

# 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

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Since 2020 **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 in Physics – 2<sup>nd</sup> year**, École Normale Supérieure (ENS) Paris, ICFP  
2011–12 **Agrégation de Physique**, Training program for Bachelors teaching in Physics, ENS Cachan  
2010–11 **Masters in Physics – 1<sup>st</sup> year**, ENS Lyon  
2009–10 **Bachelors in Physics**, ENS Lyon

## Research, supervision and teaching experience

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Since 2022 **Masters course in Physics**, DPhyMS, Univ of Luxembourg | 14 weeks/year  
Since 2020 **Group supervision**, DPhyMS, Univ of Luxembourg  
6 Postdocs | LK Davis (2020–22), A Manacorda\* (2021–24), T Banerjee<sup>†</sup> (since 2022),  
WD Piñeros\* (since 2022), UA Dattani (since 2023), F Serafin (since 2024)  
\*Marie-Curie Fellow (Horizon Europe), <sup>†</sup>CORE Junior Fellow (Luxembourg)  
6 PhDs | Y Zhang (2020–23), BN Radhakrishnan (since 2021, main supervisor: TL Schmidt),  
L Casagrande (since 2023), IJC Miranda (since 2024), M Antonioli (since 2024),  
N Setzkorn (since 2024)  
3 Masters | L Casagrande (2022–23), T Desaleux (2022–23), N Setzkorn (2023–24)  
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 (Main supervisor: ME Cates)  
2 PhDs | ØL Borthne (2017–20), T Ekeh (2018–21)  
3 Masters | D Martin (2016–17), T Ekeh (2017–18), JW Knight (2019–20, 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

## Fundings, fellowships, and awards

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2024–27 **CORE grant**, Fonds National de la Recherche, Luxembourg | 830 kEUR  
2020–25 **ATTRACT Fellowship**, Fonds National de la Recherche, Luxembourg | 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  
2011–13 **Masters Scholarship**, ENS Cachan

**Invited conference talks**

- 2025      **Statistical Physics of Living Systems**, CECAM, Lausanne  
**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**

- 2024      **Dissipative Processes in Molecular Systems**, Padova  
**Workshop on Stochastic Thermodynamics V** (online)  
**DPG Spring Meeting**, Berlin
- 2023      **StatPhys, 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      **StatPhys, 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      **StatPhys, 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**

- 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
- 2022 **Student Fair**, DPhyMS, Univ of Luxembourg
- 2021 **Open Day**, DPhyMS, Univ of Luxembourg

**Review service** (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 | Agence Nationale de la Recherche (France), Deutsche Forschungsgemeinschaft (Germany), Israel Science Foundation, US Dept of Energy

### PhD committees

- 2025 DPhyMS, Univ of Luxembourg (Student: SGM Srinivas, Supervisor: M Esposito)  
DPhyMS, Univ of Mons (Student: G Palumbo, Supervisor: P Damman)  
DPhyMS, Univ of Luxembourg (Student: M Bilancioni, Supervisor: M Esposito)  
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

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- Main publications: Phys Rev Lett [40][35][34][32][7], Phys Rev X [36][25][18][17][9], Reviews [28][24][13]
- [43] **Species interconversion of deformable particles yields transient phase separation**  
Y Zhang, A Manacorda, and ÉF, arXiv:2501.07169
  - [42] **Hydrodynamics of pulsating active liquids**  
T Banerjee, T Desaleux, J Ranft, and ÉF, arXiv:2407.19955
  - [41] **Diffusive oscillators capture the pulsating states of deformable particles**  
A Manacorda and ÉF, arXiv:2310.14370
  - [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