Siavash Golkar

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Employment History

2023 – present   🔖 **Research Scientist** Polymathic-AI, New York University.
- Leading the development of next generation foundation models for scientific analysis
- Focus on long-context Transformers as well as mechanistic interpretability.

2020 – present   🔖 **Machine Learning Consultant** AirHop Communications.
- Reinforcement Learning applied to real-world systems
- Time-series Forecasting of infrastructure load

2019 – 2023   🔖 **Associate Reseach Scientist** Flatiron Institute, Simons Foundation.
- Neuroscience inspired ML research
- Applied interdisciplinary ML in biology and astrophysics

2016 – 2019   🔖 **Postdoctorol Fellow** Center for Cosmology & Particle Physics, New York University.
- Research in continual learning and transfer in ML
- Applied machine learning in quantum systems

2015 – 2016   🔖 **Postdoctorol Fellow** Department of Applied Mathematics and Theoretical Physics, University of Cambridge.
- Theoretical research in topological and effective field theory.

Education

2009 – 2015   🔖 **Ph.D. Theoretical Physics, University of Chicago** .
High Energy Physics, String Theory, Effective Field Theory.
Thesis: *Geometry, topology and anomalies in condensed matter Effective Field Theories.*

Skills

Coding   🔖 Expert in ML related programming and packages

🔖 NVIDIA Certified in Data and Model Parallelism: How to Build, Train, and Deploy Large Neural Networks.

Teams   🔖 Experienced in leading ML teams from inception to deployment

Languages.   🔖 English(fluent), Farsi (fluent), French (advanced), Japanese (intermediate)

Misc.   🔖 Academic research, teaching, training, consultation, LaTeX typesetting and publishing.

Miscellaneous

🔖 Author of over 20 publications in leading journals and conferences

🔖 Area Chair and Top Reviewer for NeurIPS machine learning conference

🔖 Recipient of the James Arthur Fellowship award (2016 – 2019)

🔖 Co-organizer of the Machine Learning Seminar Series at Flatiron Institute (2020 – 2023)

🔖 Visual artist experienced in both traditional and AI-assisted art (siavashgolkarart.com)

List of Publications

Conference Proceedings

1. **S. Golkar**, D. Lipshutz, T. Tesileanu, and D. B. Chklovskii, "An online algorithm for contrastive principal component analysis," in *ICASSP 2023-2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, IEEE, 2023, pp. 1–5.

2. A. Genkin, D. Lipshutz, **S. Golkar**, T. Tesileanu, and D. Chklovskii, "Biological learning of irreducible representations of commuting transformations," in *Advances in Neural Information Processing Systems*, 2022.

3. **S. Golkar**, T. Tesileanu, Y. Bahroun, A. Sengupta, and D. Chklovskii, "Constrained predictive coding as a biologically plausible model of the cortical hierarchy," in *Advances in Neural Information Processing Systems*, vol. 35, 2022, pp. 14 155–14 169.

4. P. Karimi, **S. Golkar**, J. Friedrich, and D. Chklovskii, "Learning a biologically plausible linear controller for nonlinear systems," in *APS March Meeting Abstracts*, vol. 2022, 2022, N00–269.

5. J. Friedrich, **S. Golkar**, S. Farashahi, A. Genkin, A. Sengupta, and D. Chklovskii, "Neural optimal feedback control with local learning rules," in *Advances in Neural Information Processing Systems*, vol. 34, 2021, pp. 16 358–16 370.

6. **S. Golkar**, D. Lipshutz, Y. Bahroun, A. Sengupta, and D. Chklovskii, "A simple normative network approximates local non-hebbian learning in the cortex," in *Advances in neural information processing systems*, vol. 33, 2020, pp. 7283–7295.

7. **S. Golkar**, D. Lipshutz, Y. Bahroun, A. M. Sengupta, and D. B. Chklovskii, "A biologically plausible neural network for local supervision in cortical microcircuits," in *NeurIPS 2020 Workshop 'Beyond backpropagation'*, 2020.

8. D. Lipshutz, C. Windolf, **S. Golkar**, and D. B. Chklovskii, "A biologically plausible neural network for slow feature analysis," in *Advances in Neural Information Processing Systems 33*, 2020.

9. K. Cranmer, **S. Golkar**, and D. Pappadopulo, "Inferring the quantum density matrix with machine learning," in *ICML 2019 Workshop on Theoretical Physics for Deep Learning*, 2019.

10. **S. Golkar**, "Emergent structures and lifetime structure evolution in artificial neural networks," in *NeurIPS 2019 Workshop on Real Neurons & Hidden Units*, 2019.

11. **S. Golkar** and K. Cho, "Task-driven data verification via gradient descent," in *KDD 2019 Workshop on Data Collection, Curation, and Labeling for Mining and Learning (DCCL)*, 2019.

