

Shu Fay Ung

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Education

- **Columbia University** **New York, NY**
Ph.D. Chemical Physics
- Advisor: David Reichman
Expected May 2026
- **Columbia University** **New York, NY**
MPhil. Chemical Physics
- Cumulative GPA: 4.1
Feb 2025
- **California Institute of Technology** **Pasadena, CA**
B.Sc. Physics
- Advisor: Garnet Chan
- Cumulative GPA: 4.0
June 2021

Research Experience

- **Graduate Researcher, Columbia University** **New York, NY**
Advisor: David Reichman
August 2021 – Present
- Studying strongly-correlated electronic states in moiré materials, particularly in twisted bilayer transition metal dichalcogenides.
- **Research Fellow, Harvard University** **Cambridge, MA**
Advisor: Joonho Lee
July 2024 – September 2024
- Studied topological phases in rhombohedral pentalayer graphene in collaboration with Ashvin Vishwanath's group.
- **Undergraduate Researcher, Caltech** **Pasadena, CA**
Advisor: Garnet Chan
October 2019 – August 2021
- Developed a spin-projected perturbation theory (MP2) method for electronic structure calculations.
- **Undergraduate Researcher, Caltech** **Pasadena, CA**
Advisors: Peter Love (Tufts University), John Preskill
June 2019 – August 2019
- Worked on term reduction techniques (e.g. unitary partitioning) for solving electronic structure Hamiltonians via variational quantum algorithms.
- Worked to extend the OpenFermion software library to include plane wave basis and plane wave dual basis electronic structure Hamiltonians for (i) non-periodic 3D systems, and (ii) periodic and non-periodic 2D systems.
- **Undergraduate Researcher, Caltech** **Pasadena, CA**
Advisor: Maria Spiropulu
June 2018 – March 2019
- Analyzed data from the CMS detector at the Large Hadron Collider (LHC) to obtain exclusion limits on the parameters of the hypothesized dark photon.
- Simulated the decay of dark photons to dimuons and the detector response using the CMS Software Framework (CMSSW).

Awards and Honors

- 2022-2023 Jack Miller Teaching Award
- 2022-2023 Blanche R. and David Kasindorf Fellowship Fund in Physical Chemistry, Columbia University
- 2020 Donald and Trudy Bergen Math Scholarship, Caltech
- 2020 John Stauffer SURF Fellowship, Caltech
- 2017, 2018, 2019 Wylie Endowed Scholarship, Caltech
- 2017 Pearson Outstanding Learner Awards - Highest Mark in Malaysia for A Level Further Mathematics

Publications and Preprints

- [4] T. Jiang, M.K.A. Baumgarten, P.F. Loos, A. Mahajan, A. Scemama, **S.F. Ung**, J. Zhang, F.D. Malone, J. Lee. *Improved modularity and new features in ipie: Toward even larger AFQMC calculations on CPUs and GPUs at zero and finite temperatures.* J. Chem. Phys. 161, 162502 (2024), [arXiv:2406.16238](#)
- [3] **S.F. Ung**, J. Lee, D.R. Reichman. *Competing Generalized Wigner Crystal States in Moiré Heterostructures.* Phys. Rev. B 108, 245113 (2023), [arXiv:2308.03020](#)
- [2] R. Babbush, W.J. Huggins, D.W. Berry, **S.F. Ung**, A. Zhao, D.R. Reichman, H. Neven, A.D. Baczewski, and J. Lee. *Quantum simulation of exact electron dynamics can be more efficient than classical mean-field methods.* Nat. Commun. 14, 4058 (2023), [arXiv:2301.01203](#)
- [1] A. Zhao, A. Tranter, W. Kirby, **S.F. Ung**, A. Miyake, and P.J. Love. *Measurement reduction in variational quantum algorithms.* Phys. Rev. A 101, 062322 (2020), [arXiv:1908.08067](#)

Talks

- *Correlated electronic states in moiré heterostructures: insights from quantum chemistry.* Contributed talk at Materials Innovators Workshop, Columbia University. 01/2025
- *Competing generalized Wigner crystal states in moiré heterostructures.* Invited talk at MRSEC IRG Symposium, Columbia University. 11/2023
- *Competing generalized Wigner crystal states in moiré heterostructures.* Invited talk at Physical Chemistry Seminar, Columbia University. 09/2023
- *Competing generalized Wigner crystal states in moiré heterostructures.* Invited talk at Joonho Lee's group, Harvard University, 08/2023
- *Spin-symmetry restored many-body perturbation theory.* SURF Seminar Day, Caltech, 10/2020
- *Representation of molecular wavefunctions with plane wave bases.* SURF Seminar Day, Caltech. 10/2019

Mentoring and Teaching Experience

Volunteer Mentor and Facilitator

- USAPPS **Malaysia**
September 2020 – Present
 - Provide guidance for Malaysian students applying to U.S. colleges and volunteered for the annual USAPPS workshops.

Teaching Assistant

- *Columbia University & Caltech*
 - Columbia University, August 2021 – December 2023
 - CHEMGU 4230: Statistical Thermodynamics (Graduate)
 - CHEMUN 1500: General Chemistry Lab (Undergraduate)
 - CHEMUN 1507: Intensive General Chemistry Lab (Undergraduate)
 - Caltech, January 2020 – March 2020
 - Ph 6: Physics Laboratory (Undergraduate)

Skills

- **Natural languages** English (native), Mandarin (native), Malay (Limited working proficiency)
- **Programming languages** Python, C++, Julia, Q#, Bash, \LaTeX
- **Scientific software** pySCF, Q-Chem, ipie, Qiskit
- **Miscellaneous** Adobe Suite (Illustrator, InDesign, Photoshop, Lightroom)