

EDUCATION

PhD. in Physics <i>Universitat de Barcelona</i> Thesis supervisor: Demian Levis Title: Non-equilibrium statistical physics of chiral active and actuated particles systems	2024–Present Barcelona, Spain
MSc. in Physics <i>Universidad de Chile</i> (Honors: summa cum laude) Thesis supervisors: María Luisa Cordero and Moniellen Pires Monteiro Title: <i>Motility of soil bacteria <i>Bradyrhizobium diazoefficiens</i> in microfluidic devices</i>	2021–2023 Santiago, Chile
BSc. in Physics <i>Universidad Católica del Maule</i> (Honors: summa cum laude)	2017–2021 Talca, Chile

GRANTS, SCHOLARSHIPS AND AWARDS

FPI Fellowship <i>Agencia Estatal de Investigación MCIU and ESF+</i> Predoctoral researcher contract	2024–Present
Becas Chile PhD Scholarship <i>Agencia Nacional de Investigación y Desarrollo (ANID)</i> Funding for doctoral studies abroad	2024–Present
National Master Fellowship <i>Agencia Nacional de Investigación y Desarrollo (ANID)</i> Full tuition funding and salary for MSc. degree	2022–2023
Outstanding Student <i>Universidad Católica del Maule</i> Award for outstanding academic performance in undergraduate studies	2021
Sapere Aude Internal Funding for Research <i>VRIP Universidad Católica del Maule</i> Funding for research project entitled <i>Entropy production in excitable cells and their ion channels</i> in collaboration with Dr. Carlos Paiva	2021
Honors Scholarship <i>Universidad Católica del Maule</i> Full funding of undergraduate tuition for outstanding academic performance	2018–2020

RESEARCH

Research Interests: Active Matter, Biophysics, Microfluidics, Non-equilibrium Statistical Physics.

Internships and Stays:

* Research stay “ <i>Dynamic self-assembly of colloidal rotors at fluid interfaces</i> ” at Laboratory of Colloids, Polymers and Interfaces (GSC), Universidad Complutense de Madrid	October 2024 Madrid, Spain
* Research internship “ <i>Growth and motility of soil bacteria</i> ” at Laboratory of Out-of-Equilibrium Matter LMFE, Universidad de Chile	January 2020 Santiago, Chile

Research Projects:

Ongoing Collaborations <i>LMFE–UCH, Gulliver–ESPCI, GISC–UCM</i> Research funded by <i>Millennium Nucleus Physics of Active Matter</i> and others	Present
---	---------

- Clustering of active particles in narrow microchannels
- Bio-convection patterns formed by magnetotactic bacteria
- Collective dynamics of constrained self-aligning polar active agents
- Self-propelled particles in evolving domains

PhD. Thesis Project | *Universitat de Barcelona*

2024–Present

Research funded by *Agencia Estatal de Investigación (AEI) MCIU*
and *European Social Fund Plus (ESF+)*

- Non-equilibrium statistical physics of dense systems of chiral active particles
- Dynamics, transport and phase transitions in self-aligning active particles systems
- Dynamic self-assembly of colloidal rotors at fluid interfaces

MSc. Thesis | *Universidad de Chile*

2021–2023

Research funded by *Millennium Nucleus Physics of Active Matter*
and *Agencia Nacional de Investigación y Desarrollo (ANID)*

- Effects of confinement on the motility of bacteria in synthetic soils
- Active diffusion of soil bacteria in disordered porous media
- Effects of shear flows on the motility and self-agglutination of soil bacteria

BSc. Project | *Universidad Católica del Maule*

2020–2021

Research funded by *Vicerrectoría de Investigación y Postgrado (VRIP)*

- Entropy production by transmembrane ionic flows in electrically excitable cells

