

# Michael Zurel

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Work email: [mzurel@sfsu.ca](mailto:mzurel@sfsu.ca)  
Website: [mzurel.github.io](https://mzurel.github.io)

## EDUCATION

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|---|---|
| <ul style="list-style-type: none"><li><b>PhD</b></li><li>Physics (Quantum information and computation)<ul style="list-style-type: none"><li>Supervisors: Dr. Robert Raussendorf and Dr. William G. Unruh</li><li>Thesis: <a href="#">Classical descriptions of quantum computations: foundations of quantum computation via hidden variable models, quasiprobability representations, and classical simulation algorithms</a></li></ul></li></ul> | University of British Columbia<br>Sep., 2020 – Aug., 2024 |
| <ul style="list-style-type: none"><li><b>MSc</b></li><li>Physics (Quantum information and computation)<ul style="list-style-type: none"><li>Supervisor: Dr. Robert Raussendorf</li><li>Thesis: <a href="#">Hidden variable models and classical simulation algorithms for quantum computation with magic states on qubits</a></li></ul></li></ul>   | University of British Columbia<br>Sep., 2019 – Oct., 2020 |
| <ul style="list-style-type: none"><li><b>BSc</b></li><li>Combined honours in Physics and Mathematics<ul style="list-style-type: none"><li>Honours thesis: Contextuality and Simulating Quantum Computation with Magic States</li></ul></li></ul>  | University of British Columbia<br>Sep., 2014 – May, 2019  |

## EXPERIENCE

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| <ul style="list-style-type: none"><li><b>NSERC Postdoctoral Fellow</b></li><li>Department of Mathematics, Simon Fraser University</li></ul>             | Vancouver, Canada<br>Sep., 2024 –            |
| <ul style="list-style-type: none"><li><b>Research Assistant</b></li><li>Department of Physics &amp; Astronomy, University of British Columbia</li></ul> | Vancouver, Canada<br>Sep., 2018 – Aug., 2024 |
| <ul style="list-style-type: none"><li><b>Teaching Assistant</b></li><li>Department of Physics &amp; Astronomy, University of British Columbia</li></ul> | Vancouver, Canada<br>Sep., 2019 – Dec., 2023 |
| <ul style="list-style-type: none"><li><b>Research Assistant</b></li><li>Department of Geography, Memorial University</li></ul>                          | St. John's, Canada<br>May, 2017 – Aug., 2018 |

## AWARDS

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| <ul style="list-style-type: none"><li>NSERC Postdoctoral Fellowship (NSERC PDF), \$140,000</li><li>CGS - Michael Smith Foreign Study Supplement (NSERC CGS-MSFSS), \$6,000</li><li>Alexander Graham Bell Canada Graduate Scholarship (NSERC CGS-D), \$105,000</li><li>UBC Four Year Doctoral Fellowship (UBC 4YF)</li><li>President's Academic Excellence Initiative PhD Award</li><li>UBC Faculty of Science PhD Tuition Award</li></ul> | 2024 – 2026<br>2023<br>2021 – 2024<br>2021 – 2024<br>2020 – 2024<br>2020 – 2024 |
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## SUCCESSFUL FUNDING

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| <ul style="list-style-type: none"><li>PIMS Workshop grant: Mathematical Foundations of Quantum Advantage II, \$20,000</li><li><i>Joint with Nadish de Silva (SFU)</i></li></ul>                                 | Awarded Dec., 2025<br>Unlisted co-author |
| <ul style="list-style-type: none"><li>PIMS Workshop grant: Mathematical Foundations of Quantum Advantage, \$20,000</li><li><i>Joint with Nadish de Silva (SFU) and Carmen Constantin (UCL/Oxford)</i></li></ul> | Awarded Nov., 2024<br>Unlisted co-author |
| <ul style="list-style-type: none"><li>NSERC Alliance Catalyst Grant, \$25,000</li><li><i>Joint with Nadish de Silva (SFU) and Mark Howard (Galway)</i></li></ul>  | Awarded Jul., 2024<br>Unlisted co-author |

## PATENTS

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|--|-----------------|
| <ul style="list-style-type: none"><li>Patent Application US20230206102A1; EP4128083A1; WO2021195783A1</li><li><i>Method of simulating a quantum computation, system for simulating a quantum computation, method for issuing a computational key, system for issuing a computational key</i></li></ul> | Status: Pending |
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## PUBLICATIONS & PREPRINTS

