Shanshan Qin

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Research and Academic Positions

2025/05 –   **Associate Professor**, *Institute of Natural Sciences*, Shanghai Jiao Tong University, Shanghai, China.

2024–2025   **Associate Research Scientist**, *Center for Computational Neuroscience*, Flatiron Institute, New York, NY.
Faculty mentor: Dmitri "Mitya" B. Chklovskii.
- Developing normative frameworks to understand neural computation.
- Algorithmic understanding of single neuron computation through the lens of predictive information processing.

2019–2023   **Postdoctoral Fellow**, *School of Engineering and Applied Sciences*, Harvard University, Cambridge, MA.
Faculty mentor: Cengiz Pehlevan.
- Designed novel biologically plausible learning algorithms.
- Unraveled causes and dynamics of drifting neural representations.
- Characterized ensemble-level odor coding properties in C. *elegans*, olfactory information processing in fly larvae (in collaboration with Aravinthan Samuel lab).

2012–2019   **Research Assistant**, *Center for Quantitative Biology*, Peking University, Beijing, China.
Faculty mentors: Chao Tang and Yuhai Tu.
- Established a theoretical framework for nonlinear compressed sensing problems and applied it to the peripheral olfactory systems.
- Early warning signals in nonlinear complex systems.
- Elucidated the nonlinear dynamics of the intrinsic apoptosis signaling pathway.

2016   **Graduate Visiting Scholar**, *Hernan Garcia Lab, Department of Molecular and Cell Biology*, The University of California, Berkeley, CA.
Designed and performed experimental study on the temperature-dependent speed of embryogenesis in *Drosophila Melanogaster*.

2009-2011   **Undergraduate Research Assistant**, *Jinping Liu Lab, School of Physics*, Central China Normal University, China.
Successfully prepared the hematite nanorods array, and studied its electrochemical properties as an anode material and reversible lithium storage.

Education

2012–2019   **Ph.D. in Condensed Matter Physics**, *Peking University*, China.
Thesis: Theoretical study on odor coding in peripheral olfactory systems.
Advisors: Chao Tang and Yuhai Tu.

2008–2012   **B.S. in Physics**, *Central China Normal University*, China.
Advisor: Jinping Liu.

Publications

See also Google Scholar or ORCID. ∗ Equal contribution; † Corresponding author.

Selected Publications

1. **S. Qin**, S. Farashahi, D. Lipshutz, A. M. Sengupta, D. B. Chklovskii, and C. Pehlevan. "Coordinated drift of receptive fields in Hebbian/anti-Hebbian network models during noisy representation learning". *Nature Neuroscience* 26 (2), 339-349 (2023).

2. P. Masset*, **S. Qin***, J. Zavatone-Veth*. "Drifting Neuronal Representations: Bug or Feature?", *Biological Cybernetics*, 116, 253–266 (2022).

3. Y. Liu, Q. Li, C. Tang, **S. Qin**†, and Y. Tu†. "Short-Term Plasticity Regulates Both Divisive Normalization and Adaptive Responses in Drosophila Olfactory System". *Frontiers in Computational Neuroscience* 15, 730431 (2021).

4. **S. Qin**, N. Mudur, C. Pehlevan,"Contrastive Similarity Matching for Supervised Learning", *Neural Computation* 33(5), 1300 (2021).

5. **S. Qin***, Q. Li*, C. Tang and Y. Tu, "Optimal compressed sensing strategies for an array of nonlinear olfactory receptor neurons with and without spontaneous activity", *Proc. Natl. Acad. Sci. U.S.A.*, 116, 20286 (2019).

6. **S. Qin** and C. Tang, "Early-warning signals of critical transition: Effect of extrinsic noise", *Physical Review E*, 97, 032406 (2018).

Additional Published Research

7. Y. Cai†,J. Kanyo*, R. Wilson*, S. Bathla*, P. L. Cardozo*, L. Tong*, **S. Qin***, L. A. Fuentes*, I. Pinheiro-de-Sousa*, T. Huynh*, L. Sun*, M. S. Mansuri, Z. Tian, H. Gan, A. Braker, H. K. Trinh, A. Huttner, T. T. Lam, E. Petsalaki, K. J. Brennand, Angus C. Nairn, J. Grutzendler†. Subcellular proteomics and iPSC modeling uncover reversible mechanisms of axonal pathology in Alzheimer's disease. (2024) *Nature Aging, in press*. *bioRxiv* doi: https://doi.org/10.1101/2022.09.30.510408.

