

Haotian WEI

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EDUCATION

- Ph. D. in Theoretical Physics**, Rice University, *Houston, TX* Expected May 2026
Research in Quantum Science and Engineering
- M. Sc. in Theoretical Physics**, Rice University, *Houston, TX* Dec 2024
- B.Sc. in Physics**, Fudan University, *Shanghai, China* Jun 2020
GPA: 3.72/4.00 (9th/111), Major GPA: 3.94/4.00
Outstanding Graduate of Class 2020 (top 10%)
- Visiting Student**, University of California, *Berkeley, CA* Aug - Dec 2017
GPA: 4.00/4.00, sponsorship by Fudan University

RESEARCH EXPERIENCE

- Doctoral Researcher**, *Rice University, Houston, TX* Jun 2021 - Present
Advisor: Dr. Kaden Hazzard
- Developed dynamical simulation program by NumPy to explain the world's first fermion 2d optical tweezer array experiment results
 - Independently developed Riemannian-manifold-optimization-based Python package to calculate and precisely optimize effective model parameters in the above experiment of arbitrary geometry
 - Unveiled a universal thermodynamical law in the above quantum system, research featured *Editors' Suggestion* in professional research journal *Physical Review A*
 - Proposed a novel and efficient variational quantum algorithms on fermionic quantum simulators and showed its exponential advantage over classical algorithms
 - Related work featured in *Physics Magazine*
- Visiting Undergraduate Researcher**, *Rice University, Houston, TX* Jul – Oct 2019
Advisor: Dr. Kaden Hazzard
- Developed state-of-the-art Exact Diagonalization Matlab code of SU(N) Fermi-Hubbard Model (FHM) in arbitrary optical lattices
 - Performed large-scale computations and derived the world's first-ever theoretical thermometry on the coldest quantum fermion system in the universe - ultracold SU(6) Fermi gas in an optical lattice
 - Helped con calculations to discover the universal thermodynamical law behind SU(N) FHM
 - Related work reported on international media, including *physics.org*, *BBC News Mundo* (Spanish), *Principia* (Chinese)
- Research Assistant**, *Fudan University, Shanghai, China* Sep 2018 – Jun 2020
Advisor: Dr. Yang Qi
- Developed stochastic-gradient-descent-based algorithms in C++ code to learn effective potential of statistical physics model sampled by Hybrid Monte Carlo
 - Predicted the phase diagram of triangular lattice quantum Ising model by field theory analysis
 - Performed Monte-Carlo-based dynamical simulation in C++ for a Berezinskii-Kosterlitz-Thouless transition model
 - Completed Bachelor's thesis and published relevant research work with broad reception

PUBLICATIONS

- 6 articles, 200+ citations and 5 h-index from Google Scholar profile: scholar.google.com/citations?user=mu--7-UAAAAJ
- **Hao-Tian Wei**, Eduardo Ibarra-García-Padilla, Michael L. Wall, and Kaden R. A. Hazzard. "Hubbard Parameters for Programmable Tweezer Arrays" *Physical Review A [Editors' Suggestion]* **109**, 013318 (2024).

