Maxime Lucas

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date of birth: 25 Jan 1992
nationality: Belgian
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Current position

Apr 24–now **FNRS postdoctoral fellow**, *UCLouvain and UNamur*, Belgium
Characterizing underground fungal networks for my project UNDER-NET funded by the FNRS, hosted by T. Carletti (naXys, UNamur) and S. Declerck (Team Mycology, UCLouvain).

Past positions

Jun 22–Mar 24 **Postdoctoral researcher**, *CENTAI Institute*, Turin, Italy
Mainly higher-order interactions (synchronisation, structure), TDA applied to neuroscience, and deciphering sperm whale language (Project CETI), with G. Petri

Oct 21–May 22 **Postdoctoral researcher**, *ISI Foundation*, Turin, Italy
Mainly higher-order interactions (synchronisation, structure), TDA applied to neuroscience, and deciphering sperm whale language (Project CETI), with G. Petri

Jun 19–Aug 21 **CENTURI postdoctoral fellow**, *Aix-Marseille University*, Marseille, France
Cell cycle modelling as a temporal network of protein interactions with A. Barrat, B. Habermann, and L. Tichit.

Oct 15–Feb 19 **PhD candidate**, *Lancaster University (UK) and University of Florence (Italy)*
Synchronization of oscillators with time-varying parameters, supervised by A. Stefanovksa (Lancaster) and D. Fanelli (Florence), funded by the Marie Curie ITN COSMOS.

Education

2014–2015 **Master of Artificial Intelligence**, *Katholieke Universiteit Leuven*, Leuven, Belgium, *cum laude*
Thesis: Instabilities in Cortical Networks with Embedded Synfire Chains

2012–2014 **MSc Physics**, *Université Libre de Bruxelles*, Brussels, Belgium, *magna cum laude*
Thesis: Instabilités dynamiques de systèmes de billards avec interactions rares

2012 **One-term exchange programme**, *University of Toronto*, Toronto, Canada

2009–2012 **BSc Physics**, *Université Libre de Bruxelles*, Brussels, Belgium, *cum laude*

Publications

'*' indicates first co-authorship.

Preprints

○. **Lucas, M.**, Francois, D., Donato, C., Skupin, A. & Proverbio, D. *Topological analysis of brain dynamical signals indicates signatures of seizure susceptibility* arXiv:2412.01911. 2025.

○. **Lucas, M.**, Gallo, L., Ghavasieh, A., Battiston, F. & De Domenico, M. *Functional reducibility of higher-order networks* arXiv:2404.08547. 2024.

○. Moriamé, M., **Lucas, M.** & Carletti, T. *Hamiltonian control to desynchronize Kuramoto oscillators with higher-order interactions* arXiv:2409.13578. 2024.

○. Nurisso, M., Morandini, M., **Lucas, M.**, Vaccarino, F., Gili, T. & Petri, G. *Higher-order Laplacian Renormalization* (accepted in Nature Physics) arXiv:2401.11298. 2024.

○. Robiglio, T., Neri, M., Coppes, D., Agostinelli, C., Battiston, F., **Lucas, M.** & Petri, G. *Synergistic signatures of group mechanisms in higher-order systems* (accepted in Physical Review Letters) arXiv:2401.11588. 2024.

Journal articles

○. Santoro, A., Battiston, F., **Lucas, M.**, Petri, G. & Amico, E. Higher-order connectomics of human brain function reveals local topological signatures of task decoding, individual identification, and behavior. *Nature Communications* **15,** 10244 (2024).

○. Zhang, Y., Skardal, P. S., Battiston, F., Petri, G. & **Lucas, M.** Deeper but smaller: Higher-order interactions increase linear stability but shrink basins. *Science Advances* (2024).

○. Brondetta, A., Bizyaeva, A., **Lucas, M.**, Petri, G. & Musslick, S. On the Benefits of Heterogeneity in Cognitive Stability and Flexibility for Collaborative Task Switching. *Proceedings of the Annual Meeting of the Cognitive Science Society* **46** (2024).

