

Étienne Fodor

Physics of Active Matter

Associate Professor

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Dept of Physics and Materials Science (DPhyMS)

Univ of Luxembourg

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Scientific positions and education

- Since 2025 **Associate Professor**, DPhyMS, Univ of Luxembourg
- 2020–25 **Assistant Professor + ATTRACT Fellow**, DPhyMS + Fonds National de la Recherche (FNR)
- 2017–20 **Oppenheimer + Junior Research Fellow**, DAMTP, Univ of Cambridge
- 2016–17 **Postdoctoral Research Associate**, DAMTP, Univ of Cambridge (Supervisor: ME Cates)
- 2013–16 **PhD in Physics**, Univ Paris Diderot (Supervisors: P Visco, F van Wijland), summa cum laude
- 2012–13 **Masters (2nd year) in Physics**, École Normale Supérieure (ENS), Paris
- 2011–12 **Agrégation de Physique**, Training program for teaching in Physics Bachelors, ENS Cachan
- 2009–11 **Bachelors + Masters (1st year) in Physics**, ENS Lyon

Research, supervision, and teaching

- Since 2022 **Masters course in Physics**, DPhyMS, Univ of Luxembourg | 14 weeks/year

- Since 2020 **Group supervision**, DPhyMS, Univ of Luxembourg

8 Postdocs | LK Davis (20–22), A Manacorda* (21–24), T Banerjee[†] (22–26), WD Piñeros* (22–25), UA Dattani (23–25), F Serafin (24–25), A Soriani (26–27), F Thewes (26–27)

*Marie-Curie Fellow (Horizon Europe), [†]CORE Junior Fellow (Luxembourg)

6 PhDs | Y Zhang (20–23), BN Radhakrishnan (21–25, co-supervised with TL Schmidt), L Casagrande (23–26), N Setzkorn (24–27), IJC Miranda (24–27), M Antonioli (24–27)

4 Masters | L Casagrande (22–23), T Desaleux (22–23), N Setzkorn (23–24), A Jagannathan (25–26)

- 2024 **Masters course in Physics**, Dept of Physics, Univ of Liège | 10 hours, 1 week

- 2021 **Doctoral course in Physics**, DPhyMS, Univ of Luxembourg | 6 hours, 1 day

- 2016–20 **Student co-supervision**, DAMTP, Univ of Cambridge (Supervisor: ME Cates)

2 PhDs | ØL Borthne (17–20), T Ekeh (18–21)

3 Masters | D Martin (16–17), T Ekeh (17–18), JW Knight (19–20, best thesis prize)

- 2015–16 **Research visit**, YITP, Kyoto Univ (Host: H Hayakawa) | 2 months/year

- 2013–16 **Bachelors tutorials in Physics**, Univ Paris Diderot | 14 weeks/year

- 2013 **Research internship**, Univ Paris Diderot (Supervisors: P Visco, F van Wijland) | 16 weeks

- 2012–13 **Bachelors tutorials in Physics**, Lycée Fénelon, Paris | 30 weeks

- 2011 **Research internship**, Univ of Oxford (Supervisors: AS Wyatt, IA Walmsley) | 12 weeks

- 2010–11 **Bachelors tutorials in Physics**, Lycée la Martinière Monplaisir, Lyon | 30 weeks

- 2010 **Research internship**, Univ de Genève (Supervisors: L Bonacina, J-P Wolf) | 8 weeks

Funding, fellowships, and awards

- 2026 **Outstanding Junior Fellowship**, Institute of Advanced Studies, Tel Aviv Univ

- 2026–29 **CORE grant, OptimalControlTransition**, FNR, Luxembourg | 800 kEUR

- 2025–28 **Doctoral Training Network, CAFE-BIO**, Horizon Europe (Program lead: R Blythe) | 1 PhD

- 2024–27 **CORE grant, ActiveTopo**, FNR, Luxembourg | 830 kEUR

- 2021–26 **Doctoral Training Unit, ACTIVE**, FNR (Program lead: M Esposito) | 1 PhD