8. B. Liu, **S. Qin**, V. Murthy, and Y. Tu, "One nose but two nostrils: Learning to align with sparse connections between two olfactory cortices". *PRX Life* 2(4),043016 (2024).

9. A. Lin, **S. Qin**, H. Casademunt, M. Wu, W. Hung, G. Cain, N. Z. Tan, R. Valenzuela, L Lesanpezeshki, C. Pehlevan, V. Venkatachalam, M. Zhen, A. D. T. Samuel, "Functional imaging and quantification of multi-neuronal olfactory responses in C. elegans". *Science Advances* 9(9),eade1249 (2023).

10. Y. Yuan, H. Ren, Y. Li, **S. Qin**, X. Yang, and C. Tang. "Cell-to-cell variability in inducible Caspase9-mediated cell death". *Cell Death & Disease* 13(1) (2022)

11. K. Vogt, D. Zimmerman, M. Schlichting, L. A. H. Nunez, **S. Qin**, K. Malacon, M. Rosbash, C. Pehlevan, A. Cardona, A. D. T. Samuel, "Internal state configures olfactory behavior and early sensory processing in Drosophila larva", *Science advances* 7(1), eabd6900 (2021).

12. Z. Gao, H. Sun, **S. Qin**, X. Yang and C. Tang, "A systematic study of the determinants of protein abundance memory in cell lineage", *Science Bulletin*, 63, 1051 (2018).

13. Z. Gao, S. Chen, **S. Qin** and C. Tang, "Network Motifs Capable of Decoding Transcription Factor Dynamics", *Scientific Reports*, 8, 3594 (2018).

14. L. Cao, D. Yang, W. Wu, X. Zeng, B. Jing, M. Li, **S. Qin**, C. Tang, Y. Tu, D. Luo, "Odor-evoked inhibition of olfactory sensory neurons drives olfactory perception in Drosophila", *Nature Communications*, 8, 1357 (2017).

15. Y. Song, **S. Qin**, Y. Zhang, W. Gao, and J. Liu, "Large-Scale Porous Hematite Nanorod Arrays: Direct Growth on Titanium Foil and Reversible Lithium Storage", *the Journal of Physical Chemistry C*, 114, 21158 (2010).

Preprint and manuscript under review

16. L.Cao, W. Wu, C. Xia, **S. Qin**, C. Chang, D. Yang, B. Jing, K. Leng, C. Tang, Y. Tu, G. Si, D. Luo , "Bidirectional coding enables temperature compensation in olfactory sensation", 2024

17. S. Zhao, H. Shen, **S. Qin**, S. Jiang, X. Tang, M. Lee, X. Zhang, J. Lee, J. Chen and J. Liu, "Realigning representational drift in mouse visual cortex by flexible brain-machine interfaces ", 2024