○. Nurisso, M., Arnaudon, A., **Lucas, M.**, Peach, R. L., Expert, P., Vaccarino, F. & Petri, G. A unified framework for Simplicial Kuramoto models. *Chaos* **34** (2024).

○. Leitão, A., **Lucas, M.**, Poetto, S., Hersh, T. A., Gero, S., Gruber, D., Bronstein, M. & Petri, G. Evidence of social learning across symbolic cultural barriers in sperm whales. *eLife* **13** (2024).

○. Zhang*, Y., **Lucas, M.***. & Battiston, F. Higher-order interactions shape collective dynamics differently in hypergraphs and simplicial complexes. *Nature Communications* **14,** 1605 (2023).

○. **Lucas, M.**, Townsend-Teague, A., Neri, M., Poetto, S., Morris, A., Habermann, B. H. & Tichit, L. Phasik: a Python package to identify system states in partially temporal networks. *Journal of Open Source Software* **8,** 5872 (2023).

○. Landry, N. W., **Lucas, M.**, Iacopini, I., Petri, G., Schwarze, A., Patania, A. & Torres, L. XGI: A Python package for higher-order interaction networks. *Journal of Open Source Software* **8,** 5162 (2023).

○. **Lucas, M.***., Iacopini*, I., Robiglio, T., Barrat, A. & Petri, G. Simplicially driven simple contagion. *Physical Review Research* **5,** 013201 (1 2023).

- **Lucas, M.**, Morris, A., Townsend-Teague, A., Tichit, L., Habermann, B. H. & Barrat, A. Inferring cell cycle phases from a partially temporal network of protein interactions. *Cell Reports Methods*, 100397 (2023).

- Newman, J., **Lucas, M.** & Stefanovska, A. Stabilization of cyclic processes by slowly varying forcing. *Chaos* **31,** 123129 (2021).

- Battiston, F., Cencetti, G., Iacopini, I., Latora, V., **Lucas, M.**, Patania, A., Young, J.-G. & Petri, G. Networks beyond pairwise interactions: structure and dynamics. *Physics Reports* **874,** 1–92 (2020).

- **Lucas, M.**, Cencetti, G. & Battiston, F. Multiorder Laplacian for synchronization in higher-order networks. *Physical Review Research* **2,** 033410 (2020).

- **Lucas, M.**, Fanelli, D. & Stefanovska, A. Nonautonomous driving induces stability in network of identical oscillators. *Physical Review E* **99,** 012309 (2019).

- **Lucas, M.**, Fanelli, D., Carletti, T. & Petit, J. Desynchronization induced by time-varying network. *Europhys. Lett.* **121,** 50008 (2018).

- **Lucas, M.**, Newman, J. & Stefanovska, A. Stabilization of dynamics of oscillatory systems by nonautonomous perturbation. *Physical Review E* **97,** 042209 (2018).

- Duncan, R. & **Lucas, M.** Verifying the Steane code with Quantomatic. *Electronic Proceedings in Theoretical Computer Science* **171,** 33–49 (2014).

Book chapters

- **Lucas, M.**, Cencetti, G. & Battiston, F. *Higher-Order Systems* 233 (Springer Nature, 2022).

- **Lucas, M.**, Newman, J. & Stefanovska, A. *Physics of Biological Oscillators* 85–110 (Springer, 2021).

- Newman, J., **Lucas, M.** & Stefanovska, A. *Physics of Biological Oscillators* 111–129 (Springer, 2021).

Presentations

Invited talks

2025 **Physical Networks satellite @NetSci**, Maastricht, Netherlands, (upcoming)

2024 **AATRN Networks Seminar**, Online, 3 December

2022 **MB2022**, IPAM, Los Angeles, USA, 31 August

2022 **Biomat 2022**, *Invited*, Granada, Spain, 18 November

2021 **XIX Curso Boliviano de sistemas complejos**, *Invited*, Online, 5 October

Contributed talks

2024 **Conference on Complex Systems CCS2024**, Exeter, UK, 5 September

2024 **NetSci-X**, Venice, Italy, 23 January

2023 **Dynamics Days Europe**, Naples, Italy, 12 September

2023 **OHBM**, Montreal, Canada, 25 July

2023 **NetSci**, Vienna, Austria, 12 July

2022 **Conference on Complex Systems CCS2022**, Palma de Mallorca, Spain, 21 October

