

# Cheng Yi Liu (Cheng-Yu Liu)

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## EDUCATION

### Department of Physics, National Taiwan University

Sep. 2021—Jul. 2024

Master of Science → Relevant courses: *Introduction to Quantum Optics (A<sup>+</sup>), Applications of Quantum Computation (A<sup>+</sup>), Introduction to Quantum Computation and Quantum Information (A<sup>+</sup>), Quantum Mechanics (I)(tigp) (A<sup>+</sup>)*

### Department of Physics, National Central University

Sep. 2017—Jun. 2021

Bachelor of Science → Relevant courses: *Applied Mathematics (97/100), Mathematical Methods in Physics I (99/100), Mathematical Methods in Physics II (91/100), Quantum and Statistical Physics (94/100), General Physics A First Semester (97/100), General Physics A Second Semester (100/100), Quantum Physics (83/100, among top in class)*

## RESEARCH EXPERIENCE & PROJECTS

### Project Collaborator | Advisor: Hsi-Sheng Goan | Department of Physics, National Taiwan University Jul. 2025—Current

1. Investigated bosonic quantum error correction using GRAPE, L-BFGS, and Nelder–Mead (with Julia and also on CUDA) to optimize pulse sequences for encoding and logical gate implementation [[Project](#)]
2. Exploring QEC mathematical formalism extensions [[Notes](#)] and hypergraph product-code decoding in Python.

### Independent Study and Research

(Four-month mandatory military service) Feb. 2025—Current

1. Studied quantum error correction, Qiskit global summer school excellence badge, error analysis and QEC code on trapped ion
2. Worked on Qiskit Hackathon projects on BB84 protocol, conduct experiments on IBM cloud real hardware [[Project](#)]
3. Studied on algebraic topology, quantum error correction [[Notes](#)]

### Research Assistant | Advisor: Hsiang-Hua Jen | IAMS, Academia Sinica

Oct. 2024—Feb. 2025

1. Studied on non-Hermitian physics
2. Generated numerical and analytic results on one-step GHZ states creation (Two publications shown below)
3. Investigated possible improvement in quantum platforms from state-dependent spatially separated atoms

### Research Assistant | Advisor: Guin-Dar Lin | Department of Physics, National Taiwan University

Sep. 2024—Oct. 2024

1. Integrated and further improved the results from my master's thesis [[Master's Thesis](#)] with the aim of preparing them for publication.

### Graduate Researcher | Advisor: Guin-Dar Lin | Department of Physics, National Taiwan University

Sep. 2021—Jul. 2024

1. Researched trapped-ion systems, Mølmer–Sørensen (MS) quantum gates, and micromotion trajectories through numerical simulations [[2D micromotion trajectories](#)]
2. Developed a novel cavity-mediated entangling gate for atomic qubits: proposed a theoretically exact controlled-Z gate using the Tavis–Cummings model [[Gate scheme](#)]
3. Developed a CZ entangling gate scheme for trapped ions by combining motional and cavity modes [[Early sketch](#)]
4. A simple derivation of the first-order micromotion trajectory amplitudes and notes [[Trapped ion notes](#)]
5. Provided a nonstandard derivation of the spin-dependent force Hamiltonian based on classical wave interference and tweezer-potential formulation from trigonometric identities [[Thesis Ch. 1.2](#)]

## TECHNICAL SKILLS

**Programming Languages:** Python (Qiskit advocate), Julia (Fast numerical calculations), Mathematica (Proficient)

**Theoretical Background and Training:** Quantum optics, trapped-ion quantum computing, cavity QED, quantum error correction, mathematical methods in physics, application of AI in research, English oral presentation

## PUBLICATIONS

1. C.-Y. Liu, C. G. Feyisa, M. S. Hasan, and H. H. Jen, “High-fidelity multipartite entanglement creation in non-Hermitian qubits,” J. Phys. B: At. Mol. Opt. Phys. 58, 075501 (2025). <https://doi.org/10.1088/1361-6455/adc2bd>
2. G. Feyisa, C.-Y. Liu, M. S. Hasan, J. S. You, H.-Y. Ku, and H. H. Jen, “Robustness of tripartite entangled states in passive PT-symmetric qubits,” Phys. Rev. Research 7, 033060 (2025). <https://doi.org/10.1103/ypd8-r9gq>

## ACTIVITIES

- Qiskit advocate (2025) / Qiskit global summer school excellence badge (2025)
- QRACON 2025 Quantum Research Competition (Master's Division) – Second Prize, and Best Speaker Award at the Annual Meeting.
- Member of the Taiwan Physical Society (2025)
- Poster session at the Joint International Workshop on Quantum Computing (Poster title: High-Fidelity Multipartite Entanglement Creation in Non-Hermitian Qubits) (2025)
- Poster session at the Annual Meeting of the Physical Society of Taiwan (Poster title: Novel Drive-Through Entangling Gate Mediated by a Cavity for Atomic Qubits) (2024)
- Joint Symposium on Quantum Computing (2024) (Thesis work on atomic qubit entanglement was presented by the speaker. )
- Participant in the Workshop on Quantum Science and Technology (2024)
- Participant in the *Atomic, Molecular, and Optical Summer School* (2023)
- Poster session and oral presentation at the *Physics Annual Meeting*, National Central University (2020)
- Street performance in Taipei and member of music clubs (2023)
- Vice President and host of the English Conversation Group at National Central University (2020–2021)