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.
- *Relevant courses:* 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.

Current Employment

QC Ware, Corp: Quantum Algorithms Researcher   *CA; Jan 2019 – Present*

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

Research

MIT UROP: 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. We worked in collaboration with Thomas Jefferson National Accelerator in Virginia, using data collected there for our analysis. I worked alongside a graduate student and perform data analysis using C++ and ROOT. This includes particle identification and various detector specific work such as acceptance and fiducial analysis for ^{3}He and ^{4}He(e,e'p) and (e,e'd) reactions. Our goal was to filter out inelastic reaction channels so as to compare quasielastic collisions with theoretical models.

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 a novel quantum algorithm called *Variational Fast Forwarding* (see Publications).

Joint Quantum Institute, University of Maryland   *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 acknowledged for work in a separate project – (Nature24654) *Observation of a Many-Body Dynamical Phase Transition with a 53-Qubit Quantum Simulator*.

MIT UROP: 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 UROP: 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.
- We tested a proposed pin and filler structure against the model we generated.

Publications

- 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].
- 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.
- 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].

Presentations

NISQ Workshop at TQC, 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.
  An initial condition robust outer- loop optimization strategy for a Quantum Approximate Optimization Algorithm.

Internship Experience

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.

Projects and Skills

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.

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*