SHI FENG

TUM Physics Department, James-Franck-Str. 1, 85748 Garching, Germany
(+49) 152 5628 7360 • shi.feng@tum.de • fengshi96.github.io

Education and Qualification

Technical University of Munich — **Garching, Germany**
Postdoctoral Fellow in Quantum Matter and Quantum Information Theory Group — *2024–Present*
- Advisors: M. Knap, J. Knolle and F. Pollmann

The Ohio State University — **Columbus, Ohio, USA**
Ph.D in Theoretical Condensed Matter Physics — *2018–2024*
- Advisor: N. Trivedi
- Dissertation: Fractionalization in Frustrated Quantum Matter

Xi'an Jiaotong University — **Xi'an, Shaanxi, China**
B.S. in Physics (Honors Program), Qian Xuesen College — *2014–2018*
- Visiting student in UCR and UCLA, 2016-2017

Interest and Expertise

1. Theoretical study of quantum spin liquids and topologically ordered matter
2. Non-equilibrium quantum dynamics, non-linear response and their application in condensed matter
3. Anderson localization, many-body localization, super-/sub-diffusion and anomalous transport
4. Quantum magnetism and frustrated systems: phase transitions, spin and energy transport
5. Tensor network methods for many-body systems: MPS, DMRG, time-evolution of tensor-network states
6. Statistical models and machine learning methods relevant for condensed matter theory

Publications and Preprints

1. *FFT-accelerated auxiliary variable MCMC for fermionic lattice models: a determinant-free approach with $O(N \log N)$ complexity*
   D. Kong, **S. Feng**, J. Xie, Y. N. Wu
   arXiv:2510.13866 (2025)
2. *Transient localization from fractionalization: vanishingly small conductivity in gapless quantum magnets*
   S. Feng, P. Zhu, J. Knolle, M. Knap
   arXiv:2509.07062 (2025)
3. *Finite spinon density-of-states in triangular-lattice delafossite $TlYbSe_2$*
   B. Belbase, A. Unnikrishnan, **S. Feng**, E. S. Choi, J. Knolle, A. Banerjee
   arXiv:2504.05436 (2025)
4. *Obstruction to broken symmetries in topological flat bands*
   P. Zhu, **S. Feng**, Y.-M. Lu
   Phys. Rev. B 111, L161411 (2025)
5. *Emergent quantum Majorana metal from a chiral spin liquid*
   P. Zhu[†], **S. Feng**[†], K. Wang[†], T. Xiang, N. Trivedi ([†]*Contributed Equally*)
   Nat. Commun. 16, 12345 (2025)
6. *Fractionalization signatures in the dynamics of quantum spin liquids*
   K. Wang[†], **S. Feng**[†], P. Zhu, R. Chi, H. Liao, N. Trivedi, T. Xiang ([†]*Contributed Equally*)
   Phys. Rev. B 111, L100402 (2025), *Editor's Suggestion*
7. *Spin-orbit coupling controlled 2D magnetism in chromium trihalides*
   I. Lee, J. Chen, O. Molchanov, **S. Feng**, W. Huey, J. Tol, J. Goldberger, N. Trivedi, H.-Y. Kee, P. C. Hammel
   arXiv:2405.16709 (2024)

8. *Dimensional reduction of Kitaev spin liquid at quantum criticality*
   S. Feng, A. Agarwala, N. Trivedi
   Phys. Rev. Research 6, 013298 (2024)
9. *Hidden subsystem symmetry protected states in competing topological orders*
   S. Feng
   Phys. Rev. B 109, 075151 (2024)
10. *Machine learning reveals features of spinon Fermi surface*
    K. Zhang, **S. Feng**, Y. D. Lensky, N. Trivedi, E. A. Kim
    Commun. Phys. 7, 54 (2024)
11. *A statistical approach to topological entanglement: Boltzmann machine representation of high-order correlation*
    S. Feng, D. Kong, N. Trivedi
    arXiv:2302.03212 (2023)
12. *Anyon dynamics in field-driven phases of the anisotropic Kitaev model*
    S. Feng, A. Agarwala, S. Bhattacharjee, N. Trivedi
    Phys. Rev. B 108, 035149 (2023)
13. *Detection of long-range entanglement in gapped quantum spin liquids by local measurements*
    S. Feng, Y. He, N. Trivedi
    Phys. Rev. A 106, 042417 (2022)
14. *Gapless to gapless phase transitions in quantum spin chains*
    S. Feng, G. Alvarez, N. Trivedi
    Phys. Rev. B 105, 014435 (2022)
15. *Magnetic phase transitions in quantum spin-orbital liquids*
    S. Feng, N. D. Patel, P. Kim, J. H. Han, N. Trivedi
    Phys. Rev. B 101, 155112 (2020)
16. *Film-depth-dependent Crystallinity for Light Transmission and Charge Transport in Semitransparent Organic Solar Cells*
    T. Xiao, J. Wang, S. Yang, Y. Zhu, D. Li, Z. Wang, **S. Feng**, L. Bu, X. Zhan, G. Lu
    Journal of Materials Chemistry, A, 2020, 8, 401 (2020)
17. *Rapidly measuring charge carrier mobility of organic semiconductor films upon a point-contact four-probes Method*
    D. Li, S. Li, W. Lu, **S. Feng**, P. Wei, Y. Hu, X. Wang, G. Lu
    IEEE J-EDS 2018.2872714 (2018)
18. *Film-depth-dependent light absorption and charge transport for polymer electronics: A Case Study on Semiconductor/Insulator Blends by Plasma Etching*
    L. Bu, S. Gao, W. Wang, L. Zhou, **S. Feng**, X. Chen, D. Yu, S. Li, G. Lu
    Adv. Electron. Mater 2:1600359 (2016)

