

# SHI FENG

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## Education

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### The Ohio State University (OSU)

Columbus, Ohio, USA

Ph.D in Condensed Matter Theory

2018–Present

◦ Advisor: Nandini Trivedi

◦ Thesis: Fractionalization and entanglement in frustrated systems

### Xi'an Jiaotong University (XJTU)

Xi'an, Shaanxi, China

B.S. in Physics

2014–2018

◦ Honors Science Program (Physics), Qian Xuesen College

◦ Visiting Student in University of California, Riverside (UCR), 2016

## Interest & Expertise

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

## Publications & Preprints

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1. *Dimensional reduction of Kitaev spin liquid at quantum criticality*  
**S. Feng**, A. Agarwala, N. Trivedi  
[arXiv:2308.08116](https://arxiv.org/abs/2308.08116) (2023)
2. *Machine learning feature discovery of spinon Fermi surface*  
K. Zhang, **S. Feng**, Y. D. Lensky, N. Trivedi, E. A. Kim  
[arXiv:2306.03143](https://arxiv.org/abs/2306.03143) (2023)
3. *A statistical approach to topological entanglement: Boltzmann machine representation of higher-order correlation*  
**S. Feng**, D. Kong, N. Trivedi  
[arXiv:2302.03212](https://arxiv.org/abs/2302.03212) (2023)
4. *Anyon dynamics in field-driven phases of the anisotropic Kitaev model*  
**S. Feng**, A. Agarwala, S. Bhattacharjee, N. Trivedi  
[Phys. Rev. B 108, 035149](https://arxiv.org/abs/2305.14949) (2023)
5. *Detection of long-range entanglement in gapped quantum spin liquids by local measurements*  
**S. Feng**, Y. He, N. Trivedi  
[Phys. Rev. A 106, 042417](https://arxiv.org/abs/2204.04241) (2022)
6. *Gapless to gapless phase transitions in quantum spin chains*  
**S. Feng**, G. Alvarez, N. Trivedi  
[Phys. Rev. B 105, 014435](https://arxiv.org/abs/2204.04241) (2022)
7. *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](https://arxiv.org/abs/2005.15511) (2020)
8. *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](https://doi.org/10.1021/acs.jmaterchem.1c01401) (2020)
9. *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 \(2018\)](#)

10. *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 \(2016\)](#)

#### In preparation:

1. Kinetic constraint and emergent dipole conservation in perturbed  $Z_2$  topological matter  
**S. Feng**, N. Trivedi
2. Non-linear pump-probe response of composite gauge fermions of  $Z_2$  topological order  
**S. Feng**, X. Yang, N. Trivedi

## Research Experiences

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### OSU

Columbus, OH, USA

*Graduate Research Assistant*

2018–Present

Advisor: Nandini Trivedi (Department of Physics, OSU)

- Theory of topological order: quantum spin liquid, Kitaev model, Toric code; detection of fractionalization and (long-range) entanglement; linear and non-linear response of fractionalized particles, emergent lattice gauge theory, anyon statistics, projected symmetry group.
- 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

### XJTU

Xi'an, Shaanxi, China

*Undergraduate Research Assistant*

2017 - 2018

Advisor: Guanghao Lu (Frontier Institute of Science and Technology, XJTU)

- Absorption and charge transport in semiconductor/insulator polymers
- Algorithm for the in-situ reconstruction of nano-tomography in conjugated polymers

### UCLA

Los Angeles, CA, USA

*Cross-disciplinary Scholars in Science and Technology*

2017

Advisor: Hongwen Jiang (Department of Physics and Astronomy, UCLA)

- Electron beam induced defects in  $\text{SiO}_2$  using Monte Carlo simulation
- Nano-imprint lithography of MOS quantum dots

### UCR

Riverside, CA, USA

*Undergraduate Research Assistant*

2016

Advisor: Marc Bockrath (Department of Physics, UCR)

- Nano fabrication and the analysis of electronic transport in twisted bilayer graphene

## Academic Activities

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Jul, 2023: [Boulder Summer School](#) – Non-Equilibrium Quantum Dynamics, Boulder, Colorado, 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
- Invited Lecture: Frustrated magnetism and quantum spin liquid

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: Strongly Correlated 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

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**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

## Teaching Experiences

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**Department of Physics, OSU**

**Columbus, OH, USA**

*Graduate Teaching Assistant*

*2018-2021*

- 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

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**Projects:** Developer and maintainer of

- **ExactDiagPy**: Exact diagonalization for a generic many body Hamiltonian in Python, 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

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