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- [1] **MZ**, L. Z. Cohen, and R. Raussendorf, “Simulation of quantum computation with magic states via Jordan-Wigner transformations,” *Physical Review A*, vol. 112, p. 042602, 2025. DOI: [10.1103/PhysRevA.112.042602](https://doi.org/10.1103/PhysRevA.112.042602) eprint: [arXiv:2307.16034](https://arxiv.org/abs/2307.16034).
- [2] **MZ**, C. Okay, and R. Raussendorf, “Simulating Quantum Computation: How Many ‘Bits’ for ‘It’?” *PRX Quantum*, vol. 5, p. 030343, 2024. DOI: [10.1103/PRXQuantum.5.030343](https://doi.org/10.1103/PRXQuantum.5.030343) eprint: [arXiv:2305.17287](https://arxiv.org/abs/2305.17287).
- [3] **MZ** and A. Heimendahl, “Efficient classical simulation of quantum computation beyond Wigner positivity,” 2024. eprint: [arXiv:2407.10349](https://arxiv.org/abs/2407.10349).
- [4] **MZ**, C. Okay, R. Raussendorf, and A. Heimendahl, “Hidden variable model for quantum computation with magic states on qudits of any dimension,” *Quantum*, vol. 8, p. 1323, 2024. DOI: [10.22331/q-2024-04-30-1323](https://doi.org/10.22331/q-2024-04-30-1323) eprint: [arXiv:2110.12318](https://arxiv.org/abs/2110.12318).
- [5] R. Raussendorf, C. Okay, **MZ**, and P. Feldmann, “The role of cohomology in quantum computation with magic states,” *Quantum*, vol. 9, p. 979, 2023. DOI: [10.22331/q-2023-04-13-979](https://doi.org/10.22331/q-2023-04-13-979) eprint: [arXiv:2110.11631](https://arxiv.org/abs/2110.11631).
- [6] C. Okay, **MZ**, and R. Raussendorf, “On the extremal points of the  $\Lambda$ -polytopes and classical simulation of quantum computation with magic states,” *Quantum Information & Computation*, vol. 21, no. 13&14, pp. 1091–1110, 2021. DOI: [10.26421/QIC21.13-14-2](https://doi.org/10.26421/QIC21.13-14-2) eprint: [arXiv:2104.05822](https://arxiv.org/abs/2104.05822).
- [7] **MZ**, C. Okay, and R. Raussendorf, “Hidden Variable Model for Universal Quantum Computation with Magic States on Qubits,” *Physical Review Letters*, vol. 125, p. 260404, 2020. DOI: [10.1103/PhysRevLett.125.260404](https://doi.org/10.1103/PhysRevLett.125.260404) eprint: [arXiv:2004.01992](https://arxiv.org/abs/2004.01992).
- [8] R. Raussendorf, J. Bermejo-Vega, E. Tyhurst, C. Okay, and **MZ**, “Phase-space-simulation method for quantum computation with magic states on qubits,” *Physical Review A*, vol. 101, p. 012350, 2020. DOI: [10.1103/PhysRevA.101.012350](https://doi.org/10.1103/PhysRevA.101.012350) eprint: [arXiv:1905.05374](https://arxiv.org/abs/1905.05374).

For PDFs see [mzurel.github.io](https://mzurel.github.io); for citation statistics see [Google Scholar](https://scholar.google.com/citations?user=0000-0002-1234-5678).

## CONFERENCE TALKS

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- Quasiprobability distributions in quantum information (QuiDiQua3) [Invited] 35 minute talk
- *Efficient classical simulation of quantum computation beyond Wigner nonnegativity* Nov., 2025
- Foundations of Quantum Computation (FQC) 5 minute talk
- *The  $\Lambda$  polytopes and their applications* Jun., 2025
- Foundations of Quantum Computational Advantage (FoQaCiA) Workshop [Invited] 45 minute talk
- *Introduction to the  $\Lambda$  polytopes and their applications* Jun., 2025
- Algebraic Structures in Quantum Computation VI (ASQC6) [Invited] 45 minute talk
- *Introduction to the  $\Lambda$  polytopes and their applications* Feb., 2025
- Quantum Physics and Logic (QPL) 30 minute talk
- *Efficient classical simulation of quantum computation beyond Wigner positivity* Jul., 2024
- Southwest Quantum Information and Technology (SQuInT) Workshop 30 minute talk
- *Simulating quantum computation: how many “bits” for “it”?* Oct., 2023
- Quantum Physics and Logic (QPL) [presented by a co-author] 30 minute talk
- *Simulation of quantum computation with magic states via Jordan-Wigner transformations* Jul., 2023
- Coogee Workshop 2023 [Invited] 60 minute talk
- *No-go theorems for discrete Wigner functions and alternative quasiprobability representations for quantum computation with magic states* Feb., 2023
- Foundations of Quantum Computational Advantage (FoQaCiA) Workshop [Invited] 45 minute talk
- *$\Lambda$  polytopes and classical simulation of quantum computation with magic states* Nov., 2022

