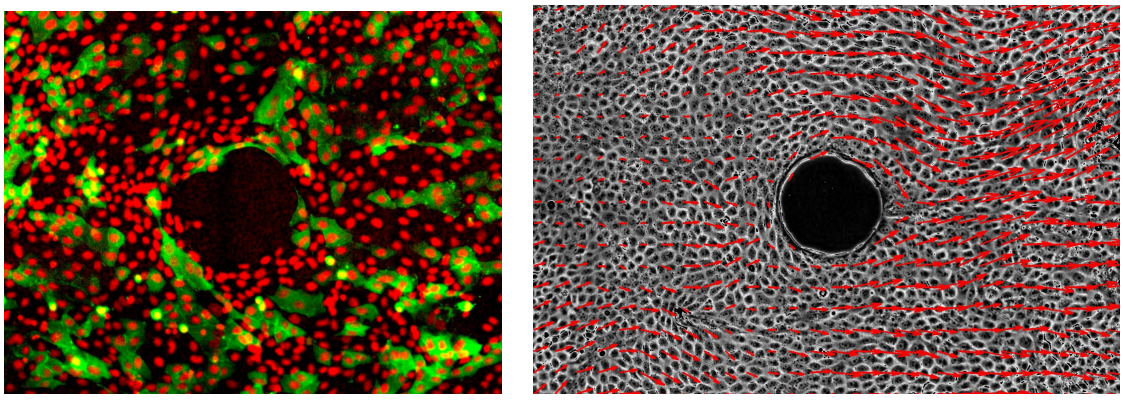
Experiment and/or modelling

In which directions do cells migrate ?

Internship and/or PhD thesis

It is now well acknowledged that mechanics is playing an important 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 force them to 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 velocitiy and polarity magnitudes and directions. Feasibility tests have been successful.



2D in vitro monolayer of cells, migrating from left to right around a circular obstacle. Left : nuclei are in red, and a few cells are highlighted in green. Right : cells contours are in grey levels, and the measured velocity field is superimposed as red arrows.

According to personal tastes and skills, the candidate could join either side of our collaboration for an internship, and even combine them for a PhD :

• Modeling in Paris, with François Graner : analyse our existing experimental data, to extract cell speed, shape, nucleus position ; then define and measure polarity ; establish a link with simulations perfomed by our colleagues in Porto Alegre (Brasil) ; incorporate the results into a theoretical modelling of active cell layers and of their instabilities.

• Experiment in Lyon, with Hélène Delanoë-Ayari : more complete experiments, with labelling of centrosomes ; tracking of proteins implied in polarisation and contractility ; force measurements.

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