Michael Vasmer

Curriculum vitae

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Experience

2025–present **Inria Starting Faculty Position**, *Inria Paris*

2023–2024 **Senior Quantum Architecture Scientist**, *Xanadu Quantum Technologies Inc.*

2022–2024 **Research Scientist**, *Perimeter Institute for Theoretical Physics*

2022–2023 **Quantum Error Correction Researcher**, *Xanadu Quantum Technologies Inc.*

2021–2022 **Independent Contractor**, *Xanadu Quantum Technologies Inc.*

2019–2022 **Postdoctoral Fellow**, *Perimeter Institute & Institute for Quantum Computing*
Mentors: Raymond Laflamme and Daniel Gottesman

Education

2016–2019 **Ph.D. Quantum Computing**, *University College London*
Thesis: *Fault-tolerant quantum computing with three-dimensional surface codes*.
Supervisor: Dan Browne.

2015–2016 **M.Res. Quantum Technologies**, *University College London*, Distinction
Dissertation: *Swapping between color codes and surface codes*.
Supervisor: Dan Browne.

2011–2015 **M.Sci. Natural Sciences**, *Durham University*, First Class Honours
Specialised in Physics and Computer Science.

Funding

2021 **Making noisy quantum processors practical: From theory to applications**, *Natural Sciences and Engineering Research Council of Canada & Innovate UK*, C$330k + £300k
Co-principal investigator. I co-authored the grant proposal and I lead the research program on the Canadian side of the grant.

2021–2022 **IonQ Academic Research Credits Program**, $20k
I secured funding for running experiments on IonQ's trapped-ion quantum computers.

Publications

[1] B. W. Walshe, B. Q. Baragiola, H. Ferretti, J. Gefaell, M. Vasmer, R. Weil, T. Matsuura, T. Jaeken, G. Pantaleoni, Z. Han, T. Hillmann, N. C. Menicucci, I. Tzitrin, and R. N. Alexander, "Linear-optical quantum computation with arbitrary error-correcting codes," *Phys. Rev. Lett.* **134** (Mar, 2025) 100602, arXiv:2408.04126.

[2] H. Aghaee Rad *et al.*, "Scaling and networking a modular photonic quantum computer," *Nature*

(Jan., 2025) 1–8.

[3] E. Sabo, L. G. Gunderman, B. Ide, M. Vasmer, and G. Dauphinais, "Weight-Reduced Stabilizer Codes with Lower Overhead," *PRX Quantum* **5** no. 4, (Oct., 2024) 040302, arXiv:2402.05228.

[4] D. Honciuc Menendez, A. Ray, and M. Vasmer, "Implementing fault-tolerant non-Clifford gates using the [[8,3,2]] color code," *Phys. Rev. A* **109** no. 6, (June, 2024) 062438, arXiv:2309.08663.

[5] J. C. Bridgeman, A. Kubica, and M. Vasmer, "Lifting Topological Codes: Three-Dimensional Subsystem Codes from Two-Dimensional Anyon Models," *PRX Quantum* **5** no. 2, (Apr., 2024) 020310, arXiv:2305.06365.

[6] G. Dauphinais, D. W. Kribs, and M. Vasmer, "Stabilizer Formalism for Operator Algebra Quantum Error Correction," *Quantum* **8** (Feb., 2024) 1261, arXiv:2304.11442.

[7] A. O. Quintavalle, P. Webster, and M. Vasmer, "Partitioning qubits in hypergraph product codes to implement logical gates," *Quantum* **7** (Oct., 2023) 1153, arXiv:2204.10812.

[8] E. Huang, A. Pesah, C. T. Chubb, M. Vasmer, and A. Dua, "Tailoring three-dimensional topological codes for biased noise," *PRX Quantum* **4** (Sep, 2023) 030338, arXiv:2211.02116.

