Dripto M. Debroy | Curriculum Vitae

Durham, NC

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I am a Research Scientist studying quantum error correction, calibration, and benchmarking, within the Google Quantum AI team. My research is focused on understanding physical error models and taking advantage of their structure to improve reliability in quantum computers.

Education

- **Duke University** — **Durham, NC**
  PhD in Physics — *August 2016–March 2021*
  Advisor: Dr. Kenneth R. Brown
- **UC Santa Barbara, College of Creative Studies** — **Santa Barbara, CA**
  Bachelor of Science in Physics, High Honors — *October 2012–June 2016*

Research Experience

- **Research Scientist** — **Google**
  Google Quantum AI — *March 2021 – Present*
  I am a member of the quantum physics division of the Quantum AI team. My work is on quantum error correction, calibration, and benchmarking. I collaborate with both the theory and hardware teams to improve system performance.
- **PhD Candidate** — **Duke University**
  Department of Physics – Brown Lab — *January 2018 – March 2021*
  Working on quantum error correction with a focus on near term error models. As an ion trap group we mostly consider error models seen in our labs. Additional work on qubit mapping problems for scalable ion-trap quantum computers and optimal circuit compiling for error resilience.
- **Undergraduate Research Assistant** — **UC Santa Barbara**
  Department of Physics – Peng Oh Group — *October 2015 – February 2016*
  Simulated the attenuation of Lyman-α line photons through ionization regions simulated by external collaborators. Seeked anti-correlation between Ly-α regions and 21cm regions in order to better understand real world interferometry data.
- **Undergraduate Research Assistant** — **UC Santa Barbara**
  Department of Physics – Lubin Lab — *May 2014 – September 2014*
  Worked on the Morphable Mirror Telescope (MMT) project. Was in charge of developing the control code for a large system consisting of a FARO laser tracker, multiple actuators, and positional sensors. Code was able to autonomously regulate curvature of mirror without the need for heavy reinforcement.

Honors

- **Charles Townes/Perkin-Elmer Fellow** — **Duke University**
  Duke University Physics Department — *Fall 2020*
  The Charles Townes/Perkin-Elmer Fellowship was created in 1981 by Prof. Charles Townes and the Perkin-Elmer corporation to recognize "an outstanding Duke physics graduate student."
- **QISE-NET Fellow** — **Duke University/Google AI Quantum**
  National Science Foundation — *Feb 2020 – Present*

QISE-NET is a fellowship where a graduate student, their academic advisor, and an industry/national lab collaborator form a triplet which receives funding for the student to meet with their industry/national lab collaborator and work on problems of mutual interest. My triplet is myself, my advisor Prof. Kenneth R. Brown, and Dr. Jarrod McClean of Google AI Quantum, and our project is on adapting flag qubit schemes for near term error detection.

- **Summer Undergraduate Research Fellow** **UC Santa Barbara**
  UCSB College of Creative Studies *Summer 2014*

  Recieved a stipend to support summer research with the lab of Dr. Phil Lubin. The fellowship was provided by the College of Creative Studies at UC Santa Barbara, and was over a two month period. After the conclusion of the fellowship the resulting research was presented at a poster session during UCSB Science Week.

Publications

- TILT: Achieving Higher Fidelity on a Trapped-Ion Linear-Tape Quantum Computing Architecture.
  X-C Wu, **DM Debroy**, Y Ding, J Baker, Y Alexeev, KR Brown, F Chong
  arXiv preprint, 2010.15876, to appear in HPCA '21
- Fault-Tolerant Operation of a Quantum Error-Correction Code.
  L Egan, **DM Debroy**, C Noel, A Risinger, D Zhu, D Biswas, M Newman, M Li, KR Brown, M Cetina, C Monroe
  arXiv preprint, 2009.11482
- Extended Flag Gadgets for Low-Overhead Circuit Verification.
  DM Debroy, KR Brown
  Physical Review A, 102, 052409 (2020).
- Architecting Noisy Intermediate-Scale Trapped Ion Quantum Computers.
  P Murali, **DM Debroy**, KR Brown, M Martonosi
  International Symposium on Computer Architecture, ISCA20, 529 - 542 (2020).
- Logical Performance of 9 Qubit Compass Codes in Ion Traps with Crosstalk Errors.
  DM Debroy, M Li, S Huang, KR Brown
  Quantum Science and Technology, 5, 034002 (2020).
- Stabilizer Slicing: Coherent Error Cancellations in Low-Density Parity-Check Stabilizer Codes.
  DM Debroy, M Li, M Newman, KR Brown
  Physical Review Letters, 121, 250502 (2018).

