

# Akhil Francis

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## SUMMARY

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- Final year PhD candidate in Physics in quantum computation with strong analytic, coding and research skills.
- Five years of experience in developing and deploying quantum algorithms.
- Expertise in benchmarking of quantum machines.
- Strong programming skills in Python and C/C++.
- Executed many computational projects including machine learning and data analysis.
- Expected to graduate before May 2023. Looking for quantum computing jobs.

## EDUCATION

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### North Carolina State University

*Ph.D. Candidate in Physics, (CGPA 4.00/4.00)*

Raleigh, NC

*Aug. 2017 – Present*

### Indian Institute of Science Education and Research

*Integrated BS-MS in Physics, (CGPA 8.0/10.0)*

Mohali, India

*Aug. 2011 – May 2016*

## TECHNICAL SKILLS

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**Programming Languages:** Python, C/C++

**Math:** Mathematica

**Quantum Computing Softwares and Libraries:** QISKIT | search-compiler, QISKIT-Nature

**Machine Learning, Data Analysis:** Scikit-learn, Keras, Pandas, NumPy, Scipy, Matplotlib

**Writing:** LaTeX, MS Office

**Softwares and Tools:** Inkscape, Gnuplot | Git, Tmux

## EXPERIENCE

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### Graduate Research Assistant

*North Carolina State University*

May 2018 – Present

*Raleigh, NC*

- Carrying out machine learning project using supervised and unsupervised machine learning techniques to study benchmarking of quantum machines using entanglement witnesses at Oak Ridge National Laboratory.
- Developed and deployed quantum algorithms to study condensed matter physics problems, executed these algorithms in quantum machines via cloud, and extracted information from the noisy data. Three published projects in peer-reviewed journals:
  - \* Computed two point correlation functions in quantum machines and extracted spectra from the noisy data.
  - \* Measured partition function zeros in a quantum computer enabling to study thermodynamic properties.
  - \* Studied phase transitions using adiabatic state preparation in quantum computers.
- Worked on independent and collaborative projects with other theory and experimental groups.
- Completed individual computational projects utilizing advanced computational methods in many-body physics and quantum simulations for computational physics courses including exact simulations of the Ising model and computing entanglement entropy in QISKIT.
- Performed Monte Carlo simulations and bootstrapping for error estimation and employed statistical tests of data from quantum machines.
- Mentored undergraduate students in research and leading to one publication.
- Credited courses related to quantum computing during undergraduate and graduate studies, and attended workshops on quantum computing.

### Graduate Teaching Assistant

*North Carolina State University*

Aug. 2017 – Dec. 2018

*Raleigh, NC*

- Conducted and evaluated problem solving sessions for undergraduate students for three semesters.
- Developed excellent leadership and communication skills by managing a large number of students in a classroom.
- Aided in designing and upgrading laboratory experiments for undergraduate students in WebAssign and performed captioning of video lectures.

### Graduate Research Assistant (MS)

*Indian Institute of Science Education and Research*

Aug. 2014 – May 2016

*Mohali, India*

- Studied CP violation and estimated Jarlskog invariant and the corresponding CP violating phase, in leptonic sector from computations using unitarity triangles, taking analogy from quark sector for the Master's thesis project.
- Completed a group computational project simulating relativistic orbits as a part of the computational physics course using the Runge-Kutta methods for solving partial differential equations.

## PUBLICATIONS

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- A. Francis, Anjali A. Agrawal, Jack H. Howard, Efehan Kökcü, Alexander F. Kemper | **“Subspace Diagonalization on Quantum Computers using Eigenvector Continuation”** | arXiv:2209.10571 (2022)
- Kathleen E. Hamilton, Nouamane Laanait, A. Francis, Sophia E. Economou, George S. Barron, Kübra Yeter-Aydeniz, Titus Morris, Harrison Cooley, Muhun Kang, Alexander F. Kemper, and Raphael Pooser | **“An entanglement-based volumetric benchmark for near-term quantum hardware”** | arXiv:2209.00678 (2022))
- A. Francis, E. Zelleke, Z. Zhang, A. Kemper, and J. Freericks | **“Determining ground-state phase diagrams on quantum computers via a generalized application of adiabatic state preparation”** | Symmetry 14(4): 809 (2022)
- A. Francis, D. Zhu, C. Huerta Alderete, Sonika Johri, Xiao Xiao, J.K. Freericks, C. Monroe, N. M. Linke, A.F. Kemper | **“Many Body Thermodynamics on Quantum Computers via Partition Function Zeros”** | Science Advances 7, 2447 (2021)
- A. Francis, J. Freericks, and A. Kemper | **“Quantum computation of magnon spectra”** | PhysRevB.101.014411 (2020)

## PRESENTATIONS

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- Graduate Student Research Symposium | April 2022 | North Carolina State University | poster presentation | **Many-Body Thermodynamics on Quantum Computers via Partition Function Zeros**
- March Meeting, APS | March 2022 | Chicago | oral presentation | **Determining ground-state phase diagrams on quantum computers via a generalized application of adiabatic state preparation**
- March Meeting, APS | March 2021 | Virtual | oral presentation | **Many-Body Thermodynamics on Quantum Computers via Partition Function Zeros**
- South Eastern Section American Physical Society | November 2020 | Virtual | oral presentation | **Many-Body Thermodynamics on Quantum Computers via Partition Function Zeros**
- Kwek Group meeting | September 2020 | National University of Singapore | Virtual | oral presentation | **Quantum Computation of Spin Systems**
- South Eastern Section American Physical Society | November 2019 | Wrightsville Beach, NC | oral presentation | **Magnon Spectra using Quantum Computers**
- NISQ | June 2019 | University of Maryland | poster presentation | **Evaluating Many-Body Correlation Functions using Quantum Computation**

## ACHIEVEMENTS

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- Selected for INSPIRE SHE fellowship, of Department of Science and Technology, Govt. of India, to study five year integrated bachelors and masters.