Zhen Huang

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Experiences

Department of Mathematics, University of California, Berkeley 2021.08 – Present
PhD candidate in applied mathematics, Advised by Prof. Lin Lin *Berkeley, California, U.S.*

Center for Computational Quantum Physics, Flatiron Institute 2023.05 – 2023.08
Summer research associate *New York, U.S.*

School of Mathematical Sciences, Peking University 2017.09 - 2021.07
Honor Bachelor degree in mathematics *Beijing, China*

Research

My research aims to understand quantum materials at the many-particle level, by developing low-scaling, high-accuracy computational tools. The long-term goal of my research is to work towards increasingly realistic simulations of quantum materials by continually advancing computational techniques and mathematical modeling.

Recently I have worked on dynamical mean-field theory, quantum embedding, non-Markovian open quantum systems, many-body Green's functions and electronic structure theory. The computational challenges arising from these areas span various computational topics, including (randomized) numerical linear algebra, rational approximation, ill-posed inverse problems, and high-dimensional partial differential equations.

In the past I have also worked on the analysis and computation of semiclassical equations.

Publications and Preprints

- *Coupled Lindblad pseudomode theory for simulating open quantum systems*, **Z. Huang**, G. Park, G. K.-L. Chan, L. Lin, arXiv: 2506.10308
- *Automated evaluation of imaginary time strong coupling diagrams by sum-of-exponentials hybridization fitting*, **Z. Huang**, D. Golež, H. U. R. Strand, J. Kaye, arXiv: 2503.19727
- *Unified analysis of non-Markovian open quantum systems in Gaussian environment using superoperator formalism*, **Z. Huang**, G. Park, Y. Zhu, L. Lin, arXiv: 2411.08741
- *Renormalization of States and Quasiparticles in Many-body Downfolding*, A. Canestraight, **Z. Huang**, V. Vlček, L. Lin The Journal of Chemical Physics 163.2, 2025
- *Real-time propagation of adaptive sampling selected configuration interaction wave function*, A. Shee, **Z. Huang**, K. B. Whaley, M. Head-Gordon, *The Journal of Chemical Physics* 162.12, 2025
- Apppendix to *Classical–quantum correspondence in Lindblad evolution*, **Z. Huang**, M. Zworski, J. Math. Phys. 66, 091503 (2025)
- *Quasi-Lindblad pseudomode theory for open quantum systems*, G. Park, **Z. Huang**, Y. Zhu, C. Yang, G. K.-L. Chan, L. Lin, *Physics Review B*, 110 (19), 195148, 2024.

- *Decomposing imaginary-time Feynman diagrams using separable basis functions: Anderson impurity model strong coupling expansion*, J. Kaye, **Z. Huang**, H. Strand, D. Golež. *Physics Review X* 14, 031034, 2024.
- *Stochastic Schrödinger equation approach to real-time dynamics of Anderson–Holstein impurities: An Open Quantum System Perspectives*, **Z. Huang**, L. Xu, Z. Zhou, *J. Chem. Theory Comput.* 20 (2), 946-962, 2024.
- *Robust analytic continuation of Green's functions via projection, pole estimation, and semidefinite relaxation*, **Z. Huang**, E. Gull, L. Lin, *Physics Review B* 107, 075151, 2023.
- *Revealing Excited States of Rotational Bose-Einstein Condensates*, J. Yin, **Z. Huang**, Y. Cai, Q. Du, L. Zhang, *The Innovation* 5 (1).
- *Efficient Frozen Gaussian Sampling Algorithms for Nonadiabatic Quantum Dynamics at Metal Surfaces*, **Z. Huang**, L. Xu, Z. Zhou, *J. Comp. Phys.* 474 (2023).
- *Constrained High-index Saddle Dynamics for Constructing a solution landscape with Equality constraints*, J. Yin, **Z. Huang** and L. Zhang, *J. Sci. Comput.* 91 (2022), 62.

Open software

- **Soehyb**: ***main developer***, with J. Kaye, H. Strand and D. Golez.
  Generic fast C++ multiband impurity solver based on hybridization expansion. Highlights are multi-band, beyond low-order diagrams, and fast deterministic evaluation through optimal compression and parallelization.
- **Adapol**: ***main developer***, with C. Yeh, L. Lin, J. Kaye, N. Wentzell.
  Python package for adaptive pole-fitting of Matsubara functions. Supports hybridization fitting and analytic continuations for both bosonic and fermionic functions.

Selected honors and awards

2025 *Friedman memorial prize in Applied Mathematics*, UC Berkeley

2021 *Outstanding Graduates*, Peking University

2016 *Gold medalist*, Chinese Mathematical Olympiad

Presentations

2025 Nov: Matrix computations seminar, Simons institute, UC Berkeley.

2025 May: Research seminar, Center for Computational Quantum Physics, Flatiron institute.

2025 March: SciDAC seminar, zoom.

2025 March: APS Global summit, Anaheim.

2024 Oct: SciDAC seminar, zoom.

2024 Oct: SIAM Northern and Central California Section conference, Merced.

2024 July: TRIQS conference, Collége de France, Paris.

2024 March: APS March Meeting, Minneapolis.

2023 Sep: Pitzer Center Theoretical Chemistry Seminar, Department of Chemistry, UC Berkeley.

2023 August: Flatiron institute, New York.

2023 March: APS March Meeting, Las Vegas.

2022 Sep: SciDAC seminar, zoom.

Teaching and mentoring experiences

2025 Fall: Complex analysis, DRP program, UC Berkeley.

2025 Spring: Introduction to quantum computing, DRP program, UC Berkeley.

2024 Fall: Tensor computations, DRP program, UC Berkeley.

2024 Spring: Stochastic sampling and stochastic differential equations, DRP program, UC Berkeley.

2022 Fall: Multivariable calculus, UC Berkeley.

2021 Fall: Calculus, UC Berkeley.

Specialized Skills

Programming languages: Python, C, C++, Matlab, Julia
Languages: English, Mandarin