Ziming Liu

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WORK EXPERIENCE

Tsinghua University, China **Aug 2026 (tentative)**
- (Incoming) Assistant Professor at College of AI

Stanford University, USA **Sep 2025 – Feb 2026**
- Postdoc on Neuroscience + AI

EDUCATION

Massachusetts Institute of Technology, USA **Feb 2021 – August 2025**
- Ph.D. in Physics, working on Physics + AI

Microsoft Research Asia, China **Sep 2020 – Feb 2021**
- Research assistant in Machine Learning Theory Group

Peking University, China **Sep 2016 – June 2020**
- B.S. in physics, undergraduate research in high-energy physics

RESEARCH

Citations: 8147 h-index: 22 i10-index: 31 (as of Feb 18, 2026)

I am generally interested in AI + Science. Recently, I am devoted to understanding "physics of AI" and building an AI agent to automate the research process.

AWARDS

- Google PhD fellowship, 2024-2026
- MIT graduate fellowship, 2021-2022
- Outstanding Graduate of Peking University, 2020

MEDIA COVERAGE

Kolmogorov-Arnold Networks
- Scientific American, "An Alternative to Conventional Neural Networks Could Help Reveal What AI Is Doing behind the Scenes"
- Quanta Magazine, "Novel Architecture Makes Neural Networks More Understandable"
- Github: most starred repo in May 2024 (15.6k stars)

Poisson Flow Generative Models
- Quanta Magazine, "The Physical Process That Powers a New Type of Generative AI"
- MIT News, "From physics to generative AI: An AI model for advanced pattern generation"

Understanding grokking
- Quanta Magazine, "How Do Machines 'Grok' Data?"

Learning symmetries
- New Scientist, "AI solves complex physics problems by looking for signs of symmetry"
- Nature Review Physics, "How machines could teach physicists new scientific concepts".

SERVICE

Reviewing
- Journals: Nature, Physical Review, Entropy, IEEE, Chaos
- Conferences: NeurIPS, ICLR, ICML

Organizing/Teaching
- AI4Science workshop at NeurIPS 2021, ICML 2022, and NeurIPS 2023.
- AI journal club at Physics of Living Systems (PLS) at MIT
- AI + Science journal club at the College of Computing at MIT
- (Tentative) Co-design and co-teach the "Physics of Deep Learning" course at MIT

Funding proposal
- Co-write NSF grant PHY-2019786 (IAIFI)

Mentoring undergraduate students
- Subhash Kantamneni (PhD @ Berkeley), Isaac Liao (PhD @ CMU), Ziqian Zhong (PhD @ CMU), Mingyang Deng (PhD @ MIT), Quan Nguyen (PhD @ Stanford), Vedang Lad (Researcher @ Stanford), Eric Gan (Researcher @ OpenAI), Xinghong Fu, Riya, Tyagi, Xiaoman Ding, Carl Guo, Anish Mudide, Chloe Loughridge, Tara Kheirkhah, Mateja Vukelic, Rohan Mehta, Leo Yao.

SELECTED PAPERS

- **KAN: Kolmogorov-Arnold Networks. ICLR (Oral), 2025**
  Ziming Liu, Yixuan Wang, Sachin Vaidya, Fabian Ruehle, James Halverson, Marin Soljačić, Thomas Y. Hou, Max Tegmark
- **Machine learning conservation laws from trajectories, Physical Review Letter (Editor's Suggestion), 2021**
  Ziming Liu, Max Tegmark
- **Towards understanding grokking: An effective theory of representation learning, NeurIPS (Oral), 2022**
  Ziming Liu, Ouail Kitouni, Niklas S Nolte, Eric Michaud, Max Tegmark, Mike Williams
- **Poisson flow generative models, NeurIPS, 2022**
  Yilun Xu*, Ziming Liu*, Max Tegmark, Tommi Jaakkola
- **The quantization model of neural scaling, NeurIPS 2022**
  Eric Michaud, Ziming Liu, Girit Uzay, Max Tegmark
- **Machine Learning Hidden Symmetries, Physical Review Letter (Editor's Suggestion), 2022**
  Ziming Liu, Max Tegmark
- **Seeing is Believing: Brain-Inspired Modular Training for Mechanistic Interpretability, Entropy, 2023**
  Ziming Liu, Eric Gan, Max Tegmark

SELECTED TALKS

- **"Unification of AI and Science: Towards AI that gets physics (fast)"**, Singapore AI tea talk (2025)
- **"KAN: Kolmogorov-Arnold Networks"**, Imagination In Action (2024), IAIFI summer workshop (2024)
- **"From Physical Processes to Generative Models"**, GenAI in STEM (2024)
- **"Discovering Physical Laws from Data"**, CMU ML seminar (2023)

FULL PUBLICATION LIST

In summary, the three pillars of my research are:
- **Science of AI**: Understanding AI using science, e.g., demystifying grokking [NeurIPS 2022, ICLR 2023]; neural

scaling laws [NeurIPS 2022]; compositionality of generative models [NeurIPS 2023]; how do AI models do math [NeurIPS 2023], physics [Entropy 2024, Preprint 2025]; analogy between learning and physics [PRE 2025, Preprint 2025, NeurIPS 2024].

