Akash Kumar Singh

Kanpur, Uttar Pradesh, India

akashkumar@students.iisertirupati.ac.in Linkedin github.com/aaronstone1310 www.akashkumarsingh.com

Education

Defence Institute of Advanced Technology (DIAT), Pune, India *Aug' 23-Jul' 25*
M.Tech in Quantum Computing, CGPA: 8.44/10
Thesis: An efficient quantum algorithm for Laplace transform

Indian Institute of Science Education and Research (IISER), Tirupati, India *Aug' 18-Jun' 23*
BS-MS in Physics, MS CGPA: 8.1/10
Thesis: Encoder for CSS codes using Measurement-Based Quantum Computing

Publications

- **Akash Kumar Singh**, Ashish Kumar Patra, Anurag K.S.V., Sai Shankar P., Ruchika Bhat, Jaiganesh G: *"A Polylogarithmic-Time Quantum Algorithm for the Laplace Transform"*, [arXiv preprint].
- **Akash Kumar Singh***, Atharva Manoj Khairnar*, S. Mandal, A. Raina: *"Creating encoders of CSS codes for Measurement-based Quantum Computing using ZX-Calculus"*, [*Equal contribution, Manuscript to be submitted to QPL 2026].

Professional Experience

Centre for Development of Advanced Computing (C-DAC), CINE, India *Jul' 25–Present*
Project Engineer
Developing quantum algorithms for Computational Fluid Dynamics with applications in flood simulations

QClairvoyance Quantum Labs, Hyderabad, India *Jan' 25–Jun' 25*
Junior Quantum Algorithm Developer Intern
Developed a novel quantum algorithm for the Laplace transform using Quantum Eigenvalue Transformation
Integrated it into QClair's QForge library for the quantum drug discovery pipeline

Research Experience

An Efficient Quantum Algorithm for Laplace Transform *Aug' 24-Jun' 25*
Supervisor: Prof. G. Raghavan and Dr. K. Srinivasan, Defence Institute of Advanced Technology (DIAT), Pune, India

- Created a quantum algorithm for the Laplace Transform by encoding the Laplace variable s into the eigenvalues of a diagonal matrix. This approach exploited the matrix's arithmetic progression structure and commutativity among its Pauli decompositions, enabling efficient Pauli decomposition and single-step Trotterization for Hamiltonian simulation.
- Proved rigorous complexity bounds showing superpolynomial quantum advantage, reducing gate complexity to $O((\log N)^3)$ compared to classical $O(N \log N)$ for an $N \times N$ Laplace transform matrix in specific cases.
- Integrated this into QClair's QForge library (using PennyLane), contributing to their quantum drug discovery pipeline.
- Analyzed potential applications in ground state energy calculations using resolvent space and in the pharmacokinetics and pharmacodynamics stages of the drug discovery pipeline.
- Conducted as part of the M.Tech dissertation and in collaboration with QClairvoyance Quantum Labs, Hyderabad.

Creating Encoders of CSS Codes for MBQC using ZX-Calculus *May' 22-Jun' 23*
Supervisor: Dr. Ankur Raina, Indian Institute of Science Education and Research (IISER), Bhopal, India

- Devised a systematic graphical framework using ZX-Calculus to directly translate CSS code stabilizers into optimal MBQC measurement patterns, resolving a longstanding challenge in efficient CSS code encoding.
- Developed the encoding by obtaining CSS code stabilizers, converting them into ZX-diagrams, transforming them into graph-like ZX-diagrams and measurement fragments, and deriving correction operators using the feed-forward method.
- Provided explicit constructions for repetition, Steane, and Shor codes within this framework.
- Verified the correctness of the scheme via stabilizer evolution techniques of Gottesman.

Awards and Honors

- **Secured highest marks in India in Quantum Computing written exam by C-DAC (Scientist 'B'), 2025.**
- Qualified GATE (2023 and 2024) Physics and awarded AICTE GATE Postgraduate Scholarship.
- Cleared IISER Aptitude Test (IAT) for admission to IISERs, 2018.

Technical Skills

Languages: Python, Fortran, Java, HTML
Libraries: Qiskit, Pennylane, Numpy, Scipy, Matplotlib, Tikzit
Tools: LaTeX, GitHub
Core strengths: Quantum Algorithms, Quantum Error Correction

Relevant Courses

M.Tech (DIAT): Quantum Computing 1 & 2, Digital System Design using FPGA, Advanced Quantum Communication, Nonlinear Optics, Quantum Metrology & Sensing, Machine Learning.

BS-MS (IISER Tirupati): Quantum Mechanics 1 & 2, Quantum Information, Optics & Photonics, Electrodynamics, Statistical Mechanics, Linear Algebra, Probability & Statistics, Structures of Mathematics, Data Science 1 & 2, Operations Research, Discrete Mathematics.

Academic Engagements & Leadership

- Completed WISER Program on Quantum Algorithms for Differential Equations — *Jun' 25–Aug' 25*
- Completed PennyLane LCU Challenge — *Aug' 25*
- Completed PennyLane Trotterization Challenge — *Aug' 25*
- Selected to attend the Fundamental Lecture Series on Theoretical Computer Science at IMSc, Chennai — *Jan' 24*
- Attended International Workshop on *Engineering and Integration Challenges in Quantum Communication and Quantum Computing*, C-DAC Pune — *Mar' 24*
- QWorld QIntern 2023: Diploma + Second Best Project & Presentation Awards — *Jul' 23–Aug' 23*
- IBM Qiskit Global Summer School 2021: Quantum Machine Learning, Certificate of Excellence — *Jul' 21*
- IBM Qiskit Global Summer School 2020: Certificate of Quantum Excellence — *Jul' 20*
- IBM Qiskit Fallfest, DIAT Pune: Led Organizing Team — *Oct' 23*
- Founding Member of QUIISER: Quantum Computing & Information Club, IISER Tirupati — *Jan' 21–Jun' 23*
- Core Member of Institute Innovation Council (IIC), IISER Tirupati — *Aug' 20–Jan' 22*
- Institute Rep.: MHRD IC sessions on Promoting Innovation, IPR, Entrepreneurship and Start-ups — *Apr' 20–May' 20*
- Certificate of Excellence: Innovation & Entrepreneurship in Post-COVID World, IIT Kgp — *Jun' 20–Aug' 20*