Wei-Hsuan, Chung 鍾瑋軒

+886-934034127 | b12202069@ntu.edu.tw | weihsuanchung | Wei-Hsuan Chung
Taipei City, Taiwan (R.O.C.) | weihsuanchung.github.io

Objective

Third-year NTU Physics undergraduate (double major in Sociology) with co-authorship on a submitted Physical Review A paper in theoretical quantum optics. Seeking a challenging research opportunity to contribute proven skills in both theoretical modeling (waveguide QED) and computational physics (LAMMPS, Python/Julia). Eager to gain advanced experience in quantum information, open quantum systems, and non-equilibrium dynamics in preparation for Ph.D. studies.

Education

- **National Taiwan University (NTU)** *Sep. 2023 - Jun. 2027 (Expected)*
  B.S. in Physics *with double Major in Sociology* Taipei, Taiwan
  - CGPA: 4.00/4.30
  - Participated in **NTU Quantum Computing and Information Program** (expected completion 2026)
- **Taichung Municipal Taichung Girls' Senior High School** *Sep. 2020 - Jun. 2023*
  Mathematics and Science Honors Program Taichung, Taiwan
  - Grade: Top 5-10% in General, Top 1% in Physics

Research Experience

- **Institute of Atomic and Molecular Sciences, Academia Sinica [🌐]** *Jul. 2025 - Present*
  Research Assistant *in Dr. Hsiang-Hua Jen's Atomic Physics and Optical Science Theoretical Group* Taipei, Taiwan
  - Investigating waveguide QED and quantum networks, focusing on Dicke-state generation and spectral analysis.
  - Currently investigating non-equilibrium phenomena, including Quantum Batteries and the Quantum Mpemba Effect in waveguide/cavity QED.
  - Weekly meetings and collaboration on theoretical modeling using `Julia` and `Python`.
- **Institute of Physics, Academia Sinica [🌐]** *Aug. 2024 - Present*
  Research Assistant *in Dr. To, Kiwing's Complex Systems of Granular Materials Group* Taipei, Taiwan
  - Conducted experiments on reciprocal force; currently extending results via `LAMMPS` simulations and manuscript preparation.
  - Developed and used custom `Linux` shell scripts to process and analyze experimental data.
  - Independent continuation after advisor's retirement, aiming for publication.
- **Department of Physics, National Taiwan University [🌐]** *Mar. 2025 - Jun. 2025*
  Research Assistant *in Prof. Pei-Yun Yang's Physics Education Research Project* Taipei, Taiwan
  - Studied Just-in-Time Teaching (JiTT) literature in physics higher education.
  - Analyzed student feedback and performance data to assess JiTT effectiveness.
  - Data analysis using `Python` and project report writing.

Patents and Publications

C=Conference, J=Journal, P=Patent, S=In Submission, T=Thesis

[S.1] I. G. N. Y. Handayana, Y.-T. Yu, **W. H. Chung** and H. H. Jen, **Manipulating Excitation Dynamics in Structured Waveguide Quantum Electrodynamics**, *Physical Review A* (submitted, Oct 2025); arXiv:2510.27310.

Skills

- **Programming:** Python, Julia (`QuantumOptics.jl`), LabVIEW, LAMMPS
- **Languages:** English (CEFR B2+), Mandarin (Native), German (Beginner)
- **Research Skills:** Experimental Physics, Theoretical Physics, Data Analysis, Scientific Writing, Academic Research

Academic Activities

- **2025 NCTS AMO Summer School** *Aug. 2024*
  National Center for Theoretical Sciences, Physics Division, Taiwan [🌐]
  - Three-day intensive program on atomic, molecular, and optical physics.
- **2025 IAMS Undergraduate Summer Internship** *Taipei, Taiwan*
  Institute of Atomic and Molecular Sciences, Academia Sinica Jul. 2025 - Aug. 2025
  - Conducted research on waveguide quantum electrodynamics under Dr. Hsiang-Hua Jen.
  - Gained hands-on experience in theoretical modeling and numerical simulations using `Julia` and `Python`.
  - Participated in weekly group meetings and presented research findings in oral.

Honors and Awards

- **Promenade of Data Science 2024 - Merit Award** *Dec. 2024*
  Institute of Statistical Science, Academia Sinica [🌐]
  - Recognized for excellence in data science skills, innovative problem-solving and great teamwork
  - Using `Python` and machine learning for data analysis and visualization
  - Awarded among 100+ participants from various universities, including undergraduate and graduate students
- **2025 NASA Space Apps Challenge** *Oct. 2025*
  NASA [🌐]
  - Recognized for innovative solutions in addressing global challenges
  - Collaborated with a diverse team to develop a data-driven application
  - Using `React.js` and `Python Flask` for APP development
  - Project Page: WeAdvisor: Discover Global Historical Weather Data
- **Entegris Foundation STEM Scholarship Fund** *2024*
  Entegris Foundation, Inc [🌐]
  - Awarded scholarship for academic excellence and commitment to STEM fields
  - Selected among numerous sophomore applicants based on academic achievements in NTU