▬▬▬ Talks and Seminars

2024 June	Flatiron Institute Center for Computational Neuroscience Retreat Seminar. *Temporal filters of neurons as low-rank forecasters*, Mohonk, NY.
2024 June	Xiaojing Wang lab meeting at NYU. *A Normative approach to neural computation - from biologically plausible learning to representational drift*, New York, NY. (**invited**)
2023 July	2023 International Workshop on "Soft Matter and Biophysics Theories". *Brain in motion: causes and dynamics of drifting neural representations*, Xi'an, China (virtual, **invited**).
2023 June	Chinese Computational and Cognitive Neuroscience Conference. *Brain in motion: causes and dynamics of drifting neural representations*, Beijing, China (virtual, **invited**).
2023 Apr	Brown University. *Brain in motion: causes and dynamics of drifting neural representations*, Providence, RI (**invited**).
2023 Mar	Neurolunch Seminar, Center for Brain Science, Harvard University. *Brain in motion: causes and dynamics of drifting neural representations*, Cambridge, MA.
2023 Mar	The Scripps Research Institute, *Brain in motion: causes and dynamics of drifting neural representations*, La Jolla, CA (**invited**).
2023 Mar	The University of Texas Southwestern Medical Center, *Brain in motion: causes and dynamics of drifting neural representations* (virtual,**invited**).
2023 Feb	Institute of Neuroscience, Chinese Academy of Sciences, *Brain in motion: causes and dynamics of drifting neural representations* (virtual,**invited**).
2023 Jan	VIB-KU Leuven Center for Brain Sciences and Disease, *Dynamics and structure of drifting neural representations* (virtual,**invited**).
2023 Jan	Washington University School of Medicine in St. Louis, *Neural representation: from optimal olfactory code to representational drift during learning*, St. Louis, MO (**invited**).
2022 Dec	Cold Spring Harbor Laboratory faculty candidate seminar, *Neural representation: from optimal olfactory code to representational drift during learning* (virtual, **invited**).
2022 Oct	Guangdong-Hong Kong-Macao Young Scientists' Forum on Interdisciplinary Studies. *Uncovering the dynamics and structure of drifting neural representations* (virtual, **invited**).
2022 Mar	Harvard Applied Mathematics Food For Thought Hour, *Unveiling the dynamics and structure of drifting neural representations*, Cambridge, MA.
2022 Mar	APS March Meeting, *Unveiling the dynamics and structure of drifting neural representations*, Chicago, IL.
2021 Oct	Gordon Research Conference on stochastic physics in biology, *Dynamics of drifting receptive fields during noisy representation Learning*, Ventura, CA.
2021 Oct	Rutgers Center for Quantitative Biology Seminar, Unveiling the dynamics and structure of drifting neural representations (virtual, **invited**).

2021 June	MIT/Harvard Computational and Theoretical Neuroscience Journal Club, *Representational drift: experiments, models, and implications* (virtual, **invited**).
2020 Oct	The online Neuromatch Conference 2.0, *Dynamics of drifting receptive fields during noisy representation learning* (virtual).
2020 Mar	The online Neuromatch Conference 1.0, *Biologically plausible supervised learning* (virtual).
2019 Dec	Sensing Chemical Spaces, Princeton, Princeton University, *Optimal compressed sensing strategies for an array of nonlinear olfactory receptor neurons*, Princeton, NJ.
2019 Mar	American Physical Society March Meeting, *Statistical properties of the optimal sensitivity matrix for compressed sensing with nonlinear sensors*, Boston, MA.
2018 Nov	Postdoctoral fellow interview symposium of the Center for the Physics of Biological Functions,*Statistical properties of the optimal sensitivity matrix for compressed sensing with nonlinear sensors.* Princeton, NJ. (**invited**).
2018 July	Quantitative Biology: Neuroscience and Artificial Intelligence – Where Do We Meet, *An information-theoretic model for odor coding*, Beijing, China.

Poster presentations

2024 Sept	From Neuroscience to Artificial Intelligent Systems. *The neuron as a low rank forecaster*, Cold Spring Harbor, NY.
2024 Aug	Computational and Cognitive Neuroscience conference. *Representational sparsity determines representational stability in sensory cortices*, Boston, MA.
2024 Feb	Computational and System Neuroscience conference. *Representational sparsity determines representational stability in sensory cortices*, Lisbon, Portugal.
2023 Sept	Harvard SEAS postdoc appreciation week poster session. *Coordinated drift of receptive fields during noisy representation learning*, Allston, MA.
2023 Sept	Harvard Program in Neuroscience orientation poster session. *Coordinated drift of receptive fields during noisy representation learning*, Boston, MA.
2023 Apr	Harvard Mind Brain Behavior poster showcase. *Coordinated drift of receptive fields during noisy representation learning*, Cambridge, MA.
2023 Apr	HHMI Janelia Conference on Causes and Implications of Representational Drift. *Coordinated drift of receptive fields during noisy representation learning*, Ashburn, VA.
2022 Sept	Harvard Program in Neuroscience orientation poster session. *Coordinated drift of receptive fields during noisy representation learning*, Cambridge, MA.
2022 July	14th Harvard-LMU young scientists' forum. *Coordinated drift of receptive fields during noisy representation learning*, Cambridge, MA.
2021 Sept	Bernstein Conference, *Coordinated drift of receptive fields during noisy representation learning* (virtual).
2021 Feb	Computational and Systems Neuroscience (Cosyne), *Dynamics of drifting receptive fields during noisy representation learning* (virtual).
2020 Nov	From Neuroscience to Artificially Intelligent Systems (NAISys) , *Contrastive Similarity Matching for Supervised Learning* (virtual).
2020 Sept	Bernstein conference, *Stable representational similarity despite drifting neural activity in noisy representation learning*, (virtual).
2020 Feb	Computational and Systems Neuroscience (Cosyne), *Supervised Deep Similarity Matching*, Denver, CO.

