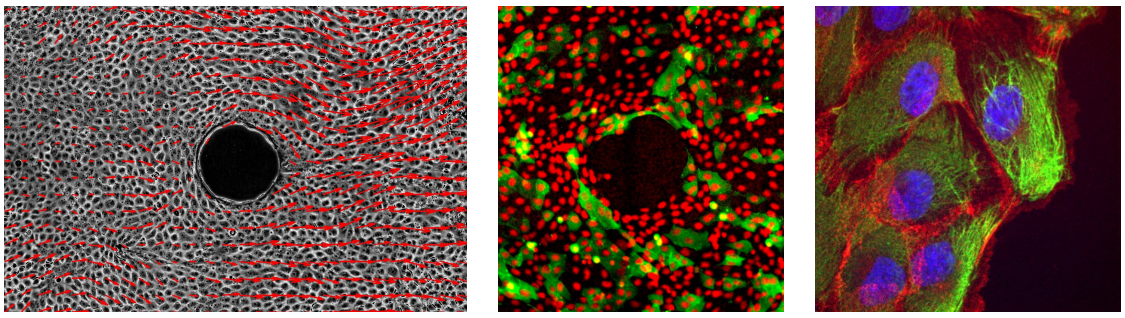
Data analysis

In which directions do cells migrate ?

Internship (not PhD thesis)

It is now well acknowledged that mechanics is playing a significant role on cell fate and behavior, in processes as different as embryonic development, blood clotting or tumor growth. To understand these behaviors, and disentangle mechanics versus genetics cues, biophysicists currently search to establish a rigorous quantitative description of tissue mechanics based on cell-level activity, and in particular on cell motility. An important quantity which drives cell migration is cell *polarity* : we and others aim at understanding how it is determined by cell shape, mechanical stress, cell velocity, and biochemical cues such as anisotropic protein distributions within the cell.

We culture cells on a substrate and let them migrate collectively. The originality of the experiment is that cells are forced to flow around an obstacle (see Figure). Such a heterogeneous geometry has already been decisive to discriminate between models of complex fluids in the case of physical cellular materials. It enables to study simultaneously cells in different controlled configurations, with a wide range of velocity and polarity magnitudes and directions. A new protocol combining live and fixed imaging has been established and feasibility tests have been successful.



2D in vitro monolayer of cells, migrating from left to right around a circular obstacle. Left : cell contours are in grey levels, and the measured velocity field is superimposed as red arrows. Middle : nuclei are in red, and a few cells are highlighted in green. Right : labeling the intermediate filaments, in green, qualitatively evidences the cell anisotropy near the monolayer front, to be quantified during the internship ; nuclei are in blue and cell contours in red.

The intern will face the challenge of defining a quantity to characterize cell polarity which is together biologically relevant, experimentally measurable, and suitable for incorporation within models. With this definition, a thorough data analysis campaign will yield polarity maps, which will be compared with cell migration speed maps. Perspectives include comparisons with traction force maps.

The internship will be in Paris, at the core of a active starting interdisciplinary collaboration. It will be supervised by François Graner and PhD student Mélina Durande, in close collaboration with Hélène Delanoë-Ayari (Lyon), and with links with applied mathematicians (Grenoble), numericians (Porto Alegre, Brazil), and developmental biologists (Paris).

Required skills : good numerical or theoretical background, willing to work at experiment / modelling interface and at physics / biology interface

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