- 2020–25 **ATTRACT Fellowship**, FNR | 1.5 MEUR

- 2017–20 **Oppenheimer + Junior Research Fellowship**, St Catharine's College, Univ of Cambridge

- 2017 **PhD prize**, Institut Systèmes Complexes, Paris + **Best talk**, SIAM-IMA Conference, Cambridge

- 2015 **Best talk**, Active Liquids, Lorentz Center, Leiden

- 2013–16 **Teaching Assistantship**, Univ Paris Diderot + **PhD Scholarship**, ENS Cachan

PhD committees

2026	Univ of Luxembourg , A Kabylda* (supervisor: A Tkatchenko) Univ of Barcelona , Y Rouzaire (supervisor: D Levis) Tata Institute of Fundamental Research , A Bansal (supervisor: M Rao)
2025	Univ of Luxembourg , SGM Srinivas (supervisor: M Esposito) Univ of Mons , G Palumbo (supervisor: P Damman) Univ of Luxembourg , M Puleva* (supervisor: A Tkatchenko)
2024	Univ Grenoble Alpes , L Guislain (supervisor: E Bertin) Univ Paris Cité , A Dinelli, (supervisor: J Tailleur) Univ of Luxembourg , N Carabba* + L Dupays (supervisor: A del Campo)
2023	Imperial College London , Z Zhang (supervisor: G Pruessner)
2022	Univ of Luxembourg , E Penocchio + D Forastiere (supervisor: M Esposito) Univ of Luxembourg , V Vassilev Galindo (supervisor: A Tkatchenko)
2021	Luxembourg Centre for Systems Biomedicine , S Martina (supervisor: A Skupin) Univ of Luxembourg , J Ekström* (supervisor: TL Schmidt)

* Head of jury for these PhD defences

Review and editorial service

Since 2025 **Editorial board member**, Journal of Statistical Mechanics

Since 2016 **Reviewer for scientific journals and agencies** | ca 30 reviews/year

Journals | Commun Phys, Entropy, EPJE, EPL, J Chem Phys, J Phys A, J Stat Mech, Nat Commun, Nat Phys, New J Phys, Newton, Phys Rev (E, Lett, Res, X), PNAS, Science, Science Adv, Soft Matter

Agencies | ANR (France), DFG (Germany), DOE (USA), FRS-FNRS (Belgium), ISF (Israel)

2026 **Guest editor**, Physical Review E | Special topics: “Controlling stochastic dynamics across scales”
Co-editor: TR Gingrich (Northwestern Univ)

2026 **Guest editor**, New Journal of Physics | Special topics: “Statistical mechanics of active matter”
Co-editors: M Fruchart (ESPCI), SAM Loos (MPI Goettingen), T Markovich (Tel Aviv Univ)

Outreach activities

2024	Outreach lecture , Institut d’Etudes Scientifiques, Cargèse Chercheurs à l’école , Seminar in high schools, Luxembourg
2023	Inaugural lecture , Faculty of Science, Technology and Medicine, Univ of Luxembourg
2022	Student fair , DPhyMS, Univ of Luxembourg
2021	Open day , DPhyMS, Univ of Luxembourg
2021–24	Internship supervision , High-school students, Univ of Luxembourg 1 week/year

Organized events

2026	Nonequilibrium Statistical Mechanics , Univ Paris Cité, Paris Workshop, 1 day Co-organizer: F van Wijland (Univ Paris Cité)
2025	Nonequilibrium Systems Under Control , Lorentz Center, Leiden Workshop, 1 week Co-organizers: TR Gingrich (Northwestern Univ), SAM Loos (Univ of Cambridge)
2024	Energy, Information and Evolution in Biology , Cargèse Summer school, 2 weeks Co-organizers: A Manacorda, M Esposito (Univ of Luxembourg) Physics Meets Mathematics , Univ of Luxembourg Workshop, 1 day
2018–20	Statistical Physics and Soft Matter , DAMTP, Univ of Cambridge Weekly seminar Co-organizers: ME Cates, RL Jack (Univ of Cambridge)
2019	Colloids as a Toolbox for Statistical Mechanics , Univ of Cambridge Workshop, 1 day Co-organizers: ME Cates, RL Jack (Univ of Cambridge)
2018	Nonequilibrium Biophysics, World Congress of Biomechanics , Dublin Session, $\frac{1}{2}$ day Co-organizer: D Mizuno (Kyushu Univ)