Research Experiences

Technical University of Munich — **Garching, Germany**
Postdoctoral Fellow — *2024 - Present*
Advisors: Michael Knap, Johannes Knolle and Frank Pollmann
- Topological physics in fractal and amorphous crystals
- Disorder-free localization and many-body localization
- Dynamical signatures of fractionalization
- Quantum spin liquid candidates in rare-earth delafossite
- Machine learning assisted QMC algorithms for condensed matter theory

The Ohio State University — **Columbus, OH, USA**
Graduate Research Assistant and Fellow — *2018–2024*

Advisor: Nandini Trivedi
- Theory of topological quantum matter: quantum spin liquid and Kitaev honeycomb model; detection of fractionalization; linear and non-linear response of fractionalized particles; spinon Fermi surface
- Quantum information: (topological) quantum entanglement, stabilizer code, cluster state, lattice gauge theory.
- Magnetism: quantum phase transitions and fractionalization in one dimensional frustrated systems
- Numerical methods: Exact diagonalization, matrix product states, density matrix renormalization group, time-evolving block decimation
- Statistical methods and machine learning approach to quantum many-body physics: Restricted Boltzmann machine, convolution neural network

Xi'an Jiaotong University **Xi'an, Shaanxi, China**
Undergraduate Research Assistant *2017 - 2018*
Advisor: Prof. Guanghao Lu
- Transfer matrix method for light absorption in semiconductor
- In-situ reconstruction algorithm for semiconductor nano-tomography

University of California, Los Angeles **Los Angeles, CA, USA**
Cross-disciplinary Scholars in Science and Technology *2017-2018*
Advisor: Prof. Hongwen Jiang
- Monte Carlo simulation of electron beam induced defects in SiO_2
- Nano-imprint lithography of MOS quantum dots

University of California, Riverside **Riverside, CA, USA**
Undergraduate Research Assistant *2016-2017*
Advisor: Prof. Marc Bockrath
- Nano fabrication and the analysis of electronic transport in twisted bilayer graphene

Invited Presentations

1. *Conference talk: Thermal paradox in quantum spin liquids*,
   44th International Conference on Strongly Correlated Systems -
   - Correlations and Coherence at Different Scales, Ustroń, Poland, 2025
2. *Seminar: From Z_2 gauge theory to quantum Majorana metal*,
   Wrocław University of Sicence and Technology, Wrocław, Poland, 2025
3. *Seminar: Dynamical features of quantum spin liquids*,
   Institute of Physics, Chinese Academy of Sciences, Beijing, China, 2024
4. *Lecture: Frustrated magnetism and quantum spin liquid*,
   Topology and Fractionalization in Magnetic Materials, Columbus, Ohio, USA, 2023

Other Conferences and Workshops

Sep. 2025: **International Workshop on Constrained Quantum Matter**, Ettal, Germany
- Poster: Anderson localization in the dynamical response of quantum magnets

Mar, 2025: **DPG Spring Meeting**, German Physical Society
- Contributed Talk: Emergent quantum Majorana metal from a chiral spin liquid

Jun, 2024: **Gordon Research Conference: Correlated Electron Systems**, Mt. Holyoke College, MA, USA
- Poster: Majorana metal from a chiral spin liquid

Mar, 2024: **APS March Meeting**, American Physical Society
- Contributed Talk: Mobility constraint of anyons in a quantum spin liquid

Oct, 2023: **Q-PHORIA**, Pittsburgh Quantum Institute, Pittsburgh, PA, USA
- Poster: Dimensional reduction of quantum spin liquids

Jul, 2023: **Boulder Summer School – Non-Equilibrium Quantum Dynamics**, CU Boulder, CO, USA
- Poster: Anyon response in field-induced quantum spin liquids

May, 2023: **TopoMag23 – Topology and Fractionalization in Magnetic Materials**, Columbus, Ohio, USA
- Poster: Anyon response in field-induced quantum spin liquids

Apr, 2023: **Topology, Symmetry and Interactions in Crystals**, KITP-UCSB, California, USA

- Poster: Dynamics of Abelian anyons in the Kitaev model

Mar, 2023: **APS March Meeting**, American Physical Society

- Contributed Talk: Transition from Kitaev quantum spin liquid to weakly coupled critical spin chains

Feb, 2023: **Edward F. Hayes Advanced Research Forum**, OSU, Ohio, USA

- Contributed Talk: Anyon, fractionalization, and their detection

Jun, 2022: **Gordon Research Conference: Correlated Electron Systems**, Mt. Holyoke College, MA, USA

- Poster: Discovery of novel topological phase in Kitaev spin liquid in a field

Mar, 2022: **APS March Meeting**, American Physical Society

- Contributed Talk: Spin response and magnetic absorption of Kitaev liquids under an external field.