PUBLICATIONS

1. J.P. Carrillo-Mora^{*}, E. Rosas^{*}, A. Garcés and I. Bordeu. Optimal collective transport of constrained self-aligning active particles. Manuscript in preparation.
2. M. Pires-Monteiro^{*}, J.P. Carrillo-Mora^{*}, N. Gutiérrez, A.R. Lodeiro, V.I. Marconi and M.L. Cordero. Effective diffusion of motile bacteria in disordered porous media. Manuscript in preparation.
3. J.P. Carrillo-Mora and C. Paiva-Sánchez. Entropy production due to transmembrane ion fluxes in excitable cells. Manuscript in preparation.
4. J.P. Carrillo-Mora, A. Garcés and D. Levis. Depinning and activated motion of chiral self-propelled robots. Manuscript under review. Pre-print (arXiv): [2506.20610](#).
5. J.P. Carrillo-Mora, M. Pires-Monteiro, V. Marconi, M.L. Cordero, R. Brito and R. Soto. Preventing clustering of active particles in microchannels. [Communications Physics](#) **8**, 374 (2025).
6. M. Pires-Monteiro, J.P. Carrillo-Mora, N. Gutiérrez, S. Montagna, A.R. Lodeiro, M.L. Cordero and V.I. Marconi. (2025). Soil-mimicking microfluidic devices reveal restricted flagellar motility of *Bradyrhizobium diazoefficiens* under microconfinement. [Communications Biology](#) **8**, 662 (2025).
7. J.P. Carrillo-Mora, M. Pires-Monteiro, A.R. Lodeiro, V.I. Marconi and M.L. Cordero. Damage and recovery of flagella in soil bacteria exposed to shear within long microchannels. [Physics of Fluids](#) **37**, 012027 (2025). Selected as *Editor's Pick* in Physics of Fluids.
8. J.P. Carrillo-Mora, C. Paiva-Sánchez, J.L. Guevara and J. Gutiérrez. Rocket mechanics: design of an inter/transdisciplinary didactic proposal. [Estudios Pedagógicos](#) **50**, 2 (2024).

^{*} Equal contribution.

- Self-Organizing and Evolving Active Matter International Workshop** 2025
 · Organized by *Max Planck Institute for the Physics of Complex Systems MPIPKS* Dresden, Germany
 · Poster titled “*Rotational rectification and depinning transition in self-aligning chiral active particles under translational forcing: theory and experiments*”
- Statistical Physics of Living Systems Flagship Workshop** 2025
 · *Centre Européen de Calcul Atomique et Moléculaire (CECAM)* Lausanne, Switzerland
 · Talks and discussions in the field of soft living matter (remote attendance)
- 29th International Conference on Statistical Physics – STATPHYS29** 2025
 · Organized by *International Union of Pure and Applied Physics – IUPAP* and *SIFS* Florence, Italy
 · Poster titled “*Emergent run-and-spin dynamics of self-aligning active Brownian dumbbells*”
- Thematic program - Active Matter: the synergy between Maths and Physics** 2025
 · School and international conference at Institut Henri Poincaré (IHP Paris) Paris, France
 · Poster titled “*Rotational depinning and activation dynamics of a chiral self-propelled robot*”
- School on Non-Equilibrium Statistical Physics** 2025
 · Organized by *Facultad de Física, Universitat de Barcelona* Barcelona, Spain
 · Advanced school on classical and quantum non-equilibrium statistical physics
- Intelligent Soft Matter Workshop** 2024
 · Organized by *Soft Matter Composites SoftComp Network of Excellence* Salou, Spain
 · Poster titled “*Run-and-spin dynamics of self-aligning active Brownian dumbbells*”
- Madrid–Barcelona Active and Actuated Matter Day – BARMAD 2024** 2024
 · Organized by *Facultad de Ciencias Físicas, Universidad Complutense de Madrid* Madrid, Spain
 · Talks and free discussions in the field of active and actuated matter
- XI GEFENOL Summer School on Statistical Physics of Complex Systems** 2023
 · Organized by *GEFENOL & UBICS, Universitat de Barcelona* Barcelona, Spain
 · Talk titled “*Measuring motility of soil bacteria in a microfluidic porous media model*”
- XXIII Chilean Physics Symposium** 2022
 · Organized by *Sociedad Chilena de Física* Valparaíso, Chile
 · Poster titled “*Effects of shear on the motility of soil bacteria *Bradyrhizobium diazoefficiens**”
- School and Conference Physics of Active Matter** 2022
 · Organized by *Millennium Nucleus Physics of Active Matter* Coyhaique, Chile
 · Poster titled “*Effects of shear on the motility of soil bacteria *Bradyrhizobium diazoefficiens**”
- WE–Heraeus Summer School: Active Matter and Complex Media** 2022
 · Organized by *Université Grenoble Alpes, Institut d’Etudes Scientifiques de Cargèse* Corsica, France
 · Talk titled “*Measuring motility of soil bacteria in a microfluidic porous media model*”
- APS March Meeting 2022** 2022
 · Organized by *American Physical Society* Chicago, USA
 · Talk titled “*Visualization and modeling of soil bacteria under confinement*”
- Physics Summer School** 2021
 · Organized by *Facultad de Ciencias, Universidad del BioBio* Concepción, Chile
 · Introduction to the research areas of postgraduate programs in Physics at the faculty
- The Physics of Life Summer School** 2020
 · Organized by *Center for the Physics of Biological Function, Princeton University* Online
 · Introduction frontiers topics in biological physics and active matter

