MASTER 2 INTERNSHIP PROPOSAL

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CNRS identification code: UMR7646
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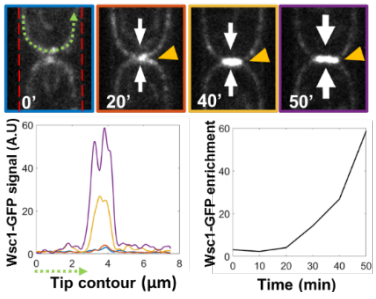
Internship location: Ecole polytechnique, Palaiseau
Thesis possibility after internship: YES
Funding: YES, through ANR CellWallSense

Using biophysical models to unravel how mechanosensing guides yeast morphogenesis

Over the last few years, force sensing, or mechanosensing, has appeared as an important cue for cell and organism function. In the framework of a collaboration with Nicolas Minc (IJM, Université de Paris), we are combining experiments and models to understand how mechanosensing enables stable morphogenesis and survival in a model organism, fission yeast.
This model organism is representative of fungi, notably of infectious fungi, and more generally of organisms with cell walls. The cell wall is a thin and stiff layer encasing and protecting bacterial, plant and fungal cells. It undergoes dynamic modifications in mechanics and composition that drive growth, reproduction, and infection. Such modifications entail risks of cell wall breakage and lysis of cells, due to their high internal pressure. In fungi, those risks are mitigated by the cell wall integrity pathway, which detects cell wall defects through membrane mechanosensors, and promotes compensatory responses.
Building on novel quantitative approaches of our consortium to dynamically map CW mechanics around live fission yeast cells, and to model walled cells morphogenesis, we are dissecting the mechanisms of CW mechanosensing by sensors of the CWI and at addressing the function of mechanosensation in cell growth. We expect our work to shed light on the mechanisms of surface mechanosensing and their role in promoting cell survival during growth.

The main goal of this internship will be to start building models of mechanosensation, which will involve formulating partial differential equations and solving them numerically. We will focus on the mechanisms of CW mechanosensation and their role in dynamically adjusting wall mechanics during cell growth. We will address how CW mechanical perturbations are sensed and how mechanical homeostasis ensues.
The intern will benefit from the expertise of the host team in the mechanics of walled cells and will be involved in discussions with experimentalists. The internship may be followed by a PhD, with funding already available through a grant from ANR.



Spatiotemporal pattern of mechanosensor protein Wsc1

[1] V. Davì, L. Chevalier, H. Guo, H. Tanimoto, K. Barrett, E. Couturier, A. Boudaoud* & N. Minc*. Systematic mapping of cell wall mechanics in the regulation of cell morphogenesis. Proc. Natl. Acad. Sci. USA 116, 13833–13838 (2019).
[2] A. Fruleux* & A. Boudaoud*. Modulation of tissue growth heterogeneity by responses to mechanical stress. Proc. Natl. Acad. Sci. USA 116, 1940–1945 (2019).
[3] V. Davì, H. Tanimoto, D. Ershov, A. Haupt, H. De Belly, R. Le Borgne, E. Couturier, A. Boudaoud* & Nicolas Minc*. Mechanosensation dynamically coordinates polar growth and cell wall assembly to promote survival. *Dev. Cell* **45**, 170–182 (2018).