

CURRICULUM VITAE

Nicolas Chevalier, born 26th of January 1983, French

EDUCATION

2007 – 2010 **PhD in Physics, Pierre & Marie Curie University**, Saclay, France, top honors

Thesis in experimental biophysics: « The influence of organic surfaces on the heterogeneous nucleation of calcium carbonate », under the supervision of Dr. P. Guenoun, LIONS laboratory, CEA Saclay.

2001 – 2006 **M.S. in Physics, Swiss Federal Institute of Technology, EPFL**, Lausanne, Switzerland

Thesis work: modeling of crystal growth in gels, Prof. M. Droz, University of Geneva.

2003 – 2004 **Lomonossov State University (MSU)**, Physics Faculty, Russia. 3rd Year abroad

2000 **Scientific Baccalaureate**, Lycée Français de Vienne, Austria, with top honors

WORK EXPERIENCE

2016 – CNRS CR2 Researcher, Biophysics & Physical Embryology
Laboratoire Matière Systèmes Complexes (MSC), Paris Diderot University, France

Together with my collaborators, I

- Demonstrated that the first digestive movements in the embryo are due to mechanosensitive *smooth muscle calcium waves* and that they drive the *anisotropic morphogenesis* of the intestine. I developed the first robust protocol to *grow embryonic intestinal explants in culture*.
- Demonstrated key roles of the *enteric nervous system* in coordinating contractions of longitudinal and circular smooth muscle layers, giving rise to *peristaltic transport*. I demonstrated how the pressure-sensitive reflex of the intestine arises during embryonic development by *asymmetric mechanosensitive neural inhibition* of the smooth muscle layer.
- Revealed a *nematic orientation phase transition of neurons* in the developing mouse gut, driven by extracellular matrix (second harmonic generation microscopy).
- Developed novel methods to quantify the *biophysical frictional properties of hair fibers*, and elaborated a method to produce *hydrophobic powders* with important industrial applications.
- Collaborated with biologists to quantify *intestinal motility in a desmin KO mouse model* (A. Lilienbaum, U. de Paris), to measure *oxygen pressure in the chicken embryo* (S. Dufour, INSERM), to identify *Cajal cells* in the embryonic gut (P. de Santa Barbara, INSERM).

2014 – 2016 Postdoctoral Fellow, MSC & Institut Jacques Monod, Paris Diderot Univ.

- Demonstrated that *umbilical cord tension* drives early anisotropic growth of the gut.
- Developed the *first study of intestinal motility development* in the chicken embryo.

2013 – 2014 Postdoctoral Fellow, MSC, team of Vincent Fleury

- Determined the effects of tissue stiffness on *neural crest cell migration* during development and its impact in *Hirschsprung disease* (colonic aganglionosis).
- Developed a new pressurized water-jet indenter and applied for the first time Atomic Force Microscopy for *soft and biological matter elastography*.

2011 – 2013 **Research Engineer, Accelerator and Cryogenic Systems, Orsay, France**

Designed helium cryogenic equipment for European accelerator projects. Managed company participation in large European projects MYRRHA and ESS, company representation at meetings and conferences, customer relations.

2007 – 2010 **PhD in Biophysics, LIONS Laboratory, CEA Saclay, France**

Studied the influence of nacre shell proteins on CaCO₃ crystallization. Determined mineral and protein structures by microscopy (phase contrast, confocal), X ray diffraction (DESY synchrotron), FTIR, AFM. Designed anti-CaCO₃ scaling surface treatments.

