

David Martin

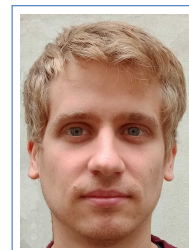
Postdoc at the University of Chicago

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Higher education – Diploma

- 2017–2021 **PhD in theoretical physics**, *Université Paris Cité*, France
Thesis entitled "Nonequilibrium signatures and phase transitions in active matter and beyond".
- 2014–2016 **ICFP Master of theoretical physics with highest honors**, *Ecole Normale Supérieure*, Paris, France
- 2013–2014 **BSc in physics**, *Ecole Normale Supérieure*, Paris, France
Admitted as Normalien at the ENS after the 2013 nationwide competitive exam.
- 2011–2013 **prep school, section Physics and Chemistry**, *Lycée Blaise Pascal*, Orsay, France

Scientific experiences

- 11/2021–now **Kadanoff Postdoctoral Fellow**, *Kadanoff Center for Theoretical Physics and Enrico Fermi Institute, University of Chicago*, USA
With the group of Prof. Vincenzo Vitelli, we are studying the impact of nonreciprocity on both equilibrium and nonequilibrium statistical mechanic systems. Together with Dr. Daniel Seara, we are also developing an hydrodynamic framework describing materials made of intelligent agents. Beside, in collaboration with Dr. Tony Jin, we are working on measurement-induced phase transitions and their renormalization flows in minimal models, classical and quantum ones alike.
- 10/2017–
10/2021 **PhD student in theoretical physics**, *Université de Paris*, France
With the guidance of my advisor Prof. Julien Tailleur, I studied collective phenomena in active matter systems. We discovered the possibility of active solidification in flocks and brought solid arguments showing the emergence of collective motion to fall in the class of fluctuation-induced first order transition. We further derived exact formulas for activity-induced phenomenon such as the birth of "ratchet" current or the entropy production rate.
- 04/2017–
09/2017 **Fellowship in statistical physics**, *Hugef*, via Nizza 52, Torino, Italy | 6 months
Theoretical work on the physicist approach to perceptron and to neural networks. Under the guidance of my supervisors Prof. Riccardo Zecchina, Dr. Carlo Lucibello and Dr. Carlo Baldassi, I used replica techniques to tackle sparse teacher/student problems. Explore-exploit models were also studied with Dr. Thomas Gueudré.
- 11/2016–
03/2017 **Soft and active matter at DAMTP**, *CMS*, Cambridge, United Kingdom | 5 months
Under the supervision of Prof. Mike Cates, Dr. Cesare Nardini and Dr. Etienne Fodor, I studied stochastic thermodynamics and applied it to a trapped active particle.
- 09/2016–
11/2016 **Start-up LightOn**, *Agoranov*, Paris | 3 months
Prototyping and developing machine learning algorithms for the four founders: Igor Carron, Laurent Daudet, Florent Krzakala and Sylvain Gigan. Details are confidentials. LightOn develops an optical CPU capable of performing very fast mathematical operations frequently used in machine learning.
- 06/2016–
08/2016 **CERN summer student**, *équipe CMS-TOTEM*, CERN, Geneva | 2 months
TOTEM is the collaboration devising two extra detectors, whose role are to detect proton deflected close to the LHC beam. With my advisor Michele Quinto, we engineered an experimental upgrade to measure the time of flight of these protons.
- 01/2016–
03/2016 **Strongly correlated electrons**, *Collège de France*, Paris | 3 months
With Dr. Michel Ferrero and Prof. Antoine Georges as advisors, I studied numerically a new theoretical model for cuprates supraconductors in order to describe their experimental fermi surface.
- 02/2015–
07/2015 **ADS/CFT correspondence**, *CONICET*, instituto de fisica de La Plata, Argentina | 5 months
With Dr. Gianni Tallarita and Prof. Fidel Schaposnik, my supervisor, we studied a new coupled Lagrangian with symmetry breaking describing type-2 superconductors.

07/2014 **SWASI: an astrophysical experiment**, *Laboratory of astrophysics*, CEA Saclay, France | 5 weeks

With Dr. Thierry Foglizzo, we worked on the experimental fountain SWASI which mimics hydrodynamic flows during a supernovae.

