Izaak Neri (25 May 1983)

Contact Information

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Current Position

Aug 2022 - Now **Senior Lecturer**
Department of Mathematics, King's College London

Sep 2018 - July 2022 **Lecturer**
Department of Mathematics, King's College London

Postdoctoral Experience

Sep 2016 - Aug 2018 **Postdoctoral Contract**
Max Planck Institute for the Physics of Complex Systems (Dresden)
Biological Physics Group of Prof. Dr. Frank Jülicher

Sep 2013 – Sep 2016 **ELBE PostDoctoral Fellowship**
Max Planck Institute for the Physics of Complex Systems
Max Planck Institute of Molecular Cell Biology and Genetics
Joint postdoc in the groups of Prof. Dr. Frank Jülicher and Prof. Dr. Marino Zerial

Sep 2010 – Sep 2013 **Postdoctoral contract on an ANR project**
University of Montpellier, Laboratoire Charles Coulomb (L2C)
Dr. Norbert Kern and Prof. Dr. Andrea Parmeggiani

Education

June 2020 **Fellow of the Higher Education Academy**
Recognition of attainment against the UK
Professional Standards Framework for teaching and learning support in higher education

Fev 2006- Jun 2010 **PhD. in Physics**
KU Leuven, Institute for Theoretical Physics
Prof. Dr. Désiré Bollé
Thesis: Statistical Mechanics of Spin Models on Graphs

Jul 2005 **Master of Science (Physics)**
Ghent University
Dr. Stefan Rombouts

Thesis: High Tc Superconductivity and the Hubbard Model

Publications (38)

8 Physical Review Letters
1 Physical Review X
3 Physical Review E
1 Physical review B
1 The European Physical Journal E
4 Journal of Statistical Mechanics
1 New Journal of Physics
2 Physical Biology
3 Journal of Physics A
1 Europhysics Letters
1 Proceedings in IEEE
4 arXiv
2 Physical Review Research
2 Book chapters
3 SciPost Physics
1 Theory of Probability and its Applications

Publication List

1. *Local sign stability and its implications for the spectra of sparse random graphs and stability of ecosystems*
   P. Valigi, I. Neri, C. Cammarota
   arXiv preprint, arXiv:2303.09897

2. *Martingales for Physicists*
   É. Roldán, I. Neri, R Chetrite, S. Gupta, S. Pigolotti, F. Jülicher, K. Sekimoto
   arxiv preprint, arXiv:2210.09983

3. *Phenomenological Boltzmann formula for currents*
   M. Polettini, I. Neri
   arXiv preprint, arXiv:2208.02888

4. *Extreme value statistics of edge currents in Markov jump processes and their use for entropy production estimation*
   I. Neri, M. Polettini
   SciPost Physics **14**, 131 (2023)
   https://scipost.org/10.21468/SciPostPhys.14.5.131

5. *Antagonistic interactions can stabilise fixed points in randomly coupled, linear dynamical systems with inhomogeneous growth rates*
   S. Cure, I. Neri
   SciPost Physics **14**, 093 (2023)
   https://scipost.org/SciPostPhys.14.5.093

6. *Optimal information usage in binary sequential hypothesis testing*
   M. Dörpinghaus, I. Neri, É. Roldán, F. Jülicher
   Theory of Probability & Its Applications **68**, 77-87 (2023)

https://epubs.siam.org/doi/10.1137/S0040585X97T991295

7. *Estimating entropy production rates with first-passage times*
   I. Neri
   J. Phys. A: Math. Theor. **55**, 304005 (2022)
   https://iopscience.iop.org/article/10.1088/1751-8121/ac736b/meta

8. *Universal tradeoff relation between speed, uncertainty, and dissipation in nonequilibrium stationary states*
   I. Neri
   SciPost Physics **12**, 139 (2022)
   https://www.scipost.org/SciPostPhys.12.4.139

