Cheng-Yu Liu

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EDUCATION

Department of Physics, Hong Kong University of Science and Technology *Sep. 2026—*

Ph.D. in Physics (Incoming)

Department of Physics, National Taiwan University *Sep. 2021—Jul. 2024*

M.Sc. in Physics | *Relevant courses: Introduction to Quantum Optics (A^+), Applications of Quantum Computation (A^+), Introduction to Quantum Computation and Quantum Information (A^+), Quantum Mechanics (I)(tigp) (A^+)*

Department of Physics, National Central University *Sep. 2017—Jun. 2021*

B.Sc. in Physics | *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*

Research Area: Quantum Error Correction

1. Investigated bosonic quantum error correction (QEC) using GRAPE, L-BFGS, and Nelder–Mead (with Julia and also on CUDA) to numerically optimize pulse sequences for encoding and logical gate implementation [Julia Project]
2. Studied QEC (algebraic topology, logical measurement, QLDPC codes,…etc.) and BP-OSD decoding [Notes]
3. Project on BP-OSD with sliding window decoding of QLDPC codes [Python Project].

Independent Study and Research *(Four-month mandatory military service) Feb. 2025—Jul. 2025*

1. Studied QEC, IBM Qiskit global summer school excellence badge, Qiskit advocate, error analysis of QEC code on trapped ion
2. Worked on Qiskit Hackathon projects on BB84 protocol, conduct experiments on IBM cloud real hardware [Project]

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.

Master's Student Assistant | Advisor: Guin-Dar Lin | Department of Physics, National Taiwan University

Project Title: Quantum Computing and Simulation with Trapped Ion Arrays (2/3, 3/3) *Sep. 2022—Jul. 2024*

1. Researched trapped-ion systems, Mølmer–Sørensen (MS) quantum gates, and micromotion trajectories through numerical simulations [2D micromotion trajectories]
2. Master Thesis: 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. Other research and theoretical derivations : Development of a CZ entangling-gate scheme for trapped ions by combining motional and cavity modes [Early sketch], derivation of the first-order micromotion trajectory amplitudes [Trapped ion notes], derivation of the spin-dependent force Hamiltonian based on classical wave interference and a tweezer-potential formulation using trigonometric identities [Thesis Ch. 1.2].

TECHNICAL SKILLS

Programming Languages: Python(Decoding), 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)