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

RESEARCH INTEREST

Many-body Physics, Light-matter Interaction in Waveguide, Atom Dynamics

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," Preprint available at: arXiv:2411.19307.

RESEARCH EXPERIENCE

Experimental Survey of Giant Atom — Aug 2024 – Oct 2024
Supervisor: Prof. Zhihui Peng, Hunan Normal University

- Calibrated frequencies and analyzed current-to-frequency relationships via dispersive readout, enabling parameter characterization.
- Developed and implemented an automated spectrum recognition script using dynamic programming in Python, increasing efficiency 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 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.
- Addressed the challenge of directly obtaining temperature and chemical potential, removing the need for adiabatic evolution from a square to a harmonic potential well for the equation of state (EoS) measurement.

Analytical and Numerical Study of 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 walk in the waveguide, investigating the dynamics of photon pairs.
- Modeled the preparation of multi-mode states in a nonlinear waveguide via the driven-dissipation method, providing a foundation for new research directions.

Numerical Study of Pulse Interaction with Localized Systems — Dec 2023 – Mar 2024
Supervisor: Prof. Zeliang Xiang, Sun Yat-sen University

- Developed waveguide simulation protocols using python, optimizing computational complexity from $O(N^3)$ to $O(N^2)$ for efficient correlation function analysis.
- Verified pulse generation numerically, aligning with key theoretical predictions.

- Supplied simulation scripts to experimental teams, enabling practical control in pulse generation.

Tunable Router via Giant Atom Nov 2022 – May 2024
Supervisor: Prof. Zeliang Xiang, Sun Yat-sen University, Prof. Franco Nori, RIKEN

- Designed a tunable router based on a three-level giant atom coupled to a dual-rail waveguide.
- 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 routing, gates, and 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.
- Modeled 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 5^{th} 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 1^{st} 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, LaTeX