9. *Instabilities of complex fluids with partially structured and partially random interactions*
   G. Carugno, I. Neri, P. Vivo
   Phys. Biology **19**, 056001 (2022)
   https://iopscience.iop.org/article/10.1088/1478-3975/ac55f9

10. *Dynamical systems on large networks with predator-prey interactions are stable and exhibit oscillations*
    A. M. Mambuca, C. Cammarota, I. Neri
    Physical Review E **105**, 014305 (2022)
    https://journals.aps.org/pre/abstract/10.1103/PhysRevE.105.014305

11. *Modelling the effect of ribosome mobility on the rate of protein synthesis*
    O. Dauloudet, I. Neri, J. C. Walter, J. Dorignac, F. Geniet, A. Parmeggiani
    Eur. Phys. J. E **44**, 1-15 (2022)
    https://link.springer.com/article/10.1140/epje/s10189-021-00019-8

12. *Localization and universality of eigenvectors in directed random graphs*
    F. L. Metz, I. Neri
    Phys. Rev. Lett. **126**, 040604 (2021)
    https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.126.040604

13. *Linear stability analysis of large dynamical systems on random directed graphs*
    I. Neri, F. L. Metz
    Phys. Rev. Research **2**, 033313 (2020)
    https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.2.033313

14. *Universal transient behavior in large dynamical systems on networks*
    W. Tarnowski, I. Neri, P. Vivo
    Phys. Rev. Research **2**, 023333 (2020)
    https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.2.023333

15. Second law of thermodynamics at stopping times
    I. Neri
    Phys. Rev. Lett. **124**, 040601 (2020)
    https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.124.040601

16. *Spectral theory of sparse non-Hermitian random matrices*
    F.L. Metz, I. Neri, T. Rogers
    J. Phys. A: Math. Theor. **52,** 434003 (2019)
    https://iopscience.iop.org/article/10.1088/1751-8121/ab1ce0

17. *Integral fluctuation relations for entropy production at stopping times*
    I. Neri, E. Roldán, S. Pigolotti, F. Jülicher
    J. Stat. Mech. (2019) 104006
    https://iopscience.iop.org/article/10.1088/1742-5468/ab40a0

18. *Extreme Reductions of Entropy in an Electronic Double Dot*
S. Singh, E. Roldán, I. Neri, I. M. Khaymovich, D. S. Golubev, V. F. Maisi, J. T. Peltonen, F. Jülicher, J. P. Pekola
Phys. Rev. B **99**, 115422 (2019)
https://journals.aps.org/prb/abstract/10.1103/PhysRevB.99.115422

19. *Martingale Theory for Housekeeping Heat*
R. Chétrite, S. Gupta, I. Neri, É. Roldán
EPL **124,** 60006 (2018)
https://iopscience.iop.org/article/10.1209/0295-5075/124/60006

20. *Testing Optimality of Sequential Decision-Making*
M. Dörpinghaus, I. Neri, É. Roldán, H. Meyr, F. Jülicher
arXiv: 1801.01574

21. *Generic Properties of Stochastic Entropy Production*
S. Pigolotti, I. Neri, E. Roldán, and F. Jülicher
Phys. Rev. Lett. **119**, 140604 (2017)
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.119.140604

22. *Statistics of Infima and Stopping Times of Entropy Production and Applications to Active Molecular Processes*
I. Neri, E. Roldán, and F. Jülicher
Phys. Rev. X **7**, 011019 (2017)
https://journals.aps.org/prx/abstract/10.1103/PhysRevX.7.011019

23. *An Information Theoretic Analysis of Sequential Decision-Making*
M. Dörpinghaus, É. Roldán, I. Neri, H. Meyr, F. Jülicher
IEEE International Symposium on Information Theory (ISIT), 3050-3054 (2017)
https://ieeexplore.ieee.org/document/8007090

