

Joseph T. Iosue, Ph.D.

Senior Researcher

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Education

- 2020 – 2025 **University of Maryland**, *Doctor of Philosophy (Physics)*, JQI Graduate Fellow
Advisors: Prof. Alexey Gorshkov and Prof. Victor Albert
- 2015 – 2019 **Massachusetts Institute of Technology**, *Bachelor of Science*
B.S. (Physics), Minor (Computer Science) – GPA 4.9/5.0

Research Experience

- 2026 – **Microsoft Quantum**, *Senior Researcher*
Senior researcher on the quantum error correction team at Microsoft
- 2025 – 2026 **Johns Hopkins University Applied Physics Laboratory**, *Senior Scientist*
Quantum research scientist in Research and Exploratory Development (REDD) researching quantum error correction, noise characterization, and sensing
- 2020 – 2025 **University of Maryland, Department of Physics**, *Research Assistant*
Affiliations:
○ Joint Quantum Institute (JQI)
○ Joint Center for Quantum Information and Computer Science (QIICS)
- 2024 **IBM Quantum Research**, *Summer intern*
Supervisor: Kunal Sharma and Minh Tran.
- 2023 **Johns Hopkins University Applied Physics Laboratory**, *Summer intern*
Supervisor: Dr. Paraj Titum. Studied a specific quantum sensing and noise characterization problem [18].
- 2019 – 2020 **QC Ware, Corp**, *Quantum Algorithms Researcher*
Developed software and algorithms for customer use cases, including [1].
- 2018 **Los Alamos National Laboratory**, *Quantum Computing Summer Fellowship*
Supervisor: Dr. Patrick Coles. Developed and published a novel quantum algorithm [3].
- 2017 **Joint Quantum Institute, University of Maryland**, *Summer Researcher*
Supervisor: Prof. Alexey Gorshkov. Studied quantum phase transitions via quench dynamics [2].
- 2015 – 2018 **Massachusetts Institute of Technology**, *Undergraduate researcher*
○ (2017 – 2018) Supervisor: Prof. Or Hen. Studied proton/neutron dynamics with C++ and ROOT.
○ (2016) Supervisor: Prof. Nuno Loureiro. Modeled particle transport in turbulent media using C.
○ (2015) Supervisor: Prof. Emilio Baglietto. Modeled nuclear waste storage canisters and fission waste.

Talks

- Higher moment theory and learnability of bosonic states**, based on [16]
- 2026 – The Theory of Quantum Computation, Communication and Cryptography (TQC), see my slides on [GitHub](#)
 - 2026 – Prof. Scott Aaronson's group meeting

Projective toric designs, quantum state designs, and mutually unbiased bases, based on [9]

- 2025 – Quantum Information Processing (QIP), see recording on [YouTube](#)
- 2024 – Codes and Expansions ([CodEx](#)) Seminar (invited, virtual), see recording on [YouTube](#)

Continuous-variable quantum state designs: theory and applications, based on [5]

- 2023 – Quantum Information Processing (QIP), see recording on [YouTube](#)
- 2023 – APS March Meeting
- 2022 – Prof. David Gross's group seminar (invited, virtual)
- 2022 – CU Boulder journal club (invited, virtual)
- 2022 – University of Maryland JQI-QulCS quantum seminar
- 2022 – APS March Meeting (virtual)

Page curves and typical entanglement in linear optics, based on [4]

- 2023 – Quantum Algorithms and Applications Collaboratory ([QuAAC](#)) Seminar, Sandia National Laboratory (invited, given by coauthor)
- 2023 – APS March Meeting

Publications

See also: [Google Scholar](#), [arXiv](#)

