Master Biologie Moléculaire et Cellulaire 'BMC',
Université Paris Cité - *UFR Sciences du Vivant*

Parcours : **Biologie et Développement Cellulaires 'BDC'**
https://master2bdc.ijm.fr/
Fiche de Projet de Stage de M2, 2026-2027

Unité INSERM ou CNRS ou Université : Institut Jacques Monod UMR7592 **Intitulé Equipe : Mechanotransduction : from the cell surface to the nucleus** **ED d'appartenance : BioSPC** **Responsable de l'Equipe : Nicolas Borghi**	**Responsable du Stage : Nicolas Borghi** **Contacts** Adresse : 15 rue Hélène Brion, 75013 Paris Email : nicolas.borghi@ijm.fr Tel : 01557278041

Titre du projet : Mechanotransduction in Epithelial Plasticity

Résumé du Projet de Stage (en 300 mots maximum, mots clés en gras)

Most cancers arise from epithelia, and their metastasis is the primary cause of death. Understanding how epithelial cells escape proliferation and migration controls is therefore of utmost importance. Proliferation and migration are fundamental behaviors that underly epithelial plasticity, and associate with mechanical forces that shape cells and trigger signaling pathways. **Our main objective is to understand how such forces govern the plasticity of epithelia**.

Our previous results point to a model in which the cytoskeletal cortex and cell nuclei are mechanosensors of tissue compression and tension. Consequently, they regulate mechanotransduction events in complexes of cell adhesion and at the nuclear envelope upstream of key signaling pathways that ultimately target cell migration and proliferation[1–4]. These results raise three outstanding questions: **1) how tissue tension and compression propagate through the cell cortex and nucleus down to the molecular level, 2) how robust is this process to physio pathological changes in the mechanical properties of the cortex and nucleus, and 3) how does this translate into decisions tailored to the metabolic requirements of migration and proliferation.**

The internship may focus on anyone of these topics. To address them, our general strategy is first to implement correlative **microscopy** approaches that combine mechanical probing at the cell and molecular scales, and mechanical and biochemical imaging at subcellular resolution. To do so, we use and develop **genetically encoded molecular biosensors** and **cell micromanipulations** with microfabricated and/or magneto-mechanical devices[1,2,4,5]. Next, we apply **genetic, pharmacological or optogenetic perturbations** to reveal molecular mechanisms. Ultimately, experimental results may feed dedicated agent-based, in silico models of collective cell behavior and the cytoskeleton, to build predictive tools for future experimental research and/or medical applications.

Publications de l'équipe relatives au projet de stage (max 5)

1. Gayrard, C., Bernaudin, C., Déjardin, T., Seiler, C. & Borghi, N. Src- and confinement-dependent FAK activation causes E-cadherin relaxation and β-catenin activity. *J. Cell Biol.* **217**, 1063–1077 (2018).
2. Déjardin, T. *et al.* Nesprins are mechanotransducers that discriminate epithelial-mesenchymal transition programs. *J. Cell Biol.* **219**, (2020).
3. Donker, L. *et al.* A mechanical G2 checkpoint controls epithelial cell division through E-cadherin-mediated regulation of Wee1-Cdk1. *Cell Rep.* **41**, 111475 (2022).
4. Laurent, L. *et al.* Epithelial density controls cell migration through an adhesion-nucleus mechanotransduction pathway. 2026.04.22.720102 Preprint at https://doi.org/10.64898/2026.04.22.720102 (2026).

5. Laplaud, V. *et al.* Pinching the cortex of live cells reveals thickness instabilities caused by myosin {II} motors. *Sci. Adv.* **7**, eabe3640 (2021).