Talks

- Using Quantum Computer Access in the Classroom.
  NSF Workshop on Undergraduate Quantum Engineering Education. February 25th, 2021. Online.
- Logical CNOT Gates in Trapped Ion Systems.
  DOE Quantum Systems Accelerator Science Seminar. December 2, 2020. UC Berkeley (virtual).
- Stabilizer Slicing: Coherent Error Cancellations in Low-Density Parity-Check Stabilizer Codes.
  Quantum Error Correction 2019. July 29 – August 2, 2019. London, UK.
- Stabilizer Slicing: Coherent Error Cancellations in Low-Density Parity-Check Stabilizer Codes.
  APS March Meeting 2019. March 4 – 8, 2019. Boston, MA.
- Mitigating Ion Trap Specific Error Models.
  EPiQC Monthly Seminar. April 23, 2019. Online.

Posters

- Extended Flag Gadgets for Near Term Error Detection.
  DM Debroy, KR Brown
  Quantum Information Processing 2021. Feb 1 – 5, 2021. Virtual.
- Logical Performance of 9 Qubit Compass Codes in Ion Traps with Crosstalk Errors.
  DM Debroy, M Li, S Huang, KR Brown

IARPA LogiQ Technical Exchange Meeting. January 13 – 15, 2020. Washington, DC

- Logical Performance of 9 Qubit Compass Codes in Ion Traps with Crosstalk Errors.
  DM Debroy, M Li, S Huang, KR Brown
  Quantum Information Processing 2020. January 6 – 10, 2020. Shenzhen, CN
- Logical Performance of 9 Qubit Compass Codes in Ion Traps with Crosstalk Errors.
  DM Debroy, M Li, S Huang, KR Brown
  IARPA LogiQ Program PI Meeting. July 1 – 2, 2019. Boulder, CO
- Stabilizer Slicing: Coherent Error Cancellations in Low-Density Parity-Check Stabilizer Codes.
  DM Debroy, M Li, M Newman, KR Brown
  NSF Software-Tailored Architectures for Quantum codesign Poster Session. June 19, 2019. Durham, NC.
- Stabilizer Slicing: Coherent Error Cancellations in Low-Density Parity-Check Stabilizer Codes.
  DM Debroy, M Li, M Newman, KR Brown
  NSF Expeditions in Practical Scale Quantum Computing Poster Session. May 22, 2019. Chicago, IL.
- Stabilizer Slicing: Coherent Error Cancellations in Low-Density Parity-Check Stabilizer Codes.
  DM Debroy, M Li, M Newman, KR Brown
  IARPA LogiQ Program Technical Exchange Meeting. January 22 – 24, 2019. Dallas, TX
- Stabilizer Slicing: Coherent Error Cancellations in Low-Density Parity-Check Stabilizer Codes.
  DM Debroy, M Li, M Newman, KR Brown
  Quantum Information Processing 2019. January 14 – 18, 2019. Boulder, CO

Teaching Experience

- **Recitation Instructor** — **Duke University**
  PHYS 151L: Mechanics for Engineers — *Spring 2018*
  Taught 2-hour lectures on the material covered in class, along with helping to write quizzes and practice problems. Also graded and held office hours.
- **Recitation Instructor** — **Duke University**
  PHYS 152L: Electromagnetism for Engineers — *Fall 2017*
  Taught 2-hour lectures on the material covered in class, along with helping to write quizzes and practice problems. Also graded and held office hours.
- **Lab Instructor** — **Duke University**
  PHYS 142L: Electromagnetism for Pre-Meds — *Summer 2017*
  Led 2-hour lab sessions where I taught the theory behind the lab, along with helping students set up and run the labs. Also graded and held office hours. Was the primary TA for the course.
- **Lab Instructor** — **Duke University**
  PHYS 142L: Electromagnetism for Pre-Meds — *Spring 2017*
  Led 2-hour lab sessions where I taught the theory behind the lab, along with helping students set up and run the labs. Also graded and held office hours.
- **Lab Instructor** — **Duke University**
  PHYS 152L: Electromagnetism for Engineers — *Fall 2016*
  Led 2-hour lab sessions where I taught the theory behind the lab, along with helping students set up and run the labs. Also graded and held office hours.

Outreach and Service

- **Physics Circles Seminar Speaker** — **North Carolina School of Science and Math**
  Seminar Speaker — *Oct 2019*
  Physics Circles is a seminar series held at NCSSM on advanced topics in physics. My talk was the first of the series, and focused on basic quantum computing principles, algorithms, and quantum error correction.
- **Quantum Error Correction Lecturer** — **UCSB School for Scientific Thought**
  Guest Speaker — *Oct 2019*

The School for Scientific Thought program at UCSB aims to inspire students from underrepresented minority groups to pursue degrees in STEM through multi-week courses on advanced topics they would not see in their schools. I received training from the New York Hall of Science Explainer program on how to best convey the information effectively.

- **District Science Fair Judge** — **North Carolina School of Science and Math**
  Physics and Mathematics/Engineering Categories — *2017, 2019, 2020*
- **NCSAS Judge** — **North Carolina School of Science and Math**
  MS/HS/HS Advanced Mathematics Judge — *2020*
- **Journals Reviewed for:**
  npj Quantum Information