- **Science for AI**: Advancing AI using science, e.g., Kolmogorov-Arnold networks [ICLR 2024A, ICLR 2024B, Preprint 2024], Physics-inspired generative models [NeurIPS 2022, ICML 2023, preprint 2024], neuroscience-inspired modular networks [Entropy 2023, NeurIPS 2023], physics-inspired sampler/eigen-solver/optimizer [Preprint 2019, CMS 2024, PRE 2021, Preprint 2025].
- **AI for Science**: Advancing science using AI. Methods include discovering conservation laws [PRL 2021, PRE 2021, PRE 2022, PRE 2023, PRE 2024], hidden symmetries [PRL 2022], physics-augmented learning [PAL], and high-precision SciML [Entropy 2023]. Applications include math [ICLR 2024A], condensed matter physics [ICLR 2024A], periodic orbits [NeurIPS 2024], chemistry [PRE 2023], fluid mechanics [PRE 2023], photonics [SPIE], neuroscience [NeurIPS 2023], high-energy physics [PRR 2021], and program synthesis [Entropy 2023]. Review papers: AI in science [Nature 2023] and in physics [Review 2025].

Science of AI: Using scientific approaches to understand artificial intelligence

- **Physics of Skill Learning, arXiv: 2501.12391, 2025**
  Ziming Liu, Yizhou Liu, Eric J. Michaud, Jeff Gore, Max Tegmark
- **Fokker-Planck to Callan-Symanzik: evolution of weight matrices under training, arXiv: 2501.09659, 2025**
  Bu Wei, Kol Uri, Ziming Liu
- **How do Transformers Model Physics? Investigating the Simple Harmonic Oscillator, Entropy 2024**
  Subhash Kantamneni, Ziming Liu, Max Tegmark
- **On the expressiveness and spectral bias of KANs, ICLR 2025**
  Yixuan Wang, Jonathan Siegel, Ziming Liu, Thomas Hou
- **A Resource Model For Neural Scaling Law, ICLR 2024 BGPT workshop**
  Jinyeop Song*, Ziming Liu*, Max Tegmark, Jeff Gore
- **Do Diffusion Models Learn Semantically Meaningful and Efficient Representations?, NeurIPS 2023**
  Catherine Liang, Ziming Liu, Michell Ostrow, Ila R. Fiete
- **GenEFT: Understanding Statics and Dynamics of Model Generalization via Effective Theory, PRE 2025**
  David Baek, Ziming Liu, Max Tegmark
- **Grokking as Compression: A Nonlinear Complexity Perspective, NeurIPS 2023 UniReps workshop**
  Ziming Liu, Ziqian Zhong, Max Tegmark
- **A Neural Scaling Law from Lottery Ticket Ensembling, arXiv: 2310.02258, 2023**
  Ziming Liu, Max Tegmark
- **The Clock and the Pizza: Two Stories in Mechanistic Explanation of Neural Networks, NeurIPS (Oral), 2023**
  Ziqian Zhong*, Ziming Liu*, Max Tegmark, Jacob Andreas
- **The quantization model of neural scaling, NeurIPS, 2023**
  Eric J Michaud, Ziming Liu, Uzay Girit, Max Tegmark
- **Towards understanding grokking: An effective theory of representation learning, NeurIPS (Oral), 2022**
  Ziming Liu, Ouail Kitouni, Niklas S Nolte, Eric Michaud, Max Tegmark, Mike Williams
- **Omnigrok: Grokking beyond algorithmic data, ICLR (Spotlight), 2022**
  Ziming Liu, Eric J Michaud, Max Tegmark

Science for AI: Improving AI models (efficiency and interpretability) with science

- **Harmonic Loss Trains Interpretable AI Models**
  David Baek*, Ziming Liu*, Riya Tyagi, Max Tegmark

