

Jizhe Lai

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Imperial College London

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EDUCATION

MSc in Quantum Fields and Fundamental Forces 09/2023-11/2024(expected)
Imperial College London London, United Kingdom

- A 12-month MSc courses in theoretical physics run by the Theoretical Physics Group of Imperial College London (**90 ECTS**).
- Awarded **Merit** upon completion of the program, including successful results from 8 written exams.
- **Completed courses:** Particle Symmetries, Quantum Field Theory, Quantum Electrodynamics (QFT II), Unification, Advanced Quantum Field Theory (QFT III), String, Supersymmetry, Black Holes, Differential Geometry.
- Writing a dissertation on generalized symmetry, higher representation and SymTFT (See details below).

BSc in physics 09/2019-06/2023
Sun Yat-sen University(SYSU) Guangzhou, China

- **GPA:**88/100
- **Courses completed:**Theoretical Mechanics (Honor Track), Quantum Mechanics, Advanced Quantum Mechanics, Group Theory in Physics, General Relativity and Gravity Theory, Optics, Methods of Mathematical Physics, Quantum Field Theory and introduction to Particle Physics (Honor Track) etc.

RESEARCH EXPERIENCE

Application of explainable artificial intelligence algorithm based on Class Activation Mapping and Layer-wise Relevance Propagation in radio Galaxy morphology classification 06/2021-09/2021
Team Research, Department of Astronomy, Tsinghua University, Supervisor: Postdoc. Hongming Tang Beijing, China

Goal: for the first time applied XAI to radio galaxy taxonomy, and horizontally compared different XAI tools.

- Pretreated data from FIRST telescopes and built FR-DEEP database;
- Built a modified version of AlexNet to classify the two types of radio galaxies;
- Implemented bayesian algorithm to adjust the parameters of the network and obtained 93% accuracy;
- Applied a total of 8 CAM XAI tools to get the decision-making focus on large scale;
- Applied LRP algorithm to get the decision-making focus on each pixels;
- Analyzed the explanation effort of 9 XAI tools with four indexes, CIC, Average Drop, Selectivity, Continuity;
- Published in IEEE, DOI:10.23919/URSIGASS57860.2023.10265388.

Postgraduate Student / MSc project – Generalized Symmetry and Generalized Charges 06/2024-10/2024
Imperial College London, Supervisor: Prof. Chris Hull, FRS London, United Kingdom

- Writing a review summarising the research frontier of generalized symmetry, including basic concept of higher-form symmetry, higher group symmetry and non-invertible symmetry;
- Concentrated on the theoretical framework and the mathematical details of higher representation of generalized symmetry and SymTFT;
- Calculated the mutual locality phases of line operators within the framework of SymTFT.

Probing the Quantum and Classical Boundary: A Tabletop Experiment Using Quantum Optics 08/2024-11/2024
Imperial College London London, United Kingdom

- Explored the phenomenon of wave function collapse, designing experiments using quantum optical systems and photomultiplier tubes to determine the number of electrons that disrupt "which-path information," leading to the collapse of quantum states as a boundary between quantum and classical;
- Designed an experimental setup employing Spontaneous Parametric Down-Conversion (SPDC) crystals to generate entangled photon pairs. Observed changes in double-slit diffraction patterns to analyze the transition from a quantum state to a classical state;
- Deepened understanding of the quantum decoherence process, also providing experimental evidence for potential theories of quantum gravity.
- Published in arXiv:2411.10347.

NonHermitian System and Conformal Field Theory 12/2022-04/2023
Independent Research, SYSU, Supervisor: Prof. Yiwen Pan Guangzhou, China

Goal: To analyze the relation between nonhermitian and CFT, and build new nonhermitian CFT

- Reviewed the nonhermitian system, PT symmetry and quantum groups theory;
- Built the Yang-Baxter equation from the Hopf algebra and related it to WZW model;
- Linked the non hermitian system and minimal model through fusion algebra;
- Analysed the relation of non unitary CFT and unitary CFT through Galois conjugation;
- Produced general entanglement entropy for non hermitian system using quantum trace.

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The flight path of a standard card

Team Research, SYSU, Supervisor: Dr. Zhencheng Huang

Goal: To analyze the stability and predict the trajectory of a rotating flying card

- Stimulated the distribution of stress of standard card in different flight attitude based on COMSOL;
- Obtained the distribution model of playing card force by symmetry analysis, and fitted the simulation data;
- Concluded that the stability of cards originates from the angular velocity, and gave the stability interval;
- Self-made card flying machine to control the initial angular velocity, elevation Angle and speed of card;
- Conducted 1000 experiments to obtain the real flight path and initial parameter of card;
- Implemented the theoretical flight path with initial conditions by Mathematica and compared the data from experiment, the margin of error between the predicted trajectory and the actual trajectory is within 30%.

12/2019-10/2020

Guangzhou, China

Joint Research on Dark Matter and Neutrinos

Independent Research, SYSU, Supervisor: Prof. Jian Tang

Goal: analyze the effect of neutrinos on the next generation Dark Matter Detector

- Implemented the dark matter direct detection energy spectrum;
- Treated the neutrino data to background energy spectrum;
- Obtained the neutrino floor on the next generation Dark Matter Detector.

10/2020-05/2021

Guangzhou, China

INTERNSHIP

Mathematical Science Engineer

Contemporary Amperex Technology Co. Ltd. (CATL) Shanghai Research Institute

- Participated in a project characterizing battery interfaces using electron microscopy, applying Python software packages py4DSTEM and abTEM for processing electron microscopy image data, and utilizing machine learning to accelerate data analysis;
- Responsible for coordinating the requirements and technical alignment across 4 battery development project teams;
- Learned and mastered the company's OA system, optimized internal workflows, thereby increasing the speed of project management at the Shanghai Research Institute by approximately 300%, significantly enhancing work efficiency.

11/2024-02/2025

Shanghai, China

COMPUTER LITERACY & LANGUAGES

- Programming languages:C(junior), LaTeX(advanced), Python(advanced):sklearn, PyTorch, Mathematica(advanced)
- languages:English(Advanced), Chinese(Native)

AWARD & HONOR

- National Second Prize (top 30% in 120 universities)in 2020 China Undergraduate Physics Tournament (CUPT) 10/2020
- Second Scholarship (top 20% in 8000 students) of Sun Yat-sen University 09/2020
- The Second Prize in the South China Division of S.T. Yau High School Physics Competition 11/2017

ACTIVITIES

Artificial Intelligence for Theoretical Sciences

Kavli ITS and IOP CAS

- Workshop about AI for science with an emphasis on applications to the theoretical sciences.

11-15/11/2024(expected)

Beijing, China

Organizer and Judge of Sun Yat-sen University Physics Test

SYSU

- Designed and decorated the test venue, rented and managed the equipment;
- Formulated test procedures, selection rules, and test contents;
- Provided physical knowledge training to the contestants, and imparted the competition experience.

12/2020

Guangzhou, China

Organizer of Home Appliance Maintenance-Public Service Activity

SYSU

- Mainly responsible for the maintenance of computers and related electronic equipment;
- Taught basic computer skills to older adults-adapting to their needs, such as typing, surfing, hardware assembling.

10/2018-06/2022

Guangzhou, China