Dripto M. Debroy | Curriculum Vitae

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I am a Physics PhD student in the Brown Lab at Duke University with a focus on Quantum Error Correction. In order to perform the large computations quantum computing has promised, our machines must be resistant to error. My research is focused on numerical and analytic work on schemes for near term error mitigation, along with development of physically inspired error models for ion trap quantum computers.

Education

- **Duke University** — **Durham, NC**
  PhD in Physics, Anticipated graduation in May 2021 — *August 2016–Present*
  Advisor: Dr. Kenneth R. Brown
- **UC Santa Barbara, College of Creative Studies** — **Santa Barbara, CA**
  Bachelor of Science in Physics, High Honors — *Received in 2016*
  GPA: 3.81 (includes graduate level courses)

Research Experience

- **PhD Candidate** — **Duke University**
  Department of Physics – Brown Lab — *January 2018 – Present*
  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.
- **PhD Student** — **Duke University**
  Department of Physics – Baranger Group — *August 2017 – January 2018*
  Worked on tight-binding model simulations of graphene using the KWANT simulation package with the goal of better understanding the Quantum Hall Effect in graphene samples with superconducting leads.
- **PhD Student** — **Duke University**
  Department of Physics – Teitsworth Group — *May 2017 – August 2017*
  Wrote MatLab simulations to study the effects of breaking detailed balance in stochastic dynamical systems.
- **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 2015 – September 2015*
  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

- **QISE-NET Fellow** — **Duke University/Google AI Quantum**
  National Science Foundation Fellowship — *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.

Publications

- Architecting Noisy Intermediate-Scale Trapped Ion Quantum Computers.
  P Murali, **DM Debroy**, KR Brown, & M Martonosi
  International Symposium on Computer Architecture (ISCA) (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 (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

- 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

- 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 Activities

- **Physics Circles Seminar Speaker** — **North Carolina School of Science and Math**
  Seminar Speaker — *Oct 2019*
  Physics Circles is a seminar series held at NCSSM to teach high schoolers about advanced topics in physics. My talk was the first of the series, and focused on basic quantum computing principles, an explanation of the Deutsch-Josza algortihm, and a very basic overview of quantum error correction.

- **Quantum Error Correction Lecturer** — **UCSB School for Scientific Thought**
  Guest Speaker — *Oct 2019*
  The School for Scientific Thought program at UCSB is aimed at inspiring students from underrepresented minority groups to pursue degrees in STEM by offering multi-week courses on advanced topics they would not see in their schools. My lecture was a video guest lecture within a course on Quantum Computing. I received training from 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*