- **FOCUS: First Order Concentrated Updating Scheme, arXiv: 2501.12391, 2025**
  Yizhou Liu, Ziming Liu, Jeff Gore
- **KAN: Kolmogorov-Arnold Networks, ICLR 2025 (oral)**
  Ziming Liu, Yixuan Wang, Sachin Vaidya, Fabian Ruehle, James Halverson, Marin Soljačić, Thomas Y. Hou, Max Tegmark
- **Restart Sampling for Improving Generative Processes, NeurIPS, 2023**
  Yilun Xu, Mingyang Deng, Xiang Cheng, Yonglong Tian, Ziming Liu, Tommi Jaakkola
- **Seeing is Believing: Brain-Inspired Modular Training for Mechanistic Interpretability, Entropy**
  Ziming Liu, Eric Gan, Max Tegmark
- **GenPhys: From Physical Processes to Generative Models, arXiv: 2304.02637, 2023**
  Ziming Liu, Di Luo, Yilun Xu, Tommi Jaakkola, Max Tegmark
- **Pfgm++: Unlocking the potential of physics-inspired generative models, ICML, 2023**
  Yilun Xu, Ziming Liu, Yonglong Tian, Shangyuan Tong, Max Tegmark, Tommi Jaakkola
- **Poisson flow generative models, NeurIPS, 2022**
  Yilun Xu*, Ziming Liu*, Max Tegmark, Tommi Jaakkola
- **Second order ensemble Langevin method for sampling and inverse problems, arXiv: 2208.04506, 2022**
  Ziming Liu, Andrew M Stuart, Yixuan Wang
- **Schrödinger principal-component analysis: On the duality between principal-component analysis and the Schrödinger equation, Physical Review E, 2021**
  Ziming Liu, Sitian Qian, Yixuan Wang, Yuxuan Yan, Tianyi Yang
- **Quantum-inspired hamiltonian monte carlo for bayesian sampling, arXiv: 1912.01937, 2019**
  Ziming Liu, Zheng Zhang

AI for Science: Accelerating scientific discoveries with AI

- **Do Two Scientists Agree?**
  Xinghong Fu, Ziming Liu, Max Tegmark
- **Interpretable Machine Learning in Physics: A Review**
  Sebastian Johann Wetzel, Seungwoong Ha, Iten Raban, Klopotek Miriam, Ziming Liu
- **KAN 2.0: Kolmogorov-Arnold Networks Meet Science. arXiv: 2408.10205**
  Ziming Liu, Pingchuan Ma, Yixuan Wang, Wojciech Matusik, Max Tegmark
- **Growing Brains: Co-emergence of Anatomical and Functional Modularity in Recurrent Neural Networks, NeurIPS 2023 UniReps workshop**
  Ziming Liu, Mikail Khona, Ila R. Fiete, Max Tegmark
- **Scientific discovery in the age of artificial intelligence, Nature, 2023**
  Hanchen Wang, Tianfan Fu, Yuanqi Du, Wenhao Gao, Kexin Huang, Ziming Liu, …
- **Discovering New Interpretable Conservation Laws as Sparse Invariants, Physical Review E**
  Ziming Liu, Patrick Obin Sturm, Saketh Bharadwaj, Sam Silva, Max Tegmark
- **Precision machine learning, Entropy, 2023**
  Eric J Michaud, Ziming Liu, Max Tegmark
- **Machine learning conservation laws from differential equations, Physical Review E, 2022**
  Ziming Liu, Varun Madhavan, Max Tegmark
- **Machine learning hidden symmetries, Physical Review Letter (Editor's suggestion), 2022**
  Ziming Liu, Max Tegmark
- **Machine-learning nonconservative dynamics for new-physics detection, Physical Review E, 2021**
  Ziming Liu, Bohan Wang, Qi Meng, Wei Chen, Max Tegmark, Tie-Yan Liu
- **Physics-augmented learning: A new paradigm beyond physics-informed learning, NeurIPS 2021 AI4Science workshop, 2021**
  Ziming Liu, Yunyue Chen, Yuanqi Du, Max Tegmark

- **Applications of deep learning to relativistic hydrodynamics, Physical Review Research, 2021**
  Hengfeng Huang, Bowen Xiao, Ziming Liu, Zeming Wu, Yadong Mu, Huichao Song
- **Machine learning conservation laws from trajectories, Physical Review Letter (Editor's Suggestion), 2021**
  Ziming Liu, Max Tegmark
- **Robustness of principal component analysis of harmonic flow in heavy ion collisions, Physical Review C, 2020**
  Ziming Liu, Arabinda Behera, Huichao Song, Jiangyong Jia
- **Principal component analysis of collective flow in relativistic heavy-ion collisions, European Physical Journal C, 2019**
  Ziming Liu, Wenbin Zhao, Huichao Song