Contribution to conferences, seminars, and colloquia

Invited presentations in conferences

- 2026 **Nonequilibrium Dynamics, from Active Matter to Evolutionary Dynamics**, KITP
Control and Optimisation of Out-of-equilibrium Processes, Beg Rohu
SigmaPhi2026, Statistical Physics of Complex Systems, Kolymbari
Frontiers in Statistical Physics and Soft Matter, Edwards Symposium, Univ of Cambridge
- 2025 **Statistical Physics of Living Systems**, CECAM, Lausanne
International Discussion Meeting on Relaxations in Complex Systems, Barcelona
Self-Organization Far From Equilibrium, APS March meeting, Anaheim
Machine Learning for Enhanced Sampling of Atomistic Systems, Berkeley
- 2024 The Many Faces of Active Mechanics, KITP, Santa Barbara
Nonequilibrium Statistical Physics of Complex Systems, Seoul
- 2023 Computational Advances in Active Matter, Lorentz Center, Leiden
Frontiers in Nonequilibrium Physics: Active Matter, Topology and Beyond, Kyoto
Conference on Statistical Mechanics, Sitges
Physics of Dense and Active Disordered Materials, Kyoto
Frontiers in Nonequilibrium Physics, Institute of Mathematical Sciences, Chennai
- 2022 Statistical Mechanical Theories of Emergence in Biological Systems, Edinburgh
Numerical Techniques for Nonequilibrium Steady States, CECAM, Mainz
- 2020 Symmetry, Thermodynamics and Topology in Active Matter, KITP (online)
- 2018 Why Measure Entropy Production?, Princeton Univ
Active Matter Session, Berkeley

Contributed presentations in conferences

- 2026 DPG Spring Meeting, Active Matter V, Dresden
- 2025 Multiscale Modeling of Chemically Active Mixtures, CECAM, Lausanne
StatPhys29, Out-of-equilibrium Statistical Physics, Florence
From Flocking Birds to Migrating Cells: Recent Advances in Active Matter, Leiden
- 2024 Dissipative Processes in Molecular Systems, Padova
Workshop on Stochastic Thermodynamics V (online)
DPG Spring Meeting, Stochastic Thermodynamics, Berlin
- 2023 StatPhys28, Soft Matter, Tokyo
Bridge between Non-equilibrium Statistical Physics and Biology, Cambridge
New Perspectives in Active Systems, Dresden
From Soft Matter to Biophysics, Les Houches
- 2021 Liquid Matter Conference, Prague (online)
Workshop on Stochastic Thermodynamics II (online)
- 2020 Motile Active Matter Conference, Bonn (online)
- 2019 StatPhys27, Out-of-equilibrium aspects, Buenos Aires
International Soft Matter Conference, Edinburgh
Statistical Physics of Complex Systems, Nordita, Stockholm
- 2018 Nonequilibrium Collective Dynamics, Technische Univ Berlin
Fundamental Problems in Active Matter, Aspen Center for Physics
- 2017 SIAM-IMA Annual Conference, Univ of Cambridge
Edwards Centre Mini Conference, Univ of Cambridge
Open Statistical Physics, Milton Keynes
- 2016 StatPhys26, Biological Physics, Lyon
Non-Gaussian Workshop, YITP, Kyoto
- 2015 Active Liquids, Lorentz Center, Leiden
- 2014 Condensed Matter in Paris, Univ Paris Descartes
Journées de Physique Statistique, Paris