[9] J. Huang, S. M. Li, L. Yeh, A. Kissinger, M. Mosca, and M. Vasmer, "Graphical CSS code transformation using ZX calculus," in *Proceedings of the Twentieth International Conference on Quantum Physics and Logic (QPL 2023)*, vol. 384 of *Electronic Proceedings in Theoretical Computer Science*, pp. 1–19. August, 2023. arxiv:2307.02437.

[10] A. Kubica and M. Vasmer, "Single-shot quantum error correction with the three-dimensional subsystem toric code," *Nat. Commun.* **13** no. 1, (Oct., 2022) 6272, arXiv:2106.02621.

[11] T. R. Scruby, M. Vasmer, and D. E. Browne, "Non-Pauli errors in the three-dimensional surface code," *Phys. Rev. Research* **4** no. 4, (Oct., 2022) 043052, arXiv:2202.05746.

[12] H. Chen, M. Vasmer, N. P. Breuckmann, and E. Grant, "Automated discovery of logical gates for quantum error correction," *Quantum Inf. Comput.* no. 11&12, (Sept., 2022) 0947–0964, arXiv:1912.10063.

[13] M. Vasmer and A. Kubica, "Morphing quantum codes," *PRX Quantum* **3** no. 3, (Aug., 2022) 030319, arXiv:2112.01446.

[14] T. R. Scruby, D. E. Browne, P. Webster, and M. Vasmer, "Numerical implementation of just-in-time decoding in novel lattice slices through the three-dimensional surface code," *Quantum* **6** (May, 2022) 721, arXiv:2012.08536.

[15] P. Webster, M. Vasmer, T. R. Scruby, and S. D. Bartlett, "Universal fault-tolerant quantum computing with stabilizer codes," *Phys. Rev. Research* **4** no. 1, (Feb., 2022) 013092, arXiv:2012.05260.

[16] A. O. Quintavalle, M. Vasmer, J. Roffe, and E. T. Campbell, "Single-shot error correction of three-dimensional homological product codes," *PRX Quantum* **2** no. 2, (June, 2021) 020340, arXiv:2009.11790. Editors' suggestion.

[17] J. E. Bourassa, R. N. Alexander, M. Vasmer, A. Patil, I. Tzitrin, T. Matsuura, D. Su, B. Q. Baragiola, S. Guha, G. Dauphinais, K. K. Sabapathy, N. C. Menicucci, and I. Dhand, "Blueprint for a scalable photonic fault-tolerant quantum computer," *Quantum* **5** (Feb., 2021) 392, arXiv:2010.02905.

[18] M. Vasmer, D. E. Browne, and A. Kubica, "Cellular automaton decoders for topological quantum codes with noisy measurements and beyond," *Sci. Rep.* **11** no. 1, (Jan., 2021) 2027, arXiv:2004.07247.

[19] M. Vasmer, *Fault-tolerant quantum computing with three-dimensional surface codes*. PhD thesis, University College London, Dec., 2019.

[20] M. Vasmer and D. E. Browne, "Three-dimensional surface codes: Transversal gates and fault-tolerant architectures," *Phys. Rev. A* **100** no. 1, (July, 2019) 012312, arXiv:1801.04255.

Preprints

[1] A. Ray, E. Swaroop, N. Cao, M. Vasmer, and A. Chowdhury, "Quasiprobabilistic imaginary-time evolution on quantum computers," arXiv:2505.06343.

[2] P. J. Nadkarni, S. Adonsou, G. Dauphinais, D. W. Kribs, and M. Vasmer, "Unified and Generalized Approach to Entanglement-Assisted Quantum Error Correction," arXiv:2411.14389.

[3] T. Hillmann, G. Dauphinais, I. Tzitrin, and M. Vasmer, "Single-shot and measurement-based quantum error correction via fault complexes," arXiv:2410.12963.

