Zheng-Hao Liu, Dr.

Date of Birth:	25/06/1995
Nationality:	Chinese
Current affiliation:	Center for Macroscopic Quantum States (bigQ)
	Technical University of Denmark
Address:	Fysikvej 307, 2800 Kgs. Lyngby, Denmark

zheli@dtu.dk
+45-50329787
https://manekimeow.github.io/
Full CV

Academic and Research Experience

2023 – **Marie Skłodowska–Curie postdoc fellow**, Center for Macroscopic Quantum States (bigQ), Department of Physics, Technical University of Denmark

Project name: *Gate-teleported Gaussian boson sampling* (EU).

Supervisor: Prof. Ulrik L. Andersen, A/Prof. Jonas S. Neergaard-Nielsen.

Objective: Ultra-large-scale Gaussian boson sampling with measurement-based quantum computation and feed-forward.

2022 – 2023 **Postdoc**, Department of Physics, Technical University of Denmark

Supervisor: A/Prof. Jonas S. Neergaard-Nielsen, Prof. Ulrik L. Andersen.

Research topics: Optical fiber-based multimode interferometer, quantum correlations and quantum information with continuous-variable systems.

2018 – 2022 **Research assistant**, University of Science and Technology of China.

Research topics: Optical quantum information processing, quantum simulation, theoretical investigations, and experimental tests of quantum foundations.

Education

2017 – 2022 **Ph.D. in physics, University of Science and Technology of China**
CAS Key Laboratory of Quantum Information. Mentor: Prof. Jin-Shi Xu.

Doctoral thesis: *Exploring quantum contextuality with photons*.
Note: Direct entry Ph.D. program. No master degree.

2016 **Exchange student, University of Michigan**, Ann Arbor, MI, USA.
College of Literature, Science and the Arts. Project advisor: Prof. Hui Deng.

Report title: Calculation of cooperative light scattering in fractional dimensions.

2013 – 2017 **B.Sc., University of Science and Technology of China**, Hefei, China.
Yan Ji-Ci Talent Program in Physics, School of Physics. GPA:3.76/4.3.

Bachelor thesis: Experimental half-degenerate optical orbital angular momentum resonant cavities.

Industry Experience

2021 – 2022 **Adjunct research associate**, Beijing QBoson Quantum Technology Co., Ltd.
Job: Developing optical fiber network and high-speed modulation system for coherent Ising machine and studying high-dimensional quantum information.

Social Activities, Community Service, etc.

- **Referee** for academic journals including: *Physical Reviewe Letters*, *PRX Quantum*, *Light: Science & Applications*, *Optics Express*, *Annalen der Physik*, and *Science China Physics, Mechanics & Astronomy*.

2019
- **Conference assistant** in *Quantum Optics Science and Tech Forum*, Chuzhou.
- **Volunteer** in *Chinese Optical Society Conference* at Hefei.

2016
- **Teaching assistant**, University of Science and Technology of China.
Course: electromagnetism. Lecturer: Dr. Xiao-Ping Tao. Responsibility includes deliver exercise lessons, overreading homework and examination papers.

Awards

2022
- **Wang Daheng Ph.D. fellowship** by the Chinese Optical Society.
- **Elite graduate student** by University of Science and Technology of China.
- **Elite graduate student** by Anhui province, China.
- **The president award of the Chinese Academy of Sciences**, first prize.

2021
- **National scholarship** for doctoral students in China (¥30k).
- **Light: Science & Applications (LSA) academic league** for doctoral students in optics and optical engineering, advanced to grand finals (30 candidates per year) at Changchun Institute of Optics, Fine Mechanics and Physics.
- **Review article** commissioned by LSA. Certification.

2020
- **PFUNT best oral report award**, first prize, at Nanjing University.
PFUNT refers to the association of Peking University, Fudan University, USTC, Nanjing University and Tsinghua University—top 5 mainland China universities in physics.
- **China Aerospace Science and Technology fellowship**, first prize (¥10k), by University of Science and Technology of China.

2017
- **Elite undergraduate student** by University of Science and Technology of China.

