Co-dynamics of contraction and adhesion in animal morphogenesis

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A fundamental challenge in biology is to understand **how microscopic forces generated within individual cells bring about collective changes** in cell shape and position **to produce complex and reproducible morphologies**. The rapid remodelling of embryonic tissues involves a dynamic combination of cell division, cell shape changes and cell neighbour exchange, which are governed by the dynamic interplay between (i) force generation by the actin cytoskeleton within cells and (ii) force transmission by cadherin molecules across cell-cell contacts.

The objective of this interdisciplinary project is **to understand how the macroscopic dynamics of force transmission and dissipation emerge from the microscopic architecture, assembly/disassembly dynamics and physical coupling of contractile and adhesion networks.**

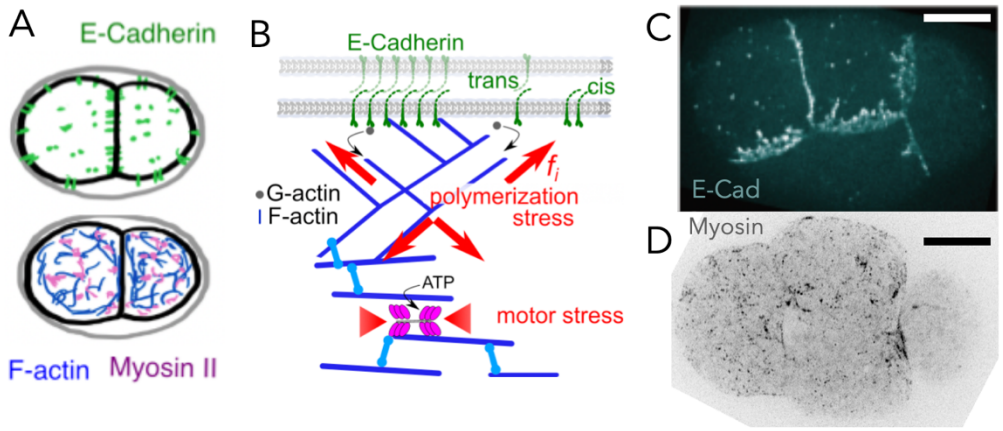

Figure 1 Adhesive and contractile networks in the early C elegans embryo (A). Molecular players at cell-cell contacts (B). Distribution of E-cadherin (C) and Myosin-II (D) at 4-cell stage.

More specifically, the project aims to apply advanced imaging approaches including light sheet microscopy and random illumination microscopy to observe the architecture and dynamics of the adhesion molecule E-cadherin and of the actomyosin networks at cell-cell contacts *C. elegans* embryos. We will combine two-color imaging of E-cadherin and F-actin or Myosin-II with particle tracking analysis to quantify correlated motions of E-cadherin and actomyosin that underlie both local remodelling and large-scale redistribution of E-cadherin networks. To probe the physical coupling between the two networks, we will use two laser-based methods to induce rapid local deformation/displacements of actomyosin networks (by laser ablation) or cell-cell contacts (using laser tweezers) and observe the co-response of actomyosin and cadherin networks to draw inferences on local coupling

The project requires a solid background in physics, computational skills and a strong interest in living systems. The project will be carried in a biophysics lab that combines experimental and theoretical approaches, in collaboration with the group of Edwin Munro (University of Chicago). This master project can eventually be continued by a funded PhD.

Keywords: complex systems, advanced microscopy, image analysis, cell mechanics, developmental biology, physical models.

Team*: Physical Approaches to Cell Dynamics and Tissue Morphogenesis*

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