Invited talks

Jul 2024 **Implementing fault-tolerant non-Clifford gates using color codes**
International Conference on Atomic Physics 2024 Satellite Workshop, University of Sussex, Brighton, UK

May 2024 **Weight Reduced Stabilizer Codes with Lower Overhead**
Canadian Association of Phyicists Congress, London ON, Canada

Mar 2024 **Weight Reduced Stabilizer Codes with Lower Overhead**
Yukawa Institute for Theoretical Physics Error Correction Workshop, Kyoto, Japan

Nov 2023 **Fault-tolerant quantum computation beyond the surface code**
Quantum Innovators Workshop, Waterloo ON, Canada

Jun 2023 **Fault-tolerant quantum computation with topological subsystem codes**
International Workshop on General-Purpose Quantum Computing and Information Theory, Institute of Theoretical Physics, Chinese Academy of Sciences (online)

Mar 2023 **3D subsystem codes from 2D topological codes**
APS March Meeting, Las Vegas NV, USA

Oct 2022 **Fault-tolerant quantum computing in the age of "good codes"**
Q-SITE Conference, Toronto ON, Canada

Jul 2022 **Single-shot quantum error correction: Part II**
IBM Quantum Error Correction Summer School, Tarrytown NY, USA

Contributed talks & seminars

May 2025 **Fault-tolerant transformations of spacetime codes**
Quandela, Massy, France

Apr 2025 **Non-Clifford gates in (2+1)-dimensions and just-in-time decoding**
Yale University, New Haven CT, USA

Apr 2025 **Review of recent progress in constructing codes with transversal non-Clifford gates**
Perimeter Institute, Waterloo ON, Canada
Yale University, New Haven CT, USA

2025 **Teleporting quantum errors: Knill error correction in the era of modern quantum processors**
University of Guelph, Guelph ON, Canada
International Conference on Quantum Computing, Paris, France

2025 **Single-shot and measurement-based quantum error correction via fault complexes**
NISQ2LSQ workshop, L'université d'Aix-Marseille, Marseille, France
QIP 2025, Raleigh NC, USA

May 2024 **Overview of quantum error correction with a view on machine learning opportunities**
Future Horizons: Bridging AI, Quantum and New Materials workshop, Montréal QC, Canada

May 2024 **Quantum error correction with constant time overhead**
Quantum Spain seminar (online), Recoding: `https://youtu.be/HXuIFxHMmZg`

Apr 2024 **Weight Reduced Stabilizer Codes with Lower Overhead**
Quandela, Massy, France

2024 **Implementing fault-tolerant non-Clifford gates using the [[8,3,2]] color code**
IBM Quantum Information Technical Exchange colloquium (online)
Alice & Bob (online)

Dec 2023 **Decoding the 3D subsystem toric code**
Inria Paris, France

Dec 2023 **Photonic quantum computation beyond the surface code**
Télécom Paris, France

May 2022 **Fault-tolerant quantum computation beyond the surface code**
QuEra Computing (online)

2022 **Morphing quantum codes**
Riverlane, Cambridge, UK
APS March Meeting, Chigaco IL, USA

2021 **Single-shot quantum error correction with the 3D subsystem toric code**
Cambridge Quantum Computing, UK
University College London, UK
Freie Universität Berlin (online), Recording: `https://youtu.be/idmrNQy09Aw`

2021 **Locally unencoding the color code**
TQC 2021 (online), Recording: `https://youtu.be/jUYOjC9Z68g`
1QB Information Technologies (online)

2020 **Cellular automaton decoders for toplogical codes with noisy measurements and beyond**
Quantum Code Design and Architecture seminar (online)
Université de Sherbrooke, Sherbrooke QC, Canada

Mar 2019 **Cellular automaton decoder for topological codes with boundaries**
APS March Meeting, Boston MA, USA
Quantum Code Design and Architecture kick-off meeting, Paris, France

2018 **Quantum computing with 3D surface codes**
Perimeter Institute, Waterloo ON, Recording: `https://doi.org/10.48660/18110080`
Quantum Roundabout 2018, Nottingham, UK
Northern Quantum meeting, Durham, UK

Awards

Aug 2019 **Poster Prize**, *5th International Conference on Quantum Error Correction, London UK*

Sep 2017 **Prize for outstanding performance in the MRes in Quantum Technologies**, *University College London*

Jun 2012 **Outstanding Achievement Prize**, *Durham University Physics Department*

Supervision

2021–2024 Supervised one PhD student and one master's students at the University of Waterloo for projects on quantum error correction and quantum error mitigation (resulted in preprint [1]).

