Hanlin Sun

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Professional Experience

NORDITA, Stockholm University and KTH Royal Institute of Technology Stockholm, Sweden
WINQ Research Fellow Sep 2023 –Current

Education

Queen Mary, University of London London, United Kingdom
Ph.D. in Applied Mathematics, Advisor: Prof. Ginestra Bianconi Sep 2019 –Sep 2023

- Thesis: "Dynamic processes on networks and higher-order structures"

Aston University Birmingham, United Kingdom
Visiting student, Advisor: Prof. David Saad Jul 2018 –Aug 2018

KTH Royal Institute of Technology Stockholm, Sweden
Visiting student Jan 2018 –Jun 2018

University of Chinese Academy of Sciences Beijing, China
B.Sc. in Physics, Advisor: Prof. Pan Zhang Sep 2015 –Jul 2019

- Thesis: "Low rank approximation of tensor networks"

Talks and poster presentations

Conference presentations

- 1st British NetSci Symposium, London May 2024
  Contributing talk. Title: "Triadic percolation induces dynamical topological patterns in higher-order networks"
- APS March meeting 2024 (Minneapolis, United States) Mar 2024
  Contributed talk. Title: "Network science Ising state of matter"
- CCS/Italy 2023 (Naples, Italy) Oct 2023
  Contributed talk. Title: "The dynamic nature of percolation on networks with triadic interactions"
- NetSci 2023 (Vienna, Austria) Jul 2023
  Contributed talk. Title: "The dynamic nature of percolation on networks with triadic interactions"
- Conference on Complex Systems 2022 (Palma de Mallorca, Spain) Oct 2022
  Contributed talk. Title: "Triadic interactions induce blinking and chaos in connectivity of higher-order networks"
- 4th IMA Conference on The Mathematical Challenges of Big Data (Oxford, United Kingdom) Sep 2022
  Contributed talk. Title: "A message-passing approach to epidemic tracing and mitigation with apps"
- Satellite @ NetSci2022: Signed Networks and their Applications (Online) Jul 2022
  Invited talk. *Title: "Triadic interactions induce blinking and chaos in connectivity of higher-order networks"*
- Satellite @ NetSci2022: Higher-Order Topology & Dynamics in Complex Networks (Online) Jul 2022
  Contributed talk. Title: "Higher-order percolation processes on multiplex hypergraphs"
- Conference on Complex Systems 2021 (Lyon, France) Oct 2021
  Contributed talk. Title: "Higher-order percolation processes on multiplex hypergraphs"

- Satellite @ Networks 2021: TopoNet2021: Networks beyond pairwise interactions (Online) Jun 2021
  Contributed talk. Title: "Higher-order percolation processes on multiplex hypergraphs"
- The 46th Conference of the Middle European Cooperation in Statistical Physics (Online) May 2021
  Contributed talk. Title: "A message-passing approach to epidemic tracing and mitigation with apps"
- Conference on Complex Systems 2020 (Online) Dec 2020
  Contributed talk. Title: "A message-passing approach to epidemic tracing and mitigation with apps"

Other presentations

- Workshop "Quantitative Methods for Dynamics on Networks", Los Alamos National Laboratory Aug 2024
  Invited talk. *Title: To be determined*
- Isaac Newton Institute Satellite Programme on "Hypergraphs: theory and applications" Jul 2024
  Invited talk. *Title: To be determined*
- BrainNet+ 2024, KTH May 2024
  Contributing talk. Title: "Triadic percolation induces dynamical topological patterns in higher-order networks"
- Applied CATS (Combinatorics, Algebra, Topology and Statistics) seminar, KTH Nov 2023
  Invited talk. *Title: "Network science Ising states of matter"*
- Internal seminar, Institute of Theoretical Physics, Chinese Academy of Sciences Aug 2023
  Invited talk. *Title: "The dynamic nature of percolation on networks with triadic interactions"*
- Internal seminar, Aston University Aug 2023
  Invited talk. *Title: "The dynamic nature of percolation on networks with triadic interactions"*
- NetPLACE seminar Feb 2023
  Invited talk. *Title: "Message-passing approach to epidemic tracing and mitigation with apps"*
- Networks and Time Workshop, Queen Mary University of London Jan 2023
  Contributed talk. Title: "Triadic interactions induce blinking and chaos in connectivity of higher-order networks"
- Complex Systems Seminar, Queen Mary University of London Apr 2022
  Invited talk. *Title: "Mathematics in epidemic spreading: from containment measures to critical behaviours"*
- Postgraduate Research Day 2022, Queen Mary University of London May 2022
  Talk. Title: "Triadic interactions induce blinking and chaos in connectivity of higher-order networks"
- Internal seminar, Aston University Mar 2022
  Invited talk. *Title: "Mathematics in epidemic spreading: from containment measures to critical behaviours"*
- Postgraduate Research Day 2021, Queen Mary University of London May 2021
  Poster presentation. Title: "A message-passing approach to epidemic tracing and mitigation with apps"
- Queen Mary Internal Postgraduate Seminar (QuIPS) Nov 2020
  Invited talk. *Title: "A message-passing approach to epidemic tracing and mitigation with apps"*

