

# Curriculum Vitae

*Pablo de Castro*



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## Research Interests

Statistical Physics, Soft Condensed Matter, Active Matter, Theoretical Ecology, Nonlinear Dynamics

## Degrees and research positions

- 2022– **Postdoctoral Research Fellow**, ICTP - South American Institute for Fundamental Research & Institute for Theoretical Physics - São Paulo State University (UNESP), Brazil  
Title: “Pattern formation in active matter and biology”.  
Mentor: Ricardo Martínez-García. Sponsor: FAPESP. Group: Theoretical Ecology.
- 2019–2021 **Postdoctoral Researcher**, Dept of Physics, Universidad de Chile, Chile  
Title: “Active Matter”.  
Mentor: Rodrigo Soto. Sponsor: Millennium Nucleus Physics of Active Matter. Group: Active Matter.
- 2015–2019 **PhD Physics**, Dept of Mathematics, King’s College London, UK  
Title: “Phase separation of polydisperse fluids”. Degree obtained in April 2019.  
Supervisors: Peter Sollich and Chiara Cammarota. Sponsor: CNPq. Grant: £154k. Group: Disordered Systems
- 2012–2014 **MSc Physics**, Federal University of Pernambuco (UFPE), Brazil  
Title: “Friction effects on reverse rotations of circularly-driven rigid bodies.”  
Supervisor: Fernando Parisio. Sponsor: CAPES. Group: Theoretical Physics Lab.
- 2007–2011 **BSc Physics**, Federal University of Pernambuco, Brazil  
Title: “Trapped Waves on the Brazilian Coast”.  
Supervisor: Moacyr Araújo. Sponsor: FAPE. Group: Risk and Environmental Modelling.

## Journal publications

Google Scholar: <https://scholar.google.com/citations?user=jQ2Mn1sAAAAJ&hl=en>

### Peer-reviewed

- 2024 **Restoring the fluctuation-dissipation theorem in Kardar-Parisi-Zhang universality class through a new emergent fractal dimension**  
M. S. GOMES-FILHO, P. DE CASTRO, D. B. LIARTE AND F. A. OLIVEIRA  
*Entropy* 2024, Volume 26, Issue 3, 260
- 2023 **Mixtures of self-propelled particles interacting with asymmetric obstacles**  
M. ROJAS-VEGA, P. DE CASTRO, AND R. SOTO  
*The European Physical Journal E*, 46, 95.
- 2023 **Sequential epidemic-like spread between agglomerates of self-propelled agents in one dimension**  
P. DE CASTRO, F. URBINA, A. NORAMBUENA, F. GUZMÁN-LASTRA  
*Physical Review E*, 108 (4), 044104
- 2023 **Wetting dynamics by mixtures of fast and slow self-propelled particles**  
M. ROJAS-VEGA, P. DE CASTRO, AND R. SOTO  
*Physical Review E*, 107, 014608.
- 2022 **Spinning rigid bodies driven by orbital forcing: The role of dry friction**  
P. DE CASTRO, T. ARAÚJO LIMA AND F. PARISIO  
*Nonlinear Dynamics*, 2022, 107, 3473–3484.

- 2021 **Diversity of self-propulsion speeds reduces motility-induced clustering in confined active matter**  
P. DE CASTRO, F. M. ROCHA, S. DILES, R. SOTO AND P. SOLLICH  
*Soft Matter*, 2021, 17, 9926-9936.
- 2021 **Active mixtures in a narrow channel: Motility diversity changes cluster sizes**  
P. DE CASTRO, S. DILES, R. SOTO AND P. SOLLICH  
*Soft Matter*, 2021, 17, 2050 - 2061.
- 2020 **Run-and-tumble bacteria slowly approaching the diffusive regime**  
A. VILLA-TORREALBA, C. CHÁVEZ-RABY, P. DE CASTRO AND R. SOTO  
*Physical Review E*, 101, 062607.
- 2019 **Phase separation of mixtures after a second quench: composition heterogeneities**  
P. DE CASTRO AND P. SOLLICH  
*Soft Matter*, 2019, 15, 9287 - 9299.
- 2018 **Critical phase behavior in multi-component fluid mixtures: Complete scaling analysis**  
P. DE CASTRO AND P. SOLLICH  
*The Journal of Chemical Physics*, 2018, 149, 204902.
- 2017 **Phase separation dynamics of polydisperse colloids: a mean-field lattice-gas theory**  
P. DE CASTRO AND P. SOLLICH  
*Physical Chemistry Chemical Physics*, 2017, 19, 22509-22527.
- 2014 **Role of viscous friction in the reverse rotation of a disk**  
P. DE CASTRO AND F. PARISIO  
*Physical Review E*, 90, 013201.

