M2 internship and PhD thesis

Fluctuations, forces and organization in active cellular systems

Laboratory :
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Thesis possibility after internship: YES
**Funding:** Contrat Doctoral

Summary

Active cellular systems, such as cell monolayer or biological tissues, form perfect tilings of the space or plane, and whose organization evolves in time though local rearrangements, requiring the consumption of energy. Because cells present high deformability and low compressibility, interactions between cells cannot be modelized by pairwise-interactions, what sets them apart from other active systems.

The structure is essential for the function of a tissue. Stability of the frontier between two tissues is also crucial to preserve their integrity [1]. The aim of the present study is to analytically and numerically investigate how the structure and integrity of a tissue resist to the active local rearrangements. Of special interest, we will study if an order-disorder transition similar to the one observed in cellular systems at thermal equilibrium [2] also occurs in active cellular systems. We will also investigate whether the spectrum of fluctuations captures useful information on the mechanical properties of such systems..

Required skills: the candidate should have a strong inclination for theory (especially statistical physics) and numerical simulations.

[1] D. Sussman *et al.*, *Physical Review Letters* **120**, 058001 (2018).

[2] M. Durand and J. Heu, arXiv preprint arXiv:1910.02742, *Physical Review Letters* **123**, 188001 (2019).
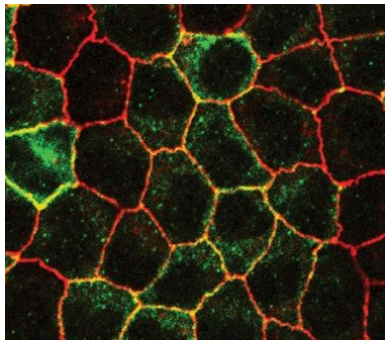
Contour fluctuations in a biological cellular system (epithelium).