JACOB HAUSER

jhauser@pitp.ca • 909-541-6443 • jahauser.github.io

EDUCATION

Perimeter Scholars International, *Perimeter Institute*, Waterloo, Ontario — Fall 2020 – present
Expected in June 2021
Supervisors: Alioscia Hamma, Tim Hsieh, Roger Melko

M.Sc. Physics, *University of Waterloo*, Waterloo, Ontario — Fall 2020 – present
Expected in June 2021

B.A. Physics, *Pomona College*, Claremont, California — Fall 2016 – Spring 2020
Concentrations: Physics major; Mathematics and Computer Science minors
GPA: 3.96/4.00, Magna Cum Laude, Phi Beta Kappa, Distinction in the Senior Exercise

SELECTED HONOURS

NSF Graduate Research Fellowship — 2020 – 2025
138,000 USD – awarded to 2,000 out of 13,000 applicants

Perimeter Scholars International Award — 2020 – 2021
45,000 CAD – awarded to 22 out of 814 applicants

RESEARCH

Emergent Irreversibility in Random Quantum Circuits, *Perimeter Institute* — Spring 2020 – present
Supervisor: Alioscia Hamma (University of Massachusetts Boston)

Analytically modeling purity fluctuations in random ensembles of physical Clifford and Haar states, and using finite-size scaling analysis to determine the transition between two regimes of "state learnability" in random quantum circuits. Developed and characterized a method for distinguishing random Haar and stabilizer states based on periodic structure.

t-Design Transition in Doped Clifford Circuits, *Pomona College* — Fall 2019 – Spring 2020
Supervisor: Alioscia Hamma (University of Massachusetts Boston)

Prepared a year-long senior thesis computationally analyzing the unitary t-design transition in Clifford circuits doped with non-Clifford gates. Created a random quantum circuit engine which simulates local quantum circuits up to 20 times faster than standard libraries.

Causality Violations in General Relativity, *Perimeter Institute* — Summer 2019
Supervisors: Barak Shoshany, Beatrice Bonga, and Rafael Sorkin (Perimeter Institute)

Developed a concrete model for analyzing multiple-history resolutions to causality violations in 1+1 dimensions. Introduced a novel covering space approach to resolving paradoxes and explicitly constructed solutions using infinite and finite numbers of histories. Calculated the number of histories required for consistent evolution for a family of toy physical laws.

Experimental Quantum Optics, *Pomona College* — Fall 2017 – Spring 2019
Supervisor: Dwight Whitaker (Pomona College)

Revitalized single-photon optics equipment to produce entangled, down-scattered photon pairs and prepared equipment and procedure for use in Sophomore-level laboratory class. Locked diode lasers to Rubidium atomic spectra using saturated absorption spectroscopy. Cared for equipment, including repairing electronics and recollimating lasers.

Simulating & Fabricating GaAs Devices, *University of British Columbia* — Summer 2017
Supervisor: Joshua Folk (Quantum Devices Group)

Characterized experimental nanowire design by simulating quantum device electrostatics using COMSOL. Conducted and analyzed wet etches to test new back-gated GaAs chip design. Supported installation of new dilution refrigerator by developing a high frequency shielding component and analyzing lab vibration data.

Simulating nEDM Electrode Profiles, *TRIUMF* Summer 2016

Supervisor: Rüdiger Picker (Ultra-Cold Neutron Project)

Used finite element analysis simulations to determine the optimal electrode profile for group's neutron electric dipole moment (nEDM) experiment. Prepared 5,000-word report supporting my recommendation, which the group then used in subsequent designs. Automated electrode modeling and electric field analysis to streamline simulations.

PUBLICATIONS & PRESENTATIONS

Publications

- **J. Hauser** and B. Shoshany, (2020), "Time Travel Paradoxes and Multiple Histories", *Phys. Rev. D 102*, 064062, *DOI: 10.1103/PhysRevD.102.064062*.

In Preparation

- **J. Hauser** and A. Hamma, "Characterization of a T-Gate-Doping Transition in Random Quantum Circuits".

Presentations

- **J. Hauser** and B. Shoshany, (2020), "A Hybrid Approach to Resolving Causality Violations". Contributed talk at 30th Midwest Relativity Meeting in Notre Dame, IN.
- **J. Hauser** and B. Shoshany, (2019), "Solving Time Travel Paradoxes". Contributed talk at 29th Midwest Relativity Meeting in Grand Rapids, MI.
- I. Cui and **J. Hauser**, (2019), "Retention from Physics 70 to 101: Experiences in Introductory Physics". Poster presentation at the PKAL Southern California Regional Meeting 2019 in Claremont, CA.