24. *Eigenvalue Outliers of non-Hermitian Random Matrices with a Local Tree Structure*
I. Neri, and F. L. Metz
Phys. Rev. Lett. **117**, 224101 (2016)
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.117.224101

25. *Decision Making in the Arrow of Time*
E. Roldán, I. Neri, M. Dorpinghaus, H. Meyr, and F. Jülicher,
Phys. Rev. Lett. **115**, 250602 (2015)
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.115.250602

26. *Motor Protein Traffic Regulation by Supply-Demand Balance of Resources*
L. Ciandrini, I.Neri, J-C Walter, O. Dauloudet, and A. Parmeggiani
Phys. Biol. **11**, 056006 (2014)
Featured article, and in the 2014 highlights of Physical Biology
https://iopscience.iop.org/article/10.1088/1478-3975/11/5/056006

27. *On the Equivalence of Ising Models on 'Small-World' Networks and LDPC Codes on Channels with Memory*
I. Neri, and N. S. Skantzos
J. Phys. A **47**, 385002 (2014)
https://iopscience.iop.org/article/10.1088/1751-8113/47/38/385002

28. *Modelling Collective Cytoskeletal Transport and Intracellular Traffic*
A. Parmeggiani, I. Neri, and N. Kern
The Impact of Applications on Mathematics, 1-25 (2014)

29. *Exclusion Processes on Networks as Models for Cytoskeletal Transport*
I. Neri, N. Kern, and A. Parmeggiani
New Journal of Physics **15**, 085005 (2013)

https://iopscience.iop.org/article/10.1088/1367-2630/15/8/085005

30. *Modelling Cytoskeletal Traffic: an Interplay Between Passive Diffusion and Active Transport* *
I. Neri, N. Kern, and A. Parmeggiani
Phys. Rev. Lett. **110**, 098102 (2013)
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.110.098102

31. *On the Spectra of Large Sparse Graphs with Cycles*
D. Bollé, F. L. Metz, and I. Neri
Spectral Analysis, Differential Equations and Mathematical Physics:
A Festschrift in Honor of Fritz Gesztesy's 60th Birthday, pages 35-58 (2013)

32. *Spectra of Sparse non-Hermitian Random Matrices: an Analytical Solution*
I. Neri, and F. L. Metz
Phys. Rev. Lett. **109**, 030602 (2012)
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.109.030602

33. *Totally Asymmetric Simple Exclusion Process on Networks*
I. Neri, N. Kern, and A. Parmeggiani
Phys. Rev. Lett. **107**, 068702 (2011)
Appeared in Physics
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.107.068702

34. *Spectra of Regular Graphs with Loops*
F. L. Metz, I. Neri, and D. Bollé
Phys. Rev. E **84**, 055101 (2011)
https://journals.aps.org/pre/abstract/10.1103/PhysRevE.84.055101

35. *Localization Transition in Symmetric Random Matrices*
F. L. Metz, I. Neri, and D. Bollé
Phys. Rev. E **82**, 031135 (2010)
https://journals.aps.org/pre/abstract/10.1103/PhysRevE.82.031135

36. *The Phase Diagram of Lévy Spin Glasses*
I. Neri, F. L. Metz, and D. Bollé,
J. Stat. Mech. P01010 (2010)
https://iopscience.iop.org/article/10.1088/1742-5468/2010/01/P01010

37. *The Cavity Approach to Parallel Dynamics of Ising Spins on a Graph*
I. Neri, and D. Bollé
J. Stat. Mech. P08009 (2009)
https://iopscience.iop.org/article/10.1088/1742-5468/2009/08/P08009

38. *Gallager error-correcting codes for binary asymmetric channels*
I. Neri, N. S. Skantzos, D. Bollé
J. Stat. Mech. P08009 (2008)
https://iopscience.iop.org/article/10.1088/1742-5468/2008/10/P10018

Talks at International Conferences, Workshops, and Schools (22 --- 8 invited and 14 contributed)

