

Michael Zurel

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EDUCATION

- **PhD (in progress)** University of British Columbia
Physics (Quantum information and computation) September, 2020 – Present
 - Research supervisor: Dr. Robert Raussendorf
 - Academic co-supervisor: Dr. William G. Unruh
 - Affiliations: University of British Columbia (Physics) & Stewart Blusson Quantum Matter Institute
 - Expected completion: May, 2024
- **MSc** University of British Columbia
Physics (Quantum information and computation) September, 2019 – November, 2020
 - Supervisor: Dr. Robert Raussendorf
 - Thesis: [Hidden variable models and classical simulation algorithms for quantum computation with magic states on qubits](#)
- **BSc** University of British Columbia
Combined honours in Physics and Mathematics September, 2014 – May, 2019
 - Honours thesis: Contextuality and Simulating Quantum Computation with Magic States

PUBLICATIONS & PREPRINTS

- [1] **MZ**, Lawrence Z. Cohen, and Robert Raussendorf. “Simulation of quantum computation with magic states via Jordan-Wigner transformations”. 2023.
- [2] **MZ**, Cihan Okay, and Robert Raussendorf. “Simulating quantum computation with magic states: how many ‘bits’ for ‘it’?” 2023. arXiv: [2305.17287](#).
- [3] Robert Raussendorf, Cihan Okay, **MZ**, and Polina Feldmann. “The role of cohomology in quantum computation with magic states”. In: *Quantum* 9 (2023), p. 979. DOI: [10.22331/q-2023-04-13-979](#). arXiv: [2110.11631](#).
- [4] **MZ**, Cihan Okay, Robert Raussendorf, and Arne Heimendahl. “Hidden variable model for quantum computation with magic states on qudits of any dimension”. 2021. arXiv: [2110.12318](#).
- [5] Cihan Okay, **MZ**, and Robert Raussendorf. “On the extremal points of the Λ -polytopes and classical simulation of quantum computation with magic states”. In: *Quantum Information & Computation* 21.13&14 (2021). DOI: [10.26421/QIC21.13-14-2](#). arXiv: [2104.05822](#).
- [6] **MZ**. “Hidden variable models and classical simulation algorithms for quantum computation with magic states on qubits”. MSc thesis. University of British Columbia, 2020. DOI: [10.14288/1.0394790](#).
- [7] **MZ**, Cihan Okay, and Robert Raussendorf. “Hidden Variable Model for Universal Quantum Computation with Magic States on Qubits”. In: *Physical Review Letters* 125.26 (2020), p. 260404. DOI: [10.1103/PhysRevLett.125.260404](#). arXiv: [2004.01992](#).
- [8] Robert Raussendorf, Juani Bermejo-Vega, Emily Tyhurst, Cihan Okay, and **MZ**. “Phase-space-simulation method for quantum computation with magic states on qubits”. In: *Physical Review A* 101.1 (2020), p. 012350. DOI: [10.1103/PhysRevA.101.012350](#). arXiv: [1905.05374](#).

For PDFs see mzurel.github.io; for citation data see [Google Scholar](#).

PATENTS

- US Patent Application 20230206102A1 Status: Pending
- *Method of simulating a quantum computation, system for simulating a quantum computation, method for issuing a computational key, system for issuing a computational key*

SOFTWARE

- [RandomQM.jl](#) — Julia functions for generating random quantum states and random quantum channels
- [RandomStabilizers.jl](#) — Julia code for generating random stabilizer states and random symplectic group elements based on the “SYMPLECTICImproved” algorithm of J. Math. Phys. **55** 122202 (2014).
- [BinarySymplectic.jl](#) — Tools for working with symplectic vector spaces and symplectic groups over \mathbb{Z}_2 .
- [FiniteSymplectic.jl](#) — Tools for working with symplectic modules and symplectic groups over \mathbb{Z}_d .
- [NetworkViz](#) — Data visualization web app for input-output data, census data, and other socio-economic data in Newfoundland and Labrador. Written in R.

