Shu Fay Ung

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Education

Columbia University — **New York, NY**
Ph.D. Chemical Physics — *Expected Aug 2026*
- Advisor: David Reichman

Columbia University — **New York, NY**
MPhil. Chemical Physics — *Feb 2025*
- Cumulative GPA: 4.1

California Institute of Technology — **Pasadena, CA**
B.Sc. Physics — *June 2021*
- Advisor: Garnet Chan
- Cumulative GPA: 4.0

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
- *Correlated electronic states in moiré heterostructures*. Invited talk at Joonho Lee's group, Harvard University, 09/2024
- *Competing generalized Wigner crystal states in moiré heterostructures*. Contributed talk at American Physical Society March Meeting, Minneapolis, MN, 03/2024
- *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*. Contributed talk at SURF Seminar Day, Caltech, 10/2020
- *Representation of molecular wavefunctions with plane wave bases*. Contributed talk at SURF Seminar Day, Caltech, 10/2019

Mentoring and Teaching Experience

- **Volunteer Mentor and Facilitator** — **Malaysia**
  USAPPS — *September 2020 – Present*
  - Provide guidance for Malaysian students applying to U.S. colleges and volunteered at the annual USAPPs workshops.
  - Paired with a mentee (now enrolled at the University of Pennsylvania) during the 2021 application cycle and met weekly to brainstorm, edit, and proofread application essays.

- **Teaching Assistant** — **New York, NY**
  Department of Chemistry, Columbia University — *August 2021 – December 2023*
  - Wrote and graded problem sets; held weekly office hours; led exam review sessions; supervised experiments; graded lab reports; updated the lab manual.
    - CHEMGU 4230: Statistical Thermodynamics (Graduate)
    - CHEMUN 1500: General Chemistry Lab (Undergraduate)
    - CHEMUN 1507: Intensive General Chemistry Lab (Undergraduate)

- **Teaching Assistant** — **Pasadena, CA**
  Division of Physics, Mathematics, and Astronomy, Caltech — *January 2020 – March 2020*
  - Supervised experiments; graded pre-lab assignments.
    - Ph 6: Physics Laboratory (Undergraduate)

Other Experience

- **President, 2020-21** — **Pasadena, CA**
  Caltech Undergraduate Physics Club — *October 2019 – June 2021*
  - Organized talks by faculty and graduate students, graduate school application panels, and social events.

- **Co-Editor-in-Chief, 2020-21** — **Pasadena, CA**
  Caltech Big T Yearbook — *October 2017 – June 2021*
  - Oversaw the publication of the annual yearbook.
  - Served as copywriter, designer, photographer, and copy editor before being appointed co-editor-in-chief.

Skills

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

References

- **David Reichman** — **Advisor**
  Centennial Professor of Chemistry, Columbia University
  drr2103@columbia.edu

- **Joonho Lee** — **Collaborator**
  Assistant Professor, Harvard University
  joonholee@g.harvard.edu