1. *Nonequilibrium, thermodynamics bounds for first-passage problems*
Fluctuations and First-Passage Problems
17-18 April 2023 (Nordita, Stockholm, Sweden)

2. *Introduction to Martingales in Stochastic Thermodynamics* **(invited)**
   (Post) Modern Thermodynamics
   5-9 December 2022 (School for Phd Students, University of Luxembourg)

3. *Thermodynamic tradeoff relations involving first-passage times* **(invited)**
   Stochastic thermodynamics: recent developments
   14 June 2022 - 17 June 2022 (ICTS, online discussion meeting)
   https://www.youtube.com/watch?v=6E8pvgu8ICY

4. *Dissipation bounds the moments of first-passage times of dissipative currents*
   Interdisciplinary Challenges in Nonequilibrium Physics **(invited)**
   12 April 2021 - 16 April 2021 (Erwin Schroedinger International Institute for Mathematics and Physics, Vienna, Austria)
   https://www.youtube.com/watch?v=etZI4oHAcLo

5. *Eigenvalue outliers of non-hermitian random matrices with a local tree structure*
   Random Geometries and Multifractality in Condensed Matter and Statistical Mechanics
   24 June 2019 - 02 August 2019 (International Institute of Physics, Natal, Brazil)

6. *Stochastic thermodynamics with martingales* **(invited)**
   Workshop on martingales in Finance and Physics
   24 May 2019 (ICTP, Trieste, Italy)

7. *Martingale Theory for Universal Statistics of Stochastic Entropy Production* **(invited)**
   Stochastic Thermodynamics: Experiment and Theory
   10-14 September 2018 (Dresden, Germany)

8. *Eigenvalue Outliers of non-Hermitian Random Matrices with a Local Tree Structure* **(invited)**
   XIII Brunel-Beilefeld Workshop on Random Matrix Theory
   14 -16 December 2017 (Bielefeld, Germany)

9. *Stopping Times and Entropy Production of Nonequilibrium Steady States*
   Current and Future Trends in Stochastic Thermodynamics
   4 - 29 September 2017 (Nordita, Stockholm, Sweden)

10. *Universal Statistics of Infima and Stopping Times of Entropy Production*
    Climate Fluctuations and Non-Equilibrium Statistical Mechanics: an Interdisciplinary Dialogue
    17 - 21 July 2017 (Dresden, Germany)

11. *Universal Statistics of Entropy Production in Langevin Processes* **(invited)**
    Frontiers of Quantum and Mesoscopic Thermodynamics
    9 - 15 July 2017 (Prague, Czech Republic)

12. *Statistics of Infima and Stopping Times of Entropy Production and Applications to Active Molecular Processes*
    DPG Condensed Matter Section Spring Meeting
    6-10 March 2017 (Dresden, Germany)

13. *Eigenvalue Outliers of non-Hermitian Random Matrices with a Local Tree Structure*
    DPG Condensed Matter Section Spring Meeting
    6-10 March 2017 (Dresden, Germany)

14. *The Endosomal Network Regulates Signal Specificity and Robustness using Quanta of Phosphorylated Receptors*
    12th International Congress of Cell Biology
    21-25 July 2016 (Prague, Czech Republic)

15. First-passage fluctuation theorems
    DPG Condensed Matter Section Spring Meeting
    6-11 March 2016 (Regensburg, Germany)

16. Exclusion Processes on Networks **(invited)**
    VU TASEP conference
    11 June 2015 (Amsterdam, Netherlands)

17. Exclusion Processes on Networks
    DPG Condensed Matter Section Spring Meeting
    15-20 March 2015 (Berlin, Germany)

18. *Totally asymmetric simple exclusion process on networks*
    Journées de Physique Statistique
    24-25 January 2012 (Paris, France)

19. *Exclusion processes through networks*
    Traffic and Granular Flow
    25-27 September 2013 (Jülich, Germany)

