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 $CaCO_3$ cristallization. Determined mineral and protein structures by microscopy (phase contrast, confocal), X ray diffraction (DESY synchrotron), FTIR, AFM. Designed anti-$CaCO_3$ 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

2021-2024 **PhD superviser, ANR "GASTROMOVE" project,** Richard J. Amedzrovi-Agbesi

2019-2021 **Practical Labwork (TP) Supervisor, Master 2 Biomed. Engineering, Univ. de Paris**

7 students, 36h labwork (one week) on organ culture, physiology & immunochemistry

2019-2021 **Lecturer on « Biophysics of the Cell », Master 1 Physique Médicale, Univ. Paris Sud**

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

2016 - 2021 **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, ENS Ulm); 2 L3 students (1 month each, Université Paris Diderot), 4 high-school students (1 week, "stage de 3ème").

2014 - 2020 **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), « L'œuf : physique et physiologie », 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. Jury member (2009, 2010, 2012) of international tournament; jury member (2015, 2016) of French IPT.

NATIONAL & INTERNATIONAL INVITED CONFERENCES

2021 Physics & Biological Systems, June, Palaiseau, France
2021 4th Meeting on Neurogastroenterology & Motility, 14-17 April, Adelaide, Australia
2020 Workshop on Transport in the digestive tract: experiments, modeling, applications to microbiology, Sorbonne Université, 21-22 Oct., Paris, france
2019 Congrès International d'Etiopathie, 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

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

MEDIA & PRESS COVERAGE

2020 ***Université de Paris, dépêche*** "Quand les pacemakers de l'intestin se mettent en route dans l'embryon», Sept. 2020
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

(0) Amedzrovi-Agebsi, R.J., Chevalier, N.R. R. Luminal Flow Induced by Single and Trains of Slow Wave Contractions: A Finite Element Simulation Study *Eur. Phys. J. E.* **2021**, *under prep*aration

(1) Chevalier, N.R. Amedzrovi-Agebsi, R.; Ammouche, Y.; Langlois, L.; Dufour, S.; How smooth muscle contractions shape the developing enteric nervous system *Front. Cell Dev. Biol.* **2021**, *accepted*

(2) Harald, H.; Eva, C.; Chevalier, N.; Moosmann, J.; Schultheis, D.; Haas, J.; Schowalter, M.; Berwanger, C.; Weyerer, V.; Agaimy, A.; et al. Dual Functional States of R406W-Desmin Assembly Complexes Cause Cardiomyopathy with Severe Intercalated Disc Derangement in Man and in Knock-in Mice. *Circulation* **2020**, *142* (22), 2155.

(3) Chevalier, N. R.; Ammouche, Y.; Langlois, L.; Dufour, S. A Neural Crest Cell Isotropic-to-Nematic Phase Transition in the Developing Mammalian Gut. *Commun. Biol.* **2021**, *minor revision*

(4) Chevalier, N.; Ammouche, Y.; Gomis, A.; Teyssaire, 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**, *319* (4), 519.

(5) Khalipina, D.; Kaga, Y.; Dacher, N.; Chevalier, N. Smooth Muscle Contractility Causes the Gut to Grow Anisotropically. *J. R. Soc. Interface* **2019**, *16*, 20190484.

(6) Chevalier, N. R.; Dacher, N.; Jacques, C.; Langlois, L.; Guedj, C.; Faklaris, O. Embryogenesis of the Peristaltic Reflex. *J. Physiol.* **2019**, *597* (10), 2785.

(7) 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.

(8) 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. https://doi.org/10.1038/s41598-018-24368-1.

(9) 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.

(10) 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.

(11) 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.

(12) Chevalier, N. R.; Gazguez, 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. https://doi.org/10.1038/srep20927.

(13) 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. https://doi.org/10.1103/PhysRevE.94.022426.

(14) 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.jpclett.6b01312.

(15) 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.

(16) Chevalier, N. R.; Gazguez, 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.

(17) 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*.

https://doi.org/10.1140/epje/i2015-15006-7.

(18) 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.

(19) 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. https://doi.org/10.1021/jz4006114.

(20) Chevalier, N. R.; Chevallard, C.; Goldmann, M.; Brezesinski, G.; Guenoun, P. CaCO3 Mineralization under Beta-Sheet Forming Peptide Monolayers. *Cryst. Growth Des.* **2012**, *12*, 2299–2305. https://doi.org/10.1021/cg201597c.

(21) Chevalier, N. R.; Chevallard, C.; Guenoun, P. Monovalent Cations Trigger Inverted Bilayer Formation of Surfactant Films. *Langmuir* **2010**, *26* (20), 15824–15829. https://doi.org/10.1021/la102976e.

PEER REVIEWED CONFERENCE PROCEEDINGS

(22) 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.

(23) 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. https://doi.org/10.1063/1.4860717.

THESIS & MASTER

(24) 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.

(25) Chevalier, N. The Influence of Thermal Noise on Liesegang Pattern Formation, EPFL, 2006.

SCIENCE POPULARIZATION

(26) Chevalier, N. L'embryogenèse Dévoile Un Rôle Du « second Cerveau » Dans La Digestion. *TheConversation* **2019**.

(27) Chevalier, N. Le Mystère Hirschsprung. *Pour Sci.* **2018**, *2*.

(28) Chevalier, N.; Toombes, G.; Bottineau, P. IYPT : Un Tournoi International Pour Jeunes Physiciens. *Reflets la Phys.* **2010**, *19*.

(29) Chevalier, N. IYPT : Un Tournoi International Pour Jeunes Physiciens. *Bull. l'Union des Professeurs Phys.* **2010**, *920*, 91–96.

REVIEWING ACTIVITY

I reviewed manuscripts in the field of mechanobiology, gut development, enteric nervous system physiology and physical chemistry for the following journals: Nature Communications, Development, Clinical Science, PLOS ONE, Médecine Science, Phil. Trans. Royal Soc. B., RSC Advances.