INTERNSHIP / PhD PROPOSAL 2019

Laboratory name: Matière & Systèmes Complexes (MSC) - UMR 7057
Internship Supervisors: Nicolas Chevalier (CR2 CNRS), Vincent Fleury (DR2 CNRS)
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Internship location: Laboratoire MSC, Univ. Paris Diderot, 10 rue Alice Domon 75013 Paris

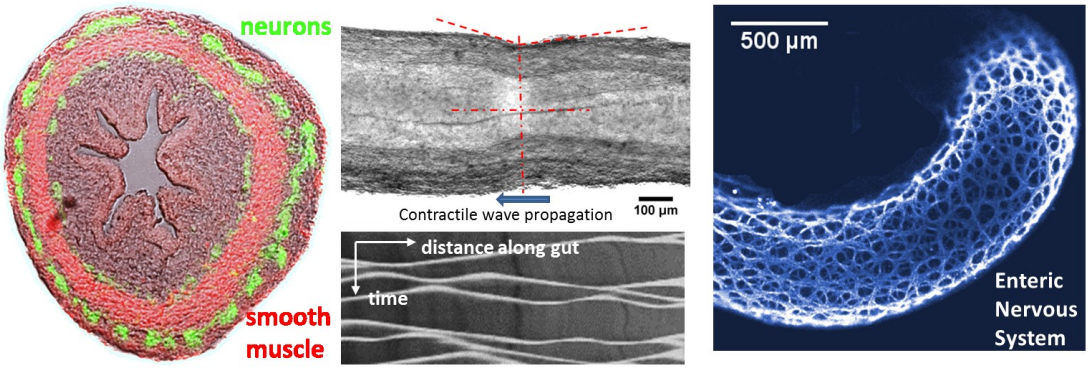
Internship type: Master 1 or Master 2
Thesis possibility after internship: YES Funding for internship: YES

Physical Organogenesis of the Gut

We work on **physical embryogenesis**, which is the study of how **mechanical or electrical fields** generated within the embryo influence, guide and control its development. This line of research is strongly **interdisciplinary**, it involves physics, developmental biology, physiology, genetics and medicine. We work on the development of a particular organ, **the gut**, a phenomenological gold mine. Our work is **experimental** and carried out mostly on chicken embryos, although we also use mice for genetic purposes.

Current topics developed in the lab include 1°) how **physical forces**[1,2] and **bioelectricity**[3] affect embryonic gut **growth** and **regeneration,** 2°) how the intrinsic innervation of the intestine (the enteric nervous system) wires up during embryonic development and couples to **digestive peristaltic movements**[4–6]**,** 3°) how **neural crest cells**[7] migrate in the embryonic gut to give rise to the enteric nervous system - migration defects result in an ill-understood pathology, Hirschsprung disease.

We are currently looking for highly motivated M1 or M2 students to join us in this research venture; the work can be pursued as a PhD. This internship will offer the possibility to develop strong experimental and analytical skills in biophysics and embryology: dissection, biomechanical testing, organ culture, electrophysiology, tissue staining, biochemistry (WB, PCR), microscopy (optical, time-lapse, confocal, second harmonic generation etc.), image analysis (ImageJ), computational methods (Matlab, finite-element modeling). Applications from outstanding students with various backgrounds will be considered (e.g. medicine, physics, physiology, biology…). The internship can start as from February 2019.



1. Khalipina, D., Dacher, N. & Chevalier, N. Smooth muscle contractility causes anisotropic growth of the embryonic gut. Under review at *Sci. Advances* (2018).
2. Chevalier, N. R. et al. Mechanical Tension Drives Elongational Growth of the Embryonic Gut. Sci. Rep. 8, 1–10 (2018).
3. Levin, M., Pezzulo, G. & Finkelstein, J. M. Endogenous Bioelectric Signaling Networks: Exploiting Voltage Gradients for Control of Growth and Form. Annu. Rev. Biomed. Eng. (2017). doi:10.1146/annurev-bioeng-071114-040647
4. Chevalier, N. R., Fleury, V., Dufour, S., Proux-Gillardeaux, V. & Asnacios, A. Emergence and development of gut motility in the chicken embryo. PLoS One 12, e0172511 (2017).
5. Chevalier, N. R. The first digestive movements in the embryo are mediated by mechanosensitive smooth muscle calcium waves. Philos. Trans. R. Soc. B Biol. Sci. 373, 1759 (2018).
6. Chevalier, N. et al. Embryogenesis of the Peristaltic Reflex. J. Physiol. - under review (2019).
7. Chevalier, N. R. et al. How tissue mechanical properties affect enteric neural crest cell migration. Sci. Rep. 6, 20927 (2016).