20. *Modelling active transport and spatial-temporal organisation of motor proteins along the cytoskeleton*
    European conference on complex systems
    3-7 September 2012 (Brussels, Belgium)

21. *Transport on networks*
    Journées plénières, Physique de la cellule au tissue
    12-13 October 2011 (Lille, France)

22. *Steady states of spin models on graphs*
    Statistical Physics and Computer Science
    8-11 July 2010 (Beijing, China)

Posters at International Conferences (10)

1. *Liquid Hopfield Model*
   *B*iological Condensates: cellular mechanisms governed by phase transitions
   Workshops at the Isaac Newton Institute for Mathematical Sciences
   9 - 13 October 2023

2. *On a Test of Optimality for Decision Making*
   Frontiers of Quantum and Mesoscopic Thermodynamics
   9 - 15 July 2017 (Prague, Czech Republic)

3. *Infimum Law and First-Passage-Time Fluctuation Theorem for Entropy Production*
   Stochastic Physics in Biology, Gordon Research Conference
   8-13 May 2017 (Ventura, California)

4. *Infimum Law and First-Passage-Time Fluctuation Theorem for Entropy Production*
   Circle Meeting

9-10 May 2016 (Paris, France)

5. *Infimum Law and First-Passage-Time Fluctuation Theorem for Entropy Production*
   The Information, Probability and Inference in Systems Biology Conference
   18-20 May 2016 (Klosterneuburg, Austria)

6. *Exclusion processes on networks*
   International Summer School Fundamental Problems in Statistical Physics XIII
   June 16-29 2013 (Leuven, Belgium)

7. *Modelling active transport and spatial-temporal organisation of motor proteins along the cytoskeleton*
   13eme Journées de la Matière Condensée,
   27-31 August 2012 (Montpellier, France)

8. *Modelling active transport and spatial-temporal organization of motor proteins along the cytoskeleton*
   DPG Physics School on Forces and Flow in Biological Systems
   23-28 September 2012 (Bad-Honnef, Germany)

9. *Transport on networks*
   Workshop on Systems Biology, 2nd Baltic Autumn School
   5-9 September 2011 (Lübeck, Germany)

10. *Gallager codes on asymmetric channel*
    Annual Conference of the Middle European Cooperation in Statistical Physics
    14-16 April 2008 (Puchberg-Wels, Austria)

Invited Talks at Scientific Institutes

1. *Liquid Hopfield Model: Retrieval in Heterogeneous Mixtures*
   Biological Complexity Unit talk, Okinawa Institute for Science and Technology
   25 October 2023

2. *Spectral theory for networks and its applications to economy*
   Financial computing and analytics seminar, University College London
   23 November 2022

3. A first-passage perspective on trade-offs between dissipation, speed, and uncertainty
   Mathematical Physics Seminar Series, Imperial College London
   9 November 2022

4. *Leading eigenvalue and right eigenvector of infinitely large directed graphs,*
   Bielefeld-Melbourne random matrices seminars
   16 December 2020 (online seminar)

5. *Second law of thermodynamics at stopping times*,
   Complex Systems Seminar, Queen Mary University of London
   28 January 2020 (London, United Kingdom)

6. *Second law of thermodynamics at stopping times*,
   DAMTP Statistical Physics and Soft Matter Seminar, University of Cambridge
   29 Octobre 2019 (Cambridge, United Kingdom)

7. *Stochastic thermodynamics with martingales*
   Theoretical Condensed Matter Seminar, University of Nottingham
   14 June 2019 (Nottingham, United Kingdom)

8. *Eigenvalue Outliers of non-Hermitian Sparse Random Matrices*
   Disordered Systems Group, King's College London
   28 November 2017 (London, United Kingdom)

9. *Decision Making in the Arrow of Time*
   Laboratoire Charles Coulomb, Universite Montpellier 2
   14 December 2015 (Montpellier, France)

