

François Fagotto

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François Graner

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Master internship 2024-2025

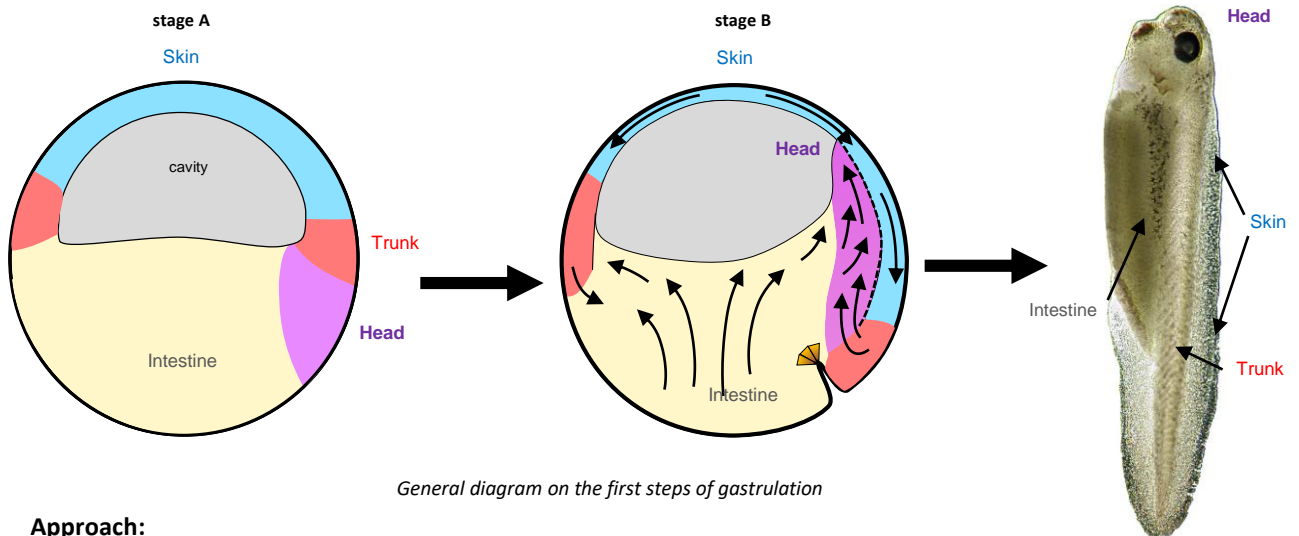
Biophysics & Computer Modelling

Cell automaton-based simulation of tissue migration in early embryonic development

This is a new multidisciplinary collaboration between two internationally renowned teams: one in biophysics (Paris) and one in cell developmental biology (Montpellier).

Background:

Embryonic development involves large scale auto-organised tissue remodelling. Gastrulation is the process during which a sphere-like embryo acquires a multi-layered structure with a distinction between an “inside” and an “outside”. This is a major event, highly conserved across evolution. This internship focuses on the stage where the mesoderm tissues (purple and red in the diagrams below) enter inside the embryo and prepare the head-trunk organisation of the future animal. Our model is here an amphibian, for which the Fagotto team measures experimentally [1] all physical properties (stiffness, adhesiveness, tensions, motility) that control the individual or collective cell activity.



Approach:

We aim at integrating experiment-driven information into a robust numerical simulation of collective movements emerging at tissue scale. This internship will focus on the onset of gastrulation (transition from stage A to stage B in the diagram). The intern will exploit an open-source software based on the “cellular Potts model” in the Graner team [2]. The aim is to propose predictions which the Fagotto team will experimentally test.

[1] Kashkooli et al. (2021), <https://doi.org/10.1371/journal.pbio.3001060> ; Rozema et al. (2023), <https://doi.org/10.1101/2023.03.27.534409>

[2] CompuCell3D: <https://compuCell3d.org> ; Beatrice et al. (2023), <https://doi.org/10.1039/d3sm00187c>

Requirements:

High academic record in biophysics or equivalent, good computer coding skills.
No knowledge on embryonic development is required.

Internship duration: from 3 to 6 months.

Prolongation by a PhD: to be discussed. It would involve a whole simulation of gastrulation.

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