References

Available upon request

List of Publications

Journal Articles

1. **Liu**, **Z.-H.**, Pan, W.-W., Xu, X.-Y., Yang, M., Zhou, J., Luo, Z.-Y., Sun, K., Chen, J.-L., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2020). Experimental exchange of grins between quantum cheshire cats. *Nature Communications*, **11**, 3006. https://doi.org/10.1038/s41467-020-16761-0

2. **Liu**, **Z.-H.**, Sun, K., Pachos, J. K., Yang, M., Meng, Y., Liao, Y.-W., Li, Q., Wang, J.-F., Luo, Z.-Y., He, Y.-F., Ding, G.-R., Xu, J.-S., Han, Y.-J., Li, C.-F., & Guo, G.-C. (2021). Topological contextuality and anyonic statistics of photonic-encoded parafermions. *PRX Quantum*, **2**, 030323. https://doi.org/10.1103/PRXQuantum.2.030323

3. **Liu**, **Z.-H.**, Liang, X.-B., Sun, K., Li, Q., Meng, Y., Yang, M., Li, B., Chen, J.-L., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2021). Photonic implementation of quantum information masking. *Physical Review Letters*, **126**, 170505. https://doi.org/10.1103/PhysRevLett.126.170505

4. **Liu**, **Z.-H.**, Zhou, J., Meng, H.-X., Yang, M., Li, Q., Meng, Y., Su, H.-Y., Chen, J.-L., Sun, K., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2021). Experimental test of the Greenberger–Horne–Zeilinger-type paradoxes in and beyond graph states. *npj Quantum Information*, **7**, 66. https://doi.org/10.1038/s41534-021-00397-z

5. **Liu**, **Z.-H.**, Meng, H.-X., Xu, Z.-P., Zhou, J., Chen, J.-L., Xu, J.-S., Li, C.-F., Guo, G.-C., & Cabello, A. (2023). Experimental test of high-dimensional quantum contextuality based on contextuality concentration. *Physical Review Letters*, **130**, 240404. https://doi.org/10.1103/PhysRevLett.130.240202

6. Sun, K., **Liu**, **Z.-H.**, Wang, Y., Hao, Z.-Y., Xu, X.-Y., Xu, J.-S., Li, C.-F., Guo, G.-C., Castellini, A., Lami, L., Winter, A., Adesso, G., Compagno, G., & Lo Franco, R. (2022). Activation of indistinguishability-based quantum coherence for enhanced metrological applications with particle statistics imprint [co-first author]. *Proceedings of the National Academy of Sciences*, **119**, e2119765119. https://doi.org/10.1073/pnas.2119765119

7. **Liu**, **Z.-H.**, Meng, H.-X., Xu, Z.-P., Zhou, J., Ye, S., Li, Q., Sun, K., Su, H.-Y., Cabello, A., Chen, J.-L., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2019). Experimental observation of quantum contextuality beyond Bell nonlocality. *Physical Review A*, **100**, 042118. https://doi.org/10.1103/PhysRevA.100.042118

8. **Liu**, **Z.-H.**, Li, Q., Liu, B.-H., Huang, Y.-F., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2022). Twenty years of quantum contextuality at USTC [cover paper, review article]. *Journal of University of Science and Technology of China*, **52**(10), 1–20. https://doi.org/10.52396/JUSTC-2022-0073

9. **Liu**, **Z.-H.**, Xu, J.-S., & Li, C.-F. (2022). Quantum information masking [cover paper, invited review]. *Acta Optica Sinica*, **42**, 0327001. https://doi.org/10.3788/AOS202242.0327001

10. Yang, M., **Liu**, **Z.-H.**, Cheng, Z.-D., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2019). Deep hybrid scattering image learning [co-first author]. *Journal of Physics D: Applied Physics*, **52**, 115105. https://doi.org/10.1088/1361-6463/aafa3c

11. Wang, J.-F., **Liu**, **Z.-H.**, Yan, F.-F., Li, Q., Yang, X.-G., Guo, L., Zhou, X., Huang, W., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2020). Experimental optical properties of single nitrogen vacancy centers in silicon carbide at room temperature. *ACS Photonics*, **7**, 1611–1616. https://doi.org/10.1021/acsphotonics.0c00218

12 Meng, Y., **Liu**, **Z.-H.**, Zhao, Z., Yin, P., Wang, Y.-T., Liu, W., Li, Z.-P., Yang, Y.-Z., Wang, Z.-A., Xu, J.-S., Yu, S., Tang, J.-S., Li, C.-F., & Guo, G.-C. (2024). Probing asymmetry in spatial-temporal correlations in quantum causal inference. *Science China Information Sciences*, in press. https://www.sciengine.com/SCIS/doi/10.1007/s11432-024-4007-y

13 Cheng, Z.-D., **Liu**, **Z.-H.**, Li, Q., Zhou, Z.-W., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2019). Flexible degenerate cavity with ellipsoidal mirrors. *Optics letters*, **44**, 5254–5257. https://doi.org/10.1364/OL.44.005254