Other academic activities

Organization of events

- Organiser of program WINQ Program on Complex and Quantum Systems at NORDITA, Stockholm Apr 2024
  A program hosts a series of four workshops dedicated to the topics in complex systems and quantum systems
- Organiser of panel NetPLACE@NetSciX 2024 at NetSciX 2024, Venice Jan 2024
  Panel discussion on scientific communication
- Organiser of panel NetPLACE@NetSci at NetSci 2023, Vienna Jul 2023
  A 2-day panel discussion on academic writing and mental well-being in academia
- Organiser of DERI PhD forum 2020-2023
  A seminar at the Digital Environment Research Institute, Queen Mary University of London

- Organiser of NetPLACE Seminar 2021-Current
  An international online seminar for early-career researchers about Network, Phd Life And ComplExity

Attendance of other events

- Lipari School Computational Complex and Social Systems, Lipari, Italy Jul 2022
  DATA SCIENCE: Models, Algorithms, AI and Beyond

Referee and editorial service

- Reviewer for: Nature Communication, Nature Physics, Physica A, Communication Physics, Scientific Reports, New Journal of Physics, Bioinformatics, Chaos Solitons and Fractals, IEEE Transactions on Network Science and Engineering, Journal of Physics A, Chaos: An Interdisciplinary Journal of Nonlinear Science, Journal of Statistical Physics
- Guest Editor Assistant of the Special Issue "Models, Topology and Inference of Multilayer and Higher-Order Networks" in *Entropy.*

Teaching

- **Teaching Associate** at Queen Mary University of London 2019-2023
  Calculus II, *Level 4 module, Jan 2023-Apr 2023*
  Vectors and Matrices, *Level 4 module, Jan 2023-Apr 2023*
  Calculus I, *Level 4 module, Sep 2022-Dec 2022*
  Calculus I, *Level 4 module, Sep 2021-Dec 2021*
  Machine Learning with Python, *Level 7 module, Jun 2021-Aug 2021*
  Calculus II, *Level 4 module, Jan 2021-Apr 2021*
  Calculus I, *Level 4 module, Sep 2020-Dec 2020*
  Linear Algebra I, *Level 5 module, Sep 2020-Dec 2020*
  Vectors and Matrices, *Level 4 module, Jan 2020-Apr 2020*
- **Demonstrator** at Queen Mary University of London 2019-2021
  Introduction to Machine Learning, *Level 6 module, Jan 2021-Mar 2021*
  Complex Networks, *Level 6 module, Jan 2020 - Mar 2020*
  Electricity and Atomic Physics, *Introductory module, Jan 2020-Mar 2020*
- **Graduate Teaching Associate** at King's College London 2021-2022
  Theory of Complex Networks, *Level 7 module, Sep 2022-Dec 2022*
  Linear Algebra and Geometry II, *Level 5 module, Jan 2022-Apr 2022*
  Calculus I, *Level 4 module, Sep 2021-Dec 2021*

Research Interest

- **Critical phenomena on networks, multilayer network and higher-order networks**
  - Percolation theory on networks and higher-order networks
  - Dynamics and critical phenomena on signed networks
  - Critical phenomena on epidemic, rumor spreading and opinion dynamic models
- **Inference and optimization of dynamics on networks**
  - Dynamic message passing algorithm on networks
  - Apply statistical physics and Bayesian statistics methods to analysis complex systems.
- **Networked data analysis**
  - Topological data analysis (TDA) methods
  - Network analysis methods