- Theory of Quantum Computation, Communication, and Cryptography (TQC) 25 minute talk
  - Hidden variable model for quantum computation with magic states on qudits of any dimension* Jul., 2022
- Quantum Physics and Logic (QPL) 10 minute talk
  - Hidden variable model for quantum computation with magic states on qudits of any dimension* Jun., 2022
- Algebraic Structures in Quantum Computation V (ASQC5) 45 minute talk
  - Hidden variable models for quantum computation with magic states* Jun., 2022
- Theory of Quantum Computation, Communication, and Cryptography (TQC) 30 minute talk
  - Hidden variable model for universal quantum computation with magic states on qubits* Jul., 2021
- Quantum Physics and Logic (QPL) 30 minute talk
  - Hidden variable model for universal quantum computation with magic states on qubits* Jun., 2021
- Algebraic Structures in Quantum Computation IV (ASQC4) 60 minute talk
  - Hidden variable model for universal quantum computation with magic states on qubits* Jun., 2020
- Quantum Physics and Logic (QPL) 25 minute talk
  - Phase-space-simulation method for quantum computation with magic states on qubits* Jun., 2019

For slides, videos, etc., see [mzurel.github.io/talks](https://mzurel.github.io/talks)

## INVITED SEMINARS

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- School of Mathematical & Statistical Sciences seminar @ University of Galway 60 minute talk
  - Efficient classical simulation of quantum computation beyond Wigner nonnegativity* Nov., 2025
- David Gross group seminar @ University of Cologne 60 minute talk
  - Efficient classical simulation of quantum computation beyond Wigner positivity* Apr., 2024
- Quantum information group seminar @ Leibniz University Hannover 60 minute talk
  - A hierarchy of classical simulation algorithms for quantum computation of increasing complexity* Apr., 2024
- Quantum information group seminar @ DAMTP, University of Cambridge 60 minute talk
  - A hierarchy of classical simulation algorithms for quantum computation of increasing complexity* Apr., 2024
- Dan Browne group seminar @ University College London 60 minute talk
  - A hierarchy of classical simulation algorithms for quantum computation of increasing complexity* Apr., 2024
- QLOC Group Seminar @ Iberian Nanotechnology Laboratory 60 minute talk
  - A hierarchy of classical simulation algorithms for quantum computation* Sep., 2023
- Sheaf talks (Samson Abramsky group seminar @ University of Oxford) 60 minute talk
  - The role of cohomology in quantum computation with magic states* Dec., 2022
- David Gross group seminar @ University of Cologne 60 minute talk
  - Quasiprobability representations for quantum computation with magic states* Jul., 2022
- Math Grad Seminar @ Bilkent University 60 minute talk
  - Polytopes in quantum computation and quantum information* Jun., 2022
- Institute of Applied Mathematics Seminar @ University of British Columbia 60 minute talk
  - Polytopes in quantum computation and quantum information* Jun., 2022
- Internal talk for QuEra Computing Inc. software/algorithms team 45 minute talk
  - Classical simulation of quantum computation with magic states* Apr., 2022