Summer 2022 Supervised two undergraduate students for projects on quantum error correction and quantum error mitigation (resulted in publication [4]).

Summer 2021 Supervised a Perimeter Scholars International master's student for his thesis (resulted in publication [8]).

Teaching

Winter 2024 Graduate course at the University of Waterloo on quantum error correction and fault tolerance. Five (three-hour) lectures on quantum LDPC codes and fault-tolerant quantum computation and assessment of students' final projects. Course website: `https://www.math.uwaterloo.ca/~wcleung/qic890-w2024.html`.

Winter 2022 Graduate course at the University of Waterloo on quantum error correction and fault tolerance. Six (one-hour) lectures on fault-tolerant quantum computation and assessment of students' final projects. Course website: `https://www.math.uwaterloo.ca/~wcleung/co781-w2022.html`.

2017–2019 Delivered tutorials on quantum technologies to master's students at University College London. Total: 12 hours.

Community contributions

Apr 2025 Thesis examiner: The locality of quantum codes by Nouédyn Baspin, University of Sydney, Australia.

Sep 2025 Organiser: Quantum error correction meets ZX-calculus workshop (Dagstuhl, Germany).

2025–present Organiser: QASAR (Quantum Architectures, Small And Reliable) online seminar series.

2024, 2026 Organiser: Fault-tolerant quantum technologies workshop (Benasque, Spain).

2022, 2024 Program committee member: Quantum Computing Theory in Practice workshop.

2022 Organiser: Workshop on industrial quantum error mitigation (London, UK).

2020–2022 Organiser: Perimeter Institute quantum information seminar.

2017 Organiser: QCumber 2017 student conference (Windsor, UK).

2020–present Reviewer for scientific journals (number of reviewed articles in brackets):

- ACM Transactions on Quantum Computing (1)
- Nature (3)
- Nature Physics (2)
- npj Quantum Information (1)
- Physical Review Letters (3)
- Physical Review X (2)
- PRX Quantum (7)
- Quantum (6)

2021–present Reviewer for academic conferences:

- Conference on Quantum Information Processing (QIP)
- Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC)
- IEEE International Symposium on Information Theory (ISIT)
- IEEE Information Theory Workshop (ITW)

Equity, diversity and inclusion (EDI)

2022–2023 Member: Institute for Quantum Computing EDI committee.

2017–2019 PhD tutor, The Brilliant Club (`https://thebrilliantclub.org`).
Delivered university-style tutorials about quantum computing to students at low-participation schools. Designed my own course over multiple placements.

Computer skills

Software development	Programming languages: Python, C++, Julia, GAP, Mathematica. Source control: Git, GitHub.
Quantum computers	Experience running quantum circuits on superconducting and trapped-ion quantum comptuers over the cloud, see publication [4].
High-performance computing	Experience with multiple supercomputing clusters, including the Digital Research Alliance of Canada systems, see publications [3, 5, 10, 11, 14, 16, 17, 18].

Media Coverage

Jan 2025	Lighting up the quantum computing horizon with Aurora, *Xanadu press release*.
Jan 2024	Quantum computing is taking on its biggest challenge: noise, *MIT Technology Review*.
May 2021	Phasecraft kicks off Innovate UK-Canada project, *Phasecraft press release*.
Mar 2021	When physicists consult, *Perimeter Institute press release*.
Oct 2020	From a state of light to state of the art: the photonic path to millions of qubits, *Xanadu press release*.

Personal details

Date of birth	January 19th 1993
Citizenship	United Kingdom, Canada
Languages	English (native), Welsh (native), French (B1), German (A2).

References

Available on request.