Ziyu He

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EDUCATION

Sun Yat-sen University, Guangzhou, China — 9.2021 — 6.2025 (Expected)
BS in Physics — **GPA: 4.0/4.0, Ranking: 4/95**
Shenzhen Middle School, Shenzhen, China — 9.2018 — 6.2021

RESEARCH INTERESTS

Superconducting Circuit, Ultracold Atom, Quantum Computation, Quantum Simulation, Quantum Optics

PUBLICATIONS

- Rui-Yang Gong, Zi-Yu He, Cheng-He Yu, Ge-Fei Zhang, Ze-Liang Xiang*, "Tunable quantum router in a dual-rail quantum network via giant atom" (in preparation for submission to Communication Physics)

RESEARCH EXPERIENCE

Experimental Survey of Giant Atom in Superconducting Circuits — 08.2024 — Current
Intern, Supervisor: Prof. Zhihui Peng, Hunan Normal University

- Conducting experiments on a transmon qubit capacitively coupled at two distinct points to a coplanar waveguide.
- Calibrated the transmon frequency and analyzed its relationship with the Z line bias using dispersive readout techniques.

Fitting the ToF of the 2D Yb Ultracold Atom — 07.2024 — 08.2024
Summer Research, Supervisor: Prof. Gyu-Boong Jo, Hong Kong University of Science and Technology

- Examined quasi-2D ultracold Yb gases confined in a strong z-direction harmonic potential and a square potential well in the xy-plane.
- Developed codes using the Hartree-Fock method to iteratively calculate the occupation distribution of interacting atoms in z-direction eigenlevels at finite temperature T and chemical potential μ.
- Computed the theoretical spatial distribution of the gases after Time of Flight (ToF), accounting for the finite time effect by integrating over initial positions.
- Develop scripts to fit experimental measurements with theoretical predictions, enabling determination of the sample's temperature and chemical potential.
- Analyzed experimental data by averaging multiple optical density measurements, successfully separating contributions from the condensed phase and the thermal cloud.

Analytical and Numerical Study of Photons in Nonlinear Waveguide — 05.2024 — 06.2024
Remote collaboration with Prof. Xueyue (Sherry) Zhang, Columbia University

- Calculated the energy spectrum for the two-photon subspace in a nonlinear waveguide constructed by a cavity array.
- Analyzed how nonlinear interactions contribute to the formation of two-photon bound states.
- Explored parameter adjustments in the nonlinear waveguide and emitters to facilitate two-photon interactions, inducing phenomena like effective four-body interactions and supercorrelated radiance.
- Modeled the generation of flying cat states under driven-dissipation conditions and investigated the potential for preparing entangled cat states in two cavities side-coupled to the nonlinear waveguide.

Numerical Study of Quantum Pulse Interaction with Localized Quantum Systems — 12.2023 — 03.2024
Research Assistant, Supervisor: Prof. Zeliang Xiang, Sun Yat-sen University

- Investigated the dynamics between incident light in various quantum states and localized quantum systems within a waveguide, utilizing the numerical method from Phys. Rev. Lett. 123, 123604 (2019).
- Developed Python scripts using the QuTiP library to simulate these dynamics, effectively reducing the computational complexity of correlation functions from $O(N^3)$ to $O(N^2)$.
- Reproduced key results, including pulse shaping of a cavity with phase noise and the generation of a flying Schrödinger cat state.
- Provided simulation scripts to an experimental group, facilitating their research in quantum control.

Tunable Quantum Router in a Dual-Rail Quantum Network via Giant Atom — 11.2022 — 12.2023
Research Assistant, Supervisor: Prof. Zeliang Xiang, Sun Yat-sen University

- Theoretically designed a tunable quantum router using a three-level giant atom in a dual-rail waveguide on a superconducting circuits platform.
- Applied the Bethe ansatz method to analytically calculate the scattering properties of incident photons interacting with the giant atom.
- Discovered chiral and nonreciprocal scattering behaviors, enabling high-fidelity quantum routing, quantum gates, and quantum circulators through parameter tuning.
- Investigated non-Markovian effects and their influence on the system's quantum device performance.
- Prepared a manuscript detailing our findings for submission to a peer-reviewed journal.

PROJECTS

China Undergraduate Physics Tournament 11.2021 — 10.2022
Team Captain

- Led a team of twelve to tackle seventeen physics problems, requiring theoretical modeling, experimental work, and data analysis, resulting in a comprehensive final report.
- Coordinated weekly team meetings to facilitate problem-solving and task distribution.
- Directed the 'Droplet Explosion' project, modeling the wetting dynamics of water-ethanol solutions and instability at three-phase contact lines, awarded Best Player for outstanding research contribution.

AWARDS

First Prize of SYSU Outstanding Student Scholarship 11.2023 & 12.2022
Top 5% in Physics major, Sun Yat-sen University.

First prize in the 13th China Undergraduate Physics Tournament 10.2022
Ranked 5^{th} nationwide, worked as a team captain.

First Prize in the National Undergraduate Mathematical Contest in Modelling 9.2022
Top 5% in Guangdong Province Division.

First prize in the 13th China Undergraduate Physics Tournament (South Central China) 6.2022
Ranked 1^{st} in the South Central China, worked as a team captain.

The Best Player in the 13th China Undergraduate Physics Tournament (South Central China) 6.2022
The best performance in the South Central China.

MEMBERSHIP

Society of Physics Students in Sun Yat-sen University Guangzhou, China
Vice President 9.2022 — 7.2023

- Coordinated lectures by professors on current physics research, aiming to broaden the academic perspectives of students.
- Invited senior students to share research methods and experiences, contributing to the professional growth of peers.

SKILLS

Mathematica, MATLAB, Python, C++, COMSOL, LabVIEW.

SELECTED COURSES

Theoretical Physics Courses

- Theoretical Mechanics: 96.4
- Electrodynamics: 95
- Thermodynamics and Statistical Physics: 98
- Quantum Mechanics: 97
- Solid State Physics: 95
- Methods of Mathematical Physics: 94
- Group Theory in Physics*: 96
- Topological Physics*: 99
- Advanced Quantum Mechanics*: 94

Numerical & Experimental Physics Courses

- Numerical Calculations: 98
- Analysis of Circuits: 97
- Electronic Technology: Analog Electronics: 92
- Electronic Technology: Digital Circuit: 92
- Experiments in Electronic Technology: 93
- Basic Designed Physics Experiment: 90
- Experiments of Frontier Physics: 90

* denotes graduate courses.