10. *Active Transport Processes along Networks*
    Institute for Theoretical Physics, KULeuven
    23 May 2012 (Leuven, Belgium)

Referral Activity

Phys. Rev. Lett.; Phys. Rev. X; Phys. Rev. E; J. Phys. A: Math. and Theor.; Europhys. Lett.; J. Stat. Mech.; Journal of Statistical Physics; Neural Computation; New Journal of Physics; Mathematical Biosciences; Physica A: Statistical Mechanics and its Applications; Chaos, Solitons & Fractals; The European Physical Journal Plus; ACS Nanoscience Au;

Member of thesis committees (PhD and Habilitation)

- Jean-Francois Derivaux, Universite Libre de Bruxelles (ULB), *Stochastic thermodynamics of transport systems and reactive systems: an extended local equilibrium approach*, Thesis for Doctor of Philosophy, 3rd of June 2020 (private defense) and 3rd of July 2020 (public defense)

- Dr. Jean-Charles Walter, University of Montpellier, *Modeling the formation and the positioning of intracellular macromolecular assemblies: application to bacterial DNA segregation*, Thesis for Habilitation, 24th of June 2020

- Mayank Schreshtha, Queen Mary University of London, *Fluctuations and uncertainty in stochastic models with persistent dynamics,* Thesis for Doctor of Philosophy, 11th of January 2021

- Akriti Jindal, Department of Mathematics, Indian Institute of Technology Ropar Rupnagar, Punjab, India, *Mathematical modelling of driven diffusive transport processes: Analyses and simulations*, Thesis for Doctor of Philosophy, August 2021

Supervision of PhD students

- **Dr. Andrea Mambuca**
  Thesis title: New results on the stability of large antagonistic systems on complex networks
  Viva defence date: 11 February 2021
  Online available here

- **Dr. Giorgio Carugno**
  Thesis project: Phase coexistence and instabilities of polydisperse mixtures through the prism of random matrix theory
  Viva defence date: 19 June 2023

- **Gyeong-Gyun Ha**
  Thesis project: Networks with higher order interactions

- **Adarsh Raghu**
  Thesis project: Thermodynamics bounds on first-passage times

Research visits

- Scientific visit at the Federal University of Rio Grande do Sul for two weeks (29th of July till 9th of August 2019). Host: Prof. Fernando Metz at the Physics Institute

Awards

- *Best poster award* in the Workshop on Systems Biology, 2nd Baltic Autumn School, 5-9 September 2011 (Lübeck, Germany). Poster title: *Transport on networks*
- Outstanding APS Referee (lifetime award, received in 2020)
- IOP Publishing Outstanding Reviewer 2022: Physical Biology
- Irwin Oppenheim Award 2024
  https://www.aps.org/programs/honors/prizes/oppenheim.cfm

Organization of Workshops

Random Matrix Theory and Networks, 7-11 June 2021, Max Planck Institute for the Physics of Complex Systems

Editorial work

Member of the Editorial board of Physical Review E (2023-2025) (https://journals.aps.org/pre/)

Volunteering work

Host for In2ScienceUK, 21-25 August 2023
https://in2scienceuk.org/

Teaching Activities

- *Theory of Complex Networks (*2018-2024, 6 years)
- Equilibrium Analysis of Complex Systems (2019-2021, 2 years)
- Research Methods and Advanced Topics in Complex Systems (2018-2021, 3 years)
- Project coordinator (2020-2024, 4 years)
- GTA Lead (2020-2022, 2 years)
- Exam Board Chair for MSC in Complex Systems Modelling (2021-2023, 2 years)
- Supervision of student projects: 16 MSc dissertations, 3 BSc dissertations, 5 UG Research Fellowships (KURF), 3 MSci dissertations

- PGT Tutor (2021-2023, 2 years)
- Member of the marketing team (2018-2021, 3 years)
- Computing Lead (2019-2023, 4 years)