- Dasom Kim, Sohail Dasgupta, Xiaoxuan Ma, Joong-Mok Park, **Hao-Tian Wei**, Liang Luo, Jacques Doumani, Xinwei Li, Wanting Yang, Di Cheng, Richard HJ Kim, Henry O Everitt, Shojiro Kimura, Hiroyuki Nojiri, Jigang Wang, Shixun Cao, Motoaki Bamba, Kaden RA Hazzard and Junichiro Kono. “Observation of the magnonic Dicke superradiant phase transition” arXiv:2401.01873 (2024).
- Zoe Z. Yan, Benjamin M. Spar, Max L. Prichard, Sungjae Chi, **Hao-Tian Wei**, Eduardo Ibarra-García-Padilla, Kaden R. A. Hazzard, and Waseem S. Bakr. “Two-Dimensional Programmable Tweezer Arrays of Fermions” *Physical Review Letters [Editors' Suggestion] [Featured in news]* **129**.123201 (2022).
- Shintaro Taie, Eduardo Ibarra-García-Padilla, Naoki Nishizawa, Yosuke Takasu, Yoshihito Kuno, **Hao-Tian Wei**, Richard T. Scalettar, Kaden R. A. Hazzard, and Yoshiro Takahashi. “Observation of Antiferromagnetic Correlations in an Ultracold SU(N) Hubbard Model” *Nature Physics [Featured in news]* **18**.1356–61 (2022).
- Ibarra-García-Padilla, Eduardo, Sohail Dasgupta, **Hao-Tian Wei**, Shintaro Taie, Yoshiro Takahashi, Richard T. Scalettar, and Kaden R. A. Hazzard. “Universal Thermodynamics of an SU(N) Fermi-Hubbard Model” *Physical Review A [Editors' Suggestion]* **104**.043316 (2021).
- Yuan Da Liao, Han Li, Zheng Yan, **Hao-Tian Wei**, Wei Li, Yang Qi, and Zi Yang Meng. “Phase Diagram of the Quantum Ising Model on a Triangular Lattice under External Field” *Physical Review B* **103**.104416 (2021).

CONFERENCE PRESENTATIONS & POSTERS

Presentations:

- “Fermionic programmable quantum simulators running variational algorithms”, *APS Division of AMO Physics Meeting* 2024.
- “Parameters and algorithms for programmable Fermi-Hubbard tweezer arrays for quantum simulations”, *Rice Quantum Group Meeting* 2023.
- “Effective Hubbard parameters for programmable tweezer arrays”, *APS March Meeting* 2023.
- “Hubbard parameters of optical tweezer arrays in arbitrary 1- and 2-D geometries”, *IUPAP Conference on Computational Physics* 2022.
- “Stroboscopic fermion tweezer arrays: heating and Hubbard parameters”, *APS Division of AMO Physics Meeting* 2022.

Posters:

- “Programmable Hubbard model in tweezer arrays”, *RCQM Workshop* 2022.

PROFESSIONAL SKILLS

Proficient Programming Languages: Python (NumPy/SciPy/PyTorch), C/C++, MATLAB, Mathematica & Julia

Algorithms: Variational Quantum Algorithms, Numerical Analysis, Optimization Algorithms, Monte Carlo Sampling, Large-scale Tensor Network Algorithms, matrix decomposition algorithms especially Arnoldi/Lanczos method, data correlation analysis

Expertise in Quantum Hardware: Neutral Atom, Ion Traps, Superconducting Qubits, Quantum Dots

Application Skills: High-performance scientific computing (HPC), cloud computing, code development workflow based on Git, LaTeX, Microsoft Office, data visualizations

GitHub Profile: github.com/htwei17

- Independently developed all-in-one Hubbard model parameter calculation package *HubbardTweezer*
- Contributed to 600+ starred Riemannian manifold optimization package *pymanopt*

Research Grants: Google Cloud research credits (maximum annual amount)

Languages: English (fluent), Mandarin (native)

Interests: Linguistics (phonetics and phonology), Saxophone

LEADERSHIP SERVICES

Physics & Astronomy Graduate student Association (PAGSA), Rice University, Houston, TX Jun 2022 – Jun 2024

Treasurer & Journal club coordinator

- Organized 10+ PAGSA journal clubs throughout one academic year with 150+ total attendance counts
- Proposed and managed spending of around \$10,000 annual budget of PAGSA

- Organized around 20 faculty candidate meetings with PhD students and postgraduate researchers
- Assisted the departmental new PhD student recruitment open house & orientation events
- Initiated the American Physics Society (APS) Chapter at Rice University and served in its leadership board
- Mentored first-year PhD students on school life and advisor match

Academic Journal Referee

Aug 2024 - Present

Physical Review Letters, PRX Quantum, Physical Review A & B, New Journal of Physics,

Session Chair, APS March Meeting 2023

Mar 2023