Publications

1. **"Fluctuation-Induced First Order Transition to Collective Motion"**
D. Martin, G. Spera, H. Chaté, C. Duclut, C. Nardini, J. Tailleur, F. van Wijland
Under review at JSTAT, ArXiv 2402.05078 (February 2024)
2. **"Sociohydrodynamics: data-driven modelling of social behavior"**
DS. Seara, J. Colen, M. Fruchart, Y. Avni, D. Martin, V. Vitelli
Under review at PNAS, ArXiv 2312.17627 (December 2023)
3. **"The non-reciprocal Ising Model"**
Y. Avni, M. Fruchart, D. Martin, D. Seara, V. Vitelli
Under review at PRL, ArXiv 2311.05471 (November 2023)
4. **"Measurement-induced phase transition in a single-body tight-binding model"**
T. Jin, D. Martin
Under review at PRL, ArXiv 2309.15034 (September 2023)
5. **"The transition to collective motion in nonreciprocal active matter: coarse graining agent-based models into fluctuating hydrodynamics"**
D. Martin, D. Seara, Y. Avni, M. Fruchart, and V. Vitelli
Under review at PRX, ArXiv 2307.08251 (July 2023)
6. **"KPZ physics and phase transition in a classical single random walker under continuous measurement"**
T. Jin, D. Martin
Phys. Rev. Lett. 129, 260603 (December 2022), ArXiv 2204.00070
7. **"AOUP in the presence of Brownian noise: a perturbative approach"**
D. Martin, T. Arnoux de Pirey
J. Stat. Mech. 043205 (April 2021), ArXiv 2009.13476
8. **"Statistical Mechanics of Active Ornstein Uhlenbeck Particles"**
D. Martin, J. O'byrne, M. E. Cates, E. Fodor, C. Nardini, J. Tailleur, F. Van Wijland
Phys. Rev. E 103, 032607 (March 2021), ArXiv 2008.01397
9. **"Fluctuation-induced phase separation in metric and topological models of collective motion"**
D. Martin, H. chaté, C. Nardini, A. Solon, J. Tailleur, F. Van Wijland
Phys. Rev. Lett. 126, 148001 (April 2021), ArXiv 2008.12972
10. **"Freezing a Flock: Motility-Induced Phase Separation in Polar Active Liquids"**
G. Geyer, D. Martin, J. Tailleur and D. Bartolo
Phys. Rev. X 9, 031043 (September 2019), ArXiv 1903.01134
11. **"The balance of growth and risk in population dynamics"**
T. Gueudré, D. Martin.
EPL 121, 68005 (May 2018), ArXiv 1712.00979. Selected as editor's choice.
12. **"Extracting maximum power from active colloidal heat engines"**
D. Martin, C. Nardini, M.E. Cates and E.Fodor
EPL 121, 60005 (May 2018), ArXiv 1803.01620. Selected as editor's choice.

Talks, Conferences and Summer Schools

- 2024 **Donders Centre for Neuroscience**, Radboud university | job interview
Rudolf Peierls centre, Oxford university | job interview
Rudolf Peierls centre, Oxford university | seminar
L2C, Université de Montpellier | lab seminar
- 2023 **LPENS**, Ecole Normale Supérieure | lab seminar
LIPhy, Université Grenoble Alpes | lab seminar
LOMA, Université de Bordeaux | lab seminar
SPEC, CEA Saclay | lab seminar
ILM, Université Claude Bernard | lab seminar

- LPTMS, Université d'Orsay | lab seminar
 LPTMC, Sorbonne Université | lab seminar
 Les Gustins summer school, Aiguebelette-le-lac | seminar
 StatPhys 28, University of Tokyo | contributed talk
 Frontiers in nonequilibrium physics: active matter, topology and beyond, Yukawa Institute for Theoretical Physics, Kyoto | contributed talk
 University of Santa Barbara - group meeting, Cristina Marchetti's group | seminar
 University of Edinburgh - teaching and research proposals, Institute for Condensed Matter and Complex Systems | job interview
- 2022 **Prix de thèse des systèmes complexes**, Paris | award talk
Journées de la Matière Condensée, Lyon | contributed talk
 Les Gustins summer school, Aiguebelette-le-lac | seminar
 APS March Meeting, Chicago | contributed talk
- 2021 **Institut Curie - group meeting**, Pierre Sens' group and collaborators | seminar
Liquid Matter Conference, online | poster
 Les Gustins summer school, Aiguebelette-le-lac | seminar
Glassy systems and inter-disciplinary applications summer school, Cargèse | poster
EPFL Lausanne - group meeting, Matthieu Wyart's group | seminar
- 2020 **University of Chicago - group meeting**, Vincenzo Vitelli's group | seminar
Microswimmers International Conference SPP 1726, Bonn | contributed talk
 Les Gustins summer school, Aiguebelette-le-lac | seminar
Journées de la physique statistique, ENS Paris | contributed talk
- 2019 **ESPCI - active matter seminar**, Gulliver lab | seminar
Heraeus-Seminar "Novel Physics in Living Systems?", Roscoff | poster
Paris Diderot University - theory group, MSC lab | seminar
Bangalore School on Statistical Physics - X, ICTP
- 2018 **Active matter and non-equilibrium statistical physics school**, Les Houches | poster
Leuven school on nonequilibrium physics, KU Leuven
Correlations, fluctuations and anomalous transport in systems far from equilibrium, Weizmann Institute of Science

