

# Langxu Bai

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## RESEARCH INTERESTS & PROFESSIONAL SUMMARY

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Quantum Information, Quantum Computing especially Quantum Machine Learning

My future research interests include the geometrical structure of quantum information and interpretable condensed matter statistics.

Coding Skills: C++, python(opencv, scipy, numpy, scikit-learn, pytorch), MATLAB and Mathematica; Other Tools: LaTeX, HTML, CSS, Markdown

## EDUCATION

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### Bachelor's Degree

Sept 2021 - Present

School of Physics, Nankai University, China

Major Grade: 86.6/100 Rank:18%

**Advanced Courses:** Advanced Quantum Mechanics, Advanced Physics Experiments, Lie Group Theory, Special Functions, Soft Condensed Matter Physics.

## RESEARCH EXPERIENCE

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### Investigating Presence and Absence of Barren Plateaus in Quantum Fisher Kernel

Oct 2023 - Present

Prof. Li-Wei Yu | *Chern Institute of Mathematics, Nankai University*

- Focused on the Barren Plateaus phenomenon in quantum fisher kernel algorithm in Matrix Product State systems.
- Encountered the Barren Plateaus phenomenon, where the training of quantum neural networks is impeded due to the vanishing of both the mean and variance of the loss function's gradient.
- Utilized the quantum Fisher kernel algorithm to compute the mean and variance corresponding to the Matrix Product State model under both local and global loss functions to assess whether the Barren Plateau phenomenon persists.
- Some notes on papers: Notes for Barren Plateaus in Quantum Neural Network Training Landscapes.

### Investigating Tensor Networks Algorithms in Quantum Physics and Machine Learning

July 2023 - August 2023

Prof. Pan Zhang | *Institute of Theoretical Physics, Chinese Academy of Sciences*

- Mastered the fundamentals of tensor networks theory, encompassing tensor decompositions such as Canonical Polyadic Decomposition, Tucker Decomposition, and Higher-Order Singular Value Decomposition.
- Gained proficiency in Density Matrix Renormalization Group algorithms, infinite DMRG, and a foundational understanding of tensor network construction and its diverse applications in quantum physics and machine learning.
- Acquired relevant skills in programming tools and software to classically simulate quantum processors efficiently using ITensor(C++) and JuliaTensor (Julia).

### Developing Gainless Parity-time Symmetric Optical System

May 2023 - Present

Prof. Huanan Li | *Nankai University*

- Focused on the realization of unique scattering phenomena in parity-time symmetric optical systems under evanescent wave excitations.
- Targeted on studying the effective Hamiltonian of the systems which is derived using the quasi-normal mode method.
- Simulated parity-time symmetric optical systems under evanescent wave excitations with Mathematica.

## ACADEMIC EXPERIENCE

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### Investigating Quantum Phase Transition in Open Quantum Systems

July 2023

Prof. Shu Chen | *Institute of Physics, Chinese Academy of Sciences*

- Learnt the basics of superconductivity theory including London Theory, Ginzburg-Landau Theory, BCS Theory, and Density Functional Theory.
- Accomplished the Monte-Carlo simulation of the two-dimensional Ising model, two-dimensional solution lattice model, and two-dimensional non-lattice Lennard-Jones interaction particle motion.

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<sup>1</sup>For the latest information, please visit my personal pages.

## Participating in Quantum Computing Talent Training Plan

June 2023 - Present

Prof. Zhaofeng Su | *University of Science and Technology of China*

- Quantum Computing Talent Training Plan is an honored program for quantum computing seminars organized by Prof. Su.
- Learnt the basics through the Chap. 1 - 6 of *Quantum Computation and Quantum Information*, Nielsen M A, Chuang I L.

## HONORS

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**Outstanding Student Award(awarded for top 10% students)** | *School of Physics, Nankai University*

Oct 2023

**Third Prize of Nankai University Young Physicists' Tournament** | *Nankai University*

May 2023

**Nankai University Scholarship** | *Nankai University*

Sept 2022