WEISHUN ZHONG

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Research interests: The intersection of theoretical neuroscience, AI, and statistical physics.

EMPLOYMENT

Institute for Advanced Study, Princeton, NJ — *Sep.2023-present*
Postdoctoral Member, Simons Center for Systems Biology, School of Natural Sciences
Advisor: Misha Tsodyks

EDUCATION

Massachusetts Institute of Technology, Cambridge, MA — *Sep.2017-Jun.2023*
Ph.D. Department of Physics
Advisors: Haim Sompolinsky (Harvard) and Mehran Kardar (MIT)
Thesis: Non-equilibrium Physics: from Spin Glasses to Machine and Neural Learning

University of Chicago, Chicago, IL — *Sep.2016-Jun.2017*
M.S., *Physical Sciences Division*, Physics — GPA: 3.93/4.0
Advisors: Arvind Murugan and David J. Schwab

University of Michigan — *Sep.2013-May.2016*
B.S., *highest distinction*, Physics and Mathematics — GPA: 3.97/4.0
Advisor: James T. Liu

PUBLICATIONS

1. "Emergence of Heterogeneous Weight-distributions in Functionally Similar Neurons", **Weishun Zhong** and Haim Sompolinsky, *in preparation.*
2. "Random Tree Model of Meaningful Memory", **Weishun Zhong**, Tankut Can, Atonis Georgiou, Ilya Shnayderman, Mikhail Katkov, Misha Tsodyks, *arXiv: 2412.01806; Physical Review Letters 134.23 (2025): 237402.*
3. "Hierarchical Working Memory and a new Magic Number ", **Weishun Zhong**, Mikhail Katkov, Misha Tsodyks, *arXiv: 2408.07637, under review.*
4. "Advantage of Quantum Neural Networks as Quantum Information Decoders ", **Weishun Zhong**, Oles Shtanko, Ramis Movassagh, *arXiv:2401.06300, under review.*
5. "Many-body Localized Hidden Generative Models", **Weishun Zhong**, Xun Gao, Susanne Yelin, Khadijeh Najafi, *arXiv: 2207.02346; Physical Review Research 6.4 (2024): 043041.*
6. "A Theory of Weight Distribution-constrained Learning", **Weishun Zhong**, Ben Sorscher, Daniel D Lee, Haim Sompolinsky, *arXiv:2206.08933; NeurIPS 2022*
7. "Quantifying Many-body Learning far from Equilibrium with Representation Learning", **Weishun Zhong***, Jacob M Gold*, Sarah Marzen, Jeremy L England, Nicole Yunger Halpern, *arXiv: 2001.03623; Scientific reports 11.1 (2021): 1-11*
8. "Learning about Learning by Many-body Systems", **Weishun Zhong***, Jacob M Gold*, Sarah Marzen, Jeremy L England, Nicole Yunger Halpern, *arXiv:2004.03604; ICML workshop ML Interpretability for Scientific Discovery (2020)*
9. "Non-equilibrium Statistical Mechanics of Continuous Attractors", **Weishun Zhong**, Zhiyue Lu, David J. Schwab, and Arvind Murugan, *arXiv: 1809.11167; Neural computation (2020) 32 (6)*

10. "A Closer Look at Disentangling in β-VAE", Harshvardhan Sikka*, **Weishun Zhong***, Jun Yin, Cengiz Pehlevan, *arXiv:1912.05127; 53rd Asilomar Conference on Signals, Systems, and Computers (2019)*
11. "Associative Pattern Recognition in Macro-Molecular Self-Assembly", **Weishun Zhong**, David J. Schwab, and Arvind Murugan, *arXiv: 1701.01769; J Stat Phys (2017) 167: 806*
12. "A Holographic c-Theorem for Schrödinger Spacetimes", James T. Liu and **Weishun Zhong**, *arXiv: 1510.06975; JHEP 1512 (2015) 179*

AWARDS & HONORS

- Cosyne Travel Award, *Committee of Computational and Systems Neuroscience* 2025
- Simons Membership & Eric and Wendy Schmidt Membership, *Simons Foundation* 2024-2025
- C.V. Starr Membership, *C.V. Starr Foundation* 2023
- NeurIPS Scholar Award, *Neural Information Processing Systems Foundation* 2022
- First-year Graduate Fellowship, *Massachusetts Institute of Technology* 2017
- Physical Sciences Division Tuition Award, *University of Chicago* 2016
- George Eugene Uhlenbeck Award, *University of Michigan* 2016
- Division of Particle and Fields Travel Award, *American Physical Society* 2016
- Division of Gravitational Physics Travel Award, *American Physical Society* 2016
- Otto Graf Scholarship, *University of Michigan* 2015
- James B. Angell Scholar, *University of Michigan* 2015

GRANTS

- NSF ACCESS Discover Grant (PI), "Using Large Language Models to Understand the Cognitive Origin of Summarization and Abstraction", *National Science Foundation, USA*
  $100,000 equivalent of computational resources. 2024-2026

TEACHING EXPERIENCE

- Teaching assistant for MIT (8.592) Statistical Physics in Biology 2021
- Teaching assistant for MIT (8.03) Physics III: Vibrations and Waves 2020
- Teaching assistant for MIT (8.02) Physics II: Electricity and Magnetism 2019
- Teaching assistant for MIT (8.01) Physics I: Classical Mechanics 2018

SELECTED INVITED TALKS

- "Random Tree Model for Meaningful Memory", Mar.2025
  Theoretical Biophysics Seminar, Princeton University
- "Advantage of Quantum Neural Networks as Quantum Information Decoders", Jan.2025
  Quantum Meets Mathematics Seminar, Ohio State University and Harvard University (online)
- "Learning in Feed-forward Neural Networks under Biological Constraints", Apr.2023
  Physics of Living Systems Seminar, Massachusetts Institute of Technology
- "Many-body Localized Hidden Generative Models", Jan.2023
  Center for Computational Quantum Physics Seminar, Flatiron Institute
- "A Theory of Learning with Constrained Weight-distribution", Dec.2022
  Simons Center for Systems Biology Seminar, Institute for Advanced Study

SELECTED BROADER IMPACTS

- "How We Remember Stories". 2025
  Featured at APS *Physics* magazine.
- "IAS Scholars Discover a Universal Law of Memory ". 2025
  Featured at Institute for Advanced Study News & Ideas.
- "Investigating Natural and Artificial Intelligence: Q&A with Weishun Zhong". 2023
  Featured at Institute for Advanced Study News & Ideas.