Skills

- **Programming skills:**
  - MATLAB, Python, Mathematica, Julia, C, LaTeX
- **Languages:**
  - English: professional proficiency
  - Chinese: native speaker

Scholarships and Grants

- 2024 Visiting Research Scholar, AccelNet/MultiNet Exchange program, $6600
- 2023 INI Network Support funding, Isaac Newton Institute for Mathematical Sciences, £5000 (with Silvia Rognone, Gabriele Di Bona, Annalisa Caligiuri)
- 2022 Small Grant, The Institute of Mathematics and its applications, £600
- 2022 Student Grants, Conference on Complex Systems 2022, Fee waiver (equivalently €340)
- 2022 Research Support Funding, QMUL, £1000
- 2021 Travel Grant Complex Systems & Networks Group, QMUL, £700
- 2020 Travel Grant Complex Systems & Networks Group, QMUL, £300

Awards and Achievements

- 2023 The article 'The dynamic nature of percolation on networks with triadic interaction' is featured in **Nature Communications Editors' Highlight**
- 2022 Outstanding Teaching Assistant (Nomination), King's College London
- 2021 Press coverage: "*Competition and Collaboration: Understanding Interacting Epidemics Can Unlock Better Disease Forecasts*", **Discover Magazine**
- 2021 Press coverage: "*Competition and collaboration: Understanding interacting epidemics can unlock better disease forecasts*", Los Alamos National Laboratory

Publications

[Sun+24] **Hanlin Sun**, Rajat Kumar Panda, Roberto Verdel, Alex Rodriguez, Marcello Dalmonte, and Ginestra Bianconi. "Network science: Ising states of matter". In: *Phys. Rev. E* 109 (5 May 2024), p. 054305.

[Mil+23] Ana P Millán, **Hanlin Sun**, Joaqùn J Torres, and Ginestra Bianconi. "Triadic percolation induces dynamical topological patterns in higher-order networks". In: *arXiv preprint arXiv:2311.14877* (2023).

[Pan+23] Rajat K Panda, Roberto Verdel, Alex Rodriguez, **Hanlin Sun**, Ginestra Bianconi, and Marcello Dalmonte. "Non-parametric learning critical behavior in Ising partition functions: PCA entropy and intrinsic dimension". In: *arXiv preprint arXiv:2308.13636* (2023).

[Sun+23] **Hanlin Sun**, Filippo Radicchi, Jürgen Kurths, and Ginestra Bianconi. "The dynamic nature of percolation on networks with triadic interactions". In: *Nature Communications* 14.1 (Mar. 2023), p. 1308. ISSN: 2041-1723.

[SKB22] **Hanlin Sun**, Ivan Kryven, and Ginestra Bianconi. "Critical time-dependent branching process modelling epidemic spreading with containment measures". In: *Journal of Physics A: Mathematical and Theoretical* 55.22 (May 2022), p. 224006.

[Bia+21] Ginestra Bianconi, **Hanlin Sun**, Giacomo Rapisardi, and Alex Arenas. "Message-passing approach to epidemic tracing and mitigation with apps". In: *Phys. Rev. Research* 3 (1 Feb. 2021), p. L012014.

[St-+21] Guillaume St-Onge, **Hanlin Sun**, Antoine Allard, Laurent Hébert-Dufresne, and Ginestra Bianconi. "Universal Nonlinear Infection Kernel from Heterogeneous Exposure on Higher-Order Networks". In: *Phys. Rev. Lett.* 127 (15 Oct. 2021), p. 158301.

[SB21] **Hanlin Sun** and Ginestra Bianconi. "Higher-order percolation processes on multiplex hypergraphs". In: *Phys. Rev. E* 104 (3 Sept. 2021), p. 034306.

[SSL21] **Hanlin Sun**, David Saad, and Andrey Y. Lokhov. "Competition, Collaboration, and Optimization in Multiple Interacting Spreading Processes". In: *Phys. Rev. X* 11 (1 Mar. 2021), p. 011048.

[SZB20] **Hanlin Sun**, Robert M. Ziff, and Ginestra Bianconi. "Renormalization group theory of percolation on pseudofractal simplicial and cell complexes". In: *Phys. Rev. E* 102 (1 July 2020), p. 012308.