

Chun-Wei Liu

Portfolio

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EDUCATION

- **Columbia University** New York, NY
Master of Science in Applied Physics *Sep. 2021 – Present*
Courses: Quantum Optics, Condensed Matter Physics, Laser Physics, Semiconductor Physics, Device Microfabrication, and Statistical Mechanics
- **National Cheng Kung University** Tainan, Taiwan
Bachelor of Science in Civil Engineering *Sep. 2017 – Jun 2020*
Courses: Quantum Physics, Electromagnetism, Machine Learning, Material Engineering, Mechanics of Materials, Automata

RESEARCH EXPERIENCE

- **Quantum Simulator - Programmable Atomic Tweezer Arrays [DAMOP2022]** New York, NY
Research Assistant *Sep. 2021 - Present*
 - Building a programmable bosonic Sr-88 atomic array for quantum simulation, including a compact atomic source, laser cooling, fiber optics, and electronics design.
 - Designed the defect-free atom rearranging algorithms with high array filling rate and achieved runtime within submillisecond region, supporting assembling up to 800 atoms.
 - Developed a control system for moving atoms within optical dipole traps with multi-toned rf signals and acoustic-optical devices while imaging via EMCCD/sCMOS.
 - Constructed a multiplexing laser-optics system for laser monitoring and locking via user-interface frontend and PID control backend.
- **Quantum Walks** Tainan, Taiwan
Research Assistant *Aug. 2019 - Aug 2021*
 - Explored non-Hermitian system and the corresponding topological properties through quantum simulators based on quantum walk.
 - Conducted analytical and numerical analysis for the evolution of an engineered quantum walk Hamiltonian.
 - Investigated quantum spatial search algorithms powered by quantum walk protocols.
- **Machine Learning in Material Design [APCOM2019][CTAM44][MLDT2021][USNCCM16]** Tainan, Taiwan
Research Assistant *Feb. 2019 - Jun 2020*
 - Applied generative adversarial networks (GAN) to generate high-fidelity microstructure images.
 - Adapted the 19-layer VGG networks (VGGNet) that can predict mechanical properties from material images with 95% accuracy.
 - Simulating mechanical properties of microstructure samples via Finite Element Methods (FEM) software.
 - Investigated a Bayesian-optimization model that can fine-tune GAN-generated microstructure geometry through the rapid-labeling VGGNet.
 - Applied multi-processing on molecular simulation to generate microstructures 40 times more efficiently on cloud platforms.
 - Implemented a stochastic protocol to produce large scale homogenous microstructure datasets by two-point correlation function.

PUBLICATIONS

- [1] Chun Wei Liu, Pei Chen Kuan, "*Coherent localization in quantum walks*". (In preparation).
- [2] Minh Kwon, Aaron Holman, Quan Gan, Chun-Wei Liu, Matthew Molinelli, Ian Stevenson, Sebastian Will, "*Jet-Loaded Cold Atomic Beam Source for Strontium*", arXiv:2210.14186 (2022).
- [3] Aaron Holman, Weijun Yuan, Siwei Zhang, Quan Gan, Chun-Wei Liu, Max Aalto, Matthew Molinelli, Xiaoyan Huang, Nanfang Yu, Minh Kwon, Sebastian Will, "*Progress Towards Programmable Strontium Atom Arrays*", 53rd Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP2022), 2022.
- [4] Aaron Holman, Weijun Yuan, Siwei Zhang, Quan Gan, Max Aalto, Chun-Wei Liu, Matthew Molinelli, Minh Kwon, Sebastian Will, "*A New Platform for Programmable Arrays of Strontium Atoms*", 53rd Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP2022), 2022.
- [5] Weijun Yuan, Aaron Holman, Chun-Wei Liu, Quan Gan, Xiaoyan Huang, Nanfang Yu, Minh Kwon, Sebastian Will, "*Optical Tweezer Arrays Created by Holographic Metasurfaces*", 53rd Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP2022), 2022.
- [6] Yun-Che Wang, Chun Wei Liu, Tsai-Wen Ko, "*Optimization of Chiral Metamaterials via Deep Neural Networks*", 16th U.S. National Congress on Computational Mechanics (USNCCM16), 2021.
- [7] Yun-Che Wang, Chun Wei Liu, Tsai-Wen Ko, "*Using Deep Neural Networks to Generate Hierarchical Metamaterials for Enhanced Mechanical Properties*", Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering and Technology (MMLDT), 2021.
- [8] Yun-Che Wang, Chun Wei Liu, Pei-Chen Cheng, Jyun-Ping Wang, Tsai-Wen Ko "*Design of Chiral Metamaterials via Deep Neural Networks*", 44th National Conference on Theoretical and Applied Mechanics (CTAM44), 2020.

PROJECTS

- **Predicting Handwriting Recognition With Parametrized Quantum Circuit:**
 - Implemented 4qubit-Ry gate circuits in predicting MNIST dataset with the learning curve converged after ten iterations.
 - Analyzed the potential in predicting molecular ground state energies with Quantum LSTM Meta-Learner and VQE.
- **Subradiance of a Collective of Atoms in the Cavity:**
 - Studied the superradiance effect of compact atomic arrays in the cavity by solving the master equation with the Quantum Monte Carlo method.

SKILLS

- **Languages:** Python, C++, Matlab
- **Libraries/Tools:** MATLAB, Qiskits, Mathematica, PyTorch
- **Other Technologies:** COMSOL, GNU/Linux, Raspberry Pi, Git, LAMMPS