

# Étienne Fodor

Physics of Active Matter

Assistant Professor, ATTRACT Fellow

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Dept of Physics and Materials Science

University of Luxembourg

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## Scientific positions and education

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Since 2020 **Assistant Professor**, Dept of Physics and Materials Science, University of Luxembourg

2017–20 **Oppenheimer Research Fellow**, DAMTP, University of Cambridge

2016–17 **Postdoctoral Research Associate**, DAMTP, University of Cambridge

2013–16 **PhD in Theoretical Physics**, Université Paris Diderot | Summa cum laude  
“Tracking nonequilibrium in living matter and self-propelled systems”  
Supervisors | P Visco, F van Wijland

2012–13 **Master in Physics – 2<sup>nd</sup> year**, École Normale Supérieure de Paris  
ICFP - Macroscopic Physics and Complexity

2011–12 **Agrégation de Physique**, École Normale Supérieure de Cachan  
Competitive training for teaching Physics at College level

2010–11 **Master in Physics – 1<sup>st</sup> year**, École Normale Supérieure de Lyon

2009–10 **Bachelor in Physics**, École Normale Supérieure de Lyon

## Research, supervision and teaching experience

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Since 2021 **Masters lecture**, Dept of Physics and Materials Science, University of Luxembourg  
“Nonequilibrium soft and active matter” | 14 weeks

Since 2020 **Group supervision**, Dept of Physics and Materials Science, University of Luxembourg  
Postdocs | LK Davis, A Manacorda, WD Pineros, T Banerjee  
PhD students | Y Zhang, A Tanaji Mohite, L Casagrande

Since 2020 **PhD committees**, Dept of Physics and Materials Science, University of Luxembourg  
Student (Supervisor) | E Penocchio, S Gopal, M Bilancioni, D Forastiere (M Esposito),  
J Ekström, K Wu, Byjesh NR (T Schmidt), N Carabba (A del Campo), S Martina (A Skupin),  
B Ames, V Vassilev Galindo, A Kokorin (A Tkatchenko), N Hörnedal (A Chenu)

2017–20 **PhD co-supervision**, DAMTP, University of Cambridge  
Students | ØL Borthne, T Ekeh

2019–20 **Part III project supervision**, DAMTP, University of Cambridge | 8 months  
Part III student | JW Knight (University of Cambridge) | BP Nevill Mott Prize

2019 **Research visit** James Franck Institute, University of Chicago | 2 weeks  
Host researcher | S Vaikuntanathan

2017–18 **Part III project supervision**, DAMTP, University of Cambridge | 8 months  
Part III student | T Ekeh (University of Cambridge)

2016–17 **Internship supervision**, DAMTP, University of Cambridge | 5 months  
Master student | D Martin (École Normale Supérieure de Paris)

2015–16 **Research visit**, YITP, Kyoto University | 2 months/year  
Host researcher | H Hayakawa

2013–16 **Tutorials in medical Physics**, Université Paris Diderot | 64 hours/year

2013 **Master internship – 2<sup>nd</sup> year**, Université Paris Diderot | 16 weeks  
Supervisors | P Visco, F van Wijland

2012–13 **Physics tutorials at College level**, Lycée Fénélon, Paris | 23 hours

2011 **Master intership – 1<sup>st</sup> year**, University of Oxford | 12 weeks  
Supervisors | AS Wyatt, IA Walmsley

2010–11 **Physics tutorials at College level**, Lycée la Martinière Monplaisir, Lyon | 60 hours

2010 **Bachelor internship**, Université de Genève | 8 weeks  
Supervisors | J Extermann, L Bonacina, J-P Wolf

## Fundings, fellowships, and awards

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- 2020–25 **ATTRACT Fellowship**, Fonds National de la Recherche, Luxembourg  
2020–24 **Doctoral Training Unit Active**, Fonds National de la Recherche, Luxembourg  
Project leader | Massimiliano Esposito  
2017–20 **Oppenheimer Research Fellowship**, University of Cambridge  
**Junior Research Fellowship**, St Catharine’s College, Cambridge  
2017 **PhD prize**, Institut des Systèmes Complexes, Paris (3<sup>rd</sup> prize)  
**Best talk prize**, SIAM-IMA Annual Conference, University of Cambridge  
2015 **Best talk prize**, Active Liquids Conference, Lorentz Center, Leiden University  
2013–16 **Teaching Assistantship**, Université Paris Diderot  
**PhD Scholarship**, École Normale Supérieure de Cachan  
2011–13 **Master Scholarship**, École Normale Supérieure de Cachan

## Scientific presentations, organized events, and review service

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### Invited conference talks

- 2023 **Frontiers in Nonequilibrium Physics: Active Matter, Topology and Beyond**, Kyoto  
**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**, Higgs Centre  
for Theoretical Physics, 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 University  
**Active Matter Session**, University of California, Berkeley

### Contributed conference talks

- 2023 **StatPhys, Soft Matter**, Tokyo  
**From Soft Matter to Biophysics**, Les Houches  
2021 **Liquid Matter Conference**, Prague (online)  
**Workshop on Stochastic Thermodynamics II**, Sante Fe (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 Universität Berlin  
**Fundamental Problems in Active Matter**, Aspen Center for Physics  
2017 **SIAM-IMA Annual Conference**, University of Cambridge  
**Edwards Centre Mini Conference**, University of Cambridge  
**Open Statistical Physics**, Milton Keynes  
2016 **StatPhys, Biological Physics**, Lyon  
**Non-Gaussian Workshop**, YITP, Kyoto  
2015 **Lorentz Center, Active Liquids**, Leiden University  
2014 **Condensed Matter in Paris**, Université Paris Descartes  
**ESPCI, Journées de Physique Statistique**, Paris

### Invited seminars

- 2023 **Biological, Soft and Complex Materials and Theory Seminar**, University of Bristol  
**EMBL Theory Seminar**, Heidelberg  
2022 **Biological Physics and Physical Biology**, online  
**DAMTP, Soft Matter Seminar**, University of Cambridge (online)  
**Mathematical Physics Seminar**, Imperial College London (online)

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

#### Organized events

- 2024 **Energy, Information and Evolution in Biology**, Summer school, Cargèse
- 2018–20 **Statistical Physics and Soft Matter Seminars**, DAMTP, University of Cambridge
- 2019 **Colloids as a Toolbox for Statistical Mechanics**, University of Cambridge
- 2018 **World Congress of Biomechanics, Non-equilibrium Biomechanics session**, Dublin

**Review service** Commun Phys, 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, Sci Adv, Sci Rep | ca 10 papers/year

#### Scientific production

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- [34] **Towards a liquid-state theory for active matter**  
 YI Li, R Garcia-Millan, ME Cates, and ÉF, arXiv:2301.12155
- [33] **Pulsating active matter**  
 Y Zhang and ÉF, arXiv:2208.06831
- [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)
- [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 M Cristina 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 | Highlights of 2018
- [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 | Physics (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 | 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