Yuchen Guo Ph.D. Candidate

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Education

- B.Sc. in Physics: Tsinghua University | 2019 – 2023
- Ph.D. Candidate in Physics (Supervisor: Prof. Shuo Yang): Tsinghua University | 2023 – (expected 2028)
- Visiting student (Supervisor: Prof. J. Ignacio Cirac): Max Planck Institute of Quantum Optics (MPQ) | Mar–Aug, 2026

Awards

- Tsinghua University Special Scholarship (the highest honor for only 10 students in each year, 清华特奖), 2022
- Outstanding Graduate of Tsinghua University & Beijing (清华/北京优秀毕业生), 2023
- Outstanding Bachelor Thesis of Tsinghua University & Beijing (清华/北京优秀毕设), 2023
- National Scholarship for Ph.D. Students (博士生国奖), 2025
- NSFC Young Student Basic Research Project (博士生国自然基金), 2025

Research Interests

Currently, I am focusing on solving problems in quantum computation, quantum information, and topological quantum matter with the tool of tensor network (TN) family.

- Developing new quantum computation techniques
- Discovering novel topological quantum matter
- Exploring the interplay between dissipation and entanglement in open systems

Publications and preprints

I have published several research articles in top journals including *Phys. Rev. X*, *Phys. Rev. Lett.*, *PRX Quantum*, *npj Quantum Inform.*, etc.

1. Quantum computation & Quantum information

[1.1] Quantum Error Mitigation via Matrix Product Operators
Yuchen Guo and Shuo Yang
PRX Quantum 3, 040313 (2022)

A new error mitigation approach based on the tensor network representation of the noise channels.

[1.2] Noise effects on purity and quantum entanglement in terms of physical implementability
Yuchen Guo and Shuo Yang
npj Quantum Inform. 9, 11 (2023).

Two universal and concise inequations describing the destructive effects of quantum noise on purity and quantum entanglement.

[1.3] Triggering boundary phase transitions through bulk measurements in two-dimensional cluster states
Yuchen Guo, Jian-Hao Zhang, Zhen Bi, and Shuo Yang
Phys. Rev. Res. 5, 043069 (2023)

Rich phase diagram on the 1D boundary of a 2D cluster state subject to bulk tunable measurements.

[1.4] Efficient Quantum Circuit Compilation for Near-Term Quantum Advantage
Yuchen Guo and Shuo Yang
EPJ Quantum Technol. 12, 69 (2025)

An approximate quantum circuit compilation method that significantly reduces the circuit depth and increases the overall fidelity.

2. Locally purified density operators

[2.1] Quantum state tomography with locally purified density operators and local measurements
Yuchen Guo and Shuo Yang
Commun. Phys. 7, 322 (2024).

A new quantum state tomography method based on tensor network representation that only involves local measurements.

[2.2] Locally purified density operators for noisy quantum circuits
Yuchen Guo and Shuo Yang
Chin. Phys. Lett. 41, 120302 (2024, Editors' suggestion)

A universal scaling law between depth and error rate for tensor network representation of noisy quantum circuits.

[2.3] Locally Purified Density Operators for Symmetry-Protected Topological Phases in Mixed States
Yuchen Guo[#], Jian-Hao Zhang[#], Hao-Ran Zhang, Shuo Yang, and Zhen Bi
Phys. Rev. X 15, 021060 (2025)

Construction and classification of symmetry protected topological phases in open systems with tensor network method.

3. Non-Hermitian physics & Open systems

[3.1] Construction of non-Hermitian parent Hamiltonian from matrix product states
Ruohan Shen[#], **Yuchen Guo**[#] and Shuo Yang
Phys. Rev. Lett. 130, 220401 (2023)

A new parent Hamiltonian method for systematically constructing non-Hermitian systems.

[3.2] Composite quantum phases in non-Hermitian systems
Yuchen Guo[#], Ruohan Shen[#], and Shuo Yang

Phys. Rev. Res. 5, 033181 (2023)

A broad family of novel topological phases in non-Hermitian many-body systems without Hermitian counterpart not discovered before.

[3.3] A New Framework for Quantum Phases in Open Systems: Steady State of Imaginary-Time Lindbladian Evolution
Yuchen Guo, Ke Ding, and Shuo Yang
arXiv:2408.03239

Defining and classifying open-system quantum phases using imaginary-time version of the Lindbladian equation.

[3.4] Strong-to-weak spontaneous symmetry breaking meets average symmetry-protected topological order
Yuchen Guo and Shuo Yang
Phys. Rev. B 111, L201108 (2025, Editors' suggestion)

A new quantum phase intrinsic in open systems that exhibits both properties of spontaneous symmetry breaking and symmetry-protected topological order.

4. Strongly-correlated electron systems

[4.1] Unveiling Stripe-shaped Charge Modulations in Doped Mott Insulators
Ning Xia, **Yuchen Guo** and Shuo Yang
Phys. Rev. Lett. 135, 116504 (2025)

Reproduction of experimentally observed stripe- and ladder-shaped structures by simulation of doped Hubbard model with impurity potentials.

Talks and presentations

- Oral presentation, Asia Pacific Physics Conference), 2025.
- Oral presentation, APS Global Physics Summit, 2025.
- Invited talk, Fuzhou University Quantum Matter Seminars, 2024
- Invited talk, Youth Science Biweekly Forumm, 2023

Reference

For more information about my study and research, please contact my supervisor and some of collaborators:

1. Prof. Shuo Yang, Tsinghua University, shuoyang@tsinghua.edu.cn.
2. Prof. Zhen Bi, The Pennsylvania State University, zjb5184@psu.edu.
3. Dr. Jian-Hao Zhang, University of Colorado Boulder, sergio.zhang@colorado.edu.