Fellowships/Prizes/Grants

- April 2023 - Recipient of SLiM-Ex Scientist Exchange Award (3k\$) for a research stay at University of Santa Barbara with Prof. Cristina Marchetti.
- October 2022 - Recipient of the PhD award "Prix de thèse des systèmes complexes" (1k\$).
- 2021 - 2024 - Independent Kadanoff Postdoctoral Fellowship at the University of Chicago.
- 2021 - 2022 - Joint grant FACCTS of 25k\$ with Vincenzo Vitelli at the University of Chicago.
- September 2019 - Best poster prize awarded for the WE-Heraeus-Seminar "Novel Physics in Living Systems?" held in Roscoff.

Review service

Physical Review E, Physics Letters A, Journal of Statistical Mechanics, Journal of Statistical Physics, Physical Review Letters, Soft Matter, SciPost Physics

Teaching

- 10/2018– **Teaching assistant for first-year medical students**, *Université Paris Cité*, 30 h/years
 10/2021 Exercise classes covering topics in electrostatics, hydrodynamics and thermodynamics for the competitive exam.

- 10/2018–10/2021 **Teaching assistant for third-year pharmacy students**, *Université Paris Cité*, 34 h/years
Exercise classes of geometrical and wave optics. Practical work session of goniometry and rheometry. Under the supervision of Jean-François Gaucher and Mohamed Selkti, I helped designing the experimental set-ups that were used within the teaching unit.
- 2015–2016 **Physics tutorials "Colles"**, *Lycée Henri IV*, 30 hours
Individual oral examinations of prep school students.
- 2013–2018 **Private lessons in physics for prep school students**, 100 hours

Collective responsibilities and outreach

- 09/2023–now Co-supervision of undergraduate student Antti Eero Asikainen (20%), *Prof. Julien Tailleur's group*, MIT, USA
- 05/2022–now Co-supervision of graduate student Soshana Chipman (20%), *Prof. Vincenzo Vitelli's group*, University of Chicago, USA
- 01/2022–now Writing of grant proposals as well as funding reports, *Prof. Vincenzo Vitelli's group*, University of Chicago, USA
- 05/2018–06/2019 Organization of doctoral and postdoctoral seminars with Camille Gaulon, *Laboratoire Matière et Systèmes Complexes*, Paris, France

Languages and skills

Languages French (mother tongue), English (fluent), Italian (fluent), Spanish (fluent), German (notions), Japanese (notions)

Programming Julia, C++, C, python, Mathematica, Matlab

Edition LaTeX, Beamer, photoshop

Numerical methods

Integration of PDEs and SPDEs using semi-spectral and semi-implicit schemes. Simulations of particle-based models using coupled Langevin equations. Numerical implementation of Borel-Padé resummation. Training of Teacher-Student models and neural nets for machine learning applications. High performance computing using optimized libraries such as MPI or BLAS/LAPACK.

Theoretical methods

Field-theoretic approaches, path-integral formalism and quasi-linear renormalization. Coarse-graining procedures using Doi-Peliti formalism. Stochastic calculus and replica technics. Perturbative solution of Fokker-Planck equations.

Interests

- Drawing Charcoal sketches, pencil drawing, watercolours...
- Sailing Practice with sailing dinghies and cruise ships.
- Biking Travelling and commuting around.

Academic references

Prof. Julien Tailleur

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Dr. Cesare Nardini

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