Code available on GitHub: github.com/mzurel

CONFERENCE TALKS AND SEMINARS

- Southwest Quantum Information and Technology (SQuInT) Workshop, October 2023 30 minute talk
Simulating quantum computation: how many “bits” for “it”?
- QLOC Group Seminar @ Iberian Nanotechnology Laboratory, September 2023 60 minute talk
A hierarchy of classical simulation algorithms for quantum computation
- Quantum Physics and Logic (QPL), July 2023 (presented by a co-author) 30 minute talk
Simulation of quantum computation with magic states via Jordan-Wigner transformations
- Coogee 2023 Workshop, February 2023 60 minute talk
No-go theorems for discrete Wigner functions and alternative quasiprobability representations for quantum computation with magic states
- Shealf talks (Samson Abramsky group seminar @ University of Oxford), December 2022 60 minute talk
The role of cohomology in quantum computation with magic states
- “FoQaCiA” collaboration kick-off meeting, November 2022 60 minute talk
A polytopes and classical simulation of quantum computation with magic states
- Theory of Quantum Computation, Communication, and Cryptography (TQC), July 2022 25 minute talk
Hidden Variable Model for Quantum Computation with Magic States on Qudits of Any Dimension
- David Gross group seminar @ University of Cologne, July 2022 60 minute talk
Quasiprobability representations for quantum computation with magic states
- Quantum Physics and Logic (QPL), June 2022 10 minute talk
Hidden Variable Model for Quantum Computation with Magic States on Qudits of Any Dimension
- Bilkent University Math Grad Seminar, June 2022 60 minute talk
Polytopes in quantum computation and quantum information
- Algebraic Structures in Quantum Computation V (ASQC5), June 2022 45 minute talk
Hidden variable models for quantum computation with magic states
- UBC Institute of Applied Mathematics Grad Seminar, June 2022 60 minute talk
Polytopes in quantum computation and quantum information
- Internal talk for QuEra Computing Inc. software/algorithms team, April 2022 45 minute talk
Classical simulation of quantum computation with magic states
- Theory of Quantum Computation, Communication, and Cryptography (TQC), July 2021 30 minute talk
Hidden variable model for universal quantum computation with magic states on qubits
- Quantum Physics and Logic (QPL), June, 2021 30 minute talk
Hidden variable model for universal quantum computation with magic states on qubits

- Algebraic Structures in Quantum Computation IV (ASQC4), June, 2020 60 minute talk
Hidden variable model for universal quantum computation with magic states on qubits
- Quantum Physics and Logic (QPL), June 2019 25 minute talk
Phase-space-simulation method for quantum computation with magic states on qubits

For slides, videos, etc., see mzurel.github.io/talks

POSTER PRESENTATIONS

- Southwest Quantum Information and Technology (SQuInT) Workshop, October 2023
Simulation of quantum computation with magic states via Jordan-Wigner transformations
- Quantum Physics and Logic (QPL), July 2023
Simulating quantum computation with magic states: how many “bits” for “it”?
- Max Planck - UBC - UTokyo Centre for Quantum Materials Annual Meeting, September 2022
Hidden variable model for quantum computation with magic states on qudits of any dimension
- Max Planck - UBC - UTokyo Centre for Quantum Materials Annual Meeting, September 2022
The role of cohomology in quantum computation with magic states
- Theory of Quantum Computation, Communication, and Cryptography (TQC), July 2022
The role of cohomology in quantum computation with magic states
- Quantum Information Processing (QIP), March 2022
Hidden Variable Model for Quantum Computation with Magic States on Any Number of Qudits of Any Dimension
- Quantum Information Processing (QIP), March, 2021
Hidden variable model for universal quantum computation with magic states on qubits
- Southwest Quantum Information and Technology (SQuInT), February 2020
Phase-space-simulation method for quantum computation with magic states on qubits

For poster PDFs see mzurel.github.io/talks

WORKSHOP & SUMMER SCHOOL ORGANIZATION

- Summer School on the Foundations of Quantum Computational Advantage July, 2023 (postponed to 2024)
Bilkent University, Ankara, Turkey Project mentor
- Algebraic Structures in Quantum Computation V (ASQC5) June, 2022
University of British Columbia, Vancouver, Canada Co-organizer
- Cornerstone Models of Quantum Computing Summer School August, 2021
TRIUMF, Vancouver, Canada Teaching assistant for MBQC section
- Cornerstone Models of Quantum Computing Summer School August, 2020
TRIUMF, Vancouver, Canada Teaching assistant for MBQC section

AWARDS

- CGS - Michael Smith Foreign Study Supplement (NSERC CGS-MSFSS) 2023
- Alexander Graham Bell Canada Graduate Scholarship (NSERC CGS-D) 2021 – 2024
- UBC Four Year Doctoral Fellowship (4YF) 2021 – 2025
- President’s Academic Excellence Initiative PhD Award 2020 – 2024
- UBC Faculty of Science PhD Tuition Award 2020 – 2024

PEER REVIEW

Referee for the following journals:

- Physical Review Letters
- PRX Quantum
- Physical Review A
- Quantum Journal
- Journal of Physics A: Mathematical and Theoretical

TECHNICAL SKILLS

- Programming languages: Python, Julia, Matlab, Octave, R, SQL
- Technologies: Linux, Latex, Git, AWS, MariaDB

TEACHING EXPERIENCE

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|---|----------------------------------|
| • Teaching assistant: Computational Physics | September, 2023 – December, 2023 |
| • Teaching assistant: Frontiers in Physics | September, 2023 – December, 2023 |
| • Teaching assistant: Introduction to Quantum Mechanics | January, 2022 – April, 2022 |
| • Teaching assistant: Electricity and Magnetism | September, 2021 – December, 2021 |
| • Teaching assistant: Electricity and Magnetism | September, 2020 – December, 2020 |
| • Teaching assistant: Enriched Physics I | September, 2020 – December, 2020 |
| • Teaching assistant: Introductory Physics for Engineers II | January, 2020 – April, 2020 |
| • Teaching assistant: Introductory Physics | September, 2019 – December, 2019 |

Last updated: September, 2023