- [21] M. A. Alekseyev, **J. T. Iosue**, A. Ehrenberg, and A. V. Gorshkov, “Cycle-structure generating functions for special breakpoint graphs”, 2026, [arXiv:2608.30764 \[math.CO\]](#).
- [20] L. Shou, A. Ehrenberg, Y.-X. Wang, **J. T. Iosue**, and A. V. Gorshkov, “Anticoncentration and entanglement in Gaussian boson sampling”, 2026, [arXiv:2609.01241 \[quant-ph\]](#).
- [19] L. Shou, **J. T. Iosue**, Y.-X. Wang, V. Galitski, and A. V. Gorshkov, “Entanglement and circuit complexity in finite-depth random linear optical networks”, Apr. 2026, [arXiv:2604.14277 \[quant-ph\]](#).
- [18] **J. T. Iosue**, P. Titum, T. Lin, C. Lau, and L. M. Norris, “Superresolution in quantum noise spectroscopy via filter design”, Feb. 2026, [arXiv:2602.11275 \[quant-ph\]](#).
- [17] J. Shah, C. Fechisin, Y.-X. Wang, **J. T. Iosue**, J. D. Watson, Y.-Q. Wang, B. Ware, A. V. Gorshkov, and C.-J. Lin, “Instability of steady-state mixed-state symmetry-protected topological order to strong-to-weak spontaneous symmetry breaking”, *Quantum* **9**, 1912 (2025), [arXiv:2410.12900 \[quant-ph\]](#).
- [16] **J. T. Iosue**, Y.-X. Wang, I. Datta, S. Ghosh, C. Oh, B. Fefferman, and A. V. Gorshkov, “Higher moment theory and learnability of bosonic states”, Oct. 2025, [arXiv:2510.01610 \[quant-ph\]](#).
- [15] A. Das, **J. T. Iosue**, and V. V. Albert, “Quantum-inspired benchmark for estimating intrinsic dimension”, Oct. 2025, [arXiv:2510.01335 \[cs.LG\]](#).
- [14] J. Conrad, **J. T. Iosue**, A. G. Burchards, and V. V. Albert, “Continuous-variable designs and design-based shadow tomography from random lattices”, *Phys. Rev. Lett.* **135**, 060802 (2025), [arXiv:2412.17909 \[quant-ph\]](#).
- [13] J. Youm, **J. T. Iosue**, A. Ehrenberg, Y.-X. Wang, and A. V. Gorshkov, “Average Rényi entanglement entropy in Gaussian boson sampling”, *Phys. Rev. Res.* **7**, 023125 (2025), [arXiv:2403.18890 \[quant-ph\]](#).
- [12] A. Ehrenberg, **J. T. Iosue**, A. Deshpande, D. Hangleiter, and A. V. Gorshkov, “Transition of anticoncentration in Gaussian boson sampling”, *Phys. Rev. Lett.* **134**, 140601 (2025), [arXiv:2312.08433 \[quant-ph\]](#).
- [11] A. Ehrenberg, **J. T. Iosue**, A. Deshpande, D. Hangleiter, and A. V. Gorshkov, “Second moment of Hafnians in Gaussian boson sampling”, *Phys. Rev. A* **111**, 042412 (2025), [arXiv:2403.13878 \[quant-ph\]](#).

- [10] J. Yu, J. R. Moreno, **J. T. Iosue**, L. Bertels, D. Claudino, B. Fuller, P. Groszkowski, T. S. Humble, P. Jurcevic, W. Kirby, T. A. Maier, M. Motta, B. Pokharel, A. Seif, A. Shehata, K. J. Sung, M. C. Tran, V. Tripathi, A. Mezzacapo, and K. Sharma, “Sample-based Krylov quantum diagonalization”, Jan. 2025, [arXiv:2501.09702 \[quant-ph\]](#).
- [9] **J. T. Iosue**, T. C. Mooney, A. Ehrenberg, and A. V. Gorshkov, “Projective toric designs, quantum state designs, and mutually unbiased bases”, *Quantum* **8**, 1546 (2024), [arXiv:2311.13479 \[quant-ph\]](#).
- [8] Z. Liang, B. Yang, **J. T. Iosue**, and Y.-A. Chen, “Operator algebra and algorithmic construction of boundaries and defects in (2+1)d topological pauli stabilizer codes”, Oct. 2024, [arXiv:2410.11942 \[quant-ph\]](#).
- [7] Z. Liang, Y. Xu, **J. T. Iosue**, and Y.-A. Chen, “Extracting topological orders of generalized Pauli stabilizer codes in two dimensions”, *PRX Quantum* **5**, 030328 (2024), [arXiv:2312.11170 \[quant-ph\]](#).
- [6] S. P. Jain, **J. T. Iosue**, A. Barg, and V. V. Albert, “Quantum spherical codes”, *Nature Physics*, [10.1038/s41567-024-02496-y](#) (2024), [arXiv:2302.11593 \[quant-ph\]](#).
- [5] **J. T. Iosue**, K. Sharma, M. J. Gullans, and V. V. Albert, “Continuous-variable quantum state designs: theory and applications”, *Phys. Rev. X* **14**, 011013 (2024), [arXiv:2211.05127 \[quant-ph\]](#).
- [4] **J. T. Iosue**, A. Ehrenberg, D. Hangleiter, A. Deshpande, and A. V. Gorshkov, “Page curves and typical entanglement in linear optics”, *Quantum* **7**, 1017 (2023), [arXiv:2209.06838 \[quant-ph\]](#).
- [3] C. Cîrstoiu, Z. Holmes, **J. T. Iosue**, L. Cincio, P. J. Coles, and A. Sornborger, “Variational fast forwarding for quantum simulation beyond the coherence time”, *npj Quantum Information* **6**, 82 (2020), [arXiv:1910.04292 \[quant-ph\]](#).
- [2] P. Titum, **J. T. Iosue**, J. R. Garrison, A. V. Gorshkov, and Z.-X. Gong, “Probing ground-state phase transitions through quench dynamics”, *Phys. Rev. Lett.* **123**, 115701 (2019), [arXiv:1809.06377 \[quant-ph\]](#).
- [1] R. M. Parrish, **J. T. Iosue**, A. Ozaeta, and P. L. McMahon, “A Jacobi diagonalization and Anderson acceleration algorithm for variational quantum algorithm parameter optimization”, Apr. 2019, [arXiv:1904.03206 \[quant-ph\]](#).