Invited seminars and colloquia

2026	Center for Data Science and Complexity Colloquium , Univ of Münster Institut für Theoretische Physik Seminar , Univ of Münster Gulliver Lab Seminar , ESPCI, Paris MPI Physics of Complex Systems Seminar , Dresden Physics Dept Seminar , Technion Institute of Advanced Studies Colloquium , Tel Aviv University
2025	Soft Condensed Matter Seminar , Harvard University Biophysics Seminar , Massachusetts Institute of Technology Solitons at Work Seminar (online)
2024	Dept of Chemistry Seminar , Univ of California, Berkeley LPTMC Seminar , Sorbonne Univ, Paris Dept of Physics Seminar , Univ of Liège Institute of Physics Seminar , Univ of Leiden Niels Bohr Institute Seminar , Univ of Copenhagen
2023	Biological, Soft and Complex Materials and Theory Seminar , Univ of Bristol EMBL Theory Seminar , Heidelberg
2022	Biological Physics and Physical Biology Seminar (online) Soft Matter Seminar , DAMTP, Univ of Cambridge (online) Mathematical Physics Seminar , Imperial College London (online)
2021	Dept of Physics , Guangdong Technion (online) Quantum Science and Technology Seminar , Univ of Luxembourg (online) Non-equilibrium Statistical Physics Seminar , Georg-August-Univ Göttingen (online) Centre de Physique Théorique Seminar , Aix-Marseille Univ (online)
2020	School of Physics and Astronomy Seminar , Univ of Edinburgh (online) Dept of Physics Seminar , Univ of Bath
2019	Quantitative Life Sciences Seminar , ICTP, Trieste Dept of Chemistry Seminar , James Franck Institute, Univ of Chicago Physics of Living Systems Seminar , Massachusetts Institute of Technology DPhyMS Seminar , Univ of Luxembourg Institute of Physics Seminar , Univ of Amsterdam
2018	LiPhy Seminar , Univ Grenoble Alpes Charles Coulomb Lab Seminar , Univ de Montpellier Gulliver Lab Seminar , ESPCI, Paris Graduate Research Seminar , St Catharine's College, Cambridge Research Colloquium , California State Univ, Fullerton
2017	Soft Matter Seminar , DAMTP, Univ of Cambridge BioLunch Seminar , DAMTP, Univ of Cambridge
2016	School of Mathematical Sciences Seminar , Queen Mary Univ of London Soft Matter Seminar , DAMTP, Univ of Cambridge MSC Lab Seminar , Univ Paris Diderot YITP Seminar , Kyoto
2015	LiPhy Seminar , Univ Grenoble Alpes Physics-Biology Interface Seminar , Univ Paris Sud Soft Matter Seminar , DAMTP, Univ of Cambridge YITP Seminar , Kyoto
2014	MSC Lab Seminar , Univ Paris Diderot

Recording of some selected presentations are available at efodorphysics.github.io/talks.html

Scientific manuscripts

Main publications: Phys Rev Lett [40][35][34][32][7], Phys Rev X [36][25][18][17][9], Reviews [28][24][13]

[48] **Contraction waves in pulsating active liquids: From pacemaker to aster dynamics**

T Banerjee, T Desaleux, J Ranft, and ÉF, arXiv:2509.19024

[47] **Control of active field theories at minimal dissipation**

A Soriani, E Tjhung, ÉF, and T Markovich, arXiv:2504.19285

[46] **Hydrodynamics of pulsating active liquids**

T Banerjee, T Desaleux, J Ranft, and ÉF, arXiv:2407.19955

[45] **Irreversibility in scalar active turbulence: The role of topological defects**

BN Radhakrishnan,* F Serafin,* TL Schmidt, and ÉF, New J Phys **28**, 034601 (2026)

[44] **Entropy production rate in thermodynamically consistent flocks**

T Agranov, RL Jack, ME Cates, and ÉF, New J Phys **27**, 104602 (2025)

[43] **Quantifying dissipation in flocking dynamics: When tracking internal states matters**

K Proesmans, G Falasco, A Tanaji Mohite, M Esposito, and ÉF, Phys Rev E **112**, 024103 (2025)

[42] **Diffusive oscillators capture the pulsating states of deformable particles**

A Manacorda and ÉF, Phys Rev E **111**, L053401 (2025)

[41] **Species interconversion of deformable particles yields transient phase separation**

Y Zhang, A Manacorda, and ÉF, New J Phys **27**, 043023 (2025)

