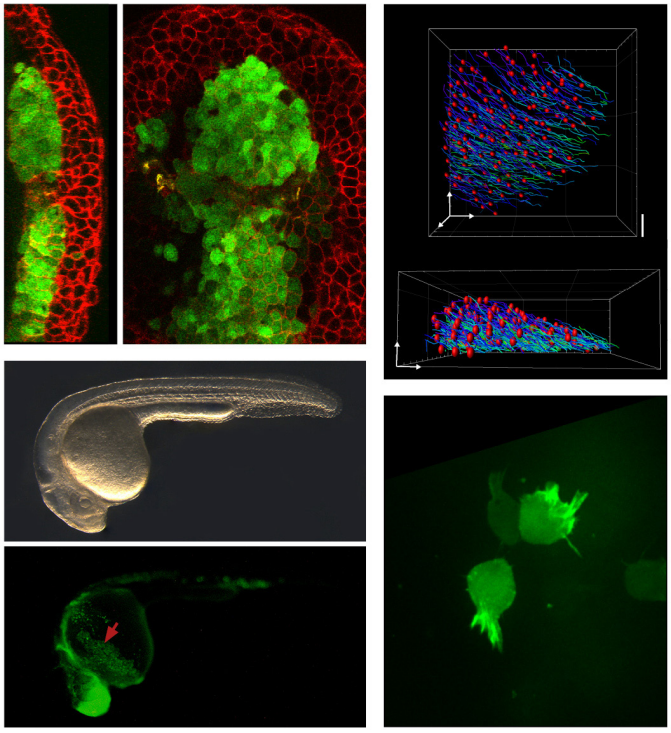
Molecular and cellular bases of collective migration in the zebrafish embryo.

The role

We are seeking a highly motivated candidate strongly interested in cell and developmental biology, to join our team and work on a project that aims at elucidating the mechanisms driving the collective movements ensuring embryonic axis elongation.

Collective cell migrations are migrations in which the movement of a cell is influenced by its neighbours. Collective migrations are frequent and key to many physiological and pathological situations, yet, their cellular and molecular basis is just starting to be unraveled.

A few years ago, we established that cells leading the embryonic axis extension undergo a collective migration. Our latest results demonstrate that cells perceive the mechanical forces exerted by their neighbours, and use it a directional information. Propagation of this information through the tissue allows large scale coordination of cell movements.



The PhD candidate will work towards:

- Better characterizing the cellular basis of cell migration, through high spatial and temporal resolution imaging He will in particular perform morphometric analyses to correlate cell shape changes to cell movements, and disentangle the cell autonomous and non-cell autonomous components of the movement.
- Further unravelling the molecular events linking mechanical perception to cell orientation. This will imply looking at the dynamic localization of the known constituent of the mechano-perception pathway (cadherin, catenin, vinculin), in the presence or absence of a mechanical stimulus. Identification of the downstream events will involve assessement of the importance of the arp recruitment by vinculin, as well as analysis of the cell autonomous and non cell-autonomous roles of myosin in establishing cell polarity.
- Establishing how general is the mechanically induced cell orientation, and trying to build a unified model of gastrulation movements.

The project involves classical embryological approaches (embryo injections, cell transplants), live-imaging (regular confocal, two-photon, laser ablations, potentially light-sheet), image and data analysis, basic molecular biology. All techniques are in use in the lab, and all the required equipment is available.

Keywords: cell migration, zebrafish, live imaging, development, morphogenesis.

Whom we would like to hire:

The candidate should be enthusiastic and creative, have good communication skills and be eager to learn and work in a highly interdisciplinary lab. A background in developmental or cell biology is required. Skills in microscopy and/or basic coding are preferred but not required.

The offer:

- 3 year PhD position, funded by ANR.
- Target start date : October 2021

Applications and inquiries:

Applications should include a CV and a cover letter.
Applications or questions should be addressed to Nicolas David: nicolas.david@polytechnique.edu

The team and lab:

This project will be carried out in the Laboratoire d'Optique et Biosciences at Ecole Polytechnique (Palaiseau, France), in the team of Nicolas David, who demonstrated the collective nature of the prechordal plate migration, and has a long standing experience in analysing in vivo cell migration. The laboratory is equipped with a fish facility and has all the required material and expertise for working on Zebrafish embryos. In addition, the LOB comprises world leading experts of fast and non-linear in vivo imaging. The project will directly benefit from their expertise and unique microscopes.

Ecole Polytechnique is located on the 'Plateau de Saclay', in the rapidly developing Paris-Saclay area. The campus can easily be reached by bus from Massy. It offers a wide range of activities (sports, culture, associations). More info on https://www.ip-paris.fr/en

Relevant publications:

- Boutillon, A., Brusch, L., Staruss, J., David, N.B. Long range cell coordination through a-catenin mechanoperception. In prep.
- Polesskaya, A., Boutillon, A., Wang, Y., Lavielle, M., Vacher, S., Schnitzler, A., Molinie, N., Fokin, A., Bièche, I., David, N.B., et al. CYFIP2 containing WAVE complexes inhibit cell migration. BiorXiv (in revision at Curr. Biol.)
- Boutillon, A., Giger, F.A., and David, N.B. (2018). Analysis of In Vivo Cell Migration in Mosaic Zebrafish Embryos. Methods Mol. Biol. 1749, 213–226.
- Giger, F.A., and David, N.B. (2017). Endodermal germ-layer formation through active actin-driven migration triggered by N-cadherin. Proc. Natl. Acad. Sci. 114, 10143–10148.
- Giger, F.A., Dumortier, J.G., and David, N.B. (2016). Analyzing in vivo cell migration using cell transplantations and time-lapse imaging in zebrafish embryos. J. Vis. Exp. 53792, 1–10.
- Dumortier, J.G., and David, N.B. (2015). The TORC2 Component, Sin1, Controls Migration of Anterior Mesendoderm during Zebrafish Gastrulation. PLoS One 10, e0118474.
- Dumortier, J.G., Martin, S., Meyer, D., Rosa, F.M., and David, N.B. (2012). Collective mesendoderm migration relies on an intrinsic directionality signal transmitted through cell contacts. Proc. Natl. Acad. Sci. U. S. A. 109, 16945–16950.