

Calcium Waves and Signaling During Animal Morphogenesis

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Internship proposal for : Master 1 or Master 2

Laboratory

IBDML

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Main discipline : Molecular biology/Biophysics

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Subjects / Tools-Methodologies

- 1 : Calcium mediated signaling/imaging of injected Calcium sensors
- 2 : adhesion/contractile behavior/actin-myosin network/data processing & imaging analysis.
- 3 : morphogenesis/

During recent years biology has integrated new approaches to analyse the dynamics and the mechanics of supramolecular structures. Moving away from the qualitative study of individual components, biology is ready to welcome quantitative studies addressing the physics of living systems. In this context, our group tackles questions concerning the dynamics of multicellular systems, with a special focus on the forces shaping cells in developing embryos. We try to understand how forces are produced in cells, how they transmit from individual cells to their neighbours and how such forces drive morphogenetic movements. To get insight into the molecular origin of these forces we also study the supramolecular organization of force generators and transmitters. By nature, our work is multidisciplinary and integrates physical/mechanical and molecular/genetic approaches. In particular we develop microscopes to observe subcellular structures at high resolution and probe the local mechanics of cells. We also use modeling to make quantitative and falsifiable predictions, which we test experimentally. Modeling is also a guide for new experiments. We hope that such approaches may shed light on biological processes at different scales.

Summary of lab's interests

The morphogenesis of tissues and organs relies on cell shapes changes, cell division, cell movements and cell death. During animal development, this set of cell behaviours is highly regulated. Key to this regulation is the coordination between cell adhesion and the mechanical stresses, which are exerted on cells by the cytoskeleton. Our lab uses the embryogenesis of the fruitfly (*Drosophila melanogaster*) as a model system to study the physical principles that underlie these important biological processes. In a variety of systems, Cadherin based adhesion as well as the actin/myosin cytoskeletal network were shown to be regulated by Calcium mediated signaling. Calcium is a highly versatile signaling ion present in all animal tissues but surprisingly, we know very little about its role during early *Drosophila* morphogenesis. This project shall address a potential role of Calcium mediated signaling on tissue remodeling in fly embryos. We will investigate whether Calcium regulates adhesion strength of embryo cells as well as the contractile behavior of the actin-myosin network during morphogenesis. This project offers the opportunity to combine a variety of experimental techniques, predominantly based on imaging of injected Calcium sensors in living fly embryos as well as data processing such as imaging analysis. Hosted in a biology institute, our interdisciplinary lab gathers a mixture of physicists, engineers and biologists. Candidate should have a strong background in at least one of the following disciplines: physics, engineering, biology or computer sciences.

