Atanu Chatterjee

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Research Interests

Statistical Mechanics and Thermodynamics of Far–from–equilibrium Processes, Soft–Condensed Matter: Theory and Experiment, Complex Systems, Network Theory

Professional Experience

Postdoctoral Fellow — Department of Physics of Complex Systems, Weizmann Institute of Science, Israel (July 2020 – present)

Visiting Scientist — Department of Physics of Complex Systems, Weizmann Institute of Science, Israel (Dec 2019 – Jan 2020)

Visiting Scientist — Department of Energy, Politecnico di Torino, Italy (Oct 2017 – Jan 2018)

Education

Ph.D. in Physics, Worcester Polytechnic Institute (2020)

Thesis: Studies on the Emergence of Order in Out–of–equilibrium Systems

Advisor: Prof. Germano S. Iannacchione

Committee members: Prof. Mor Nitzan, Prof. Aravind K. Padmanabhan, and Prof. L. Ramdas Ram–Mohan

M.S. in Physics, Worcester Polytechnic Institute (2018)

M.S. in Applied Mathematics and Computational Science, Indian Institute of Technology Madras (2016)

Thesis: Studies on the Structure and Dynamics of Urban Bus Networks in Indian Cities (arXiv)

Advisor: Prof. Gitakrishnan Ramadurai

Committee members: Prof. Krishna Jagannathan (co-advisor), Prof. Karthik Raman, and Prof. Karthik Srinivasan

B.Eng. in Mechanical Engineering, Bhilai Institute of Technology (2013)

Publications

Chatterjee, A. and Iannacchione, G. (2020) Equation of State for a Far–from–equilibrium Thermodynamic System with Emergent Order, **Physical Review E** (submitted)

Chatterjee, A., Mears, N., Algarni, S., Charest, A. and Iannacchione, G.S., (2020) High-resolution Experimental Study and Numerical Modeling of Population Dynamics in a Bacteria Culture, **Proceedings of the Royal Society A** (arXiv) (under review)

Chatterjee, A. and Iannacchione, G. (2020) Local Equilibrium as the Principle of Equivalence in Thermodynamics?, **Entropy** (under review)

Chatterjee, A. and Iannacchione, G. (2020) Time and Thermodynamics – Extended Discussion on "Time & clocks: A thermodynamic approach", **Results in Physics** 17, 103165 (arXiv)

Chatterjee A., Mears, N., Yadati. Y., and Iannacchione, G. (2020) An Overview of Emergent Order in Driven Systems: From Kuramoto Oscillators to Rayleigh–Bénard Convection, **Entropy** 22 (5), 561 (arXiv)

Yadati, Y., Mears, N. and **Chatterjee, A.** (2019) Spatio–temporal Characterization of Thermal Fluctuations in a Non–turbulent Rayleigh–Bénard Convection at Steady State, **Physica A** 547, 123867 (arXiv)

Chatterjee A., Yadati, Y., Mears, N. and Iannacchione, G. (2019) Coexisting Ordered States, Local Equilibrium Points, and Broken Ergodicity in a Non–turbulent Rayleigh–Bénard Convection at Steady–state, **Scientific Reports** 9 (1), 10615 (arXiv)

Chatterjee A. and Iannacchione, G. (2019) The Many Faces of Far–from–equilibrium Thermodynamics: Deterministic Chaos, Randomness, or Emergent Order?, **MRS Bulletin** 44 (2), 130–133 (arXiv)

Chatterjee, A., Georgiev, G.Y. and Iannacchione, G.S. (2016) Aging and Efficiency in Living Systems: Complexity, Adaptation and Self-organization, **Mechanisms of Ageing and Development** 163, 2–7

Georgiev, G.Y., **Chatterjee, A.** and Iannacchione, G.S., (2016) Exponential Self-Organization and Moore's Law: Measures and Mechanisms, **Complexity**, Article ID 8170632

Chatterjee, A., Manohar, M. and Ramadurai, G. (2016) Statistical Analysis of Bus Networks in India, **PLoS One** 11 (12), e0168478

Chatterjee, A., Ramadurai, G. and Jagannathan, K. (2016) Contagion Processes on Urban Bus Networks in Indian Cities, **Complexity** 21 (S2), 451–458

