

Étienne Fodor

Physics of Active Matter

Assistant Professor, ATTRACT Fellow

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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**, DPhyMS, Univ of Luxembourg
2017–20 **Oppenheimer 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[†] (22–25), 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), L Casagrande (23–26), N Setzkorn (24–27),
IJC Miranda (24–27), M Antonioli (24–27)
3 Masters | L Casagrande (22–23), T Desaleux (22–23), N Setzkorn (23–24)
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 Fénélon, Paris | 30 weeks
2011 **Research intership**, 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

2025–28 **Innovative training network**, Horizon Europe (Program lead: R Blythe) | 1 PhD
2024–27 **CORE grant**, Fonds National de la Recherche (FNR), Luxembourg | 830 kEUR
2021–26 **Doctoral training unit**, FNR (Program lead: M Esposito) | 1 PhD
2020–25 **ATTRACT Fellowship**, FNR | 1.5 MEUR
2017–20 **Oppenheimer Research Fellowship**, Univ of Cambridge | 160 kGBP
Junior Research Fellowship, St Catharine's College, Cambridge
2017 **PhD prize**, Institut des Systèmes Complexes, Paris
Best talk prize, SIAM-IMA Annual Conference, Univ of Cambridge
2015 **Best talk prize**, Active Liquids, Lorentz Center, Leiden
2013–16 **Teaching Assistantship**, Univ Paris Diderot + **PhD Scholarship**, ENS Cachan

Scientific events and committees

Invited conference talks

- 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 conference talks

- 2025 **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, 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
 ESPCI, Journées de Physique Statistique, Paris

Invited seminars

- 2025 **Biophysics Seminar Series**, Massachusetts Institute of Technology
- 2024 **Dept of Chemistry**, Univ of California, Berkeley
 LPTMC, Sorbonne Univ, Paris
 Dept of Physics, Univ of Liège
 Institute of Physics, Univ of Leiden

	Niels Bohr Institute , 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 , online DAMTP, Soft Matter Seminar , Univ of Cambridge (online) Mathematical Physics Seminar , Imperial College London (online)
2021	Dept of Physics , Guangdong Technion (online) Quantum Science and Technology , Univ of Luxembourg (online) Non-equilibrium Statistical Physics , Georg-August-Univ Göttingen (online) Centre de Physique Théorique , Aix-Marseille Univ (online)
2020	School of Physics and Astronomy , Univ of Edinburgh (online) Dept of Physics , Univ of Bath
2019	ICTP, Quantitative Life Sciences Group , Trieste James Franck Institute, Dept of Chemistry , Univ of Chicago Physics of Living Systems , Massachusetts Institute of Technology Physics and Materials Science Research Unit , Univ of Luxembourg Institute of Physics, Computational Soft Matter , Univ of Amsterdam
2018	LiPhy Laboratory , Univ Grenoble Alpes Charles Coulomb Laboratory , Univ de Montpellier ESPCI, Gulliver Laboratory , Paris St Catharine's College, Graduate Research Seminars , Cambridge Research Colloquium Series , California State Univ, Fullerton
2017	DAMTP, Soft Matter Seminar , Univ of Cambridge DAMTP, BioLunch Seminar , Univ of Cambridge
2016	School of Mathematical Sciences , Queen Mary Univ of London DAMTP, Soft Matter Seminar , Univ of Cambridge MSC Laboratory Seminar , Univ Paris Diderot Yukawa Institute for Theoretical Physics , Kyoto
2015	LiPhy Laboratory , Univ Grenoble Alpes Physics-Biology Interface Seminar , Univ Paris Sud DAMTP, Soft Matter Seminar , Univ of Cambridge Yukawa Institute for Theoretical Physics , Kyoto
2014	MSC Laboratory, Physique du vivant , Univ Paris Diderot MSC Laboratory, Theory Group , Univ Paris Diderot

Organized events

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)

Outreach activities

Since 2021	Internship supervision , High-school students, Univ of Luxembourg 1 week/year
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

Review and editorial service

Since 2016 **Reviewer for scientific journals and agencies** | ca 20 reviews/year

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

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

2025–26 **Guest Editor** (co-Guest Editor: TR Gingrich), Physical Review E

Special topics: “Controlling stochastic dynamics across scales”

PhD committees

- 2025 DPhyMS, Univ of Luxembourg (Student: SGM Srinivas, Supervisor: M Esposito)
Univ of Mons (Student: G Palumbo, Supervisor: P Damman)
DPhyMS, Univ of Luxembourg (Student: BN Radhakrishnan, Supervisor: TL Schmidt)
- 2024 Univ Grenoble Alpes (Student: L Guislain, Supervisor: E Bertin)
Univ Paris Cité (Student: A Dinelli, Supervisor: J TAILLEUR)
DPhyMS, Univ of Luxembourg (Student: N Carabba, Supervisor: A del Campo)
DPhyMS, Univ of Luxembourg (Student: L Dupays, Supervisor: A del Campo)
- 2023 Imperial College, London (Student: Z Zhang, Supervisor: G Pruessner)
- 2022 DPhyMS, Univ of Luxembourg (Student: D Forastiere, Supervisor: M Esposito)
DPhyMS, Univ of Luxembourg (Student: E Penocchio, Supervisor: M Esposito)
DPhyMS, Univ of Luxembourg (Student: V Vassilev Galindo, Supervisor: A Tkatchenko)
- 2021 Luxembourg Centre for Systems Biomedicine (Student: S Martina, Supervisor: A Skupin)
DPhyMS, Univ of Luxembourg (Student: J Ekström, Supervisor: TL Schmidt)

Scientific production

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

- [47] **Quantifying irreversibility from defect statistics in active turbulence**
BN Radhakrishnan, F Serafin, TL Schmidt, and ÉF, in preparation
- [46] **Quantifying dissipation in flocking dynamics: When tracking internal states matters**
K Proesmans, G Falasco, A Tanaji Mohite, M Esposito, and ÉF, arXiv:2505.13113
- [45] **Entropy production rate in thermodynamically consistent flocks**
T Agranov, RL Jack, ME Cates, and ÉF, arXiv:2505.13117
- [44] **Control of active field theories at minimal dissipation**
A Soriani, E Tjhung, ÉF, and T Markovich, arXiv:2504.19285
- [43] **Hydrodynamics of pulsating active liquids**
T Banerjee, T Desaleux, J Ranft, and ÉF, arXiv:2407.19955
- [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