Feng PAN

8 Somapah Rd
Singapore 487372
(+65) 8039 1807
feng_pan@sutd.edu.sg
fanerst.github.io/

Research Interests

Statistical Physics, Tensor Network Algorithm, Machine Learning, AI for Quantum, Quantum Computational Architecture, Quantum Error Correction.

Academic Positions

Jan 2025 - Present **Assistant Professor**, *Science, Mathematics and Technology Cluster*, Singapore University of Technology and Design.

Aug 2023 - Dec 2024 **Postdoctoral Research Fellow**, *Centre for Quantum Technologies, National University of Singapore*, Advisor: Prof. Patrick Rebentrost.

Visiting Positions

Feb 2023 - Jul 2023 **Visiting Scholar**, *CAS Center For Excellence in Quantum Information and Quantum Physics, University of Science and Technology of China*,
Host: Prof. Chaoyang Lu and Prof. Jianwei Pan.

July 2022 - Jan 2023 **Visiting Scholar**, *Institute of Theoretical Physics, Chinese Academy of Sciences*,
Host: Prof. Pan Zhang.

Sep 2015 - Jan 2016 **Visiting Student**, *Massachusetts Institute of Technology, Cambridge*,
Physics Department.

Education

Sep 2017 - Jul 2022 **Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing**,
PhD in Theoretical Physics, Supervisor: Prof. Pan Zhang.

Sep 2012 - Jun 2016 **Nanjing University of Aeronautics and Astronautics, Nanjing**,
Bachelor of Science, Mathematics & Physics.

Funding

2026 **Advanced Quantum Algorithms and Solutions**,
Singapore Flagship Project under National Quantum Strategy, Pillar 4 Lead, 49 million SGD, 2026-2031.

2026 **Quantum-Enhanced Machine Learning Solvers for Optimisation Problems in Supply Chains and Logistics**,
MTC Young Individual Research Grant,, 300K SGD, 2026-2029.

2025 **Tensor-Network solutions to large-scale combinatorial optimization problems**,
NQCH-NVIDIA collaboration under Quantum Engineering Program 3.0 sub-project, 697K SGD (including NVIDIA EOM). , 2026-2027.

2025 **Towards implementing and decoding of logical quantum algorithms on present-day quantum hardware**,
MOE SKI Grant, 100K SGD, 2025-2028.

Awards

2023 **Second Prize, Beijing Natural Science Award**,
The highest scientific honor for researchers in Beijing; awarded annually to only 13 First Prize and 39 Second Prize recipients.

2023 **Outstanding Doctoral Dissertation Award, Beijing**,
Awarded to the top 0.1% of doctoral dissertations across Beijing.

2023 **Outstanding Doctoral Dissertation Award, Chinese Academy of Sciences**,
Awarded to the top 0.5% of doctoral dissertations at the Chinese Academy of Sciences.

2021 **National Scholarship for Doctoral Students, Ministry of Education of China**,
The highest national honor for doctoral students in China; awarded to the top 1%.

2021 **Principal Scholarship, Chinese Academy of Sciences**,
The highest honor for doctoral students within the Chinese Academy of Sciences; awarded to the top 1.25%.

2013 **National Scholarship for Bachelor Students, Ministry of Education of China**,
The highest national honor for undergraduate students in China; awarded to the top 1%.

Selected Talks

May 2026 **Differentiable Maximum Likelihood Noise Estimation for Quantum Error Correction**
Invited talk at Google Quantum AI.

Mar 2026 **Differentiable Maximum Likelihood Noise Estimation for Quantum Error Correction**
Invited talk at Quantinuum, London, UK.

Dec 2025 **Tensor Networks as a Unified Language: From Quantum Computing to Artificial Intelligence**
Invited talk at Quantum Algorithms and Optimization in Athens, Athens, Greece Talk link.

Oct 2025 **Machine Learning Solutions to Combinatorial Optimization Problems: Insights from Statistical Physics**
Invited talk at The 16th Asia Pacific Physics Conference, Haikou, China.

Aug 2025 **Advancements in Decoding for Quantum Error Correction**
Invited talk at The Conference of Condensed Matter Physics, Liyang, China.

Feb 2024 **Arbitrary Tensor Network Algorithm: Theory, Methods and Applications**
Invited talk at IPAM workshop TNK 2024, UCLA, Los Angeles, USA, Talk link.

Oct 2023 **Classical Simulation of Quantum Circuits by Arbitrary Tensor Network Algorithms**
Prof. Jens Eisert Group, Online.

Sep 2023 **Classical Simulation of Quantum Circuits by Arbitrary Tensor Network Algorithms**
Centre for Quantum Technologies, Singapore.

Nov 2021 **Contracting Arbitrary Tensor Networks: Approximate and Exact Approach with Applications in Graphical Models and Quantum Circuit Simulations**
Perimeter Institute, Waterloo, Canada, Talk link.

Service

PC Member — Asian Conference of Quantum Information Science 2026

Journal Referee — Physical Review Letters, Physical Review A, Physical Review B, Quantum, Neural Computing

Conference Referee — Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC)

Patents

[1] Pan Zhang, **Feng Pan**, Methods, devices and quantum virtual machines for simulating probabilistic amplitudes of quantum states, CN114254755, 2022.

