Keerthi Kumaran A M

West Lafayette, United States
github.com/keerthikumara
keerthikumara.github.io

kalagars@purdue.edu
+1 765 479 2375
linkedin.com/in/keerthikumaran
Google Scholar

Summary

PhD student in Physics at Purdue University specializing in quantum computing. Experienced in quantum algorithms, error mitigation, and simulation of condensed matter systems. Research at IBM Quantum involves developing scalable quantum algorithms, improving diagonalization routines, and advancing GPU-accelerated analysis for quantum circuits. Familiar with quantum error correction, particularly non-Abelian anyons for topological QEC. Proficient in Qiskit, CUDA-Q, and tensor network methods for practical quantum algorithm development.

Education

Purdue University — **West Lafayette, USA**
PhD, Physics (Quantum Computing), GPA: 3.9/4.0 — *Aug 2022 – Present*

Indian Institute of Science (IISc) Bengaluru — **Bengaluru, India**
BS in Physics, CGPA: 9.3/10.0 — *Aug 2018 – Jul 2022*

Work Experience

IBM Quantum — **Yorktown Heights, NY**
Quantum Research Intern — *May 2025 – July 2025*

- Improved energy estimation algorithms for Sample-Based Quantum Diagonalization (SQD) subroutines, boosting accuracy and noise resilience.
- Performed GPU-parallelized diagonalization routines for large quantum bitstring outputs, enabling high-throughput assessment of circuit outputs.
- Developed and maintained internal tools for quantum algorithm research within a team of researchers.
- Worked on proprietary projects related to quantum chemistry (details confidential).

IBM Quantum — **Yorktown Heights, NY**
Quantum Research Intern — *May 2024 – Feb 2025*

- Simulated superdiffusion breakdown in 2D Heisenberg spin chains using high depth quantum circuits in IBM hardware.
- Applied advanced error mitigation, including Probabilistic Error Cancellation and error amplification, to improve quantum simulation results.
- Built an internal software package to compute two-body correlation functions with automated testing (Travis, tox).
- Implemented transmon qutrit calibration (Rabi/Ramsey) and simulated AKLT chains to demonstrate advantages of using qutrits over qubits (arXiv:2412.19786).

Relevant Research Experience

Quantum Simulation — **Purdue University**
Graduate Research Assistant — *Aug 2022 - Present*

- Simulated the physics of spin-1 AKLT models using both calibrated qutrit gates (on IBM transmons) and tensor networks, demonstrating advantages of using qutrits over qubits (arXiv:2412.19786).
- Investigated robust chiral edge dynamics of Kitaev honeycomb lattice models on a trapped ion processor (arXiv:2507.08939).
- Quantum simulation of superdiffusive breakdown in Heisenberg chains using quantum circuits, leveraging error mitigation protocols to improve the results (arXiv:2503.14371).
- Physics-inspired quantum simulation of resonating valence bond ground states: Designed auxiliary Hamiltonians and modular, gate-efficient ansatz for high-accuracy simulation results; achieved $< 1\%$ ground-state energy accuracy on IBMQ hardware. Published in J. Phys. Chem. A 2023.

Quantum Algorithms **Purdue University**

Graduate Research Assistant *Aug 2022 - Present*

- Developed improved sample-based quantum diagonalization (SQD) routines and variational quantum algorithms, integrating Qiskit, PennyLane, and custom tensor network algorithms.
- Benchmarked quantum random projection for dimensionality reduction and compared against classical PCA for MNIST/CIFAR100; extracted dominant singular vectors using variational quantum SVD (Phys. Rev. Research 2024).
- Designed accurate time-evolution circuits for non-Abelian anyon simulation, advancing topological quantum error correction schemes.
- Built automated internal tools and test suites for scalable quantum algorithm research (Travis, tox).

HPC and GPU Acceleration **Purdue University**

Graduate Research Assistant *Aug 2022 - Present*

- Utilized Purdue's NVIDIA A30 GPUs and SLURM cluster to run large-scale quantum simulations (including spin transport and ground state circuit optimization).
- Worked with CUDA-Q libraries and open-source quantum error correction (QEC) toolkits for syndrome decoding and fault-tolerant circuit simulation workflows.
- Accelerated matrix product state simulations and quantum algorithm workflows using GPU resources.

Open Source Contributions

Qutrit Calibration Toolkit & AKLT Simulations

- My spin-1 AKLT research directly led to the development and deployment of transmon qutrit calibration codes in the Qiskit Community project (qutrit-calibration).

Skills

Programming: Python, R, C/C++, Matlab, Mathematica. **Libraries**: Pandas, PyTorch, NumPy, Scikit-learn, Keras, TensorFlow. **Quantum Programming**: Qiskit, PennyLane, Cirq, CUDA-Q, STIM. **HPC Tools**: SLURM, CUDA, tensor networks, DMRG, variational algorithms. **Hardware simulation**: qutip, scqubits. **Benchmarking**: Tensor networks, DMRG, Variational algorithms. **Tools**: Git, Visual Studio Code, Jupyter.

Publications and Preprints

1. Robust Chiral Edge Dynamics of Kitaev Honeycomb on a Trapped Ion Processor, arXiv:2507.08939, 2025
2. Quantum simulation of superdiffusion breakdown in Heisenberg chains, arXiv:2503.14371, 2025
3. Transmon qutrit-based simulation of spin-1 AKLT systems, arXiv:2412.19786, 2025
4. Random projection using random quantum circuits, Phys. Rev. Res. 6, 2024
5. Physics-Inspired Quantum Simulation of RVB States, J. Phys. Chem. A, 127(41), 2023

Achievements

- Reviewer, Journal of Physics A: Mathematical and Theoretical (2023)
- DAAD WISE Scholar (2021), KVPY Scholar (2018–22)
- JEE All India Rank 850 (2018)
- NTSE Student Scholar (2016)
- TOEFL Score: 106/120 (2021)

Mentoring, Teaching and Extracurricular Involvement

Actively mentored and taught undergraduates as **QSTEP 2025 Workshop Instructor**, served as **Teaching Assistant at Purdue University** (Aug 2021–May 2023), and participated in quantum computing competitions and training events including **MITiQuHack**, **QHack 2023** (ranked 112/800), **PennyLane Coding Camp** (ranked 59/450), **IBM Fall Quantum Challenge**, and **Quantum ML Summer School**.