

Ziyu He

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EDUCATION

Sun Yat-sen University, Guangzhou, China

Sep 2021 – Jun 2025 (Expected)

Bachelor of Science in Physics

GPA: 4.0/4.0, Rank: 4/94

Shenzhen Middle School, Shenzhen, China

Sep 2018 – Jun 2021

First Prize in the Chinese Physics Olympiad (CPhO), ranking top 0.1% in Guangdong Province

PUBLICATIONS

- Rui-Yang Gong*, **Zi-Yu He***, Cheng-He Yu, Ge-Fei Zhang, Franco Nori, and Ze-Liang Xiang[†], “Tunable quantum router with giant atoms, implementing quantum gates, teleportation, non-reciprocity, and circulators,” (Manuscript in preparation for submission to PRX Quantum). Preprint available at: arXiv:2411.19307.

RESEARCH EXPERIENCE

Experimental Survey of Giant Atom in Superconducting Circuits

Aug 2024 – Oct 2024

Supervisor: Prof. Zhihui Peng, Hunan Normal University

- Calibrated qubit frequencies and analyzed current-to-frequency relationships via dispersive readout, enabling precise system parameter characterization for enhanced control.
- Developed and implemented an automated spectrum recognition script using dynamic programming in Python, increasing efficiency by 80% compared to the manual point-picking method.
- Verified resonance fluorescence in an artificial giant atom coupled to a coplanar waveguide via power spectral density measurements.

Fitting the ToF of the 2D Er Ultracold Atom

Jul 2024 – Aug 2024

Supervisor: Prof. Gyu-Boong Jo, Hong Kong University of Science and Technology

- Developed Hartree-Fock-based Python scripts to calculate the occupation distribution of interacting atoms, enhancing applicability to strongly interacting systems and broadening the scope of simulations.
- Modeled thermal swing Time-of-Flight distribution in Python, achieving 98% fit accuracy to experimental data.
- Identified the condensed and thermal phase, enabling accurate temperature and chemical potential extraction.
- Modeled the generation of flying cat states and preparation of multi-mode entangled cat states in a nonlinear waveguide via the driven-dissipation method, providing a foundation for new research directions.

Analytical and Numerical Study of Photons in Nonlinear Waveguide

May 2024 – Jul 2024

Supervisor: Prof. Xueyue (Sherry) Zhang, Columbia University

- Calculated two-photon subspace energy spectrum, uncovering bound states in the nonlinear waveguide.
- Explored parameter adjustments in the nonlinear waveguide and emitters to facilitate two-photon interactions, inducing novel phenomena like effective four-body interactions and supercorrelated radiance.
- Calculated the two-photon quantum walk in the waveguide, investigating the dynamics of photon pairs.
- Modeled the generation of flying cat states and preparation of multi-mode entangled cat states in a nonlinear waveguide via the driven-dissipation method, contributing to the initiation of Prof. Zhang’s research projects.

Numerical Study of Quantum Pulse Interaction with Localized Quantum Systems Dec 2023 – Mar 2024

Supervisor: Prof. Zeliang Xiang, Sun Yat-sen University

- Developed waveguide QED simulation protocols using the QuTiP library, optimizing computational complexity from $O(N^3)$ to $O(N^2)$ for efficient correlation function analysis.
- Verified Schrödinger cat state generation numerically, aligning with key theoretical predictions.
- Supplied simulation scripts to experimental teams, enabling practical quantum control in microwave photonics.

Tunable Quantum Router in a Dual-Rail Quantum Network via Giant Atom

Nov 2022 – May 2024

Supervisor: Prof. Zeliang Xiang, Sun Yat-sen University, Prof. Franco Nori, RIKEN

- Designed a tunable quantum router based on a three-level giant atom coupled to a dual-rail waveguide in superconducting circuits, enhancing scalability and integration in quantum networks.
- Applied the Bethe ansatz method to calculate the scattering amplitude of incident photons analytically.
- Discovered chiral and nonreciprocal scattering behaviors of the photons and proposed further applications in high-fidelity quantum routing, quantum gates, and quantum circulators through parameter tuning.
- Authored a manuscript presenting these findings, prepared for submission to a peer-reviewed journal.

CONTESTS

China Undergraduate Physics Tournament (CUPT) Nov 2021 – Oct 2022

Team Captain, Instructor: Prof. Jian Tang, Sun Yat-sen University

- Led a 12-member team to solve 17 complex physics problems, achieving a top 5 national ranking—the best ranking in Sun Yat-sen University’s 12-year history of participation.
- Directed weekly team meetings to coordinate theoretical modeling, experimental work, and data analysis, improving collaboration and efficiency.
- Spearheaded the ‘Droplet Explosion’ project, modeling the wetting dynamics of water-ethanol solutions and instability at three-phase contact lines using COMSOL Multiphysics.

AWARDS

National Scholarship Oct 2024

Top 1% in Physics major, Sun Yat-sen University.

First Prize of SYSU Outstanding Student Scholarship Dec 2022, Nov 2023, Oct 2024

Top 5% in Physics major, Sun Yat-sen University.

Outstanding Student Organization Leader Oct 2023

Top leaders in student organizations & clubs at Sun Yat-sen University.

First Prize in the 13th CUPT Oct 2022

Ranked 5th nationwide.

First Prize in the National Undergraduate Mathematical Contest in Modelling Sep 2022

Top 5% in Guangdong Province Division.

First Prize in the 13th CUPT (South Central China) Jun 2022

Ranked 1st in South Central China.

Best Player in the 13th CUPT (South Central China) Jun 2022

Best individual performance in South Central China.

MEMBERSHIPS

Society of Physics Students, Sun Yat-sen University Guangzhou, China

Vice President

Sep 2022 – Jul 2023

- Organized 8 professor-led lectures on advanced physics research topics, fostering academic engagement within the department.
- Initiated and moderated student-led seminars, inviting over 20 students to share research methods and experiences.

SKILLS

Programming Languages: Python (Advanced), Mathematica (Advanced), C (Intermediate)

Software Tools: COMSOL Multiphysics, Origin, Git, LabVIEW, L^AT_EX

CONFERENCES

The 21st Chinese Quantum Optics Conference Fuzhou, China

“Tunable Quantum Router in a Dual-Rail Quantum Network via Giant Atom”

Aug 2024

Poster Presentation