

Joseph T. Iosue

Doctoral Candidate

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Mathematical Physics
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Education

- 2020 – **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

- 2020 – **University of Maryland, Department of Physics**, *Research Assistant*
Affiliations:
○ Joint Quantum Institute (JQI)
○ Joint Center for Quantum Information and Computer Science (QIICS)
- 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.

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
- Quantum Information Processing (QIP) conference 2024, 2023
- Theory of Quantum Computation, Communication and Cryptography (TQC) conference 2024

2023-2024 Mentor

Mentored high school summer student Jason Youm studying extensions of my work [5]. Resulted in publication [11].

- 2020 – 2022 **Volunteer Tutor**, *UMD Department of Physics*

Publications

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

- [11] J. Youm, **J. T. Iosue**, A. Ehrenberg, Y.-X. Wang, and A. V. Gorshkov, “Average Rényi entanglement entropy in Gaussian boson sampling”, [10.48550/arXiv.2403.18890](#) (2024).
- [10] A. Ehrenberg, **J. T. Iosue**, A. Deshpande, D. Hangleiter, and A. V. Gorshkov, “The second moment of hafnians in Gaussian boson sampling”, [10.48550/arXiv.2403.13878](#) (2024).
- [9] **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), [10.48550/arXiv.2211.05127](#) (2022).
- [8] Z. Liang, Y. Xu, **J. T. Iosue**, and Y.-A. Chen, “Extracting topological orders of generalized Pauli stabilizer codes in two dimensions”, [10.48550/arXiv.2312.11170](#) (2023).
- [7] A. Ehrenberg, **J. T. Iosue**, A. Deshpande, D. Hangleiter, and A. V. Gorshkov, “Transition of anticoncentration in Gaussian boson sampling”, [10.48550/arXiv.2312.08433](#) (2023).
- [6] **J. T. Iosue**, T. C. Mooney, A. Ehrenberg, and A. V. Gorshkov, “Projective toric designs, difference sets, and quantum state designs”, [10.48550/arXiv.2311.13479](#) (2023).
- [5] **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), [10.48550/arXiv.2209.06838](#) (2022).
- [4] S. P. Jain, **J. T. Iosue**, A. Barg, and V. V. Albert, “Quantum spherical codes”, [10.48550/arXiv.2302.11593](#) (2023).
- [3] C. Cirstoiu, 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), [10.48550/arXiv.1910.04292](#) (2019).
- [2] P. Titum, **J. T. Iosue**, J. R. Garrison, A. V. Gorshkov, and Z.-X. Gong, “Probing ground-state phase transitions through quench dynamics”, *Physical Review Letters* **123**, 115701 (2019), [10.48550/arXiv.1809.06377](#) (2018).
- [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”, [10.48550/arXiv.1904.03206](#) (2019).

Talks

Projective toric designs, difference sets, and quantum state designs, based on [6]

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

Continuous-variable quantum state designs: theory and applications, based on [9]

- 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 [5]

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

Posters

Page curves and typical entanglement in linear optics, based on [5]

- 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 287k downloads** from PyPI and 35 stars and 8 forks on GitHub.

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++.

2023 **rcal**, Python package for review calibration

- Devised a novel review calibration algorithm (**written report**)
- Implemented the algorithm in a Python **package**.

Miscellaneous

2024 **QuICS blog**, Popular science article, based on [9]

Carving Up Infinite Quantum Spaces into Simpler Surrogates, [Online](#)

2023 **On-Line Encyclopedia of Integer Sequences**, based on [6]

Our work is included in the [OEIS:A108625](https://oeis.org/A108625) entry

2022 **On-Line Encyclopedia of Integer Sequences**, based on [5]

Our work is included in the [OEIS:A062991](https://oeis.org/A062991) entry

2020 **PHYS.ORG**, Popular science article, based on [3]

New quantum computing algorithm skips past time limits imposed by decoherence, [Online](#)

Skills

Programming Python, C, C++, Mathematica/WolframScript, Javascript, Julia, \LaTeX , Git