2022 **Conference on Complex Systems CCS2022**, Palma de Mallorca, Spain, 18 October

2021 **BeNet2021**, Namur, Belgium, 18 November

2021 **Networks 2021**, Online, 5-10 July

2021 **NetBioMed (Networks2021 satellite)**, Online, 25 June

2021 **Complenet Live**, Online, 24-26 May

2020 **CENTURI day, Aix-Marseille University**, Marseille, France, 20 November

2020 **Belgian Network Research Meeting (BeNet)**, Brussels, Belgium, 12 November

2020 **Toponets (NetSci satellite)**, Rome, Italty, 18–19 September

2020 **Networks and Molecular Biology winter school**, Marseille, France, 2–6 March

2019 **Belgian Network Research Meeting (BeNet)**, Hasselt, Belgium, 22 February

2018 **COSMOS meeting**, Dolenjske Toplice, Slovenia, 24–27 September

2018 **Workshop on Long-range Interactions and Synchronization**, São Paulo, Brazil, 28–31 June

2017 **COSMOS toolbox laboratory**, Brijuni, Croatia, 8–13 October

2017 **Dynamics Days**, Szeged, Hungary, 5–9 June

2017 **COSMOS retreat**, Wittenberg, Germany, 26–31 March

2016 **COSMOS workshop 2**, Amsterdam, Netherlands, 11–16 December

2016 **COSMOS school 2**, Aberdeen, UK, 27 June–6 July

2013 **Quantum Physics and Logic (QPL) workshop**, Barcelona, Spain, 17–19 July

Seminars

2024 **naXys, Université de Namur**, Namur, Belgium, 21 November

2021 **naXys, Université de Namur**, Namur, Belgium, 18 February

2021 **CENTURI seminar, Aix-Marseille University**, Marseille, France, 4 February

2019 **naXys, Université de Namur**, Namur, Belgium, 16 May

2019 **Department of Network and Data Science, Central European University**, Budapest, Hungary, 29 March

2018 **Université Libre de Bruxelles**, Brussels, Belgium, 3 April

2017 **University of Florence**, Florence, Italy, 7 December

Posters

2022 **Oustanding challenges in nonlinear dynamics**, Les Houches, France, 21–25 March

2020 **NetSci**, Rome, Italy, 17–25 September

2020 **NetBioMed2020 (Netsci satellite)**, Rome, Italty, 17 September

2020 **Alea day**, Marseille, France, 7 February

2019 **4th CENTURI day**, Marseille, France, 22 February

2019 **IBDM days**, Arles, France, 3–4 October

2019 **Workshop on Higher-order Interaction Networks: Dynamics, Structure, Data**, Oxford, UK, 9–11 September

2019 **Complenet**, Tarragona, Spain, 18–21 March

2018 **Analysis and Modeling of Complex Oscillatory Systems (AMCOS)**, Barcelona, Spain, 19–23 March

2017 **STATPHYS26**, Lyon, France, 18–22 July

2016 **International conference on biological oscillations (ESGCO)**, Lancaster, UK, 10–14 April

2015 **Lancaster University Christmas Conference**, Lancaster, UK, 15 December

Organisation and service

Organisation

2022– **"Toponets" satellite meeting at NetSci 22, 23, 24, 25**, *Co-Organiser*

2023 **"Tutorial Thursdays"**, *Organiser*, monthly internal tutorials at CENTAI Institute

2018 **"Analysis and Modeling of Complex Oscillatory Systems" (AMCOS) conference**, *Co-Organiser*, Barcelona, Spain, 100+ participants

Peer review

Phys. Rev. Lett. ∘ Philos. Trans. Royal Soc. A ∘ J. R. Soc. Interface ∘ Chaos ∘ Phys. Rev. E ∘ Chaos Solit. ∘ Commun. Phys. ∘ SIAM J. Appl. Dyn. Syst. ∘ PLOS ONE ∘ Sci. Rep. ∘ Fluct. Noise Lett. ∘ Commun. Nonlinear Sci. Numer. Simul. ∘ Springer book: Physics of Biological Oscillations

