

Julia Steinberg

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Background

Harvard Physics PhD with a track record of research in quantum condensed matter and computational neuroscience, including work at the intersection of statistical physics, machine learning, and neural computation. Most recently, three years as a quantitative researcher in high-frequency trading, designing and running large-scale experiments to evaluate forecast models and trading strategies, and contributing to the deployment of these models into live trading systems.

Technical Skills

Programming: Python (NumPy, SciPy), C++, MATLAB

Research areas: Computational neuroscience, Statistical physics of learning and disordered systems, Quantum condensed matter

Education

Ph.D., Physics · Harvard University 2020

- Thesis: *Universal Aspects of Quantum-Critical Dynamics In and Out of Equilibrium* · Advisor: Subir Sachdev

A.M., Physics · Harvard University 2019

M.S., Physics · University of Pennsylvania 2014

B.A., Physics · University of Pennsylvania 2014

- Magna cum laude with distinction in physics · Minor in mathematics

Experience

Quantitative Researcher · Radix Trading LLC, New York, NY Mar 2023 – Mar 2026

- Researcher on the core quant team designing and running large-scale, multi-stage experiments for forecast model development and strategy optimization
- Responsible for deploying models into live production systems; contributed to shared C++ production codebase with commits to core trading binaries.
- Research on forecasting/latency tradeoffs and development of latency models for research simulation.

Associate Research Scholar / CPBF Fellow · Center for the Physics of Biological Function, Princeton University, Princeton, NJ Aug 2020 – Mar 2023

- Independent postdoctoral researcher at the CUNY/Princeton Center for the Physics of Biological Function
- Developed a theoretical model of associative memory for structured knowledge (episodic memories, cognitive maps, semantic structures) — work bearing directly on how neural networks represent, store, and retrieve relational and hierarchical information.
- Periodic visiting researcher, Simons Center for Systems Biology, Institute for Advanced Study (2020–2022).
- Invited speaker: APS March Meeting, Les Houches School of Physics, van Vreeswijk Theoretical Neuroscience Seminar Series, Context and Episodic Memory Symposium, Flatiron Institute NeuroAI group, and others.

Postdoctoral Fellow, Swartz Program in Theoretical Neuroscience · Jun 2020 – Aug 2020
Center for Brain Science, Harvard University, Cambridge, MA

- Developed theories of learning and long-term memory using minimal neural network models, using tools and techniques from physics of disordered systems and statistical learning theory, combining analytical theory and numerical simulation.

Graduate Researcher · Department of Physics, Harvard University, Aug 2014 – May 2020
Cambridge, MA

- Studied dynamical properties of strongly correlated quantum systems: relaxation and thermalization rates, transport coefficients, and onset of many-body quantum chaos, using tools from statistical physics, quantum field theory, and gauge-gravity duality .
- Swartz Program in Theoretical Neuroscience: extended graduate research into neural computation and learning theory.

Teaching Fellow · Harvard University, Cambridge, MA Sep 2019 – May 2020

- Physics 232 (Advanced Electromagnetism, grad), AM 226 (Neural Computation, grad), Physics 15A (Intro Mechanics, undergrad), AP 284 (Statistical Mechanics, grad).
- Derek Bok Certificate of Distinction in Teaching, Fall 2019.

Undergraduate Researcher · University of Pennsylvania & University of Michigan 2011 – 2014

- Rappe Group (Penn Chemistry): Electronic structure calculations using DFT to propose materials with novel band topology; collaboration with Kane and Mele (Penn Physics) on topological insulators as part of the Penn LRSM topological insulator seed.
- NSF Physics REU, University of Michigan (Summer 2013): Edge states in lattice models of 2D/3D topological semimetals.
- A.T. Johnson Group, Penn Physics (Summer 2011): Fabrication of graphene transistors using CVD and mechanical exfoliation.

Peer-Reviewed Publications and Review Articles

Neural Networks, Learning Theory & Statistical Physics of Machine Learning

10. J. Steinberg, U. Adomaityt, A. Fachech, P. Mergny, D. Barbier, and R. Monasson. Replica

method for computational problems with randomness: principles and illustrations. *Journal of Statistical Mechanics: Theory and Experiment* 2024 (10), 104002.

9. J. Steinberg. Performance Capacity of a Complex Neural Network. *Physics* 16, 108 (2023).
8. J. Steinberg and H. Sompolinsky. Associative memory of structured knowledge. *Scientific Reports* 12, 21808 (2022). bioRxiv: 2022.02.22.481380.
7. J. Steinberg, M. Advani, and H. Sompolinsky. New role for circuit expansion for learning in neural networks. *Physical Review E* 103, 022404 (2021). **[Editors' Suggestion]** arXiv:2008.08653.