HONOURS & ACHIEVEMENTS

Richard P. Edmunds Physics Prize	Spring 2020
Alfred Kwok Memorial Physics Prize	Spring 2020
Elected to Phi Beta Kappa Honor Society	Spring 2020
Elected to Sigma Xi Scientific Honor Society	Spring 2019
Tileston Sophomore Physics Prize	Fall 2018
Bixby Mathematics Prize	Fall 2018
88th percentile (572 of 4623) on Putnam Competition	Fall 2018
Tileston First Year Physics Prize	Fall 2017
Pomona College Scholar	Each Semester
Graduation Program Examinations Scholarship (top 20 graduating students in province)	Summer 2016
National Merit Finalist	Spring 2016

SERVICE

Perimeter Institute, Member of Inclusive PI (Anti-Racism & Mental Health) Fall 2020 – present

Pomona College, Member of Academic Affairs Committee Fall 2019 – Spring 2020

Physics Department, Chair of Physics Pedagogy Reading Group Fall 2019 – Spring 2020

Studying Retention in Introductory Physics Sequence Fall 2017 – Spring 2020

- Conducted multi-year survey to determine factors in physics department retention
- Wrote 200-page report analyzing findings and proposing action items for department
- Developed and launched new student-driven course PHYS 009: Peer Mentoring in STEM

Physics Department, Department Liaison Fall 2017 – Spring 2020

Physics Department, Cohort Program Organizer Fall 2017 – Winter 2019

Residence Life, Orientation Leader and Sponsor Summer 2017 – Spring 2018

National High School Model UN, Director of Security Council Simulation Summer 2017 – Spring 2018

Mock Trial, Team Captain and Tournament Coordinator Spring 2017 – Spring 2018

WORK EXPERIENCE

Pomona College, Claremont, California — Summer – Fall 2020
Professor Thomas Moore – Textbook Editor

- Edited new 400+ page particle physics textbook written for advanced undergraduates
- Produced 128 pages of notes in LaTeX addressing technical and grammatical errors

Pomona College, Claremont, California — Fall 2017 – Spring 2020
Physics Department – Teaching Assistant

- Ran weekly mentor sessions for majors and non-majors, teaching
  - general relativity (including cosmology, gravitational waves, and the Kerr metric)
  - intermediate Newtonian, Lagrangian, and Hamiltonian mechanics
  - introductory classical mechanics, introductory electricity and magnetism
- Assisted with weekly lab classes, resolving student questions and equipment issues
- Led three class sessions when professor was travelling

Pure Storage, Mountain View, California — Summer 2018
FlashBlade Division – Software Engineering Intern

- Developed an incremental VMware virtual machine backup and restoration solution for FlashBlade, Pure Storage's high-bandwidth network-attached flash storage product
- Optimized backup/restore with single-file-restore, changed block tracking, & threading

Vancouver Model UN, Vancouver, British Columbia — Spring 2015 – Spring 2016
Secretary-General (Chief Executive Officer)

- Led planning and execution of one of the world's largest high-school-run Model UN conferences (1300+ attendees)
- Hired and oversaw volunteer staff of 80+ and managed $300,000 budget
- Negotiated arrangements with hotels, suppliers, and sponsors

COMPUTATIONAL PROJECTS

Tensor-Based Quantum Circuit Engine, Python — Summer 2019 – present
Simulates quantum circuits, implementing quantum states and circuits as tensor objects to achieve simulation speedup over standard libraries when using circuits assembled from local gates.

Numerical Topology Library, Haskell — Spring 2020
Computes persistent homology and Betti barcodes of filtered simplex streams.

Physics Education Applets, JavaScript, HTML — Fall 2017 – Spring 2019
Equipotentials: models the electric potential around arbitrary 2D charge distributions.
EField/BField: model 3D electric and magnetic fields (contributed to existing software).

AllSky Data Pipeline, awk, bash, Python — Fall 2018
Uses multiprocessing and solution-caching to efficiently process high volume of low-resolution wide-angle 'AllSky' photos from Table Mountain Observatory.

n-Body Orbit Simulator, Python — Spring 2017
Simulates 2D Newtonian gravity (or other force laws) in the user's preferred reference frame.

WORKSHOPS & SEMINARS

Quantum Matter Frontier Seminars — September 2020 – present
Quantum Matter in the Age of Entanglement — December 2020
Perimeter Institute Undergraduate Summer School — July 2019
Perimeter Institute International Summer School for Young Physicists — July 2015

SKILLS

Programming Languages: Python (including machine learning and quantum information packages), awk, bash, C++, Haskell, HTML, Java, JavaScript, Lua, Mathematica, MATLAB, OCaml, and Standard ML

Computer Software: AutoCAD, COMSOL, Fusion 360, LabVIEW, virtual machine management

Lab: clean room and machine shop fabrication, telescope operation, single-photon optics and doppler-free spectroscopy