Akshay Gaikwad

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Education

Postdoc | **Quantum tomography and superconducting qubits** — Jan. 2024 – Present
Supervisors: Anton Frisk Kockum — **Chalmers University of Technology, Sweden**

Research Assistant — May. 2023 – Dec.2023
Supervisors: Prof. Kavita Dorai and Prof. Arvind, Dept.of Physical Sciences — **IISER Mohali, India**

PhD, Physics | **Quantum simulation, tomography and NMRQC** — Aug. 2016 – May.2023
Supervisors: Prof. Kavita Dorai and Prof. Arvind, Dept.of Physical Sciences — **IISER Mohali, India**

BS-MS Integrated Dual Degree | ***CPI: 7.8/10, Major: Physics*** — Aug. 2011 – Aug. 2016
MS Thesis: Characterizing quantum processes on NMR — **IISER Mohali, India**

Senior Secondary Education | ***Percentage: 83 (88 in Basic Science)*** — Aug. 2009 – Aug. 2011
Subjects: Physics, Chemistry, Biology, Mathematics, English, Hindi — S.N.B.P. Jr. College, Pune

Secondary Education | ***Percentage: 90.92*** — Aug. 2009
Subjects: Science, Mathematics, Social Science, Hindi, English, Marathi — BPHS, Satara

Publications

2024 Jiaying Yang, Maryam Khanahmadi, Ingrid Strandberg, **Akshay Gaikwad**, Claudia Castillo-Moreno, Anton Frisk Kockum, Muhammad Asad Ullah, Gäran Johansson, Axel Martin Eriksson, and Simone Gasparinetti
Deterministic generation of frequency-bin-encoded microwave photons
arXiv:2410.23202

2024 Gayatri Singh, **Akshay Gaikwad**, Kavita Dorai
Experimental decoherence mitigation using a weak measurement-based scheme and the duality quantum algorithm
arXiv:2409.12752

2024 Jiaying Yang, Ingrid Strandberg, Alejandro Vivas-Viana, **Akshay Gaikwad**, Claudia Castillo-Moreno, Anton Frisk Kockum, Muhammad Asad Ullah, Carlos Sanchez Munoz, Axel Martin Eriksson, Simone Gasparinetti
Entanglement of photonic modes from a continuously driven two-level system
arXiv:2407.07991

2024 **Akshay Gaikwad**
Novel techniques for efficient quantum state tomography and quantum process tomography and their experimental implementation
arXiv:2401.09941

2024 **Akshay Gaikwad**, Omkar Bihani, Arvind and Kavita Dorai
Neural network assisted quantum state and process tomography using limited data sets
Phys. Rev. A 109, 012402

2023 **Akshay Gaikwad**, Gayatri Singh, Kavita Dorai and Arvind
Direct tomography of quantum states and processes via weak measurements of Pauli spin operators
Eur. Phys. J. D 77: 209

2022 **Akshay Gaikwad**, Krishna Shende, Arvind and Kavita Dorai
Implementing efficient selective quantum process tomography of superconducting quantum gates on IBM quantum experience
Scientific reports 12 (1), 1-11

2022 **Akshay Gaikwad**, Arvind and Kavita Dorai
Experimental simulation of open quantum dynamics using Sz-Nagy's dilation algorithm using NMR
Phys. Rev. A 106, 022424

2022 **Akshay Gaikwad**, Arvind and Kavita Dorai
Efficient characterization of quantum processes from reduced data set via compressed sensing using NMR
Quant. Inf. Proc. 21, (12)

2021 **Akshay Gaikwad**, Arvind and Kavita Dorai
True experimental reconstruction of quantum states and processes via convex optimization using NMR
Quant. Inf. Proc. 20, (19)

2020 **Akshay Gaikwad**, Krishna shende and Kavita Dorai
Experimental demonstration of optimized quantum process tomography on the IBM quantum experience
Int. J. Quantum Inf. 19 (07), 2040004

2018 **Akshay Gaikwad**, Diksha Rehal, Amandeep Singh, Arvind and Kavita Dorai
Experimental demonstration of selective quantum process tomography on NMR
Phys. Rev. A 97, 022311