Quantum Many-Body Physics & Holography

6. J. Steinberg and B. Swingle. Thermalization and many-body chaos in QED3. *Physical Review D* 99, 076007 (2019). arXiv:1901.04984.
5. J. Steinberg, N.P. Armitage, F.H.L. Essler, and S. Sachdev. NMR relaxation in Ising spin chains. *Physical Review B* 99, 035156 (2019). **[Editors' Suggestion]** arXiv:1810.11466.
4. A. Eberlein, V. Kasper, S. Sachdev, and J. Steinberg. Quantum quench of the Sachdev-Ye-Kitaev Model. *Physical Review B* 96, 205123 (2017). arXiv:1706.07803.
3. A. Lucas and J. Steinberg. Charge diffusion and the butterfly effect in striped holographic matter. *Journal of High Energy Physics* 10, 143 (2016). arXiv:1608.03286.
2. S. Chatterjee, Y. Qi, S. Sachdev, and J. Steinberg. Superconductivity from a confinement transition out of a FL* metal. *Physical Review B* 94, 024502 (2016). **[Editors' Suggestion]** arXiv:1603.03041.
1. J. Steinberg, S.M. Young, S. Zaheer, C.L. Kane, E.J. Mele, and A.M. Rappe. Bulk Dirac Points in Distorted Spinels. *Physical Review Letters* 112, 036403 (2014). arXiv:1309.5967.

Selected Invited Talks & Seminars

Mar 2023	Neural Networks: Insights from Physics to Models of Learning and Memory · <i>Physics Colloquium, The College of New Jersey</i>
Feb 2023	Associative memory of structured knowledge · <i>Towards a Theory of Artificial and Biological Neural Networks Workshop, Les Houches School of Physics</i>
Oct 2022	Associative memory of structured knowledge · <i>van Vreeswijk Theoretical Neuroscience Seminar Series</i>
May 2022	Associative memory of structured knowledge · <i>Context and Episodic Memory Symposium</i>
Mar 2022	Associative memory of structured knowledge · <i>APS March Meeting, Neural Systems III Focus Session</i>
Mar 2022	Associative memory of structured knowledge · <i>NeuroAI Theory & Manifolds Reading Group, Flatiron Institute</i>
Sep 2021	Associative memory of structured knowledge · <i>Saxe Group, Gatsby Computational Neuroscience Unit / Sainsbury Wellcome Centre, UCL</i>
Feb 2021	Associative memory of structured knowledge · <i>Kavli Institute for BioNano Science and Technology, Harvard</i>

Jan 2021	Associative memory of structured knowledge · <i>Simons Center for Systems Biology, Institute for Advanced Study</i>
Jan 2020	A new role for sparse expansion in neural networks · <i>Theory and Modeling of Living Systems, Emory University</i>
Jan 2020	A new role for sparse expansion in neural networks · <i>Santa Fe Institute</i>
Sep 2019	A new role for sparse expansion in neural networks · <i>Neuroscience Institute Seminar, NYU Langone Medical Center</i>

Summer Schools & Workshops

Jul 2022	Statistical Physics of Machine Learning · <i>Les Houches School of Physics</i> (Krzakala & Zdeborova, organizers)
Jul 2019	Theoretical Biophysics · <i>Boulder School 2019, University of Colorado Boulder</i>
Dec 2016	34th Jerusalem Winter School: New Horizons in Quantum Matter · <i>Hebrew University of Jerusalem</i>

Honors, Awards & Fellowships

2020–2023	CPBF Fellowship, CUNY/Princeton Center for the Physics of Biological Function
2015–2020	NSF Graduate Research Fellowship, National Science Foundation
2014–2015	E.M. Purcell Fellowship, Harvard University Physics
2014	James Mills Peirce Fellowship, Harvard Graduate School of Arts & Sciences
2014	Rose Award for Outstanding Undergraduate Research, University of Pennsylvania
Summer 2013	NSF-REU University of Michigan Physics Summer Research Fellowship
2013	Roy and Diana Vagelos Science Challenge Award, University of Pennsylvania
2012–2014	University Scholar, University of Pennsylvania
Summer 2012	NSF-REU Penn LRSM Summer Research Fellowship
Summer 2011	Penn Undergraduate Research Mentorship Program

Service & Outreach

- Referee: *Physics Letters A*, *Physical Review B*, *Physical Review Letters*, *Physical Review X*
- Physics of Life Summer School Committee — Center for the Physics of Biological Function, Princeton/CUNY (2022)
- Mentor — Physics Undergraduate Mentoring Program, Princeton University (2021–2022)
- Mentor — UWIP Mentorship Families Program, Princeton Women in Physics (2020)
- GSMI Mentor — Científico Latino, supporting underrepresented graduate school applicants (2020–2021)
- Mentor — WiSTEM Mentorship Program, Harvard College Women’s Center (2016–2020)
- Adopt-a-Physicist — American Physical Society, connecting with high school physics students (Fall 2017)