Joseph T. Iosue, Ph.D.

Staff Research Scientist

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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

2025 – **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 (QuICS)

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. Paper in progress.

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]*
- March 2, 2026 (upcoming) – 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-QuICS 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

[18] **J. T. Iosue**, P. Titum, T. Lin, C. Lau, and L. M. Norris, "Superresolution in quantum noise spectroscopy via filter design", 2026, In preparation, draft available upon request.

[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

- Quantum journal 2025, 2024, 2023
- Quantum Information Processing (QIP) conference 2026, 2025, 2024, 2023
- 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, LaTeX, Git