2006 – 2007 **Visiting Scientist, Dpt of Chem. and Biol. Eng., Northwestern University, USA**

Performed an experimental (synthesis, functionalization, characterization) and theoretical (analytical, Monte Carlo, PDE solver) study of oppositely charged nanoparticle crystals

FELLOWSHIPS & GRANTS

- 2020-2023 **ANR JCJC**, “GASTROMOVE: GASTROintestinal MOVEMENTS: from fundamentals to application”, 250 k€, project leader
- 2020 **Young Investigator support** by the 4th Meeting on Neurogastroenterology & Motility, Adelaide, Australia
- 2020 **IDEX Emergence**, U. de Paris, “GASTROMOVE”, 20 k€, project leader
- 2018-2019 **CNRS Mission pour l’Interdisciplinarité “Mécanobiologie”** grant: MECHENSDEV, Enteric Nervous System Biomechanics & Development, 60 k€, project leader
- 2016 **CNRS CR2 competition nominee**, position in Biophysics, Section 54
- 2014 – 2016 **Labex “Who Am I?”** Postdoctoral Fellowship & Project Grants, “Establishment of autonomous peristaltic waves in the gut”, 80 k€, project leader

TEACHING ACTIVITIES & SUPERVISION

2020-2023 **PhD supervision, ANR “GASTROMOVE” project**, candidate to be recruited

2020 **Practical Labwork (TP) Supervisor, Master 2 Biomedical Engineering, Univ. de Paris**

7 students, 20h labwork (one week) on organ culture, physiology & immunochemistry

2020 **Lecturer on « Biophysics of the Cell », Master 1 Physique Médicale, Université Paris Sud**

25 students, 9h course on biophysical aspects of cancer, cell mechanics & electrophysiology.

2016 - 2020 **Internship Supervision in Physical Embryology, Laboratoire MSC, U. de Paris**

16 interns; all BTS, M1 and M2 interns I have supervised contributed and signed or co-signed a peer-reviewed article.

4 technicians (BTS ESTBA, 2-3 months each); 1 M1 student (6 months, Univ. Paris Descartes); 5 M2 students (4-6 months each, Université Paris Diderot, McGill University, Ecole Polytechnique); 2 L3 students (1 month each, Université Paris Diderot), 4 high-school students (1 week, “stage de 3ème”).

2014 - 2019 Lecturer, Conférences Expérimentales, Fête de la Science

I gave original interactive experimental lectures on “Biominéralisation: le Vivant Orfèvre » (2014), « Les Temps de la Biologie » (2017), « Auto-organisation physico-chimique: de l'éprouvette à l'embryon » (2019), assistance of up to a 100 high-school students.

2007 - 2013 Coordinator, International Young Physicist Tournament, Lycée Louis-le-Grand

Initiated and coordinated the French team for the 22nd to 26th tournament editions. Set up, advertised and collected funds for an original scientific and educational project. Lead weekly experimental physics sessions with high-school students on challenging physics problems. Jury member (2009, 2010, 2012) of international tournament; jury member (2015, 2016) of French IPT (at Ecole Polytechnique and Ecole Normale Supérieure).

NATIONAL & INTERNATIONAL INVITED CONFERENCES

2020 Physics & Biological Systems, 22-24 June, Palaiseau, France
2020 4th Meeting on Neurogastroenterology & Motility, 25-29 March, Adelaide, Australia
2019 Congrès International d'Étiopathie, 30-31 March, Dijon, France
2019 Journées de Physique Statistique, 31 Jan., Paris, France
2018 Enteric Nervous System Development, 8-11 April, USA, Boston, USA
2018 Royal Society Meeting on “Mechanics of Development”, 5-7 Feb. 2018, Chicheley, UK
2017 GDR “Système Aviaire”, 27th June, Paris, France
2014 INSERM workshop, « Approches expérimentales de la mécanotransduction », 21-23 May, Bordeaux, France
2013 Rencontres des Jeunes Physiciens, 3 Nov., Paris, France

I presented my research in over 20 lab seminars in the period 2014-2020.