### In review / In preparation

- **Movement bias in asymmetric landscapes and its impact on population distribution and critical habitat size**  
V. DORNELAS\*, P. DE CASTRO\*, J. M. CALABRESE, W. F. FAGAN AND R. MARTINEZ-GARCIA  
arXiv:2306.06450. In review. \*Co-first authors.
- **Transitions in optimal search strategy induced by target signals and landscape asymmetry**  
P. DE CASTRO AND R. MARTINEZ-GARCIA  
In preparation.
- **The role of translational noise in motility-induced phase separation**  
F. HAWTHORNE, P. DE CASTRO, J. A. FREIRE  
In preparation.

### Teaching

- 2024 **Summer Course Lecturer**, IFT-UNESP  
Critical phenomena, scaling theories and renormalization groups.
- 2016–2019 **Teaching Assistant**, Dept of Mathematics, King's College London  
Complex Networks, Collective Behaviour, Dynamical Systems and Calculus tutoring (exercise classes and homework marking) for undergraduate and Master's students.
- 2013–2014 **Temporary Lecturer**, Dept of Physics, UFPE  
First- and second-year undergraduate modules: Physics I, Physics II, and Experimental Physics II.
- 2014–2014 **Temporary Lecturer**, Engineering School, University of Pernambuco (UPE)  
Electrodynamics I, Hydraulics Lab, and Electrical Materials.

### Supervision, academic referee, administration, and more

- 2024 **Project supervisor**, ICTP-SAIFR  
Supervised a research project executed by high-school students on Optimal Foraging.
- 2023 **Conference organizer**, ICTP-SAIFR  
Brazilian Workshop on Soft Matter
- 2023 **Project supervisor**, *Serrapilheira* program at ICTP-SAIFR  
Supervised a research project on the population dynamics of confined chemotactic bacteria near toxic sources.

- 2022 **Project supervisor**, *Serrapilheira* program at ICTP-SAIFR  
Supervised a research project on the individual dynamics of bacteria chemotaxing away from antibiotics.
- 2021– **Academic referee**  
PLOS Computational Biology, Soft Matter, Physical Review Letters, Physical Review E, Chaos: An Interdisciplinary Journal of Nonlinear Science, JACS Au
- 2020–2022 **Thesis main supervisor**, Universidad de Chile  
Concluded supervision of Mauricio Rojas-Vega's Master's on "Active mixtures near walls and asymmetric obstacles", defended in Jan 2022
- 2016–2018 **Seminar organiser**, Disordered Systems, King's College London  
Organised all group seminars, liaising with speakers and dept staff, chairing sessions and hosting researchers.
- 2018 **Project supervisor**, King's Maths School  
Supervised a research project executed by high-school students on percolation
- 2017 **Award judge**, King's College London  
Principal's Global Leadership Award.
- 2016 **Roche Continents**, Salzburg, Austria  
Chosen for highly-selective meeting on science-art intersections and innovation processes.
- 2012 **Competition referee**, Secretariat of Education (Pernambuco State)  
Public school teachers were asked to create special (physics) teaching material.

## Awards and nominations

- 2017 **Poster Competition Prize**, Faculty of Natural and Mathematical Sciences, King's College London, UK
- 2019 **Outstanding Doctoral Thesis - Nominated**, King's College London, UK
- 2018 **Outstanding Teaching Assistant - Nominated**, Faculty of Natural and Mathematical Sciences, King's College London, UK

## Postgraduate modules

- 2015-2018 **PhD**, King's College London, UK
- \* Research Methods and Advanced Topics in Complex Systems
  - \* Advanced Topics in Non-Equilibrium Systems
  - \* Equilibrium Analysis of Complex Systems
  - \* Theory of Complex Networks
  - \* Dynamical Analysis of Complex Systems
  - \* Mathematical Biology
  - \* Bio- and Nanomaterials in the Virtual Lab
- 2012-2014 **Master's**, UFPE, Recife, BR
- \* Quantum Theory
  - \* Classical Electrodynamics
  - \* Statistical Mechanics
  - \* Phase Transitions and Critical Phenomena
  - \* Research Topics
- 2012 **CBPF School**, Brazilian Center for Physics Research, Rio de Janeiro, BR
- \* Nonequilibrium Statistical Mechanics
  - \* Strongly Correlated Systems
  - \* Physics Models of Financial Markets

