

Étienne Fodor

Physics of Active Matter

Assistant Professor, ATTRACT Fellow

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Dept of Physics and Materials Science

Univ of Luxembourg

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Scientific positions and education

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

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

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

2013–16 **PhD in Theoretical Physics**, Univ 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 – 2nd 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 – 1st year**, École Normale Supérieure de Lyon

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

Research, supervision and teaching experience

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

Since 2020 **Group supervision**, Dept of Physics and Materials Science, Univ of Luxembourg
Postdocs | LK Davis, A Manacorda, WD Pineros, T Banerjee, UA Dattani, F Serafin
PhD students | Y Zhang, L Casagrande
Master students | L Casagrande, T Desaleux

Since 2020 **PhD committees**, Dept of Physics and Materials Science, Univ of Luxembourg
Student (Supervisor) | E Penocchio, S Gopal, M Bilancioni, D Forastiere (M Esposito),
J Ekström, K Wu, BN Radhakrishnan (T Schmidt), L Dupays, N Carabba (A del Campo),
S Martina (A Skupin), B Ames, V Vassilev Galindo, A Kokorin, N Davoine (A Tkatchenko),
N Hörnedal (A Chenu)
Other PhD committees | Z Zhang (supervised by G Pruessner), Imperial College, London

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

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

2019 **Research visit**, James Franck Institute, Univ of Chicago | 2 weeks

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

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

2015–16 **Research visit**, YITP, Kyoto Univ | 2 months/year

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

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

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

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

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

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

Fundings, fellowships, and awards

- 2024–27 **CORE grant**, Fonds National de la Recherche, Luxembourg
2020–25 **ATTRACT Fellowship**, Fonds National de la Recherche, Luxembourg
2017–20 **Oppenheimer Research Fellowship**, Univ of Cambridge
Junior Research Fellowship, St Catharine’s College, Cambridge
2017 **PhD prize**, Institut des Systèmes Complexes, Paris (3rd prize)
Best talk prize, SIAM-IMA Annual Conference, Univ of Cambridge
2015 **Best talk prize**, Active Liquids Conference, Lorentz Center, Leiden Univ
2013–16 **Teaching Assistantship**, Univ 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

Invited conference talks

- 2023 **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, Univ of California, Berkeley

Contributed conference talks

- 2023 **Computational Advances in Active Matter**, Lorentz Center, Leiden
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, 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 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 **Lorentz Center, Active Liquids**, Leiden Univ
2014 **Condensed Matter in Paris**, Univ Paris Descartes
ESPCI, Journées de Physique Statistique, Paris

Invited seminars

- 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 Department 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)
 Department of Physics, Univ of Bath
- 2019 ICTP, Quantitative Life Sciences Group, Trieste
 James Franck Institute, Department 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

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

Review service

Journals (ca 10/year) | 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, Science, Sci Adv, Sci Rep

Research agencies | Israel Science Foundation, Deutsche Forschungsgemeinschaft

Scientific production

- [37] **Pulsating with discrete symmetry**
 A Manacorda and ÉF, arXiv:2310.14370
- [36] **Active matter under control: Insights from response theory**
 LK Davis, K Proesmans, and ÉF, arXiv:2305.11078
- [35] **Pulsating active matter**
 Y Zhang and ÉF, arXiv:2208.06831
- [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)
 - [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 | 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