MEDIA & PRESS COVERAGE

2019 *New York Times* article “The twitch that helps your intestine grow”, 11 Oct. 2019
2020 *INSIS communiqué*, “L'intestin s'allonge par ses propres contractions », 14 Oct. 2019
2019 *France Culture Radio interview*, “Les mécanismes neuronaux de l'intestin, notre deuxième cerveau », 17 May
2019 *CNRS communiqué national*, « L'embryogénèse dévoile le rôle du « second cerveau » dans la digestion », 15 May
2018 *INSIS communiqué*, « Des ondes calcium aux origines de la digestion »
2018 *Université de Paris, dépêche*, « Un nouveau mécanisme de croissance pour l'intestin »
2017 *Université de Paris, dépêche*, « Mesurer la friction entre deux cheveux : un nœud suffit »

LANGUAGES & OTHER FIELDS OF INTEREST

French: native; **English:** fluent; **German:** fluent (lived 9 years in Austria); **Russian:** proficient (lived 1 year in Russia); **Interests:** music (cello, chamber music, orchestra), history of science

PUBLICATIONS IN INTERNATIONAL PEER-REVIEWED JOURNALS

- (1) **Chevalier, N.**; Ammouche, Y.; Gomis, A.; Teysaire, C.; de Santa Barbara, P.; Faure, S. Shifting into High Gear: How Interstitial Cells of Cajal Change the Motility Pattern of the Developing Intestine. *Am. J. Physiol. - Gastrointest. Liver Physiol.* **2020**, *accepted*.
- (2) Ammouche, Y.; Langlois, L.; Dufour, S.; **Chevalier, N. R.** Fetal Morphogenesis of the Enteric Nervous System. *Elife* **2020**, *under revi.*
- (3) Lilienbaum, A.; Cabet, E.; **Chevalier, N.R.**; Vicart, A.; Ferreiro, A. New Mouse Model with Severe Intestinal Pseudo-Obstruction Implicates Desmin in Gastrointestinal Muscle Pathophysiology. *Gastroenterol. under Rev.* **2020**.
- (4) Khalipina, D.; Kaga, Y.; Dacher, N.; **Chevalier, N.R.** Smooth Muscle Contractility Causes the Gut to Grow Anisotropically. *J. R. Soc. Interface* **2019**, *16*.
- (5) **Chevalier, N.R.**; Dacher, N.; Jacques, C.; Langlois, L.; Guedj, C.; Faklaris, O. Embryogenesis of the Peristaltic Reflex. *J. Physiol.* **2019**, *597* (10), 2785.
- (6) **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.* **2018**, *373*, 1759.
- (7) **Chevalier, N. R.**; De Witte, T. M.; Cornelissen, A. J. M.; Dufour, S.; Proux-Gillardeaux, V.; Asnacios, A. Mechanical Tension Drives Elongational Growth of the Embryonic Gut. *Sci. Rep.* **2018**, *8* (1), 1–10.
- (8) **Chevalier, N. R.** Super-Hydrophobic Powders Obtained by Froth Flotation: Properties and Applications. *RSC Adv.* **2017**, *7* (72), 45335–45343. <https://doi.org/10.1039/c7ra07164g>.
- (9) **Chevalier, N. R.** Hair-on-Hair Static Friction Coefficient Can Be Determined by Tying a Knot. *Colloids Surfaces B Biointerfaces* **2017**, *159*, 924–928. <https://doi.org/10.1016/j.colsurfb.2017.08.048>.
- (10) **Chevalier, N. R.**; Fleury, V.; Dufour, S.; Proux-Gillardeaux, V.; Asnacios, A. Emergence and Development of Gut Motility in the Chicken Embryo. *PLoS One* **2017**, *12* (2), e0172511.
- (11) **Chevalier, N. R.**; Gazquez, E.; Bidault, L.; Guilbert, T.; Vias, C.; Vian, E.; Watanabe, Y.; Muller, L.; Germain, S.; Bondurand, N.; et al. How Tissue Mechanical Properties Affect Enteric Neural Crest Cell Migration. *Sci. Rep.* **2016**, *6* (August 2015), 20927.
- (12) Fleury, V.; Murukutla, A. V.; **Chevalier, N. R.**; Gallois, B.; Capellazzi-Resta, M.; Picquet, P.; Peaucelle, A. Physics of Amniote Formation. *Phys. Rev. E* **2016**, *94* (2), 022426.
- (13) **Chevalier, N. R.**; Guenoun, P. Surface Tension Drives the Orientation of Crystals at the Air-Water Interface. *J. Phys. Chem. Lett.* **2016**, *7* (14), 2809–2813. <https://doi.org/10.1021/acs.jpcclett.6b01312>.
- (14) **Chevalier, N. R.**; Dantan, P.; Gazquez, E.; Cornelissen, A. J. M.; Fleury, V. Water Jet Indentation for Local Elasticity Measurements of Soft Materials. *Eur. Phys. J. E* **2016**, *39* (1), 1–11. <https://doi.org/10.1140/epje/i2016-16010-1>.
- (15) **Chevalier, N. R.**; Gazquez, E.; Dufour, S.; Fleury, V. Measuring the Micromechanical Properties of Embryonic Tissues. *Methods* **2016**, *94*, 120–128. <https://doi.org/10.1016/j.ymeth.2015.08.001>.
- (16) Fleury, V.; **Chevalier, N. R.**; Furfaro, F.; Duband, J.-L. Buckling along Boundaries of Elastic Contrast as a Mechanism for Early Vertebrate Morphogenesis. *Eur. Phys. J. E* **2015**, *38*.
- (17) **Chevalier, N. R.** Do Surface Wetting Properties Affect Calcium Carbonate Heterogeneous Nucleation and Adhesion? *J. Phys. Chem. C* **2014**, *118* (31), 17600–17607. <https://doi.org/10.1021/jp503807v>.
- (18) **Chevalier, N. R.**; Thermeau, J.-P.; Bujard, P.; Junquera, T.; Hermansson, L.; Kern, R. S.; Ruber, R. Design of a Horizontal Test Cryostat for Superconducting RF Cavities for the FREIA Facility at Uppsala University. *AIP Conf. Proc.* **2014**, *1573*, 1277–1284.

