Shi-Xin Zhang（张士欣）

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Education

Tsinghua University PhD in Physics 2016 – 2021

Institute for Advanced Study Advisor: Prof. Hong Yao
PhD Thesis: Differentiable Programming in Quantum Physics
Outstanding PhD Award (87/2981) / Outstanding PhD thesis at Tsinghua University

Tsinghua University BSc in Physics 2012 – 2016

Department of Physics GPA: 95/100 Rank: **1**/95
Top 1 in 2012 National College Entrance Examination in Hebei Province

Experience

Tencent Quantum Laboratory Senior Research Scientist 2021 –

- Quantum algorithms and applications: Project Owner / Research Scientist

  Led a small group of talented people with a focus on the research, analysis, and design for near term quantum algorithms and quantum simulation schemes. Produced a series of high quality paper publications and **20+ patent** applications (as the first inventor) in the fields of quantum circuit design automation, quantum AI hybrid solutions, and non-equilibrium system simulation. Also communicated and collaborated with top commercial partners from the finance/biology/energy/material sectors, exploring industry solutions with potential quantum advantage.
- Quantum Software R&D: Project Owner / Software Creator / Platform Architect / Core Author and Maintainer

  Created and developed a high performance open-source and full-featured quantum software framework: TensorCircuit. As the first product released by Tencent in quantum computing, TensorCircuit outperforms other counterparts from the design philosophy to the performance. The software is empowered by an advanced tensor network engine, and directly built on top of machine learning frameworks: TensorFlow, PyTorch, and Jax. TensorCircuit also supports quantum hardware experiments via elegant SDK with integrated quantum error mitigation. The package provides a great solution to utilize hybrid computational resources including CPU, GPU and QPU, and a universal platform for quantum-classical hybrid and quantum machine learning tasks.

Research

Interests

Main research interests include variational quantum algorithms, quantum machine learning, phase nature and phase transition in non-equilibrium quantum systems and strongly correlated systems, and the interplay between machine learning infrastructure and methods with quantum physics.

Publications

18 publications and preprints in total, including three works in Physical Review Letters (2 as the first author and 1 as the corresponding author). Selected works as the **first** or **corresponding*** author are listed below, please see Google Scholar for the full publication list.

1. **Shi-Xin Zhang**, Zhou-Quan Wan, Chee-Kong Lee, Chang-Yu Hsieh, Shengyu Zhang, Hong Yao, *Variational Quantum-Neural Hybrid Eigensolver*, Physical Review Letters **128**, 120502 (2022).
2. **Shi-Xin Zhang** and Hong Yao, *Universal properties of many-body localization transitions in quasiperiodic systems*, Physical Review Letters **121**, 206601 (2018).
3. Shuo Liu, **Shi-Xin Zhang***, Chang-Yu Hsieh, Shengyu Zhang, and Hong Yao, *Discrete time crystal enabled by Stark many-body localization*, arXiv:2208.02866 (2022). (PRL accepted)
4. **Shi-Xin Zhang**, et al., *TensorCircuit: a Quantum Software Framework for the NISQ Era*, Quantum **7**, 912 (2023).

5. Shuo Liu, **Shi-Xin Zhang***, Chang-Yu Hsieh, Shengyu Zhang, and Hong Yao, *Probing many-body localization by excited-state VQE*, Physical Review B **107**, 024204 (2023)
6. **Shi-Xin Zhang**, Chang-Yu Hsieh, Shengyu Zhang and Hong Yao, *Differentiable Quantum Architecture Search*, Quantum Science and Technology **7**, 045023 (2022).
7. Zhou-Quan Wan, **Shi-Xin Zhang***, and Hong Yao, *Mitigating the fermion sign problem by automatic differentiation*, Physical Review B **106**, L241109 (2022).
8. **Shi-Xin Zhang**, Chang-Yu Hsieh, Shengyu Zhang and Hong Yao, *Neural Predictor based Quantum Architecture Search*, Machine Learning: Science and Technology **2**, 045027 (2021).
9. **Shi-Xin Zhang**, Shao-Kai Jian, and Hong Yao, *Quantum criticality preempted by nematicity*, Physical Review B **103**, 165129 (2021).
10. **Shi-Xin Zhang**, Shao-Kai Jian and Hong Yao, *Correlated triple-Weyl semimetals with Coulomb interactions*, Physical Review B (Rapid Communication) **96**, 241111 (2017).
11. Shuo Liu, Ming-Rui Li, **Shi-Xin Zhang***, Shao-Kai Jian, and Hong Yao, *Universal KPZ scaling in noisy hybrid quantum circuits*, arXiv:2212.03901 (2022). (PRL, LA17791, under review)
12. **Shi-Xin Zhang**, Zhou-Quan Wan, Chang-Yu Hsieh, Hong Yao, and Shengyu Zhang, *Variational quantum-neural hybrid error mitigation*, arXiv:2112.10380 (2021).
13. **Shi-Xin Zhang**, Zhou-Quan Wan and Hong Yao, *Automatic Differentiable Monte Carlo: Theory and Application*, arXiv:1911.09117 (2019). (PRR, XM10539W, under review)
14. **Shi-Xin Zhang**, *Classification on the computational complexity of spin models*, arXiv:1911.04122 (2019).
15. Zhou-Quan Wan and **Shi-Xin Zhang***, *Automatic Differentiation for Complex Valued SVD*, arXiv:1909.02659 (2019).
16. **Shi-Xin Zhang** and Hong Yao, *Strong and weak many-body localizations*, arXiv:1906.00971 (2019).

Honors

- At Tsinghua University, won awards including National Scholarship, National Encouragement Scholarship, Future Scholar Scholarship, First Class Freshmen Scholarship, Zhang Mingwei Scholarship, Xuetang Talent Program Scholarship, etc.
- At Tencent, rated as outstanding (10%) and selected as outstanding individual of the lab.

Skills

- The interplay between quantum physics and computer science: Familiar with quantum computation, quantum artificial intelligence, and machine learning in quantum physics.
- Condensed matter physics: Familiar with the basic theory and methods for quantum many-body physics. Know about numerical methods including tensor network, quantum Monte Carlo, mean field, variational approach, and exact diagonalization.
- High-performance computation: Built the full-stack cluster in IASTU. Familiar with toolchains and the ecosystem in Ops, HPC and cloud computation.
- Python: Familiar with Python language and third-party packages for scientific computing, data science, machine learning, web development, web crawler, software engineering, etc.
- Differentiable programming, probabilistic programming and quantum programming: Familiar with the programming paradigm and especially familiar with the related Google ecosystem: TensorFlow, Jax, TensorNetwork, Cirq, TensorFlow Quantum.
- Programming language: Python, Mathematica, C++, Julia, JavaScript, Bash; Markup language: HTML, CSS, Markdown, reStructuredText, LaTeX; Natural language: Chinese, English, Korean.

Open Source Contributions

Familiar with the open source practice and created many popular open-source projects related to HPC, computational physics, finance, and web with **2000+** stars and forks in total. Also contributed to several large open-source projects including NumPy, TensorFlow, Autograd, TensorNetwork, TensorFlow Quantum, conda-smithy. Please refer to my GitHub Profile for details.

Last updated on February 22, 2023