

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 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
2013–16 **PhD in Theoretical Physics**, Univ Paris Diderot (Supervisors: P Visco, F van Wijland)
“Tracking nonequilibrium in living matter and self-propelled systems” | Summa cum laude
2012–13 **Masters in Physics – 2nd year**, École Normale Supérieure (ENS) Paris, ICFP
2011–12 **Agrégation de Physique**, Training for teaching Physics at College level, ENS Cachan
2010–11 **Masters in Physics – 1st year**, ENS Lyon
2009–10 **Bachelors in Physics**, ENS Lyon

Research, supervision and teaching experience

Since 2022 **Masters lecture**, DPhyMS, Univ of Luxembourg
“Nonequilibrium soft and active matter” | 14 weeks/year
Since 2020 **Group supervision**, DPhyMS, Univ of Luxembourg
Postdocs | LK Davis, A Manacorda (MSCA Fellow), T Banerjee (CORE Junior Fellow),
WD Piñeros (MSCA Fellow), UA Dattani, F Serafin
PhDs | Y Zhang, BN Radhakrishnan, L Casagrande, IJC Miranda, M Antonioli, N Setzkorn
Masters | L Casagrande, T Desaleux, N Setzkorn
2024 **Masters lecture**, Dept of Physics, Univ of Liège | 4 classes, 1 week
2017–20 **PhD co-supervision**, DAMTP, Univ of Cambridge (Students: ØL Borthne, T Ekeh)
2019–20 **Part III project supervision**, DAMTP, Univ of Cambridge (Student: JW Knight) | 8 months
2017–18 **Part III project supervision**, DAMTP, Univ of Cambridge (Student: T Ekeh) | 8 months
2016–17 **Internship supervision**, DAMTP, Univ of Cambridge (Student: D Martin) | 5 months
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 | 830 kEUR
2020–25 **ATTRACT Fellowship**, Fonds National de la Recherche, Luxembourg | 1.5 MEUR
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, Lorentz Center, Leiden
2013–16 **Teaching Assistantship**, Univ Paris Diderot
PhD Scholarship, ENS Cachan
2011–13 **Master Scholarship**, ENS Cachan

Scientific presentations, organized events, and review service

Invited conference talks

- 2025 **Self-Organization Far From Equilibrium**, APS March meeting, Anaheim
- 2024 **The Many Faces of Active Mechanics**, KITP, Santa Barbara
Nonequilibrium Statistical Physics of Complex Systems, Seoul
- 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

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

Outreach activity

- 2024 **Lecture for large audience**, Institut d'Etudes Scientifiques, Cargèse
Chercheurs à l'école, Seminar in high schools, Luxembourg
Internship supervision, High-school students, Luxembourg
- 2023 **Inaugural lecture**, Faculty of Science, Technology and Medicine, Univ of Luxembourg
Internship supervision, High-school students, Luxembourg

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 (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), Proc Natl Acad Sci, Science, Sci Adv, Sci Rep, Soft Matter

Research agencies | Agence Nationale de la Recherche, Deutsche Forschungsgemeinschaft, Israel Science Foundation, US Dept of Energy

PhD committees

- 2024 Univ Grenoble Alpes (Student: L Guislain, Supervisor: E Bertin)
Univ Paris Cité (Student: A Dinelli, Supervisor: J Tailleur)
DPhyMS, Luxembourg (Student: N Carabba, Supervisor: A del Campo)
DPhyMS, Luxembourg (Student: L Dupays, Supervisor: A del Campo)
- 2023 Imperial College, London (Student: Z Zhang, Supervisor: G Pruessner)

- 2022 DPhyMS, Luxembourg (Student: D Forastiere, Supervisor: M Esposito)
 DPhyMS, Luxembourg (Student: E Penocchio, Supervisor: M Esposito)
 DPhyMS, Luxembourg (Student: V Vassilev Galindo, Supervisor: A Tkatchenko)
- 2021 LCSB, Luxembourg (Student: S Martina, Supervisor: A Skupin)
 DPhyMS, Luxembourg (Student: J Ekström, Supervisor: TL Schmidt)

Scientific production

- [42] **Hydrodynamics of pulsating active liquids**
 T Banerjee, T Desaleux, J Ranft, and ÉF, arXiv:2407.19955
- [41] **Biased ensembles of pulsating active matter**
 WD Piñeros and ÉF, arXiv:2403.16961
- [40] **Pulsating with discrete symmetry**
 A Manacorda and ÉF, arXiv:2310.14370
- [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