## Invited talks

- 2024 **ICTP-SAIFR 12th Anniversary Symposium: Physics for South America**, "*Collective dynamics of self-propelled agents from active matter to ecology*", ICTP-SAIFR & Instituto Principia, São Paulo, Brazil

- 2024 **ICTP-SAIFR Summer School for Young Physicists (High-School Students)**, *"The physics of complex systems and collective phenomena: from biology to social sciences"*, ICTP-SAIFR & IFT, São Paulo State University (UNESP), São Paulo, Brazil
- 2023 **ICTP School on Collective Animal Behavior**, *"Collective Dynamics of Moving Organisms: The Statistical Physics of Self-Propelled Particles"*, Universidad de La Habana, La Havana, Cuba
- 2023 **Meetings on Soft and Biological Matter at ICTP-SAIFR**, *"Simple Models in Active Matter"*, ICTP-SAIFR, IFT, São Paulo State University (UNESP), São Paulo, Brazil
- 2023 **Colloquium at IFT-UNESP**, *"Collective Dynamics of Moving Organisms: The Statistical Physics of Self-Propelled Random Walkers"*, São Paulo State University (UNESP), São Paulo, Brazil
- 2023 **Colloquium at IF-USP**, *"Collective Dynamics of Moving Organisms: The Statistical Physics of Self-Propelled Random Walkers"*, São Paulo University (USP), São Paulo, Brazil
- 2023 **Colloquium at Center for Advanced Systems Understanding**, *"Collective Dynamics of Moving Organisms: The Statistical Physics of Self-Propelled Random Walkers"*, CASUS, Görlitz, Germany
- 2023 **Colloquium at University of Göttingen**, *"Collective Dynamics of Moving Organisms: The Statistical Physics of Self-Propelled Random Walkers"*, Institute for Theoretical Physics, University of Göttingen, Germany
- 2023 **Postgraduate Students Colloquium at IFT-UNESP**, *"Collective Dynamics of Moving Organisms: The Statistical Physics of Self-Propelled Random Walkers"*, São Paulo State University (UNESP), São Paulo, Brazil
- 2022 **Postgraduate Students Colloquium at IFT-UNESP**, *"Self-Propelled Particles: Accumulation, Diversity, Epidemics and Random Searches"*, São Paulo State University (UNESP), São Paulo, Brazil
- 2022 **Physics Department Seminars at UPE**, *"Partículas autopropelidas: acumulação, diversidade, epidemias e buscas aleatórias"*, Universidade de Pernambuco, Recife, Brazil
- 2021 **Physics Department Seminars at UFRPE**, *"Collective behavior in mixtures of self-propelled particles"*, Universidade Federal Rural de Pernambuco, Recife, Brazil
- 2021 **DAiTA Lab at Universidad Mayor**, *"Clustering self-propelled agents"*, Centro de Investigación DAiTA Lab, Facultad de Estudios Interdisciplinarios, Universidad Mayor, Santiago, Chile
- 2020 **Physics Department Seminars at UFCG**, *"Active mixtures in a narrow channel: Motility diversity changes cluster sizes"*, Universidade Federal de Campina Grande, Campina Grande, Brazil
- 2020 **Physics Department Seminars at UFPA**, *"Mixtures of self-propelled particles on a quasi-1D lattice"*, Universidade Federal do Pará, Salinópolis, Brazil
- 2018 **School of Physics and Mathematics at Open University - Seminars**, *"Phase behaviour in polydisperse systems: nonequilibrium dynamics and equilibrium criticality"*, Open University, Milton Keynes, UK
- 2011 **Colóquio Fábio Odilón - Physics Department at UFPE**, *"Oceanografia Física e Ondas Confinadas na Costa do Brasil"*, Universidade Federal de Pernambuco, Recife, Brazil