[40] **Biased ensembles of pulsating active matter**

WD Piñeros and ÉF, Phys Rev Lett **134**, 038301 (2025) | Editors' suggestion

[39] **Nonequilibrium thermodynamics of non-ideal reaction-diffusion systems: Implications for active self-organization**

F Avanzini, T Aslyamov, ÉF, and M Esposito, J Chem Phys **161**, 174108 (2024)

[38] **Controlling active matter: The need for thermodynamic consistency**

ÉF, Europhys News **55**, 20 (2024)

[37] **Thermodynamically consistent flocking: From discontinuous to continuous transitions**

T Agranov, RL Jack, ME Cates, and ÉF, New J Phys **26**, 063006 (2024)

[36] **Active matter under control: Insights from response theory**

LK Davis, K Proesmans, and ÉF, Phys Rev X **14**, 011012 (2024) | Highlight in Physics 17, 20 (2024)

[35] **Pulsating active matter**

Y Zhang and ÉF, Phys Rev Lett **131**, 238302 (2023)

[34] **Non-ideal reaction-diffusion systems: Multiple routes to instability**

T Aslyamov, F Avanzini, ÉF, and M Esposito, Phys Rev Lett **131**, 138301 (2023)

[33] **Towards a liquid-state theory for active matter**

YI Li, R Garcia-Millan, ME Cates, and ÉF, EPL **142**, 57004 (2023)

[32] **Thermodynamic control of activity patterns in cytoskeletal networks**

A Lamtyugina, Y Qiu, ÉF, AR Dinner, and S Vaikuntanathan, Phys Rev Lett **129**, 128002 (2022)

[31] **From predicting to learning dissipation from pair correlations of active liquids**

G Rassolov, L Tociu, ÉF, and S Vaikuntanathan, J Chem Phys **157**, 054901 (2022)

[30] **Mean-field theory for the structure of strongly interacting active liquids**

L Tociu, G Rassolov, ÉF, and S Vaikuntanathan, J Chem Phys **157**, 014902 (2022)

[29] **Power fluctuations in sheared amorphous materials: A minimal model**

T Ekeh, ÉF, SM Fielding, and ME Cates, Phys Rev E **105**, L052601 (2022)

[28] **Irreversibility and biased ensembles in active matter: Insights from stochastic thermodynamics**

ÉF, RL Jack, and ME Cates, Annu Rev Condens Matter Phys **13**, 215 (2022)