Publications

I have authored 12 journal articles and 1 conference proceeding, in addition to 7 preprint papers. Notably, 5 of these articles have been published in **Physical Review Letters**, the leading journal in the field of Physics, and one in **Nature Computational Science**. Detailed information about my publications can be found on Google Scholar.

[1] **Feng Pan**, Hanfeng Gu, Paul Springer, and Xipeng Li, *Parallelizing Large-Scale Tensor Network Contraction on Multiple GPUs*, arXiv:2606.01852.

[2] Hanyan Cao, Ge Yan, Yuxuan Du, and **Feng Pan**, *Maximum Likelihood Decoding of Quantum Error Correction Codes*, arXiv:2605.17230.

[3] Hanyan Cao, Dongyang Feng, Cheng Ye, and **Feng Pan**, *Differentiable Maximum Likelihood Noise Estimation for Quantum Error Correction*, arXiv:2602.19722.

[4] Yijia Wang, Xuanzhao Gao, Pan Zhang, **Feng Pan**, and Jinguo Liu, *Branch-and-Bound Tensor Networks for Exact Ground-State Characterization*, arXiv:2602.05470.

[5] Hanyan Cao, Yijia Wang, **Feng Pan**, and Pan Zhang, *Integrating Neural Networks and Tensor Networks for Computing Free Energy*, Communications in Theoretical Physics **77**, 095602 (2025).

[6] Hanyan Cao, Shoukuan Zhao, Dongyang Feng, Zisong Shen, Haisheng Yan, Tang Su, Weijie Sun, Huikai Xu, **Feng Pan**, Haifeng Yu, and Pan Zhang, *Exact Decoding of Quantum Error-Correcting Codes*, Phys. Rev. Lett. **134**, 190603 (2025) (Editors' Suggestion).

[7] Zi-Song Shen, **Feng Pan**, Yao Wang, Yi-Ding Men, Wen-Biao Xu, Man-Hong Yung, and Pan Zhang, *Free-Energy Machine for Combinatorial Optimization*, Nature Computational Science **5**, 322-332 (2025).

[8] Hanyan Cao, **Feng Pan**, Dongyang Feng, Yijia Wang, and Pan Zhang, *Generative Decoding for Quantum Error-Correcting Codes*, arXiv:2503.21374.

[9] Xian-He Zhao, Han-Sen Zhong, **Feng Pan**, et al., *Leapfrogging Sycamore: Harnessing 1432 GPUs for 7x Faster Quantum Random Circuit Sampling*, National Science Review **12**, nwae317 (2025).

[10] Rong Fu, Zhongling Su, Han-Sen Zhong, Xiti Zhao, Jianyang Zhang, **Feng Pan**, et al., *Surpassing Sycamore: Achieving Energetic Superiority Through System-Level Circuit Simulation*, SC24: International Conference for High Performance Computing, Networking, Storage and Analysis (2024).

[11] **Feng Pan**, Hanfeng Gu, Lvlin Kuang, Bing Liu, and Pan Zhang, *Efficient Quantum Circuit Simulation by Tensor Network Methods on Modern GPUs*, ACM Transactions on Quantum Computing **5**, 1-26 (2024).

[12] Yijia Wang, Yuwen Ebony Zhang, **Feng Pan**, and Pan Zhang, *Tensor Network Message Passing*, Phys. Rev. Lett. **132**, 117401 (2024) (Editors' Suggestion).

[13] Hanyan Cao, **Feng Pan**, Yijia Wang, and Pan Zhang, *qecGPT: Decoding Quantum Error-Correcting Codes with Generative Pre-Trained Transformers*, arXiv:2307.09025.

[14] Naixu Guo, **Feng Pan**, and Patrick Rebentrost, *Estimating Properties of a Quantum State by Importance-Sampled Operator Shadows*, arXiv:2305.09374.

[15] **Feng Pan**, Keyang Chen, and Pan Zhang, *Solving the Sampling Problem of the Sycamore Quantum Circuits*, Phys. Rev. Lett. **129**, 090502 (2022) (Editors' Suggestion).

[16] **Feng Pan**, and Pan Zhang, *Simulation of Quantum Circuits Using the Big-Batch Tensor Network Method*, Phys. Rev. Lett. **128**, 030501 (2022) (Editors' Suggestion).

Blog discussions: **Scott Aaronson**, **Gil Kalai**.

Media highlights for item [15]: **Science**, **The Quantum Insider**, **New Scientist**.

[17] Sujie Li, **Feng Pan**, Pengfei Zhou, and Pan Zhang, *Boltzmann Machines as Two-Dimensional Tensor Networks*, Phys. Rev. B **104**, 075154 (2021).

[18] **Feng Pan**, Pengfei Zhou, Hai-Jun Zhou, and Pan Zhang, *Solving Statistical Mechanics on Sparse Graphs with Feedback-Set Variational Autoregressive Networks*, Phys. Rev. E **103**, 012103 (2021).

[19] **Feng Pan**, Pengfei Zhou, Sujie Li, and Pan Zhang, *Contracting Arbitrary Tensor Networks: General Approximate Algorithm and Applications in Graphical Models and Quantum Circuit Simulations*, Phys. Rev. Lett. **125**, 060503 (2020).

[20] Ya-Peng Hu, **Feng Pan**, and Xin-Meng Wu, *The Effects of Massive Graviton on the Equilibrium Between the Black Hole and Radiation Gas in an Isolated Box*, Phys. Lett. B **772**, 553-558 (2017).