Chatterjee, A. (2015) Thermodynamics of Action and Organization in a System, **Complexity** 21 (S1), 307–317

Chatterjee, A. (2015) Is the Statement of Murphy's Law Valid?, **Complexity** 21 (6), 374–380

Book Chapters

Georgiev, G.Y. and **Chatterjee, A.** (2016) The Road to a Measurable Quantitative Understanding of Self–organization and Evolution in **Evolution and Transitions in Complexity: The Science of Hierarchical Organization in Nature**, ed. Dr. Gerard Jagers op Akkerhuis, pp. 223–230 *Springer*

Chatterjee, A. (2015) Energy, Entropy and Complexity – *Thermodynamic and information-theoretic perspectives on ageing* in **Challenging Ageing – The anti–senescence effects of Hormesis, Environmental Enrichment and Information Exposure**, ed. Dr. Marios Kyriazis, *Bentham Science*

Invited Talks

Non–equilibrium Thermodynamics from First Principles: Experiments, Theory, and Simulations (Dec 2019): Department of Physics of Complex Systems, Weizmann Institute of Science, Israel

The Many Faces of Far–from–equilibrium Thermodynamics (Feb 2019): MRS Webinar: Bio-inspired "Far From Equilibrium" Materials

Non–equilibrium Thermodynamics from First Principles (Dec 2017): ECCO–GBI Seminar Series, Vrije Universiteit Brussel, Belgium (YouTube)

Complexity, Organization and Self–organization (May 2014): Second International Cyprus Symposium, University of Nicosia, Cyprus (Slides)

Physical Foundations of Self–organizing Systems (Dec 2013): ECCO–GBI Seminar Series, Vrije Universiteit Brussel, Belgium (YouTube)

Conference Presentations

Chatterjee A. and Iannacchione, G. (2020) Equation of State for a Far–from–equilibrium Thermodynamic System with Emergent Scales at Steady–state, **American Physical Society (March meeting)**, USA

Chatterjee A. (2019) Pattern Formation in Out–of–equilibrium Driven Systems, **New England Complex Fluids Workshop**, USA

Yadati, Y., **Chatterjee, A.** and Iannacchione, G. (2018) Spatio–temporal Characterization of Thermal Fluctuations in a Non–turbulent Rayleigh-Bénard Convection at Steady–state, **Discrete Simulations in Fluid Dynamics**, USA

Yadati, Y., McGrath, S., **Chatterjee, A.**, Georgiev, G. and Iannacchione, G. (2018) A Detailed Thermodynamic Study of Rayleigh–Bénard Cells, **American Physical Society (March meeting)**, USA

Chatterjee A. and Iannacchione, G. (2018) Non–equilibrium Thermodynamics from First Principles, **American Physical Society (March meeting)**, USA

Chatterjee, A., Georgiev, G.Y., Vu, Thanh and Iannacchione, G.S. (2017) A Model for Entropy Production, Entropy Decrease, and Action Minimization in Self–organization, **American Physical Society (March meeting)**, USA

Chatterjee, A., Georgiev, G.Y. and Iannacchione, G.S. (2017) Variational Approaches to Quantify Self–organization in Complex Systems, **American Physical Society (March meeting)**, USA

Georgiev, G.Y., **Chatterjee, A.**, Vu, T. and Iannacchione, G.S. (2016) Variational Approaches to Self–Organization, **Conference on Complex Systems**, Netherlands

Georgiev, G.Y., **Chatterjee, A.**, Vu, T. and Iannacchione, G.S. (2016) Bénard cells as a Model for Entropy Production, Entropy Decrease and Action Minimization in Self–Organization, **Conference on Complex Systems**, Netherlands

Chatterjee, A., Georgiev, G.Y., Vu, T. and Iannacchione, G.S. (2016) On the Physical Foundations of Self–organization: Energy, Entropy and Interaction, **Conference on Complex Systems**, Netherlands

Chatterjee, A., Ramadurai, G. and Jagannathan, K. (2015) Structure and Dynamics of Urban Bus Networks, **ITRA Workshop**, India