Related Coursework

- **Quantum Algorithm for Solving PDEs and Its Applications** *2025 Spring*
  Quantum Information and Computation
  - Lectured by Prof. Hao-Chung Cheng (Dept. of Electrical Engineering, NTU)
  - Project: QIC Final Project (Presentation Video, Project Report, and Slides)

  In this project, we survey three quantum approaches to PDEs—(i) wave-equation Hamiltonian simulation with logarithmic qubit scaling, (ii) advection via block-encoded nonunitary steps with postselection reuse, and (iii) high-order finite-difference mappings to banded Hamiltonians—showing exponential space savings and polynomial (or better) time improvements over classical solvers, while highlighting boundary handling, state preparation, and Trotter error as the main bottlenecks and suggesting qubitization and improved observable extraction as promising next steps.
- **Regression and Bayesian Inference: Mean Squared Error** *2025 Fall*
  Physical Theories on (Machine) Learning
  - Lectured by Prof. Cheng, Miranda C. N. (Dept. of Physics, NTU)
  - Project: Mean Squared Error (Presentation Video and Slides)

  I outline how Gaussian-noise linear regression links mean squared error (MSE) minimization to likelihood maximization. With a Gaussian prior on parameters, the MAP estimator yields ridge regression, penalizing ℓ_2 norm with strength $\lambda = \sigma^2/\tau^2$.
- **Introduction to Neural Scaling Laws** *2025 Fall*
  Physical Theories on (Machine) Learning
  - Lectured by Prof. Cheng, Miranda C. N. (Dept. of Physics, NTU)
  - Main Reference: Bahri, Y., Dyer, E., Kaplan, J., Lee, J., & Sharma, U. (2021). Explaining neural scaling laws. arXiv.
  - Project: My Presentation Slides

  In my presentation, we explores the theoretical mechanisms behind the empirical scaling laws observed in deep neural networks. Starting with the observation that language model performance improves predictably with scale, we introduce a taxonomy of four distinct scaling regimes based on two factors: the resource constraint (under-parameterized vs. over-parameterized) and the scaling variable (dataset size D vs. model size P). We identify two fundamental mechanisms driving these laws: Variance-Limited Scaling, where performance improves with a universal exponent of -1 due to the statistical concentration of measure (akin to the Central Limit Theorem), and Resolution-Limited Scaling, where improvements are driven by the geometric resolution of the data manifold, yielding data-dependent exponents determined by the intrinsic dimension. By unifying these regimes, we provide a coherent theoretical framework that explains why large models work and predicts how they will scale.
- **Exact Decoding of Quantum Error-Correcting Codes** *2025 Fall*
  Group Meeting in Institute of Atomic and Molecular Sciences / Coding Theory
  - Presented at Dr. H. H. Jen's Weekly Group Meeting (IAMS, Academia Sinica)
  - Motivated by Prof. Chun-Ming Chen's Coding Theory Course (NTU)
  - Presentation based on Phys. Rev. Lett. 134, 190603.
  - Explored exact decoding algorithms for quantum error-correcting codes, focusing on performance and scalability
  - Project: Exact Decoding of QEC Codes (Presentation Slides)

- **The Features of Optical Computing** *2024 Spring*
  Introduction to Semiconductor Optoelectronics
  ◦ Lectured by Prof. Yun-Chorng Chang (Research Center for Applied Sciences, Academia Sinica)
  ◦ Project Video Presentation in Mandarin

  I introduced optical (photonic) computing, using photons in the visible/IR range to perform digital computation, and highlights why photonics is attractive: massive spatial parallelism, low-loss links for longer distances, low cross-talk at waveguide crossings, inherently one-way propagation, and extremely high carrier bandwidth (on the order of $\sim 500\,\mathrm{THz}$). Remaining hurdles include co-designing viable optical processor architectures, advancing photonic materials, and reducing the bulkiness of current prototypes.

- **Comparing Gate-Based vs. Unitary-Based Pulse Generation with Qiskit Pulse (in progress)** *2025 Fall*
  Introduction to Quantum Computation and Information
  ◦ Lectured by Prof. Hsi-Sheng Guan (Dept. of Physics, NTU)
  ◦ Main Reference: EPOC: An Efficient Pulse Generation Framework with Advanced Synthesis for Quantum Circuits

  This project compares gate-based and unitary-based pulse generation methods using Qiskit Pulse on IBM Quantum hardware. Gate-based pulses are predefined and optimized for standard gates, while unitary-based pulses allow custom operations. The comparison focuses on fidelity, flexibility, and implementation complexity, highlighting the trade-offs between ease of use and customization in quantum control.