## POSTER PRESENTATIONS

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- Year of Quantum Across Canada @ Perimeter Institute
- *The role of cohomology in quantum computation with magic states* Sep., 2025
- Helgoland 2025: 100 Years of Quantum Mechanics
- *Hidden variable model for universal quantum computation and Wheeler's "It from Bit"* Jun., 2025
- Southwest Quantum Information and Technology (SQuInT) Workshop
- *Efficient classical simulation of quantum computation beyond Wigner negativity* Oct., 2024
- Theory of Quantum Computation, Communication, and Cryptography (TQC)
- *Efficient classical simulation of quantum computation beyond Wigner positivity* Sep., 2024
- Quantum Information Processing (QIP)
- *Simulation of quantum computation with magic states via Jordan-Wigner transformations* Jan., 2024
- Quantum Information Processing (QIP)
- *Simulating quantum computation: how many "bits" for "it"?* Jan., 2024
- Southwest Quantum Information and Technology (SQuInT) Workshop
- *Simulation of quantum computation with magic states via Jordan-Wigner transformations* Oct., 2023
- Quantum Physics and Logic (QPL)
- *Simulating quantum computation with magic states: how many "bits" for "it"?* Jul., 2023
- Max Planck - UBC - UTokyo Centre for Quantum Materials Annual Meeting,
- *Hidden variable model for quantum computation with magic states on qudits of any dimension* Sep., 2022
- Max Planck - UBC - UTokyo Centre for Quantum Materials Annual Meeting
- *The role of cohomology in quantum computation with magic states* Sep., 2022
- Theory of Quantum Computation, Communication, and Cryptography (TQC)
- *The role of cohomology in quantum computation with magic states* Jul., 2022
- Quantum Information Processing (QIP)
- *Hidden variable model for quantum computation with magic states on qudits of any dimension* Mar., 2022
- Quantum Information Processing (QIP)
- *Hidden variable model for universal quantum computation with magic states on qubits* Mar., 2021
- Southwest Quantum Information and Technology (SQuInT)
- *Phase-space-simulation method for quantum computation with magic states on qubits* Feb., 2020

For poster PDFs see [mzurel.github.io/talks](https://mzurel.github.io/talks)

## WORKSHOP & SUMMER SCHOOL ORGANIZATION

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- Mathematical Foundations of Quantum Advantage Workshop, 2nd edition May, 2026  
*Simon Fraser University* Co-organizer
- Mathematical Foundations of Quantum Advantage Workshop May, 2025  
*Simon Fraser University, Vancouver, Canada* Co-organizer
- 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 module
- Cornerstone Models of Quantum Computing Summer School August, 2020  
*TRIUMF, Vancouver, Canada* Teaching assistant for MBQC module

## PEER REVIEW

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Referee for the following journals:

- Physical Review Letters
- PRX Quantum
- Physical Review A
- Physical Review Applied
- npj Quantum Information
- Quantum Journal
- Journal of Mathematical Physics
- Journal of Physics A: Mathematical and Theoretical
- Journal of Applied and Computational Topology

Subreviewer for the following conferences:

- Quantum Information Processing (QIP)
- Theory of Quantum Computation, Communication and Cryptography (TQC)

I also serve on NSERC Review Committee 178 (Physics and Astronomy), a review committee for postdoctoral fellowships and postgraduate scholarships offered by the Natural Sciences and Engineering Research Council of Canada (NSERC).

## SOFTWARE

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- [BinarySymplectic.jl](#) — Tools for working with symplectic vector spaces and symplectic groups over  $\mathbb{Z}_2$ .
- [QuditStabilizers.jl](#) — Tools for working with the stabilizer formalism on odd-prime-dimensional qudits.
- [RandomQM.jl](#) — Julia functions for generating random quantum states and random quantum channels
- [LasserreIS.jl](#) — Julia code for computing Lasserre bounds for the independence number of graphs.
- [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).
- 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](https://github.com/mzurel)

## TEACHING EXPERIENCE

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|---|-------------------------|
| • Teaching assistant: Computational Physics                 | Sep., 2023 – Dec., 2023 |
| • Teaching assistant: Frontiers in Physics                  | Sep., 2023 – Dec., 2023 |
| • Teaching assistant: Introduction to Quantum Mechanics     | Jan., 2022 – Apr., 2022 |
| • Teaching assistant: Electricity and Magnetism             | Sep., 2021 – Dec., 2021 |
| • Teaching assistant: Electricity and Magnetism             | Sep., 2020 – Dec., 2020 |
| • Teaching assistant: Enriched Physics I                    | Sep., 2020 – Dec., 2020 |
| • Teaching assistant: Introductory Physics for Engineers II | Jan., 2020 – Apr., 2020 |
| • Teaching assistant: Introductory Physics                  | Sep., 2019 – Dec., 2019 |