Ankur **Agrawal**

Quantum Computing and Networking

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Summary

I am a Quantum Engineer at Quantum Circuits Inc. (QCI) working in the qubit calibration and deployment team. Full stack engineer with 5+ years of experience in superconducting qubit design, gates characterization, quantum measurements, microwave engineering, and data analysis.

Work Experience

Quantum Circuits, Inc.

New Haven, USA

Quantum Engineer, Systems deployment and Gates Group — *Oct. 2024 - Present*

- Developing a scalable graph-based calibration framework for optimizing sub-system parameters in single and two-qubit gate tuning and benchmarking.
- Developing monitoring tools to understand the drifts in system parameters over time and implementing methods to mitigate it
- Collaborated with design and simulation teams to analyze spurious modes in parametrically driven couplers for optimal coupling rates
- Partnered with software and controls teams to develop a roadmap for scalable control systems supporting quantum error correction protocols

Center for Quantum Networking, Amazon Web Services (AWS)

Boston, USA

Quantum Research Scientist, Test and Measurement Team — *Sept. 2022 - Oct 2024*

- Integrated hardware and device drivers to enable spin-photon entangling gates with time-bin qubits in diamond quantum memory (in a new lab environment)
- Developed uniform protocols and a characterization pipeline with the fabrication and cryogenic teams to analyze materials grown under varying conditions
- Boosted material characterization throughput by $20\times$ with a confocal implantation detection routine, accelerating project completion by two months
- Reduced microwave signal PCB insertion loss by $10\times$ through electromagnetic simulations and optimized cryogenic cable assembly, lowering heat load on the dilution fridge base plate

Research Experience

Graduate Research Assistant with Prof. David Schuster and Dr. Aaron Chou

Chicago, USA

Physics Department, The University of Chicago — *June 2017 - Sept 2022*

- Accelerated dark photon search $2.78\times$ using a microwave cavity coupled to a transmon qubit in the $n = 4$ Fock state with GRAPE-based quantum control
- Developed a superconducting qubit-based single photon counter with error rate $1300\times$ lower than the standard quantum limit to speed up dark photon searches
- Designed, fabricated, and characterized Josephson Parametric Amplifiers (JPA) achieving nearly 50% quantum efficiency
- Built a high-Q dielectric cavity ($> 10^6$) for axion searches, $20\times$ more efficient than copper cavities, compatible with 14 Tesla magnetic fields
- Benchmarked the (QICK RFSoC-based qubit controller system to achieve 99.93% single qubit gate fidelity with randomized benchmarking

Axion Dark Matter eXperiment (ADMX)

Seattle, USA

Center for Experimental Nuclear Physics and Astrophysics (CENPA), University of Washington — *June 2017 - Sept 2022*

- Performed hot-load measurements (Y-factor method) and investigated the systematic effects of magnetic field and frequency on the noise temperature of cryogenic amplifiers.
- This tool is incorporated into mainline axion experiment for current and future runs, resulted in 4 publications.

Research Internship with Prof. Thomas Peitzmann and Dr. Marco van Leeuwen

Utrecht, The Netherlands

Institute for Subatomic Physics, Utrecht University — *May 2015 - June 2015*

- Studied radiation damage effects on silicon detectors from ionizing particles for future LHC upgrades
- Developed a FLUKA-based computational framework using NIEL hypothesis and ROOT to estimate 1 MeV Neutron Equivalent fluence, identifying high radiation dose layers

Skills

Simulation Tools	Ansys HFSS, Palace, Comsol, MEEP (FDTD), Sonnet, QuTip
Layout Tools	Autodesk Inventor, Gmsh, KLayout, Qiskit Metal
Quantum	Superconducting circuit design and characterization, gates and readout chain optimization, microwave hardware
Programming	Python, Scikit-learn, Collaborative software development with Git, QUA, Instrument drivers

Education

The University of Chicago — *Chicago, USA*

Ph.D. in Physics — *Sept. 2016 - Sept 2022*

- Superconducting Qubit Advantage for Dark Matter (SQuAD)

IIT Bombay — *Mumbai, India*

B.Tech. and M.Tech. in Engineering Physics — *July 2011 - Aug. 2016*

- Master's Thesis - Study of Radiation Damage and Fabrication of Silicon Particle Detectors

Mentorship and Service

2023-	**Peer reviewer for physics journals - PRX, PRD, EPJ, APL**
2023	**Volunteer, Computer Science Education Weekend, Museum of Science Boston**
2021-2022	**Kester Anyang, Graduate student (Illinois Institute of Technology, Chicago)**
2019-2022	**Ege Halac, High school student (Chicago)**
2021	**Judge, Chicago Area Undergraduate Research Symposium**
2017	**Coordinator, Fermilab 50th Community Open House**
2016-2019	**Teaching Assistant for Undergraduate Physics courses Phys 121, 122, 123, 131**

Selected Presentations

Fermilab Friday Seminar (Invited) — *Batavia, USA*

Dark matter signal enhancement with a superconducting qubit — *March 2023*

ASC 2022 (Invited) — *Honolulu, USA*

Dark matter signal enhancement with a superconducting qubit — *Oct 2022*

APS March Meeting 2022 — *Chicago, USA*

Dark matter signal enhancement with a superconducting qubit — *March 2022*

16th Patras Workshop 2021 — *Virtual*

Superconducting Qubit Advantage for Dark Matter (SQuAD) — *June 2021*

Selected Publications

Stimulated Emission of Signal Photons from Dark Matter Waves

Agrawal, Ankur, Akash V. Dixit, Tanay Roy, Srivatsan Chakram, Kevin He, Ravi K. Naik, David I. Schuster, Aaron Chou

Phys. Rev. Lett. *132 (14 Apr. 2024)*

The QICK (Quantum Instrumentation Control Kit): Readout and control for qubits and detectors

Leandro Stefanazzi, Kenneth Treptow, Neal Wilcer, Chris Stoughton, Collin Bradford, Sho Uemura, Silvia Zorzetti, Salvatore Montella, Gustavo Cancelo, Sara Sussman, Andrew Houck, Shefali Saxena, Horacio Arnaldi, **Agrawal, Ankur**, Helin Zhang, Chunyang Ding, David I. Schuster

Review of Scientific Instruments *93.4 (2022)*

Searching for Dark Matter with a Superconducting Qubit

Akash V. Dixit, Srivatsan Chakram, Kevin He, **Agrawal, Ankur**, Ravi K. Naik, David I. Schuster, Aaron Chou

Phys. Rev. Lett. *126 (14 Apr. 2021)*

Seamless High-Q Microwave Cavities for Multimode Circuit Quantum Electrodynamics

Srivatsan Chakram, Andrew E. Oriani, Ravi K. Naik, Akash V. Dixit, Kevin He, **Agrawal, Ankur**, Hyeokshin Kwon, David I. Schuster

Phys. Rev. Lett. *127 (10 Aug. 2021)*

Niobium coaxial cavities with internal quality factors exceeding 1.5 billion for circuit quantum electrodynamics

Andrew E. Oriani, Fang Zhao, Tanay Roy, Alexander Anferov, Kevin He, **Ankur Agrawal**, Riju Banerjee, Srivatsan Chakram, David I. Schuster

arxiv:2403.00286 *(Mar. 2024)*