Akash Kumar Singh

M.Tech Quantum Computing (School of Quantum Technology)

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Qualifications	College/University/School	Year
M.Tech Quantum Computing	Defence Institute of Advanced Technology	2023-25
MS Physics	Indian Institute of Science Education and Research (IISER), Tirupati	2022-23
BS Physics	Indian Institute of Science Education and Research (IISER), Tirupati	2018-22
Higher Secondary	Maharana Pratap Education Centre, Kanpur	2017
Secondary	Maharana Pratap Education Centre, Kanpur	2015

PROJECTS

- **An efficient quantum algorithm for Laplace Transform | DIAT and Qclairvoyance quantum labs** [Aug'24 - June'25]
  - M.Tech Dissertation, My task was to improve the complexity of the existing **quantum algorithms for differential equations by using the quantum Laplace transform.** I successfully developed a novel quantum algorithm for computing the Laplace transform using quantum eigenvalue transformation techniques. This approach achieves a **superpolynomial speedup** when used as a subroutine. The implementation has been integrated into the **QForge library**, which is part of the **QClair** quantum computing framework. The algorithm also shows promising potential for applications in **pharmacokinetics and pharmacodynamics (PK/PD)** within the **drug discovery pipeline**.

  - This project is supervised by Prof. G. Raghavan, School of Quantum Technology, DIAT Pune, and is in collaboration with Qclairvoyance Quantum Labs Pvt. Ltd., a drug discovery startup in Hyderabad.
- **Encoder for CSS Codes using Measurement-Based Quantum Computing | IISER Bhopal** [May'22 - June'23]
  - MS Dissertation on **Encoder for CSS Codes Using Measurement-Based Quantum Computing (Using ZX-Calculus)**.

  - During this project, I developed a general scheme to encode any CSS code on MBQC. I have used ZX-Calculus to develop this scheme and shown it to be explicitly working for three codes, namely, the three-bit repetition code, the Steane code, and the Shor code. I have also verified this approach using stabilizer evolution under measurements given by Gottesman.

  - This project was supervised by Dr. Ankur Raina, Electrical Engineering and Computer Science, IISER Bhopal.
- **Quantum N-Queens Solver | IISER Tirupati** [Feb'21 - Apr'21]
  - Worked on a quantum N-queen solver using Qiskit for fulfillment of a term paper requirement for the Quantum Mechanics 2 course.
  - I understood the concept behind the N-Queen problem and how quantum computing can help to solve it faster with less time and resource complexity, and I implemented it on Qiskit for a 4x4 case.
  - The instructor for this course was Dr. Sambuddha Sanyal, Department of Physics, IISER Tirupati.
- **Quantum Approach to Non-Linear Dynamics | IISER Tirupati** [Mar'21 - Apr'21]
  - The aim of the project was to discuss a formalism that can make use of the power of universal quantum computers to simulate and solve classical nonlinear dynamics problems. This was done as a fulfillment of the term paper requirement for the Non-Linear Dynamics Course.
  - The method of an arbitrary classical dynamical system extension to the quantum system was developed with an example of the Logistic Model.
  - The instructor for this course was Prof. G. Ambika, Department of Physics, IISER Tirupati.

SKILLS

- **Programming Languages**: Python, Fortran, Java, HTML
- **Libraries**: Qiskit, Pennylane, Numpy, Scipy, Matplotlib, Tikzit
- **Tools**: LaTeX, Github
- **Concepts/Techniques:** Quantum Algorithms, Quantum Error Correction. QKD, ML

SCHOLAR ACHIEVEMENTS

- Qualified the Graduate Aptitude Test in Engineering (GATE) and was awarded the AICTE GATE Postgraduate [2023] scholarship for my M.Tech in Quantum Computing.
- Cleared IISER Aptitude Test (IAT), an all-India test for joining IISERs (Institutes of National Importance). [2018]

PUBLICATIONS

- Akash Kumar Singh, Mr. Ashish Kr. Patra, Prof. G Raghavan, Dr. K. Srinivasan, "***An Efficient Quantum Algorithm for Laplace Transform***" (Based on M.Tech Dissertation Work) [Status: Preparing for submission to arxiv]
- **Akash Kumar Singh*,** Atharva Manoj Khairnar*, Saptarshi Mandal, Dr. Ankur Raina**. "*Encoder design for CSS codes using Measurement-Based Quantum Computing and ZX-calculus*"** (Based on MS Thesis Work)

  ∗These authors contributed equally. [Status: In preparation (Available on request)]

WORKSHOP ATTENDED

- **International Workshop on "Engineering and Integration Challenges in Quantum Communication and Quantum Computing." , C-DAC Pune.** [Mar'24]

ACADEMIC COURSES

- Quantum Computing 1 and 2 | Digital system design using FPGA | Advanced Quantum Communication |

  Nonlinear optics | Quantum Metrology and Sensing | Machine Learning [M.Tech, DIAT]

- Quantum Mechanics 1 and 2 | Quantum Information | Optics and Photonics | Linear Algebra | Statistical Mechanics | Electrodynamics | Probability and Statistics | Structures of Mathematics | Data Science 1 and 2 | Operations Research |Discrete Mathematics [BS-MS, IISER TPT]

POSITIONS OF RESPONSIBILITY and EXTRACURRICULARS

- **Fundamental Lecture Series on Theoretical Computer Science | IMSC, Chennai** [Jan' 24]
- **Qiskit Fallfest 2023, IBM | DIAT, Pune** [Oct' 23]

  I led the team that organized the IBM Qiskit Fallfest at DIAT, Pune, in October 2023.

- **QUIISER: The Quantum Computing and Information Club | IISER Tirupati** [Jan'21-Jun'23]

  ○ I founded the Quantum Computing Club with my colleagues at IISER Tirupati.

- **Institute Innovation Council (IIC) | IISER Tirupati** [Aug'20-Jan'22]

  ○ I was a core member of IIC at IISER Tirupati and handled the social media team of IIC.

- **IIC Online Sessions: Promote Innovation, IPR, Entrepreneurship, and Start-ups | MHRD, Innovation Cell**

  [Apr'20-May'20]

- **Innovation and Entrepreneurship in a Post-COVID World | RMSOEE, IIT Kharagpur**   [Jun' 20-Aug' 20]
  - I was awarded the Certificate of Excellence.

HOBBIES

- Badminton and table tennis.