Filipe C. Thewes

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Institute for Dynamics and Self-Organization

Göttingen, Germany

References: Prof. Dr. Peter Sollich , Prof. Dr. Matthias Krüger, Dr. David Zwicker

Research Interests

Theory of complex systems in statistical physics

Keywords: complex and disordered systems, random matrix theory, multicomponent mixtures, field theories in statistical physics

I am interested in the physics of complex systems in and out of equilibrium. In particular, I'm fascinated by the collective behaviour – both steady-state properties and spatial dynamics - arising from disordered interactions between many degrees of freedom. I approach these problems using theoretical tools such as statistical field theories and random matrices, and test predictions using computer simulations and other numerical methods.

Previous Experience

2024-current: Postdoctoral researcher at Max-Planck Institute for Dynamics and Self-Organization, - David Zwicker group, Göttingen, Germany:

Research: (i) Incorporated the effects of complex and/or disordered environments in the field-theoretical description of droplet formation in biological contexts. (ii) Uncovered the possibility of emergent length-scales in the spatial arrangement of heterogeneous elastic networks. (iii) Investigated tracer dynamics in chemically active environments.

2020-2024: Ph.D. candidate at University of Göttingen, Peter Sollich group, Göttingen, Germany:

Research: (i) Extended the theory of instabilities in multicomponent mixtures with disordered interactions using tools from random matrix theory (ii) developed a general theory for the kinetics of multicomponent mixtures to include crowding effects and glassy dynamics within a Gaussian approximation; (iii) explored design procedures in mixtures with random interactions to achieve a desirable set of thermodynamic properties.

Communication: (i) presented my work through talks and posters in multiple conferences; (ii) publication of scientific papers.

Teaching and supervision: (i) preparation of solutions to weekly exercise sheets; (ii) weekly tutorials; (iii) supervision of three bachelor student theses.

2017-2020: Bachelor and Masters candidate at Federal University of Rio Grande do Sul, Porto Alegre, Brazil:

Research: implementation of a newly developed Monte Carlo cluster algorithm for simulations of hardcore lattice gases on the honeycomb, triangular and square lattices.

Teaching: weekly tutorials on computational methods in physics.

Education

Ph.D. in statistical physics of multicomponent mixtures.

Georg-August Universität Göttingen, September 2024
Final Grade: Summa Cum Laude (with greatest honour)

Ph.D. Thesis Title: *Thermodynamics and Kinetics of Multi-component mixtures.*

Supervisor: Prof. Dr. Peter Sollich
Co-supervisor: Prof. Dr. Matthias Krüger

M.Sc. in statistical physics.

Universidade Federal do Rio Grande do Sul, March 2020
Final Average Grade: A (90.0-100.0%)

M.Sc. Dissertation Title: *Phase Transitions in Hardcore Lattice Gases on the Honeycomb Lattice.*

Supervisors: Prof. Dr. H.C.M. Fernandes, Prof. Dr. Jefferson Arenzon

B.Sc. in Physics

Universidade Federal do Rio Grande do Sul, February 2018
B.Sc. Thesis Grade: A (90.0-100.0%).

B.Sc. Thesis Title: *Hardcore Lattice Gases: Triangular and Honeycomb Lattices.*

Supervisor: Prof. Dr. H.C.M. Fernandes

Publications

[5] Thewes, F. C., & Sollich, P. Ensemble inequivalence in the design of mixtures with super-Gibbs phase coexistence. In Physical Review E (Vol. 112, Issue 2)

[4] Thewes, F. C., Krüger, M., & Sollich, P (2024). Mobility-induced kinetic effects in multicomponent mixtures. In Europhysics Letters (Vol. 147, Issue 2)

[3] Akaberian, M., Thewes, F. C., Sollich, P., & Krüger, M. (2023). Nonequilibrium mixture dynamics: A model for mobilities and its consequences. In The Journal of Chemical Physics (Vol. 158, Issue 21)

[2] Thewes, F. C., Krüger, M., & Sollich, P. (2023). Composition Dependent Instabilities in Mixtures with Many Components. In Physical Review Letters (Vol. 131, Issue 5).

[1] Thewes, F. C., & Fernandes, H. C. M. (2020). Phase transitions in hard-core lattice gases on the honeycomb lattice. In Physical Review E (Vol. 101, Issue 6)

In Preparation

[1] Thewes, F. C., Qiang, Y., Paulin, O. & Zwicker, D. Phase separation with non-local interactions.

Scholarships and Grants

[7] University of Luxembourg RISE Fellowship (2500€, 2025)

[6] Newton Gateway to Mathematics travel grant (£340, 2024)

[5] StatPhys28 travel grant (40000 JPY, 2023)

[4] Max-Planck IMPRS travel grant (750€, 2023)

[3] CNPq Ph.D. scholarship (4 years, 2020) – offer declined due to Ph.D. offer from Prof. Peter Sollich in Göttingen

[2] CNPq Masters scholarship (2 years, 2018-2020)

[1] CAPES undergraduate scholarship (2 years, 2016-2018)

Conferences and Workshops

Contributed talks: StatPhys28 (Tokyo, Japan); 8th Edwards Symposium (Cambridge, UK); Spring meeting of the German Physics Society (Berlin & Dresden & Regensburg, Germany).

Workshops: Random Matrices, Random Graphs and Statistical Physics for Machine Learning and Inference (Trieste, Italy); Biological condensates: cellular mechanisms governed by phase transitions, (Cambridge, UK); Complexity of Water and Other Liquids (Araranguá, Brazil).

Technical Skills

Statistical Physics:

Multicomponent field theories, random matrix theory, phase separation, path integrals, Monte Carlo simulations, macroscopic fluctuation theory.

Computational Skills:

Programming Languages: C, Python, Bash, Awk, Mathematica

Specialized Libraries: OpenMP, GSL

Others: Gnuplot, Latex, Overleaf.

Language Skills:

English: full working proficiency.

Portuguese: native. German: B2.

Peer Review

- Soft Matter
- ACS Omega

Teaching Experience

- Supervision of three bachelor thesis and critical reading of one masters dissertation
- Tutor: Classical Field Theory, 2022-2023
- Tutor: Thermodynamics and Statistical Mechanics, 2021-2022
- Tutor: Computational Methods in Physics, 2015.
- Volunteer teacher for an introductory course to informatics: INEVAM orphanage in Tres Coroas, Brazil. 2010/2.