# SHI FENG

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## Education and Qualification

**Technical University of Munich**                                      **Garching b. München, Germany**

Postdoctoral Fellow in Condensed Matter and Quantum Information Theory                      *2024 – present*
- Advisors: M. Knap, F. Pollmann and J. Knolle

**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 University of California, Riverside, 2016
- Visiting scholar in University of California, Los Angeles, 2017

## Interest and Expertise

1. Theoretical study of quantum spin liquids and topologically ordered matter
2. Quantum magnetism and frustrated systems: phase transitions, dynamics, and response theory
3. Quantum information, non-equilibrium quantum dynamics and their application in condensed matter
4. Tensor network methods for many-body systems: MPS, DMRG, TEBD, etc
5. Statistical models and machine learning methods relevant for condensed matter theory

## Publications and Preprints

1. *Obstruction to broken symmetries in topological flat bands*
   P. Zhu, **S. Feng**, Y.-M. Lu
   arXiv:2408.14533 (2024)

2. *Emergent Majorana metal in from a chiral spin liquid*
   P. Zhu*, **S. Feng***, K. Wang*, T. Xiang, N. Trivedi
   arXiv:2405.12278 (2024)

3. *Fractionalization signatures in the dynamics of quantum spin liquids*
   K. Wang*, **S. Feng***, P. Zhu, R. Chi, H. Liao, N. Trivedi, T. Xiang
   arXiv:2403.12141 (2024)

4. *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)

5. *Dimensional reduction of Kitaev spin liquid at quantum criticality*
   **S. Feng**, A. Agarwala, N. Trivedi
   Phys. Rev. Research 6, 013298 (2024)

6. *Hidden subsystem symmetry protected states in competing topological orders*
   **S. Feng**
   Phys. Rev. B 109, 075151 (2024)

7. *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)

8. *A statistical approach to topological entanglement: Boltzmann machine representation of high-order correlation*
   **S. Feng**, D. Kong, N. Trivedi
   arXiv:2302.03212 (2023)

9. *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)

10. *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)

11. *Gapless to gapless phase transitions in quantum spin chains*
    **S. Feng**, G. Alvarez, N. Trivedi
    Phys. Rev. B 105, 014435 (2022)

12. *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)

13. *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)

14. *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)

15. *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

**The Ohio State University**                                                       **Columbus, OH, USA**
*Graduate Research Assistant and Fellow*                                                         *2018–2024*
Advisor: Nandini Trivedi
- Theory of topological order: quantum spin liquid and Kitaev honeycomb model; detection of fractionalization; linear and non-linear response of fractionalized particles; projected symmetry group.
- 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: Guanghao Lu (Frontier Institute of Science and Technology)
- 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*                                          *Summer 2017*
Advisor: Hongwen Jiang (Department of Physics & Astronomy)
- 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*                                                               *Fall 2016*
Advisor: Marc Bockrath (Department of Physics & Astronomy)
- Nano fabrication and the analysis of electronic transport in twisted bilayer graphene

## Conferences

**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**: **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

## Other Academic Experience

**Reviewer for**: Phys. Rev. Appl.; Phys. Rev. B, E; Quantum Inf. Comput.

**Invited Talks/Lectures**:

- Invited lecture for TopoMag23 conference: Frustrated magnetism and quantum spin liquid, Columbus, Ohio, USA, 2023

- Invited seminar: Dynamical features of quantum spin liquids, Institute of Physics, Chinese Academy of Sciences, Beijing, China, 2024

## Teaching Experiences

**Department of Physics, OSU** <span style="float:right">**Columbus, OH, USA**</span>

*Graduate Teaching Assistant* <span style="float:right">*2018-2021*</span>

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

## Technical Skills

**Projects**: 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: OSU Unity and Ohio Supercomputer Center (OSC)

## References

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|---|---|---|
| Nandini Trivedi | Subhro Bhattacharjee | Eun-Ah Kim |
| Professor, Physics, | Professor, Physics | Professor, Physics, |
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