

MATTHEW HAGAN

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EDUCATION

Ph.D Candidate, University of Toronto. *Advisor*: Prof. Nathan Wiebe
Focus on Quantum Algorithms for Simulation and State Preparation. Sept. 2021 - Present

Master of Physics, University of Washington (UW) Sept. 2019 - Aug. 2021

B.S., Massachusetts Institute of Technology Sept. 2014 - June 2018
Double Major in Physics and Mathematics w/ Computer Science

ACADEMIC PUBLICATIONS

Interpreting Multipartite Entanglement through Topological Summaries

Raghav Banka, Matthew Hagan, Nathan Wiebe. arXiv:2505.00642. *In Submission*

The Thermodynamic Cost of Ignorance: Thermal State Preparation with One Ancilla Qubit

Matthew Hagan, Nathan Wiebe. arXiv:2502.03410. *In Submission*

Composite QDrift-Product Formulas for Quantum and Classical Simulations in Real and Imaginary Time

Matthew Pocrnic, Matthew Hagan, Juan Carrasquilla, Dvira Segal, Nathan Wiebe arXiv:2306.16572; *Phys. Rev. Research* 6, 013224, (2024)

Composite Quantum Simulations

Matthew Hagan, Nathan Wiebe. arXiv:2206.06409. *Quantum* 7, 1811 (2023)

INDUSTRY EXPERIENCE

External Contractor for Google Quantum Software Engineer

May 2024 - Sep. 2024

Contracted to work on Qualtran documentation and learning materials, as well as some algorithm implementations. Focused mostly on variants of Quantum Phase Estimation (QPE) and SELECT circuits. Implemented a new walk-through guide explaining how SELECT circuits work at the Toffoli level using segment trees.

Sonos, Embedded Systems Engineer

June 2018 - Aug. 2019

Implemented functionality for the Sonos Move, the companies first portable speaker. Responsible for updating core grouping protocols for collections of synchronous speakers to involve portable devices, which can be unreliable group coordinators.

TALKS AND PRESENTATIONS

- “Thermal State Preparation with One Ancilla Qubit”: Sandia National Labs QuAAC Seminar (2025), CQIQC Seminar (2023, 2025), Poster QIP (2025)
- “Composite Quantum Simulations”: C2QA at PNNL Seminar (2022), CIQC Annual Meeting (2022), Kwek Leong Chan Group (2022), CQIQC Poster (2022), SQUINT Poster (2022), QSIM Poster (2022)

TEACHING EXPERIENCE

- *Algorithms I* Jan. 2024 - June 2024
- *Graduate Quantum Information Theory* Sept 2023 - Dec. 2023
- *Undergraduate Directed Reading Program*, University of Toronto Physics Dept. Sept. 2022 - Jan. 2023
Sept. 2023 - Jan. 2024
- *Introduction to Theoretical Computer Science* June 2023 - Aug. 2023
- *Digital and Analog Circuits*, University of Washington Physics Dept. Jan. 2020 - June 2020
- *Introductory Mechanics, E&M* University of Washington Physics Dept. Sept. 2019 - Dec. 2019

OPEN SOURCE CONTRIBUTIONS

All open source contributions can be found at <https://github.com/matthagan15>

- **MHGL**: Matts HyperGraph Library. A collection of hypergraph implementations in Rust. Used to compute hypergraph links, analogous to adjacency matrices, boundary and coboundary operators, and maximal faces. Currently working on data structures for computing persistence homology.
- **Trotter-Qdrift-Simulation**: A Python library for estimating the gate costs of standard product formulas (Trotter and QDrift) as well as composite or partially randomized formulas.
- **HDX-Codec** (Work In Progress): A library to numerically compute the rank of error correcting codes defined on coset complexes as implemented in the paper “New Code on High Dimensional Expanders” by Dinur, Liu, and Zhang. Contains implementations of basic sparse linear algebra routines over finite (Galois) fields, Reed-Solomon codes, and matrix field coset complex constructions.

PROFESSIONAL SERVICE

Conference Reviewer: FOCS 2025, QSIM 2025, TQC 2023

Journal Referee: NPJ Quantum Information - 2022, 2023