Posters

Page curves and typical entanglement in linear optics, *based on* [4]

- 2023 – Boulder Summer School
- 2023 – Quantum Information Processing (QIP)

An initial condition robust outer-loop optimization strategy for QAOA

- 2019 – TQC Conference, College Park, Maryland

Selected Projects

2019 – **qubovert**, *Python package (with C extension) for binary optimization*

- Created **qubovert**, which is particularly designed to aid in converting optimization problems to a form that can be solved with quantum annealers and quantum optimization algorithms.
- qubovert can be installed with `pip install qubovert`, the source code is hosted at [github.com/jtiosue/qubovert](#), and the documentation is hosted at [qubovert.readthedocs.io](#).
- qubovert currently has **over 363k downloads** from **PyPI**, 41 stars and 8 forks on GitHub, and has been **cited** in many research articles.

2024 **(Deep) Q-learning in PyTorch**

- **PyTorch implementation** for self-playing reinforcement learning of a two player game.

- 2023 **rcal**, *Python package for review calibration*
- Devised a novel review calibration algorithm ([written report](#))
 - Implemented the algorithm in a Python [package](#).
- 2019 **Powell bounded multivariate optimization**, *SciPy contribution*
- Authored [pull request number 10648](#) on Python's SciPy package. My contribution is included in the [1.5.0](#) release and later releases
 - The pull request implements an additional feature for SciPy's minimization method. I devised a bounded version of the standard unbounded Powell minimization method and found it to often perform much better than the other gradient-free minimizers. I then implemented this variant in SciPy's software stack and created the pull request.
- 2018 **Quantum Computer Simulator**, *C++ project*
- Implemented a [quantum computer simulator](#) in C++.

Awards and Achievements

- 2023 **Boulder Summer School**, *Non-Equilibrium Quantum Dynamics*, University of Colorado, Boulder
One of 81 accepted into the four-week program
- 2020 – 2025 **JQI Graduate Fellowship**, Joint Quantum Institute, University of Maryland
- 2019, 2020 **NSF GRFP Honorable Mention**, National Science Foundation

Service and Mentoring

Journal and Conference Reviews/Subreviews

- npj Quantum Information 2026
- Quantum journal 2025, 2024, 2023
- Quantum Information Processing (QIP) conference 2026, 2025, 2024, 2023
- Quantum Computing Theory in Practice (QCTiP) conference 2026
- Theory of Quantum Computation, Communication and Cryptography (TQC) conference 2025, 2024
- Scientific Reports 2025

- 2023 – 2024 **Mentor**
Mentored high school summer student Jason Youm studying extensions of my work [\[4\]](#). Resulted in publication [\[13\]](#). See this [article](#) about the mentorship.
- 2020 – 2022 **Volunteer tutor**, *UMD Department of Physics*
- 2016 **Teaching assistant and grader**, *MIT Department of Physics*

Skills

Programming

Python, C, C++, Mathematica/WolframScript, $\text{\LaTeX}$, Git