TEACHING

Teacher – *Universitat de Barcelona, Barcelona, Spain* 2024–Present

— Courses:

- * TER–L20 Thermodynamics Laboratory (4th semester BS Physics)

Teacher Assistant – *Universidad de Chile, Santiago, Chile* 2021–2023

— Courses:

- * FI2003 Experimental Methods (3rd semester Common Engineering Programme)
- * FI6030 Introduction to Microfabrication Techniques (elective course for 7th–8th semester BS Physics and for Graduate Studies in Physics)

Teacher – *Universidad Católica del Maule, Talca, Chile* 2021

— Courses:

- * PBM–423 Physics and Chemistry II (8th semester Basic General Education Programme)

Teacher Assistant – *Universidad Católica del Maule, Talca, Chile* 2018–2020

— Courses:

- * PCI–111 Natural Sciences, Physics Module (1st semester BS Education in Sciences)
- * CCI–123 Physics I (2nd semester Commercial Engineering Programme)
- * IND–212 Physics I (3rd semester Industrial Engineering Programme)
- * PCI–123 General Physics I (2nd semester BS Education in Sciences)
- * PCM–321 Physics (6th semester BS Education in Chemistry)
- * TME–124 Physics in Medical Technology Laboratory (2nd semester BS Medical Technology)
- * QYF–125 Physics Applied to the Pharmaceutical Sciences (2nd semester Chemistry and Pharmacy Degree)
- * PCM–311 Electromagnetism (5th semester BS Education in Physics)

SUPERVISION

Thesis

- Andreu Gironella, “*Self-organisation of robot assemblies*”, Bachelor’s thesis in Physics, Universitat de Barcelona, 2025. Co-supervisor: Demian Levis.

Internships

- Constanza Rivas, summer internship: “*Collective phenomena in active matter interacting with different geometries: experiments with Hexbugs*”, Universidad de Chile, 2023. Co-supervisors: María Luisa Cordero, Rodrigo Soto and Edgardo Rosas.
- Agustín Lorca, summer internship: “*Accumulation of Hexbugs robots on a wall*”, Universidad de Chile, 2023. Co-supervisors: Rodrigo Soto and Edgardo Rosas.
- Fernanda Padró, summer internship: “*Characterization of flagellar systems in soil bacteria*”, Universidad de Chile, 2023. Co-supervisors: Moniellen Pires-Monteiro and María Luisa Cordero.

OUTREACH

General Audience

- Workshop presenter “*Emergència i auto-organització*” in the *XI Festa de la Ciència UB*, May 30–31, 2025, Barcelona, Spain.
- Workshop presenter “*Emergència i auto-organització*” in the *X Festa de la Ciència UB*, May 11–12, 2024, Barcelona, Spain.
- Workshop presenter “*Física de la Materia Activa*”, *Biblioteca de Santiago*, October 11, 2023, Santiago, Chile.

SKILLS

- **Languages:** Spanish, English.
- **Coding:** Python, MATLAB, C, LaTeX.
- **Software:** FIJI (ImageJ), BioTracker, AutoCAD, Fusion360, Adobe Illustrator.
- **Experimental:** Maskless optical lithography, Soft lithography, Bright-field and fluorescence optical microscopy, Bacterial culture, Particle tracking, FDM 3D printing.

REFERENCES

Prof. Demian Levis Computing and Understanding Collective Action (CUCA) Lab,
[University of Barcelona Institute of Complex Systems \(UBICS\)](#),
Condensed Matter Physics Department, Faculty of Physics,
Universitat de Barcelona, Martí i Franquès 1, Barcelona, Spain
levis@ub.edu

Prof. María Luisa Cordero [Out-of-Equilibrium Matter Lab \(LMFE\)](#),
Physics Department, Faculty of Physical and Mathematical Sciences,
Universidad de Chile, Avenida Blanco Encalada 2008, Santiago, Chile
mlcordero@uchile.cl

Prof. Rodrigo Soto [Millennium Nucleus Physics of Active Matter](#),
Physics Department, Faculty of Physical and Mathematical Sciences,
Universidad de Chile, Avenida Blanco Encalada 2008, Santiago, Chile
rsoto@uchile.cl