## Contributed conference presentations

### Talks

- 2023 **EOSBF 2023**, *"Spatial Distribution of Confined Interacting Organisms"*, Brazilian Physical Society, Ouro Preto, Brazil
- 2022 **Conference Physics of Active Matter**, *"Contagion dynamics of agglomerating self-propelled particles in narrow environments"*, Millennium Nucleus Physics of Active Matter, Coyhaique, Chile
- 2022 **EOSBF 2022**, *"Fast and slow self-propelled particles: Wetting, segregation, rectification, and vorticity"*, Brazilian Physical Society, São Paulo, Brazil
- 2021 **EOSBF 2021**, *"Speed diversity reduces clusters of active particles in narrow channels"*, Brazilian Physical Society, Brazil
- 2020 **EOSBF 2020**, *"Active mixtures on a quasi-1D lattice: Motility diversity changes cluster sizes"*, Brazilian Physical Society, Brazil

- 2020 **Durham Biophysical Sciences Institute Early Career Researcher Symposium**, *"Mixtures of run-and-tumble particles clustering on a quasi-one-dimensional lattice"*, Durham University, UK
- 2018 **3rd Edwards Symposium - New Horizons in Soft Matter**, *"Phase separation dynamics of polydisperse colloids: a mean-field lattice-gas theory"*, University of Cambridge, UK
- 2018 **CCP5 - Advances in Simulations and Theory of Soft Matter Systems**, *"Phase separation dynamics of polydisperse colloids: a mean-field lattice-gas theory"*, University of Manchester, UK
- 2017 **Open Stat Phys**, *"Phase-separating colloids: a mean-field lattice-gas theory"*, Open University, Milton Keynes, UK
- 2017 **Statistical Physics of Glassy, Complex and Non-Equilibrium Systems**, *"Phase-separating polydisperse colloids: a mean-field lattice-gas theory"*, King's College London, UK
- 2012 **National Meeting of Graduate Physics Students**, *"Dissipative dynamics in the reverse rotations of a circularly-driven rigid disk"*, Rio de Janeiro, Brazil
- 2010 **Meeting of The Americas - AGU**, *"Coastal-Trapped Waves propagation along the Brazilian shoreline: observed data and modelling results"*, Foz do Iguacu, Brazil
- 2010 **XVIII UFPE Scientific Initiation Conference**, *"Trapped Waves on the Brazilian Coast"*, Recife, Brazil
- Posters**
- 2023 **Active Matter at Surfaces and in Complex Environments**, *"Mixtures of active Brownian particles interacting with walls and obstacles"*, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany
- 2022 **Active and intelligent living matter**, *"Contagion dynamics in agglomerating self-propelled particles"*, Ettore Majorana Center, Erice, Italy
- 2021 **EOSBF 2021**, *"Phase separation dynamics of polydisperse colloidal mixtures"*, Brazilian Physical Society, Brazil
- 2019 **StatPhys 27**, *"Phase-separating colloidal mixtures: lattice-gas model, composition heterogeneities, and secondary quench"*, Buenos Aires, Argentina
- 2019 **StatPhys 27**, *"Critical phase behavior in multi-component fluid mixtures: Complete scaling analysis"*, Buenos Aires, Argentina
- 2018 **3rd Edwards Symposium - New Horizons in Soft Matter**, *"Phase separation dynamics of polydisperse colloids: a mean-field lattice-gas theory"*, University of Cambridge, UK
- 2018 **Thermodynamics and Energetics in Soft Matter Systems**, *"Phase separation dynamics of polydisperse colloids: a mean-field lattice-gas theory"*, Grenoble, France
- 2018 **Advanced School in Liquids and Complex Fluids**, *"Phase separation dynamics of polydisperse colloids: a mean-field lattice-gas theory"*, Bristol, UK
- 2017 **10<sup>th</sup> Liquid Matter Conference**, *"Dynamics of polydisperse colloidal systems: a mean-field lattice-gas theory"*, Ljubljana, Slovenia
- 2015 **Nonequilibrium Collective Dynamics**, *"Dynamics of the polydisperse lattice-gas model"*, Potsdam, Germany
- 2013 **Complex Systems - Foundations and Applications**, *"Role of viscous friction in the reverse rotation of a disk"*, Rio de Janeiro, Brazil
- 2012 **Workshop on Complex Flows and Turbulence**, *"Dissipative non-linear dynamics in reverse rotations of a circularly-driven rigid disk"*, Recife, Brazil
- 2011 **Conference in Honor of Eugene Stanley and Liacir Lucena**, *"Trapped Waves on the Brazilian Coast"*, Natal, Brazil

## Programming Languages

Mathematica, C and Python

## Languages

Portuguese, English and Spanish