14 Sun, K., Wang, Y., **Liu**, **Z.-H.**, Xu, X.-Y., Xu, J.-S., Li, C.-F., Guo, G.-C., Castellini, A., Nosrati, F., Compagno, G., et al. (2020). Experimental quantum entanglement and teleportation by tuning remote spatial indistinguishability of independent photons. *Optics Letters*, **45**, 6410–6413. https://doi.org/10.1364/OL.401735

15 Yang, M., Li, Q., **Liu**, **Z.-H.**, Hao, Z.-Y., Ren, C.-L., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2020). Experimental observation of an anomalous weak value without post-selection. *Photonics Research*, **8**, 1468–1474. https://doi.org/10.1364/PRJ.393480

16 Zheng, Y., Yang, M., **Liu**, **Z.-H.**, Xu, J.-S., Li, C.-F., & Guo, G.-C. (2021). Detecting momentum weak value: Shack–Hartmann versus a weak measurement wavefront sensor. *Optics Letters*, **46**, 5352–5355. https://doi.org/10.1364/OL.439174

17 Wang, Y., Hao, Z.-Y., **Liu**, **Z.-H.**, Sun, K., Xu, J.-S., Li, C.-F., Guo, G.-C., Castellini, A., Bellomo, B., Compagno, G., & Lo Franco, R. (2022). Remote entanglement distribution in a quantum network via multinode indistinguishability of photons. *Physical Review A*, **106**, 032609. https://doi.org/10.1103/PhysRevA.106.032609

18 Zheng, Y., Yang, M., **Liu**, **Z.-H.**, Xu, J.-S., Li, C.-F., & Guo, G.-C. (2022). Toward practical weak measurement wavefront sensing: Spatial resolution and achromatism. *Optics Letters*, **47**, 2734–2737. https://doi.org/10.1364/OL.460873

19 Zheng, Y., Zhang, C.-J., **Liu**, **Z.-H.**, Shao, J.-W., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2022). Experimental verification of a coherence factorization law for quantum states. *Photonics Research*, **10**(9), 2172–2177. https://doi.org/10.1364/PRJ.463829

20 Wang, Z.-A., Meng, Y., **Liu**, **Z.-H.**, Wang, Y.-T., Shang, Y., Liu, W., Li, Z.-P., Yang, Y.-Z., Guo, N.-J., Zeng, X.-D., Tang, J.-S., Li, C.-F., & Guo, G.-C. (2024). Realization of algorithmic identification of cause and effect in quantum correlations. *Physical Review A*, **109**, 012406. https://doi.org/10.1103/PhysRevA.109.012406

21 Wang, Y., Piccolini, M., Hao, Z.-Y., **Liu**, **Z.-H.**, Sun, K., Xu, J.-S., Li, C.-F., Guo, G.-C., Morandotti, R., Compagno, G., & Lo Franco, R. (2022). Proof-of-principle direct measurement of particle statistical phase. *Physical Review Applied*, **18**, 064024. https://doi.org/10.1103/PhysRevApplied.18.064024

22 Li, Q., Zhou, J.-Y., **Liu**, **Z.-H.**, Xu, J.-S., Li, C.-F., & Guo, G.-C. (2019). Stable single photon sources in the near c-band range above 400 k. *Journal of Semiconductors*, **40**, 072902. https://doi.org/10.1088/1674-4926/40/7/072902

23 Cheng, Z.-D., Li, Q., **Liu**, **Z.-H.**, Yan, F.-F., Yu, S., Tang, J.-S., Zhou, Z.-W., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2018). Experimental implementation of a degenerate optical resonator supporting more than 46 laguerre-gaussian modes. *Applied Physics Letters*, **112**(20), 201104. https://doi.org/10.1063/1.5025132

24 Yang, M., Xiao, Y., Liao, Y.-W., **Liu**, **Z.-H.**, Xu, X.-Y., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2020). Zonal reconstruction of photonic wavefunction via momentum weak measurement. *Laser & Photonics Reviews*, **14**(5), 1900251. https://doi.org/10.1002/lpor.201900251

25 Wang, J.-F., Yan, F.-F., Li, Q., **Liu**, **Z.-H.**, Liu, H., Guo, G.-P., Guo, L.-P., Zhou, X., Cui, J.-M., Wang, J., Zhou, Z.-Q., Xu, X.-Y., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2020). Coherent control of nitrogen-vacancy center spins in silicon carbide at room temperature. *Physical Review Letters*, **124**(22), 223601. https://doi.org/10.1103/PhysRevLett.124.223601