Chatterjee, A. and Ramadurai, G. (2015) On the Dynamic Stability of Complex Networks, **Dynamical Systems: Theory and Applications**, Poland

Chatterjee, A., Ramadurai, G. and Jagannathan, K. (2015) Contagion Processes on Urban Bus Networks in Indian Cities, **Dynamical Systems: Theory and Applications**, Poland

Chatterjee, A. and Ramadurai, G. (2014) Statistical Analysis of the Chennai Bus Network and its Sub–networks, **European Conference on Complex Systems**, Italy

Chatterjee, A. and Ramadurai, G. (2014) Bus–networks in India: random or scale–free?, **Dynamics Days Asia-Pacific**, India

Chatterjee, A. and Ramadurai, G. (2014) Scaling Laws in Chennai Bus Network, **International Conference on Complex Systems and Applications**, France

Chatterjee, A. and Georgiev, G. (2014) Physical Foundations of Self–organizing Systems, **American Physical Society (March meeting)**, USA

Chatterjee, A., Yadav, A. and Agrawal, A. (2012) Role of Modeling and Simulation in Engineering Sciences, **International Conference on Innovation and Research in Technology for Sustainable Development**, India

Chatterjee, A. (2012) Game–theoretic formulation of complex systems, **International Conference on Game Theory and Management**, Russia

Awards and Honors

Accepted for the Boulder School in Condensed Matter and Materials Physics, 2020/21 (declined)

Travel Award, Center of Mathematical Sciences and Applications, Harvard University, 2019 ($ 500)

Sigma Pi Sigma Honor Society for Physics Students, WPI chapter, 2019 (induction)

Sigma Xi Scientific Research Society, WPI chapter, 2017 (induction)

Inaugural Ph.D. Global Research Experience Award, 2017 ($ 10,000)

Graduate Student Travel Award, 2016, 2017, 2018 ($ 500 each)

Outstanding Graduate Research Assistant, Department of Physics, 2016

Department of Physics funding to attend NECSI – MIT Summer School, Cambridge, USA, 2016 ($ 3,000)

Graduate Teaching Assistantship, WPI, 2016 – 2020

IIT Madras International Travel Grant, 2015 (INR 150,000 $\sim$ $ 2,500)

ITRA – MIT Media Labs Asia Graduate Research Fellowship, IIT Madras, 2013 – 2016

Department of Science and Technology, Government of India: International Travel Grant, 2012 (INR 300,000 $\sim$ $ 4,000)

Professional Activities

Reviewer: Complexity, AIP Advances, Meccanica, Transportation, Physica A, Journal of Physics: Complexity, Entropy, Fluids

Member: American Physical Society (2013 – present), New England Complex Fluids (2018 – present)

Student Advising and Mentoring

Yash Yadati, WPI (May 2017 – May 2020): Experimental and Computational Studies in Far-from-equilibrium Systems

Nicholas Mears, WPI (May 2018 – May 2019): Stochastic Simulations in Far–from–equilibrium Thermal Systems (Thesis) | **Current**: Multi-disciplinary Systems Engineer, The MITRE Corporation

Emily Whittles, WPI (Oct 2017 – May 2018): Complexity at the Interface of Technology and Biology

Hope Clairmont, WPI (Oct 2017 – Dec 2018): Far–from–equilibrium Fluctuations in Soft–matter

Noor Kawmi, Assumption College (May 2017 – Jun 2017): Complexity at the Interface of Technology and Biology

Jocelyne Tamayo Vargas, Assumption College (May 2017 – Jun 2017): Stochastic Modelling and Agent–based Simulations

Sean McGrath, Assumption College (May 2017 – Jun 2017): Pattern Formation in Non-turbulent Rayleigh–Bénard Conection

Thanh Vu, Assumption College (May 2016 – Jun 2017): Stochastic Modelling and Agent–based Simulations

Yaofeng Wang, WPI (Sep 2016 – Dec 2016): Stochastic Modelling and Agent–based Simulations

Computational Skills

Programming Languages: Python, MATLAB, R, C/C++, HTML

Software & Tools: Gephi, Cytoscape, LaTeX, Inkscape, Photoshop, ImageJ, OriginPro

✔ Last updated: September 15, 2020