Research Interests

I am currently working in the field of Quantum Computing and Information Processing. My research particularly focuses on designing efficient quantum state and process tomography protocols with an eye on experimental implementation. The study includes synthesizing quantum gates using Gradient Ascent Pulse Engineering (GRAPE) algorithm, initial state preparation, unitary gate decomposition and implementation, certification of quantum states and gates via fidelity estimation as well as characterizing and modelling non-unitary decoherence processes present in real physical systems. In addition to that my interests also include: quantum algorithms, quantum simulation, quantum entanglement, open quantum systems and NMR spectroscopy.

Past Projects

Master's Project: Characterizing Quantum Processes on NMR — Aug. 2015 – May 2016
Supervisors: Dr. Kavita Dorai, Professor (Physics), IISER Mohali

Summer Project: Spin Ensemble Quantum Computation with NMR — May 2015 – July 2015
Supervisors: Dr. Kavita Dorai, Professor (Physics), IISER Mohali

Summer Project: Applied Quantum Mechanics — May 2014 – July 2014
Supervisors: Dr. Goutam Sheet, Associate Professor (Physics), IISER Mohali.

Summer Project: Random Walk Simulation — May 2013 – July 2013
Supervisors: Dr. Rajeev Kapri, Associate Professor (Physics), IISER Mohali

Summer Project: Quantum Mechanics — May 2012 – July 2012
Supervisors: Dr. K.P. Yogendran, Associate Professor (Physics), IISER Mohali.

Conference Participation

2024 Presented a **poster** at Assessing Performance of Quantum Computers (APQC) workshop held at Estes Park, CO, USA from October 7-10, 2024.

2024 **Attended** CodeRefinery workshop at Chalmers University of Technology, Gothenburg, Sweden from August 27-29, 2024

2024 **Attended** Nordic Workshop on Continuous Variable Quantum Technology, held at KTH Royal Institute of Technology, Stockholm, Sweden from May 27-28, 2024

2023 **Attended** Young Quantum-2023 (YouQu-2023) conference, held at Harish-Chandra Research Institute (HRI), Allahabad, India from February 15-18, 2023.

2023 **Attended** International Conference on Quantum Computing and Communications (QCC2023), held at Baba Farid College Bathinda, Punjab, India from February 9-11, 2023.

2020 **Attended** Young Quantum - 2020 (YouQu-2020) online conference, held at Harish-Chandra Research Institute (HRI), Allahabad, India from October 12-15, 2020.

2020 **Attended** International conference on *Quantum Foundations, Technologies and Applications* (QFTA), held at IISER Mohali, India from December 4-9, 2020.

2019 Delivered a **talk** at International Conference on *Quantum Foundations, Technologies and Applications* (QFTA), held at IISER Mohali, India from October 18-21, 2019.

2018 Presented a **poster** at International Conference on *Quantum Frontiers & Fundamentals* (QFF), held at Raman Research Institute (RRI) Bengaluru, India from April 30 - May 4, 2018.

2018 Presented a **poster** at 24th conference of the *Nuclear Magnetic Resonance Society* (NMRS) of India, held at IISER Mohali, India from February 16-19, 2018.

2018 **Attended** *Asia Pacific Conference and Workshop on Quantum Information Science* (APCWQIS), held at IISER Kolkata, India from December 19-23, 2018.

2017 Presented a **poster** at 7th *Asia Pacific NMR symposium* (APNMR) and 23rd annual meeting of the *Nuclear Magnetic Resonance Society* (NMRS) of India, held at Indian Institute of Science (IISc) Bangalore, India from February 16-19, 2017.

2017 **Attended** *International Conference on Quantum Foundations* (ICQF), held at National Institute of Technology (NIT) Patna, India from December 4-9, 2017.

2016 **Attended** *2nd IMSc School on Quantum Information*, held at The Institute of Mathematical Science (IMSc) Chennai, India from December 5-17, 2016.