26 Wang, J.-F., Yan, F.-F., Li, Q., **Liu**, **Z.-H.**, Cui, J.-M., Liu, Z.-D., Gali, A., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2021). Robust coherent control of solid-state spin qubits using anti-stokes excitation. *Nature Communications*, **12**, 3223. https://doi.org/10.1038/s41467-021-23471-8

27 Hao, Z.-Y., Sun, K., Wang, Y., **Liu**, **Z.-H.**, Yang, M., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2022). Demonstrating shareability of multipartite einstein-podolsky-rosen steering. *Physical Review Letters*, **128**(12), 120402. https://doi.org/10.1103/PhysRevLett.128.120402

28 Yang, M., Zhang, H.-Q., Liao, Y.-W., **Liu**, **Z.-H.**, Zhou, Z.-W., Zhou, X.-X., Xu, J.-S., Han, Y.-J., Li, C.-F., & Guo, G.-C. (2023). Realization of exceptional points along a synthetic orbital angular momentum dimension. *Science Advances*, **9**(4), eabp8943. https://doi.org/10.1126/sciadv.abp8943

29 Wang, Y., Hao, Z.-Y., Li, J.-K., **Liu**, **Z.-H.**, Sun, K., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2023). Observing non-markovian evolution of Einstein–Podolsky–Rosen steering. *Physical Review Letters*, **130**(20), 200202. https://doi.org/10.1103/PhysRevLett.130.200202

30 Liao, Y.-W., Li, Q., Yang, M., **Liu**, **Z.-H.**, Yan, F.-F., Wang, J.-F., Zhou, J.-Y., Lin, W.-X., Tang, Y.-D., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2022). Deep-learning-enhanced single-spin readout in silicon carbide at room temperature. *Physical Review Applied*, **17**(3), 034046. https://doi.org/10.1103/PhysRevApplied.17.034046

31 Li, J.-K., Sun, K., Wang, Y., Hao, Z.-Y., **Liu**, **Z.-H.**, Zhou, J., Fan, X.-Y., Chen, J.-L., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2023). Experimental demonstration of separating the wave–particle duality of a single photon with the quantum cheshire cat. *Light: Science & Applications*, **12**, 18. https://doi.org/10.1038/s41377-022-01063-5

32 Hao, Z.-Y., Wang, Y., Li, J.-K., Xiang, Y., He, Q.-Y., **Liu**, **Z.-H.**, Yang, M., Sun, K., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2024). Filtering one-way Einstein–Podolsky–Rosen steering. *Physical Review Applied*, **109**(02), 022411. https://doi.org/10.1103/PhysRevA.109.022411

Books

1 **Liu**, **Z.-H.** (2023). *Exploring quantum contextuality with photons*. Springer Nature. https://doi.org/10.1007/978-981-99-6167-2

Preprints

1 **Liu**, **Z.-H.**, Meng, Y., Wu, Y.-Z., Hao, Z.-Y., Xu, Z.-P., Ai, C.-J., Wei, H., Wen, K., Chen, J.-L., Ma, J., Xu, J.-S., Li, C.-F., & Guo, G.-C. (2022). *Exploring the boundary of quantum correlations with a time-domain optical processor*. https://doi.org/10.48550/arXiv.2208.07794

2 Roch i Carceller, C., Faria, L. N., **Liu**, **Z.-H.**, Sguerso, N., Andersen, U. L., Neergaard-Nielsen, J. S., & Brask, J. B. (2024). *Improving semi-device-independent randomness certification by entropy accumulation*. https://doi.org/10.48550/arXiv.2405.04244

3 Wang, Z.-A., Xie, B.-F., Ming, F., Wang, Y.-T., Wang, D., Meng, Y., **Liu**, **Z.-H.**, Tang, J.-S., Ye, L., Li, C.-F., Guo, G.-C., & Kais, S. (2022). *Generalized multipartite entropic uncertainty relations: Theory and experiment*. https://doi.org/10.48550/arXiv.2207.12693

4 Oh, C., Chen, S., Wong, Y., Zhou, S., Huang, H.-Y., Nielsen, J. A. H., **Liu**, **Z.-H.**, Neergaard-Nielsen, J. S., Andersen, U. L., Jiang, L., & Preskill, J. (2024). *Entanglement-enabled advantage for learning a bosonic random displacement channel*. https://doi.org/10.48550/arXiv.2402.18809