Cheng-Yu Liu

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EDUCATION

Department of Physics, National Taiwan University — Taipei,Taiwan

Master of Science → *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^+)* — Sept. 2021—July. 2024

Department of Physics, National Central University — Taoyaun, Taiwan

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)* — Sept. 2017—June. 2021

EXPERIENCE

Independent Study and Research

→ Studied quantum error correction, Qiskit Global Summer School, error analysis and QEC code on trapped ion [Project]
→ Qiskit Hackathon projects on BB84 protocol, learn to conduct experiments on IBM cloud real hardware [Project]
→ Developed a CZ entangling gate scheme for trapped ions by combining motional and cavity modes [Early sketch]
→ 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] — Feb. 2025—Current (2025)
→ Studied on algebraic topology, quantum error correction, notes [] — (four-month mandatory military service service)
→ Numerical results on one-step GHZ state in trapped ion Mølmer–Sørensen gate [] → studied on trapped ion parallel gate

Research Assistant | Advisor: Hsiang-Hua Jen — Taipei,Taiwan

Institute of Atomic and Molecular Science, Academic Sinica — Oct. 2024—Feb. 2025

→ Studied on non-Hermitian physics
→ Numerical and analytic results on one-step GHZ states creation in non-Hermitian systems (Publications shown below)
→ Investigated possible improvement in quantum platforms from state-dependent spatially separated atoms

Research Assistant | Advisor: Guin-Dar Lin — Taipei,Taiwan

Department of Physics, National Taiwan University — Sept. 2024—Oct. 2024

Graduate Researcher (Master's Thesis) | Advisor: Guin-Dar Lin | [Thesis: https://doi.org/10.6342/NTU202401159]

Department of Physics, National Taiwan University — Taipei,Taiwan — Sept. 2021—July. 2024

→ Researched trapped ion systems, quantum gate schemes under micromotion through numerical simulations [2D Micromotion trajectories]
→ Developed novel cavity-mediated entangling gate for atomic qubits: - Proposed a theoretically exact controlled-Z gate using the Tavis-Cummings model [Gate scheme]
→ 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]
→ A quick derivation of first order micromotion trajectories amplitude [Trapped ion notes section 3]

TECHNICAL SKILLS

Programming Languages: Python (Qiskit Advocate), Julia, Mathematica (strongest proficiency)
Theoretical Background and Training: Quantum optics, trapped-ion quantum computing, cavity-mediated interactions, 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 contributed to a presentation given by Prof. Guin-Dar Lin.)
- 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)