12. **S. Golkar**, M. Kagan, and K. Cho, "Continual learning via neural pruning," in *NeurIPS 2019 Workshop on Real Neurons & Hidden Units*, 2019.

13. **S. Golkar** and K. Cranmer, "Backdrop: Stochastic backpropagation," in *ICML 2019 Workshop on Theoretical Physics for Deep Learning*, 2018.

Journal Articles

1. **S. Golkar**, M. Pettee, M. Eickenberg, *et al.*, "Xval: A continuous number encoding for large language models," *arXiv preprint arXiv:2310.02989*, 2023.

2. F. Lanusse, L. Parker, **S. Golkar**, *et al.*, "Astroclip: Cross-modal pre-training for astronomical foundation models," *arXiv preprint arXiv:2310.03024*, 2023.

3. D. Lipshutz, Y. Bahroun, **S. Golkar**, A. M. Sengupta, and D. B. Chklovskii, "A normative framework for deriving neural networks with multi-compartmental neurons and non-hebbian plasticity," *arXiv preprint arXiv:2302.10051*, 2023.

4. M. McCabe, B. R.-S. Blancard, L. H. Parker, *et al.*, "Multiple physics pretraining for physical surrogate models," *arXiv preprint arXiv:2310.02994*, 2023.

5.   C. Pedersen, T. Tesileanu, T. Wu, *et al.*, "Reusability report: Prostate cancer stratification with diverse biologically-informed neural architectures," *arXiv preprint arXiv:2309.16645*, 2023.

6.   T. Teşileanu, **S. Golkar**, S. Nasiri, A. M. Sengupta, and D. B. Chklovskii, "Neural circuits for dynamics-based segmentation of time series," *Neural Computation*, vol. 34, no. 4, pp. 891–938, 2022.

7.   D. Lipshutz, Y. Bahroun, **S. Golkar**, A. M. Sengupta, and D. B. Chklovskii, "A biologically plausible neural network for multichannel canonical correlation analysis," *Neural Computation*, vol. 33, no. 9, pp. 2309–2352, 2021.

8.   D. X. Nguyen, **S. Golkar**, M. M. Roberts, and D. T. Son, "Particle-hole symmetry and composite fermions in fractional quantum hall states," *Physical Review B*, vol. 97, no. 19, p. 195 314, 2018.

9.   **S. Golkar**, D. X. Nguyen, and D. T. Son, "Spectral sum rules and magneto-roton as emergent graviton in fractional quantum hall effect," *Journal of High Energy Physics*, vol. 2016, no. 1, pp. 1–15, 2016.

10.   **S. Golkar**, D. X. Nguyen, M. M. Roberts, and D. T. Son, "Higher-spin theory of the magnetorotons," *Physical review letters*, vol. 117, no. 21, p. 216 403, 2016.

11.   **S. Golkar** and S. Sethi, "Global anomalies and effective field theory," *Journal of High Energy Physics*, vol. 2016, no. 5, pp. 1–20, 2016.

12.   **S. Golkar** and M. M. Roberts, "Viscosities and shift in a chiral superfluid: A holographic study," *arXiv preprint arXiv:1502.07690*, 2015.

13.   **S. Golkar**, M. M. Roberts, and D. T. Son, "The euler current and relativistic parity odd transport," *Journal of High Energy Physics*, vol. 2015, no. 4, pp. 1–22, 2015.

14.   **S. Golkar** and D. T. Son, "(non)-renormalization of the chiral vortical effect coefficient," *Journal of High Energy Physics*, vol. 2015, no. 2, p. 169, 2015.

15.   M. Geracie, **S. Golkar**, and M. M. Roberts, "Hall viscosity, spin density, and torsion," *arXiv preprint arXiv:1410.2574*, 2014.

16.   **S. Golkar**, M. M. Roberts, and D. T. Son, "Effective field theory of relativistic quantum hall systems," *Journal of High Energy Physics*, vol. 2014, no. 12, pp. 1–10, 2014.

17.   **S. Golkar** and D. T. Son, "Operator product expansion and conservation laws in non-relativistic conformal field theories," *Journal of High Energy Physics*, vol. 2014, no. 12, pp. 1–11, 2014.

18.   **S. Golkar**, "Conformal windows of sp (2n) and so (n) gauge theories from topological excitations on $R^3 \times S^1$," *Journal of High Energy Physics*, vol. 2009, no. 11, p. 076, 2009.

Invited Talks

Jan 2024	**Serialization for Heterogenous Data Challenges**
	AI-driven discovery in physics and astrophysics
	Center for Data-Driven Discovery, Kavli Institute, The University of Tokyo, Japan
Feb 2024	**Prospects of LLMs in Fundamental Physics**
	Large Language Models in Physics Symposium (LIPS)
	DESY, Hamburg, Germany
Mar 2024	**(Plenary seminar) Towards Foundation Models for Science**
	International Workshop on Advanced Computing and Analysis Techniques in Physics Research
	Stonybrook, New York, United States