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Last updated: February 22, 2023

# Maxime Lucas

## Current position

Jun 22– **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

## Past positions

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

2019–2021 **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.

## PhD Thesis

Title *Synchronisation and stability in nonautonomous oscillatory systems*  
Supervisors Pr. Aneta Stefanovska and Pr. Duccio Fanelli  
Institutions Joint degree between Lancaster University, UK, and University of Florence, Italy  
Description I investigated synchronisation and stability in driven systems and networks of coupled oscillators, with an eye on possible applications in biological and other real life systems.  
Funding COSMOS, a Marie Curie Initial Training Network (ITN) of the type European Joint Doctorate (EJD).  
Dates October 2015–February 2019

## 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*

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## Publications

'\*' indicates first co-authorship.

### Preprints: in review or accepted for publication

- Zhang, Y. \*, Lucas, M.\* & Battiston, F. *Higher-order interactions shape collective dynamics differently in hypergraphs and simplicial complexes* to appear in Nature Communications, arXiv:2203.03060. 2023.
- Lucas, M.\*, Iacopini, I. \*, Robiglio, T., Barrat, A. & Petri, G. *Simplicially driven simple contagion* to appear in Phys. Rev. Res., arXiv:2206.07645. 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* <https://github.com/openjournals/joss-papers/blob/joss.05125/joss.05125/10.21105.joss.05125.pdf>. 2023.

### Journal articles

- 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).
- Lucas, M., Cencetti, G. & Battiston, F. Multiorder Laplacian for synchronization in higher-order networks. *Phys. Rev. Research* **2**, 033410 (2020).
- Battiston, F., Cencetti, G., Iacopini, I., Latora, V., Lucas, M., Patania, A., Young, J.-G. & Petri, G. Networks beyond pairwise interactions: structure and dynamics. *Phys. Rep.* (2020).
- Lucas, M., Fanelli, D. & Stefanovska, A. Nonautonomous driving induces stability in network of identical oscillators. *Phys. Rev. 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. *Phys. Rev. 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. M. I. & Stefanovska, A. *Physics of Biological Oscillators: New Insights into Non-Equilibrium and Non-Autonomous Systems* (eds Stefanovska, A. & McClintock, P. V. E.) 85–110 (Springer International Publishing, Cham, 2021).
- Newman, J. M. I., Lucas, M. & Stefanovska, A. *Physics of Biological Oscillators: New Insights into Non-Equilibrium and Non-Autonomous Systems* (eds Stefanovska, A. & McClintock, P. V. E.) 111–129 (Springer International Publishing, Cham, 2021).

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## Presentations

### Oral at conferences, workshops, and schools

- 2022 **Conference on Complex Systems CCS2022**, Palma de Mallorca, Spain, 21 October
- 2022 **Conference on Complex Systems CCS2022**, Palma de Mallorca, Spain, 18 October
- 2022 **MB2022**, *Invited*, IPAM, Los Angeles, USA, 31 August
- 2022 **Biomat 2022**, *Invited*, Granada, Spain, 18 November
- 2021 **BeNet2021**, Namur, Belgium, 18 November
- 2021 **XIX Curso Boliviano de sistemas complejos**, *Invited*, Online, 5 October
- 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, Italy, 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

- 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, Italy, 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

- 2023 **“Toponets” satellite meeting at NetSci23 (upcoming)**, *Co-Organiser*, Vienna, Austria
- Oct 2022- **“Tutorial Thursdays”**, *Organiser*, monthly internal tutorials at CENTAI Institute
- 2022 **“Toponets” satellite meeting at CCS2022**, *Co-Organiser*, Palma de Mallorca, Spain, website: <https://sites.google.com/view/toponets-2022?pli=1>
- 2018 **“Analysis and Modeling of Complex Oscillatory Systems” (AMCOS) conference**, *Co-Organiser*, Barcelona, Spain, 100+ participants, website: [amcosconference.com](http://amcosconference.com)

### Peer review

Phys. Rev. E, Chaos, Commun. Phys., Philos. Trans. Royal Soc. A, 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 (upcoming)

### 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

- Feb 2023- **Noemi Aime**, *BSc Physics*, University of Turin, co-supervised with G. Petri
- Oct 2021- **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

- Spring 2023 **Complexity in social systems**, *MSc Physics of Complex Systems*, University of Turin, Italy, (upcoming)
- 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)**, *Bioengineering*, École Centrale Marseille, France
- 2010–2015 **Private tuitions in physics and maths**
  - 2014 **Teacher at Reussit's 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

- 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 Engineered 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/](http://xgi.readthedocs.io/)

**Phasik**: python package to infer temporal phases in temporal networks,  
[phasik.readthedocs.io/](http://phasik.readthedocs.io/)

**AMCOS\_booklet** : a  $\LaTeX$  template for conference booklets,  
[github.com/maximelucas/AMCOS\\_booklet](https://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