

Lei Zhang

lzphy@umich.edu

EDUCATION

University of Michigan (USA)

Sept. 2020 – present

Ph.D. in Physics

University of Science and Technology of China (China)

Sept. 2015 – Jul. 2019

Bachelor in Physics

EXPERIENCE

Research Assistant

Sept. 2020 – present

University of Michigan, MI, USA

- Controlled Analytic Continuation from Matsubara data
 - * Introduced a controlled approach for numerical analytic continuation.
 - * Developed a compact representation to efficiently compress Matsubara data with minimal degrees of freedom.
 - * Created the [PronyAC](#) and [MiniPole](#) libraries for analytic continuation.
- Real-frequency fitting for spectral functions
 - * Developed a method to achieve high-precision fitting of the real-frequency spectral function using a minimal number of complex poles
 - * Resolved artificial parameter dependencies and other limitations inherent in existing methodologies
- Non-crossing and one-crossing approximations for quantum impurity models
 - * Developed C++ code for non-crossing and one-crossing approximations
 - * Utilized various schemes such as block-diagonalization and non-uniform mesh to speed up the computation
 - * Ran simulations for systems with spin-orbit coupling
- Inchworm algorithm for multi-orbital steady-state impurity models
 - * Studied inchworm algorithm for non-equilibrium system
 - * Participated in the development of the InchMOSS project

Research Assistant

Jul. 2017 – Jul. 2020

University of Science and Technology of China, AH, China

- Loop-Cluster algorithm for q -state Potts model
 - * Presented the solution to couple different representations of the q -state Potts model
 - * Formulated a novel Monte Carlo algorithm: Loop-Cluster (LC) algorithm
 - * Proposed an efficient method to carry out simulations
- Graphical representations and worm algorithms for the $O(N)$ spin model
 - * Presented a variety of graphical representations for the classical $O(N)$ spin model
 - * Formulated corresponding worm algorithms to perform simulations
 - * Explored the dynamic properties of these algorithms

PUBLICATIONS

- **“Minimal pole representation for spectral functions”**,
by **Lei Zhang**, André Erpenbeck, Yang Yu and Emanuel Gull,
available on 1 April 2025 by [arXiv:2504.01163](#).
- **“Minimal pole representation and analytic continuation of matrix-valued correlation functions”**,
by **Lei Zhang**, Yang Yu and Emanuel Gull,
published on 12 December 2024 by [Phys. Rev. B 110, 235131 \(2024\)](#) [Editors’ Suggestion].
- **“Green/WeakCoupling: Implementation of fully self-consistent finite-temperature many-body perturbation theory for molecules and solids”**,
by Sergei Isakov, Chia-Nan Yeh, Pavel Pokhilko, Yang Yu, **Lei Zhang**, Gaurav Harsha, Vibin Abraham, Ming Wen, Munkhorgil Wang, Jacob Adamski, Tianran Chen, Emanuel Gull and Dominika Zgid, published by [Comput. Phys. Commun. 306, 109380 \(2025\)](#).
- **“Steady-state properties of multi-orbital systems using quantum Monte Carlo”**,
by Andre Erpenbeck, Thomas Blommel, **Lei Zhang**, Wei-Ting Lin, Guy Cohen and Emanuel Gull, published on 4 September 2024 by [J. Chem. Phys. 161, 094104 \(2024\)](#).
- **“Feynman diagrammatics based on discrete pole representations: A path to renormalized perturbation theories”**,
by Daria Gazizova, **Lei Zhang**, Emanuel Gull and JPF LeBlanc,
published on 27 August 2024 by [Phys. Rev. B 110, 075158 \(2024\)](#).
- **“Minimal Pole Representation and Controlled Analytic Continuation of Matsubara Response Functions”**,
by **Lei Zhang** and Emanuel Gull,
published on 24 July 2024 by [Phys. Rev. B 110.035154 \(2024\)](#).
- **“Tensor train continuous time solver for quantum impurity models”**,
by A. Erpenbeck, W.-T. Lin, T. Blommel, **L. Zhang**, S. Isakov, L. Bernheimer, Y. Núñez-Fernández, G. Cohen, O. Parcollet, X. Waintal and E. Gull,
published on 26 June 2023 by [Phys. Rev. B 107, 245135 \(2023\)](#).
- **“Graphical Representations and Worm Algorithms for the $O(N)$ Spin Model”**,
by Longxiang Liu*, **Lei Zhang***, Xiaojun Tan and Youjin Deng,
published on 10 November 2023 by [Commun. Theor. Phys. 75 115702 \(2023\)](#),
(*: equal contribution).
- **“Loop-Cluster Coupling and Algorithm for Classical Statistical Models”**,
by **Lei Zhang**, Manon Michel, Eren M. Elçi and Youjin Deng,
published on 12 November 2020 by [Phys. Rev. Lett. 125, 200603 \(2020\)](#).

PRESENTATIONS

Oral Presentations

- Loop-Cluster Coupling and Algorithm for Classical Statistical Models:
APS March Meeting 2021 (Online) and 2022 (Chicago)
- Controlled analytic continuation of Matsubara correlation functions using minimal pole representation:
APS Global Physics Summit 2025 (Anaheim) (Condensed Matter community)

- A fresh look at the analytic continuation problem: insights from the minimum information principle and from Nevanlinna theory:
APS Global Physics Summit 2025 (Anaheim) (Lattice QCD community)

Poster Presentations

- Application of the Prony Method in Analytic Continuation:
Autumn School on Correlated Electrons, Jülich, Germany, 2023
MQC Entanglement Conference, Lansing, MI, USA, 2024

TECHNICAL SKILLS

Programming Languages: Python, C++, Fortran, MATLAB, Julia, Java, Mathematica

Libraries and Tools: NumPy, Matplotlib, mpmath, Eigen, CMake, Git, $\LaTeX$, TikZ, Gnuplot