Program committee

FRCCS22, FRCCS23

Other

2023- **Council of the Complex Systems Society**, *Elected member*

2015–2018 **Supervisory board of the COSMOS Marie Curie ITN**, *Early Stage Researchers representative*

2011–2012 **Physics Department**, *Student representative*, Université Libre de Bruxelles, Brussels, Belgium

Teaching and outreach

Mentoring

2024- **Renée Locreille**, *MSc Bioengineering*, UCLouvain

2024- **Gianmatteo Ciulli**, *MSc Physics*, University of Turin, co-supervised with G. Petri

2023-2024 **Noemi Aime**, *BSc Physics*, University of Turin, co-supervised with G. Petri

Summer 2023 **Francesco Guadagnolo**, *BSc Maths*, University of Turin, co-supervised with G. Petri

Oct 21-Sept 23 **Antonio Leitao**, *pre-doctoral student*, CENTAI Institute, co-supervised with G. Petri

Summer 2020 **Alex Townsend-Teague**, *Undergrad*, University of Oxford

Summer 2020 **Arthur Morris**, *Undergrad*, University of Oxford

Teaching

Fall 2024 **Dynamical systems**, *MSc in Mathematics*, University of Namur, Belgium

Spring 2024 **Complexity in social systems**, *MSc Physics of Complex Systems*, University of Turin, Italy

Spring 2023 **Complexity in social systems**, *MSc Physics of Complex Systems*, University of Turin, Italy

Nov 2022 **Synchronisation with higher-order interactions**, *Invited Lecturer*, BIOMAT summer school, Granada, Spain

Oct 2021 **Bifurcations**, *Invited Lecturer*, XIX Bolivian course on complex systems

Spring 2021	**Introduction to Artificial Intelligence (S8BIO2021)**, *Bioingeneering*, École Centrale Marseille, France
2010–2015	**Private tuitions in physics and maths**
2014	**Teacher at Reussit'school**, *individual tuitions*

Outreach

2018	**Interview and videos by the STA (Slovenian Press agency)**, *Novo Mesto, Slovenia*, 15 September
2017	**Interview for Radio Moka**, *Florence, Italy*, 17 November
2017	**Masterclass "Waves and oscillations"**, *Lancaster University, UK*, 13 July, We hosted 30 A-level students within the programme Headstart from all over the UK
2017	**Masterclass "Waves and oscillations"**, *Lancaster University, UK*, 1 March, We hosted 9 A-level students

Awards and grants

2023	**Postdoctoral fellowship**, *from FRNS (Belgium)*
2020	**Travel grant**, *from COSTNET Short Term Scientific Mission (STSM)*
2019	**Travel grant**, *from COSTNET Short Term Scientific Mission (STSM)*
2018	**Best group project "Plan Bee"**, *at the Mediterranean School of Complex Networks (MSCx)*, Salina, Italy
2015	**COSMOS PhD Fellowship**, *Marie Curie ITN EJD*
2011	**Gold medal with the ULB-Brussels Team**, *at the international Genetically Engineerd Machine competition (iGEM) organised by MIT*, Amsterdam, Netherlands

Computer skills and projects

Languages	Python, Matlab, Fortran, Java, Prolog, LaTeX
OS	Linux, macOS, Windows
Code	**CompleX Group Interactions (XGI):** python package that provides data structures and algorithms for modeling and analyzing complex systems with group (higher-order) interactions, xgi.readthedocs.io/
	Phasik: python package to infer temporal phases in temporal networks, phasik.readthedocs.io/
	AMCOS_booklet : a LaTeX template for conference booklets, github.com/maximelucas/AMCOS_booklet

Languages

- ○ French: mother tongue
- ○ English: fluent (IELTS: 8/9 in 2015)
- ○ Italian: advanced
- ○ Dutch: advanced
- ○ Hungarian: beginner

Interests

Music (play the violin), football, squash, hiking, former youth movements leader