2019 June	Dynamic signaling in cells and embryos, *Nonlinear Compressed Sensing in Olfactory Systems*, Yantai, China. (Best poster award)
2019 Jan	Annual symposium of Center for Quantitative Biology, *An Information-theoretic model for odor coding*, Beijing, China. (Best poster award)
2018 Aug	*An Information-theoretic model for odor coding*, Beijing, China.
2017 Jan	Center for Quantitative Biology annual symposium, *Impact of extrinsic noise on the signals of critical transitions*, Beijing, China.
2016 Jan	Center for Quantitative Biology annual symposium, *Anticipating critical transition- effect of extrinsic noise*, Beijing, China.
2014 Sept	Workshop on Systems Biology, BICMR. *Correlation of gene expression noise during cell fate transition*, Beijing, China.
2013 Sept	Fall Meeting of Chinese Physical Society, *Modeling metaphase to anaphase transition of budding yeast cell cycle*, Xiamen, China. (Best poster award)

Teaching and Advising Experience

Teaching Assistant

Responsibilities included developing new class materials, leading class discussions, supervising labs, grading all assignments, and meeting with students individually.

2023	Introduction to applied mathematics (AM50), Harvard University.
	32 undergraduates.
2022	Introduction to applied mathematics (AM50), Harvard University.
	33 undergraduates.
2020	Neural Computation (AM226), Harvard University.
	30 graduate students.
2014	Critical reading of systems biology, Peking University.
	10 undergraduates and 20 graduates.

Advisor

2024	Advised two summer intern student at the Center for Computational Neuroscience, Flatiron Institute.
2023	Advised an undergraduate summer intern of Harvard University.
2021	Advised 4 students from the online Neuromatch Academy.
2019	Advised a rotation PhD student in the Harvard physics program.
2019	Honors thesis advisor of an undergraduate student of Peking University.
2013-2019	Advised 3 undergraduates of Peking University.
2013-2017	Advised 6 rotational graduates at Peking University.
2015	Honors thesis advisor of an undergraduate student of Tsinghua University.

Selected Awards and Honors

2023	National Natural Science Fund for Excellent Young Scientists Fund Program(Overseas)
2020	*Distinguished teaching assistant*, Harvard University.
2020	Harvard MBB young investigator awards.
2019	Quantitative Biology research scholarship, Peking University.

2017	Huirong Li scholarship, Peking University.
2014	Quantitative Biology research scholarship, Peking University.
2012	Pacemaker to merit student, Central China Normal University.
2011	Second-class prize of *Challenge Cup* national college students extracurricular academic work competition.
2011	National scholarship, Central China Normal University.
2010	National Encouragement scholarship, Central China Normal University.

Reviewer

Ad hoc reviewer for Nature Communications, Physical Review X, Physical Review X Life, Physical Review E, PLoS Computational Biology, eLife, PNAS. Review editor for the *Frontiers in Computational Neuroscience*.

University/Departmental Service

2022 Aug	Co-organizer of "Workshop on Reinforcement Learning at Harvard".
2019 - 2022	Co-organizer of "Harvard Neuro Theory journal club".
2018 Jan	Co-organizer of "Brain Storm" at Center for Quantitative Biology together with Prof. Ping Wei.
2015 May	Co-organizer, The first Young Scholars Frontier Symposium on Quantitative Biology Development.
2014 July	Co-organizer, 2014 Center for Quantitative Biology Annual Symposium.

Professional membership

2022-present	The Society of Neuroscience
2014-present	The American Physical Society