Mar, 2021: **APS March Meeting**, American Physical Society

- Contributed Talk: Field-induced gapless-to-gapless phase transitions in integer spin chains.

Aug, 2020: **Ultra Quantum Matter**, Perimeter Institute for Theoretical Physics, Waterloo, Canada

Jun, 2020: **Condensed Matter Physics in all Cities**, University of Kent Canterbury, Kent, UK

- Contributed Talk: Magnetic phase transition in quantum spin orbital liquid.

Honors and Awards

2024: **The Chinese Government Award for Outstanding Students Abroad**, Chinese Consulate in NY, USA

- The highest award granted by the Chinese government to Chinese students overseas

2023: **Presidential Fellowship**, *OSU*, Columbus, OH, USA

- The Presidential Fellowship is the most prestigious award given by the Graduate School of OSU, embodying the highest standards of scholarship in the full range of Ohio State's graduate programs

2023: **Dirac Fellowship** (offer declined), University of Florida & National MagLab, Florida, USA

2023: **2nd place, Edward F. Hayes Advanced Research Forum**, *OSU*, Columbus, OH, USA

2018: **Siyuan Scholarship**, *XJTU*, Xi'an, Shaanxi, China

- Awarded to undergraduate students for their academic excellence

2017: **CSST Scholarship**, *UCLA*, Los Angeles, CA, USA

- Awarded in the UCLA-CSST program for cross-disciplinary scholars in science and technology

2016: **Meritorious Winner** of Interdisciplinary Contest in Modelling, Bedford, MA, USA

2016: **1st Place Award** of China Mathematical Contest in Modelling, Xi'an, Shaanxi, China

Academic Service

Peer Reviewer

- American Physical Society: Physical Review Letters; Physical Review Applied; Physical Review A; Physical Review B; Physical Review E
- IOP Publishing: Reports on Progress in Physics
- Springer Nature Group: Nature Communication
- Others: Quantum Information & Computation

Teaching

Department of Physics, Technical University of Munich — **Garching, Germany**
Lecturer — *Summer, 2025*

- Advanced Methods in Quantum Many-Body Theory (Topics on Lattice Gauge Theory)

Department of Physics, The Ohio State University — **Columbus, OH, USA**
Graduate Teaching Assistant — *2018-2021*

- Statistical Mechanics (Fall 2021)
- Introductory Physics – Electromagnetism, Optics, Modern Physics (Spring 2020)
- Introductory Physics – Mechanics, Thermal Physics, Waves (Fall 2019)
- Introductory Physics – Mechanics, Kinematics, Fluids, Waves (Spring 2019)
- Statistical Mechanics (Fall 2018)

Mentored Students

Department of Physics, The Ohio State University **Columbus, OH, USA**
Undergraduate Students *2020-2022*

- Cullen Gantenberg (Dynamics of Abelian anyons in toric code, 2022) → PhD in University of Washington
- Seth Cox (Density matrix renormalization study of spin liquids, 2022) → PhD in Boston University

Technical Skills

Code Library: Developer and maintainer of
- ExactDiagPy: Exact diagonalization with implementation of various quantum entanglement measures

Programming Languages: Python, Julia, C++, Perl, Matlab, Mathematica, Java, Bash

Libraries and Softwares:
- Eigen, TenPy, DMRG++, ITensor, HDF5, OpenGL, Blas, Lapack; Blender, Inkscape

OS and Clusters:
- OS: Linux (Ubuntu), Windows, macOS, High Performance Computing (HPC) environments
- Clusters: Unity and Ohio Supercomputer Center (OSC)

References

Frank Pollmann
Professor, Physics,
TUM, Germany
frank.pollmann@tum.de

Michael Knap
Professor, Physics
TUM, Germany
michael.knap@tum.de

Johannes Knolle
Professor, Physics,
TUM, Germany
johannes.knolle@tum.de

Nandini Trivedi
Professor, Physics,
Ohio State, USA
trivedi.15@osu.edu

Tao Xiang
Professor, Physics,
IOP, CAS, China
txiang@iphy.ac.cn

Eun-Ah Kim
Professor, Physics,
Cornell University, USA
ek436@cornell.edu

Arnab Banerjee
Professor, Physics
Purdue University, USA
arnabb@purdue.edu

Subhro Bhattacharjee
Professor, Physics
ICTS, Tata Institute, India
subhro@icts.res.in

Ying Nian Wu
Professor, Statistics
UCLA, USA
ywu@stat.ucla.edu