

JOSEPH THOMAS IOSUE

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EDUCATION

Massachusetts Institute of Technology

MA; Sep 2015 – Dec 2018

Bachelor of Science in Physics and minor in Computer Science – GPA 4.9/5.0

Non-comprehensive course list: Experimental Physics, Quantum Mechanics III, Statistical Physics II, Relativity, Intro to Numerical Analysis, Classical Mechanics III, Linear Algebra, Computational Structures, Intro to Algorithms, Intro to Machine Learning, Mathematics for Computer Science, E&M, Fundamentals of Programming, Programming in Python.

APPOINTMENTS

QC Ware, Corp

CA; Jan 2019 – Present

I am a quantum algorithms researcher studying applications for near-term quantum computers (see Publications), leading the research for real-world applications of quantum computers for various customer projects, and developing software for the QC Ware software platform (see forge.qcware.com).

MIT Laboratory for Nuclear Science (Hen Lab)

MA; Sep 2017 – Dec 2018

I studied proton vs neutron dynamics in asymmetric nuclei and short-range deuteron clustering in nuclei in Professor Or Hen's group. I worked alongside a graduate student and performed data analysis using C++ and ROOT. This includes particle identification and various detector specific work such as acceptance and fiducial analysis for ^3He and $^4\text{He}(e,e'p)$ and $(e,e'd)$ reactions.

Los Alamos National Lab Quantum Computing Summer Fellowship

NM; June 2018 – Aug 2018

The fellowship lasted ten weeks, with the first two weeks being reserved for lectures and the following eight weeks for research. I studied variational quantum-classical hybrid algorithms. We developed and published a novel quantum algorithm called *Variational Fast Forwarding* (see Publications) that aims to perform quantum simulation past the coherence time of the quantum computer.

Joint Quantum Institute, University of Maryland (Gorshkov Group)

MD; May 2017 – Sep 2017

I worked for Professor Alexey Gorshkov alongside a postdoc to model short and long range interacting fermionic spin chains in condensed matter many-body quantum systems, focusing on how magnetic field and interaction strength parameters affect the steady state of the system. We studied the relationship between dynamical and quantum phase transitions via quench dynamics in integrable and nearly-integrable systems. Our paper is published in Physical Review Letters (see Publications). I was also acknowledged for work in a separate project – (Nature24654) *Observation of a Many-Body Dynamical Phase Transition with a 53-Qubit Quantum Simulator*.

MIT Plasma Science and Fusion Center

MA; Jan 2016 – May 2016

I worked with a professor to model particle acceleration and transport in turbulent media using C. We focused particularly on an electron's E cross B drift about its guiding center in spatially and time varying fields.

MIT Department of Nuclear Science and Engineering

MA; Sep 2015 – Dec 2015

I worked with a graduate student to model thermal and mechanical responses of nuclear waste storage canisters to Traveling Wave Reactor (TerraPower) fission waste using finite element software ADINA.

PUBLICATIONS

1. P. Titum, **J. T. Iosue**, J. R. Garrison, A. V. Gorshkov, Z.-X. Gong. *Probing ground-state phase transitions through quench dynamics*, 2019. Phys. Rev. Lett. 123, 115701.
2. R. M. Parrish, **J. T. Iosue**, A. Ozaeta, P. L. McMahon. *A Jacobi Diagonalization and Anderson Acceleration Algorithm For Variational Quantum Algorithm Parameter Optimization*, 2019. arXiv:1904.03206 [quant-ph].
3. C. Cirstoiu, Z. Holmes, **J. T. Iosue**, L. Cincio, P. J. Coles, A. Sornborger. *Variational Fast Forwarding for Quantum Simulation Beyond the Coherence Time*, 2019. arXiv:1910.04292 [quant-ph].

PRESENTATIONS

NISQ Workshop at TQC Conference, College Park

MD; June 2019

I presented a poster at the NISQ Workshop of TQC, June 2019 in College Park, MD, based on work in collaboration with P. L. McMahon and R. M. Parrish. The poster can be viewed on my website.

An initial condition robust outer-loop optimization strategy for a Quantum Approximate Optimization Algorithm.

SELECTED PROJECTS

QUBOVert

July 2019 – Present

I created QUBOVert, a Python package for dealing with common binary optimization problems. It is particularly designed to aid in converting optimization problems to a form that can be solved with quantum annealers and quantum optimization algorithms. I also used it as a way to learn more about best software practices, such as continuous integration, code coverage, code quality, documentation, etc. QUBOVert can be installed with `pip install qubovert`, the source code is hosted at github.com/jiosue/QUBOVert, and the documentation is hosted at qubovert.readthedocs.io. QUBOVert currently has over 5k downloads.

Contribution to SciPy

Aug 2019 – Present

I am the author of pull request number 10648 (<https://github.com/scipy/scipy/pull/10648>) on Python's SciPy package. The moderators of SciPy have labeled it to be included in SciPy's 1.5.0 release. The pull request implements an additional feature for SciPy's minimization method. In my research of variational quantum algorithms, I devised a bounded version of the standard unbounded Powell minimization method and found 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.

C++ Quantum Computer Simulator

Jan 2018

I implemented a quantum computer simulator (github.com/jiosue/Quantum-Computer-Simulator-with-Algorithms), and used it to implement various algorithms, such as the quantum and inverse quantum Fourier transform, Grover's search method, addition, modular addition, quantum period finding, and Shor's factorization method.

Android Development (Java)

Sep 2016

I have an application on the Google Play Store called *Distance to Green* under developer name "Eigenjoe". The application is free, but I included monetized banner advertisements using AdMob.

INTERNSHIPS

Department of Energy, Office of Nuclear Energy

MD; Jan 2016

I shadowed the Director of Space and Defense Power Systems, learning about the DOE's task of ensuring containment of nuclear material during NASA launches with Radioisotope Power Systems onboard. I used HTML/CSS to design a website that presents information on the department to the public.

TEACHING AND MISC WORK

Teaching Assistant and Grader

MA; Aug 2016 – Dec 2016

I was a TA for freshman level physics II, electricity and magnetism, responsible for tutoring and grading twenty students. Approximately 13 hours a week during the semester. I was referred to as “best TA ever” by several students in anonymous subject evaluations.

Intramural Ice Hockey Referee and Skate Guard

MA; Jan 2016 – Dec 2018