- [27] **Stochastic hydrodynamics of complex fluids: Discretisation and entropy production**
 ME Cates, ÉF, C Nardini, T Markovich, and E Tjhung, Entropy **24**, 254 (2022) | Editor's choice
- [26] **Optimal power and efficiency of odd engines**
 ÉF and A Souslov, Phys Rev E **104**, L062602 (2021)
- [25] **Thermodynamics of active field theories: Energetic cost of coupling to reservoirs**
 T Markovich, ÉF, E Tjhung, and ME Cates, Phys Rev X **11**, 021057 (2021)
- [24] **Active engines: Thermodynamics moves forward**
 ÉF and ME Cates, EPL **134**, 10003 (2021)
- [23] **Statistical mechanics of active Ornstein-Uhlenbeck particles**
 D Martin, J O'Byrne, ME Cates, ÉF, C Nardini, J Tailleur, and F van Wijland,
 Phys Rev E **103**, 032607 (2021)
- [22] **Collective motion in large deviations of active particles**
 Y-E Keta, ÉF, F van Wijland, ME Cates, and RL Jack, Phys Rev E **103**, 022603 (2021)
- [21] **Time-reversal symmetry violations and entropy production in field theories of polar active matter**
 ØL Borthne, ÉF, and ME Cates, New J Phys **22**, 123012 (2020)
- [20] **Thermodynamic cycles with active matter**
 T Ekeh, ME Cates, and ÉF, Phys Rev E **102**, 010101(R) (2020)
- [19] **Dissipation controls transport and phase transitions in active fluids: Mobility, diffusion and biased ensembles**
 ÉF, T Nemoto, and S Vaikuntanathan, New J Phys **22**, 013052 (2020)
- [18] **Autonomous engines driven by active matter: Energetics and design principles**
 P Pietzonka, ÉF, C Lohrmann, ME Cates, and U Seifert, Phys Rev X **9**, 041032 (2019)
- [17] **How dissipation constrains fluctuations in nonequilibrium liquids: Diffusion, structure and biased interactions**
 L Tociu, ÉF, T Nemoto, and S Vaikuntanathan, Phys Rev X **9**, 041026 (2019)
- [16] **Driven probe under harmonic confinement in a colloidal bath**
 V Démery and ÉF, J Stat Mech **2019**, 033202 (2019)
- [15] **Optimizing active work: Dynamical phase transitions, collective motion and jamming**
 T Nemoto, ÉF, ME Cates, RL Jack, and J Tailleur, Phys Rev E **99**, 022605 (2019)
- [14] **Non-Gaussian noise without memory in active matter**
 ÉF, H Hayakawa, J Tailleur, and F van Wijland, Phys Rev E **98**, 062610 (2018)
- [13] **The statistical physics of active matter: From self-catalytic colloids to living cells**
 ÉF and MC Marchetti, Physica A **504**, 106 (2018)
- [12] **Extracting maximum power from active colloidal heat engines**
 D Martin, C Nardini, ME Cates, and ÉF, EPL **121**, 60005 (2018) | Editor's choice
- [11] **Active mechanics reveal molecular-scale force kinetics in living oocytes**
 WW Ahmed,* ÉF,* M Almonacid,* M Bussonnier, NS Gov, M-H Verlhac, P Visco, F van Wijland,
 and T Betz, Biophys J **114**, 1667 (2018)
- [10] **Spatial fluctuations at vertices of epithelial layers: Quantification of regulation by Rho pathway**
 ÉF,* V Mehandia,* J Comelles, R Thiagarajan, NS Gov, P Visco, F van Wijland, D Riveline
 Biophys J **114**, 939 (2018)
- [9] **Entropy production in field theories without time-reversal symmetry: Quantifying the non-equilibrium character of active matter**
 C Nardini, ÉF, E Tjhung, F van Wijland, J Tailleur, and ME Cates, Phys Rev X **7**, 021007 (2017)
- [8] **Nonequilibrium dissipation in living oocytes**
 ÉF,* WW Ahmed,* M Almonacid,* M Bussonnier, NS Gov, M-H Verlhac, T Betz, P Visco,
 and F van Wijland, EPL **116**, 30008 (2016)

- [7] **How far from equilibrium is active matter?**
ÉF, C Nardini, ME Cates, J Tailleur, P Visco, and F van Wijland, Phys Rev Lett **117**, 038103 (2016)
Editor's suggestion | Highlight in Physics 9, s76 (2016)
- [6] **Active cage model of glassy dynamics**
ÉF, H Hayakawa, P Visco, and F van Wijland, Phys Rev E **94**, 012610 (2016)
- [5] **Modeling the dynamics of a tracer particle in an elastic active gel**
E Ben Isaac, ÉF, P Visco, F van Wijland, and NS Gov, Phys Rev E **92**, 012716 (2015)
- [4] **Active cell mechanics: Measurement and theory,**
WW Ahmed, ÉF, and T Betz, Biochimica et Biophysica Acta - Mol Cell Res **1853**, 3083 (2015)
- [3] **Activity-driven fluctuations in living cells**
ÉF,* M Guo,* NS Gov, P Visco, DA Weitz, and F van Wijland, EPL **110**, 48005 (2015)
Editor's choice | Highlight in Europhysics News 46/5 (2015)
- [2] **Generalized Langevin equation with hydrodynamic backflow: Equilibrium properties**
ÉF, DS Grebenkov, P Visco, and F van Wijland, Physica A **422**, 107 (2015)
- [1] **Energetics of active fluctuations in living cells**
ÉF, K Kanazawa, H Hayakawa, P Visco, and F van Wijland, Phys Rev E **90**, 042724 (2014)

* Equal contribution of these authors to this work