JEFFREY (JEB) SONG

js2997@cam.ac.uk jeb12301.github.io

EDUCATION

University of Cambridge *2025-2026*
MASt in Mathematics
Courses: Analysis of Boolean Functions, Mixing Time of Markov Chains, Probabilistic Combinatorics, Concentration Inequalities, Information Theory, Quantum Information Theory

Essay Title: The Gap–Hamming Problem in Communication Complexity.

University of Washington (UW) *2023-2025*
B.Sc. in Physics (Honors), B.A. in Mathematics, 3.94/4.00.

National University of Singapore (NUS) *2021-2023*
B.Sc. in Physics, NUS College Program (Honors College), 4.36/5.00.

PUBLICATIONS

J. Z. Song, H. Ha, W. W. Ho, and V. B. Bulchandani, Theory of quasiballistic spin transport, Phys. Rev. B 112, L241408 (2025).

J. Z. Song*, G. Kishony*, E. Berg, and M. S. Rudner, Vari-Cool: a non-unitary quantum variational protocol for simulated cooling, arXiv:2510.09749 (2025). (Submitted to Phys. Rev. X Quantum)

RESEARCH EXPERIENCE

UW Prof. Mark Rudner Group ——— *Variational Cooling for Dissipative State Preparation*
April 2025 - Present
Investigated dissipative state preparation of the transverse field ising model (TFIM) on IBM's quantum processors. Developed and implemented our algorithm for IBM's `Kingston` processor. Demonstrated cooling to low energy states for 28 TFIM system qubits comparable to recent results by Google.

Rice University Asst. Prof. Vir Bulchandani Group ——— *Quasi-Ballistic Spin Transport*
Sep 2024 - Dec 2025
Provided the first theoretical explanation for long-lived ballistic modes of spin on anisotropic XXZ spin-$1/2$ chains. Contributed to analytical results and developed numerical simulations of these results. Our manuscript was accepted as a letter in PRB.

UW Assoc. Prof. Samu Taulu Group ——— *EEG Calibration via Quasi-Static Models*
June 2024 - June 2025
Developed and optimized EEG calibration algorithms informed by electromagnetic models. Compared both local and global approaches in `FieldTrip`. Simulated and analyzed source localization techniques. My research was rewarded the Mary Gate scholarship.

UW Prof. Arka Majumdar Group ——— *Optical Machine Learning*
Aug 2023 - Feb 2025
Explored multi-input reservoir computing (type of recurrent neural network) using optical spiral waveguides. Developed simulation scripts in Lumerical (`varFDTD` and `FDE`) to design geometries and process results.

NUS Asst. Prof. Ho Wenwei Group ——— *1D Measurement-Based Quantum Computation*
Jan 2023 - June 2024
Studied 1D Measurement-Based Quantum Computation (MBQC) using tensor networks for my UROPS

*Equal contribution.

project. Helped extend a recent 1D MBQC scheme (Stephen et al., 2022) to qudits, and found numerical support for findings. My UROPS report was nominated for the best UROPS award by the Physics Department.

NUS Assoc. Prof. Kuldip Singh Group ——————— *Foundations of Quantum Mechanics*
Jan 2023 - May 2023
Explored ψ-ontological models, Bell's inequality, and the Pusey-Barrett-Rudolph theorem for directed reading project. Completed a project paper and presentation on limitations of such models.

NUS Asst. Prof. Lee Chinghua Group ——————— *Non-Hermitian Quantum Physics with Qiskit*
May 2022 - Feb 2023
Simulated quantum systems using IBM's `Qiskit` package. Reproduced the SSH model, implemented trotterization for arbitrary unitaries, and decomposed non-Hermitian Hamiltonians.

NUS Asst. Prof. Loh Huanqian Lab ——————— *Lasers for Neutral Atom Quantum Computing*
Feb 2022 - June 2022
Built an intensity servo system and constructed optical setups involving AOMs and DDS for precise control. Presented an internal talk on error correction techniques for laser servos.

LEADERSHIP AND MENTORSHIP

UW Undergraduate Physics Mentoring Program *Jan 2024 - Present*
Mentor
Organized by the UW Society for Physics Students (SPS). Provided academic and personal support to three mentees, facilitating bi-weekly meetings and participating in academic and social events. Part of panel for an information session for pre-majors on physics.

NUS College Philosophy Club *June 2022 - June 2023*
Founder
Organized bi-weekly philosophy discussions, with a focus on the philosophical aspects of science and math. I successfully organized several talks and lectures by philosophy professors, providing an opportunity for students to learn from experts in the field and expand their understanding of philosophy.

NUS Physics Society *August 2021 - August 2022*
Events Director
Helped organize a successful physics mentor-mentee program. Furthermore, I was instrumental in jointly planning and organizing online meetups for physics students, providing opportunities for networking and learning beyond the classroom.

AWARDS

Mary Gates Research Scholarship *2024*

Guy Pitzel Scholarship (Departmental Honours) *2024*

Goldwater Scholar UW Nominee *2024*

CRISP Award for Best UROPS Nominee *2023*

PRESENTATIONS

Improving EEG calibration using electrostatic multipole moments
UW Mary Gates Undergraduate Research Symposium *2025*

A Theory of Quasiballistic Spin Transport
UW SPS Research Symposium for Physical Sciences *2025*

TECHNICAL SKILLS

Python, PyTorch, Qiskit, Matlab, Linux (Ubuntu/Fedora), Bash/Zsh Scripting, Java, C, Lumerical, Lean.