

Junaid Aftab

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Education

- 2020 - **Ph.D. Candidate**, *University of Maryland, College Park*, Applied Mathematics.
2018 - 2020 **M.S.**, *Kansas State University*, Mathematics.
2013 - 2017 **B.S.**, *Lahore University of Management Sciences (LUMS)*, Economics & Mathematics.

Research Interests

I am interested in mathematical problems in quantum information science. Topics of interest include quantum algorithms, quantum machine learning, topological quantum computation, topological quantum field theories and topological phases of matter.

Publications & Pre-Prints

Publications and pre-prints are listed in reverse chronological order.

- **Junaid Aftab**, Haizhao Yang. Approximating Korobov functions via quantum circuits, Accepted by *Communications in Mathematical Sciences*. Awaiting publication. [arXiv:2404.14570](https://arxiv.org/abs/2404.14570).
- **Junaid Aftab**, Dong An, Konstantina Trivisa. Multi-product Hamiltonian simulation with explicit commutator scaling, Submitted to *Communications in Mathematical Physics*. [arXiv:2403.0892](https://arxiv.org/abs/2403.0892).
- **Junaid Aftab**, Adam Zaman Chaudhry. Analyzing the quantum Zeno and anti-Zeno effects using optimal projective measurements. *Scientific reports* 7.1 (2017): 1-10, [arXiv:1702.01609](https://arxiv.org/abs/1702.01609).

Research Internships

- 2023 **Quantum Computing Summer School**, Los Alamos National Laboratory.
- Used tools from representation theory to investigate the effect of noise in quantum neural networks
 - Developed a categorical framework that can be used to describe quantum machine learning models

Awards & Fellowships

- 2024 - 2026 **Math Quantum Research Training Program (RTG) Fellowship**, *University of Maryland, College Park*.
- 2024 **Herbert A. Hauptman Summer Fellowship**, *University of Maryland, College Park*.
- 2020 - 2022 **Dean's Fellowship**, *University of Maryland, College Park*.
- 2017 **NMF Gold Medal**, *Lahore University of Management Sciences*.
- 2013-2017 **Dean's Honour List**, *Lahore University of Management Sciences*.

Conferences, Summer Schools

- June 2025 **QFT and Topological Phases via Homotopy and Operator Algebras**, *Harvard University*.
- August 2024 **C*-Algebraic Quantum Mechanics and Topological Phases of Matter**, *CU Boulder*.
- July 2024 **Groundwork for Operator Algebras Lecture Series**, *Institute for Pure & Applied Math (IPAM)*.
- July 2023 **PCMI Graduate Summer School**, *Park City Mathematics Institute (PCMI)*.

Talks

- Multi-product Hamiltonian simulation with explicit commutator scaling.**
- MathQuantum Symposium 2025, *University of Maryland*
 - TQC Conference 2024, *Okinawa Institute of Science and Technology*

Research Interaction Team (RIT), *University of Maryland*.

- RIT on Geometry and Physics. March 2023, March 2025.
- RIT on ML for Rare Events. Oct. 2022.

2022 **Quantum Error Correction Reading Group**, *University of Maryland*, Homological Product Codes.

Teaching

2022, 2024 **Instructor of Record**, *University of Maryland*,

As the main instructor, I developed syllabi, quizzes, exams, and homework for the courses listed below. A star indicates I was ranked excellent by student course evaluations.

- MATH 120: Elementary Calculus. Summer 2024*
- MATH 141: Calculus II. Summer 2022*

2020 - **Graduate Teaching Assistant**, *University of Maryland*,

I organized weekly recitation sessions which were designed to go over worksheets and homework problems. My goals were for students to learn through guided exploration.

- MATH 240: Linear Algebra. Fall 2023
- MATH 140: Calculus I. Fall 2022
- MATH 135: Discrete Mathematics for Life Sciences. Fall 2021
- MATH 141: Calculus II. Spring 2021, Spring 2023
- MATH 120: Elementary Calculus. Fall 2020

2018 - 2020 **Graduate Teaching Assistant**, *Kansas State University*,

I organized weekly recitation sessions for students which were designed to go over worksheets and homework problems.

- MATH 340: Elementary Differential Equations. Fall 2019, Spring 2020
- MATH 220: Analytic Geometry and Calculus I. Fall 2018, Spring 2019

2016 - 2018 **Teaching Assistant**, *Lahore University of Management Sciences*,

I organized weekly recitation sessions for students which were designed to go over worksheets and homework problems.

- MATH 204: Introduction to Formal Mathematics. Spring 2018
- MATH 120: Linear Algebra with Differential Equations. Spring 2018
- MATH 101: Calculus I. Fall 2017
- Introduction to Analysis I. Spring 2016, Spring 2017
- Introduction to Formal Mathematics. Fall 2016

Mentoring

2025 - **Research Mentor**, *University of Maryland*.

I mentored undergraduate students as part of the MathQuantum RTG.

- Ava Petusky. Two quantum algorithms for Hamiltonian simulation.

2022 - Present **Directed Reading Program**, *University of Maryland*.

The **Directed Reading Program** (DRP) pairs undergraduate students with graduate student mentors for semester-long independent study projects. I have mentored the following students:

- Riya Metha, Fall 2025. Lie groups and Lie algebras.
- Nashita Bhuiyan, Spring 2024. Learning theory: PAC-Learning & VC dimension.
- Koran Bailey, Spring 2023. Classical and quantum random walks.
- Matthew Cimerola, Fall 2022. Neural networks and their applications.

Service

2024–2025 **MathQuantum RTG Outreach**, *University of Maryland*.

I volunteered for various outreach activities promoting quantum computing to a general audience as part of the MathQuantum RTG program.

- Maryland Day 2025.
- "Spooky Math" Halloween Science Fest 2024 in Virginia.

2024 **Course Staff**, *University of Maryland*.

I assisted professors in designing the course materials for AMSC 698: Mathematics of Quantum Information.

2024 **Guest Lecturer**, *University of Maryland*.

I was asked to deliver two lectures for a graduate-level course on differential geometry.

2022 **New Student Mentor**, *University of Maryland*.

I served as a mentor for a first-year graduate student, Valerie Wray.

Relevant Courses

Mathematics	Real Analysis, Probability, Functional Analysis, Partial Differential Equations, Differential Geometry, Algebraic Topology, Abstract Algebra, Category Theory, Algebraic Geometry, Lie Groups
Computer Science	Quantum Computing, Computational Geometry, Randomized Algorithms, Coding Theory, Numerical Optimization, Neural Modeling, Scientific Computation
Physics	Classical & Quantum Mechanics, Condensed Matter Physics, Statistical Mechanics

Skills & Certifications

Programming	Python, Julia, MATLAB, Mathematica, LaTeX, Fortran
Frameworks	PyTorch, Qiskit
Data Analysis	Pandas, Scikit-Learn, Seaborn, Jupyter
Mathematics	SageMath, SymPy, SciPy, Jupyter Notebook
Certifications	IBM Certified Qiskit Associate Developer. Passed: 2022. Badge