2016 Presented a **poster** at *International Conference on Quantum Foundations* (ICQF), held at National Institute of Technology (NIT) Patna, India from October 17-21, 2016.

2016 Presented a **poster** at 22th conference of the *Nuclear Magnetic Resonance Society* (NMRS) of India, held at Indian Institute of Technology (IIT) Kharagpur, India from February 18-21, 2016.

Academic Achievements

2022 Recipient of **senior research fellowship (SRF)** under 'Quantum Information Science and Technology **(QuST)**' research programme initiated by Department of Science and Technology (DST), Government of India.

2018 Recipient of **senior research fellowship (SRF)** at IISER Mohali from 2018-2021.

2016 Qualified **CSIR-UGC National Eligibility Test (NET)** for Lectureship/Assistant Professor in Indian universities and colleges conducted by Council of Scientific and Industrial Research (CSIR), Govt. of India.

2016 Qualified **Graduate Aptitude Test in Engineering (GATE)** organized by Indian Institute of Science (IISc) Bangalore on behalf of the Department of Higher Education, Ministry of Education (MoE), Govt. of India.

2011 Recipient of Innovation in Science Pursuit for Inspired Research **(INSPIRE) Scholarship** valued at Rs.80,000/- per year for five years for higher education from Department of Science and Technology (DST), Govt. Of India.

2011 Qualified **All India Engineering Entrance Examination (AIEEE)** conducted by Central Board of Secondary Education, Delhi (Govt. of India).

2011 Qualified **MHT-CET examination** conducted by Directorates of Medical and Technical Education, Mumbai (Govt. of Maharashtra), India.

2011 Qualified **MANET competitive exam** and got selected in **Maharashtra Academy of Naval Education and Training (MANET)**, Pune for B.Sc. Nautical Science, India.

2011 Stand **among top 1%** students of the board in senior secondary.

2010 Placed **among top 10%** in National Standard Examination in physics, conducted by Indian Association of Physics Teachers.

2008 Received certificate with **first class rank with distinction** in Hindi Creative Writing Exam conducted by Maharashtra State Hindi Teacher Association, Pune, India.

2007 Worked at **Muktangan Exploratory Science Centre**, Pune as part of Vijayadevi Shirke Science Camp (VSSC) and was Representative of my school at (VSSC) conducted by Vijayadevi Shirke Educational Trust, Pune, India.

Other experiences and duties

- **Tutorial assistant:** TA for undergraduate students for several physics courses and experimental labs, conducting exams, taking viva, checking exam papers and lab files
- **Technical experience:** Hands-on NMR spectroscopy, NMR pulse programming, disassemble and reassemble NMR, liquid nitrogen filling, and flushing in NMR, managing lab website and social media pages
- **Administrative work:** Managing paperwork, bills, and the link between administration and suppliers for the smooth process of fund release and service to the lab.

Computer and coding Skills

- **Operating systems and softwares:** Linux (Ubuntu, Joli Cloud, Fedora), Microsoft Windows, Fortran, HTML, CSS, ExpEyes, TopSpin, Microsoft Office Suite, LaTex, Matlab, Mathematica, python programming
- **Relevant coding packages:** Qiskit, Keras, Pandas, scikit-learn, GRAPE, CVX, QETLAB, YALMIP, UniversalQCompiler, quantikz

REFERENCES

- **Arvind**
  Professor, Department of Physical Sciences
  Indian Institute of Science Education & Research (IISER) Mohali
  Sector 81 SAS Nagar, Manauli PO 140306 Punjab India.
  Email: arvind@iisermohali.ac.in

- **Kavita Dorai**
  Professor, Department of Physical Sciences
  Indian Institute of Science Education & Research (IISER) Mohali
  Sector 81 SAS Nagar, Manauli PO 140306 Punjab India.
  Email: kavita@iisermohali.ac.in

- **Sandeep Kumar Goyal**
  Assistant Professor, Department of Physical Sciences
  Indian Institute of Science Education & Research (IISER) Mohali
  Sector 81 SAS Nagar, Manauli PO 140306 Punjab India.
  Email: skgoyal@iisermohali.ac.in