- (19) **Chevalier, N. R.**; Junquera, T.; Thermeau, J.-P.; Romão, L. M.; Vandeplassche, D. Cryogenic System for the MYRRHA Superconducting Linear Accelerator. *AIP Conf. Proc.* **2014**, *315* (May), 315–322.
- (20) Bishop, K. J. M.; **Chevalier, N. R.**; Grzybowski, B. a. When and Why Like-Sized, Oppositely Charged Particles Assemble into Diamond-like Crystals. *J. Phys. Chem. Lett.* **2013**, *4* (9), 1507–1511.
- (21) **Chevalier, N. R.**; Chevillard, C.; Goldmann, M.; Brezesinski, G.; Guenoun, P. CaCO₃ Mineralization under Beta-Sheet Forming Peptide Monolayers. *Cryst. Growth Des.* **2012**, *12*, 2299–2305.
- (22) **Chevalier, N. R.**; Chevillard, C.; Guenoun, P. Monovalent Cations Trigger Inverted Bilayer Formation of Surfactant Films. *Langmuir* **2010**, *26* (20), 15824–15829. <https://doi.org/10.1021/la102976e>.

PHD THESIS, M.SC. DIPLOMA

- (23) **Chevalier, N.** Influence de Surfaces Organiques Sur La Nucléation-Croissance Du Carbonate de Calcium: Et Autres Observations de Nature Physico-Chimique, Université Pierre et Marie Curie, 2010.
- (24) **Chevalier, N.** The Influence of Thermal Noise on Liesegang Pattern Formation, EPFL, 2006.

SCIENCE POPULARIZATION

- (25) **Chevalier, N.** L'embryogenèse Dévoile Un Rôle Du « second Cerveau » Dans La Digestion. *TheConversation* **2019**.
- (26) **Chevalier, N.** Le Mystère Hirschsprung. *Pour la Science*. **2018**, *2*.
- (27) **Chevalier, N.**; Toombes, G.; Bottineau, P. IYPT : Un Tournoi International Pour Jeunes Physiciens. *Reflets la Phys.* **2010**, *19*.
- (28) **Chevalier, N.** IYPT : Un Tournoi International Pour Jeunes Physiciens. *Bull. l'Union des Professeurs Phys.* **2010**, *920*, 91–96.