Dharmik Patel

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Education

University of Toronto, St. George (University College) Toronto, Canada
Honours Bachelor of Science, Mathematics & Physics Specialist Program Sep 2020 - Jun 2024

Highlighted Courses: Physics Research Project, Mathematical Foundations of Quantum Mechanics and Quantum Information Theory, Interpretations of Quantum Mechanics, General Relativity, Differential Geometry

Research and Work Experience

Theoretical Quantum Optics Research Toronto, Canada
Research Student (supervised by Prof. John E. Sipe and Dr. Colin Vendromin) Aug 2023 - Current

- Currently conducting research on lossy nonlinear generation of Gaussian states in systems with linear optics circuits and threshold detectors. Constructing novel methods to calculate detection probabilities in such systems with expected advantages with respect to computational complexity for currently known classical algorithms.
- **Undergraduate thesis**: Titled 'A unique representation for the unitary time evolution operator of an N-mode quadratic Hamiltonian'. Wrote an exhaustive reconstruction of an existence and uniqueness proof for the representation as an operator product, with emphasis on Lie algebraic foundations and operator calculus theorems. As an application, wrote a novel Julia simulation of nonlinear generation of squeezed light in a coupled channel waveguide-ring resonator system via an effective $\chi^{(2)}$ process.

2023 Compute Ontario Summer School (COSS) Toronto, Canada
Summer School Student Jun 2023

- Attended courses on high-performance computing and scientific applications using Python and Julia, solving assignments with an average grade of 98%. Gained certifications in machine learning, artificial neural networks, and advanced research computing in Julia (among others listed below).

VLT Spectroscopy of Ultra-Faint Dwarf Galaxies Toronto, Canada
Research Student (supervised by Prof. Ting Li) Apr 2022 - Aug 2022

- Wrote data classification algorithms using the `astropy` Python package to perform consistent reductions and measurements for three ultra-faint dwarf galaxies using archival data from the GIRAFFE spectrograph on the Very Large Telescope (VLT).
- Customized and optimized cross-matching algorithms using `astropy` to work in conjunction with the data classification algorithms, in close collaboration with the Near-Field Cosmology research group.

Analogue Black Hole Simulation Ahmedabad, India
Research Student at CHARUSAT (supervised by Prof. Rucha Desai) Jun 2021 - Aug 2021

- Created novel experimental approaches using videographic analysis techniques (particle image velocimetry) to probe analogue black hole formation in an electromagnetically driven fluid dynamical system.
- Developed algorithms using Python (`numpy, scipy`) to process data and customized fluid dynamics algorithms for specific experimental setups.

Private Tutor Toronto, Canada
through Street School Ahmedabad, Bluekey Education, and Superprof.ca Sep 2019 - current

- Tutored K-12, university, and underprivileged students in physics, chemistry, mathematics, and English.
- Prepared and delivered lesson plans encouraging active learning processes, resulting in higher final grades and student satisfaction.

Conferences and Talks

Q-SITE 2024 Toronto, Canada
Poster Presentation Sep 2024
Presented a poster titled 'Multimode Squeezed States in Silicon Nitride Ring Resonators' on lossy generation of multimode squeezed states via dual pump spontaneous four wave mixing (SFWM) processes.

UOttawa – NRC Quantum Optics Group Seminar Toronto, Canada
Seminar Talk Sep 2024
Gave a talk to the University of Ottawa - National Research Council joint research group, titled 'Nonlinear Generation of Gaussian States and Applications' (at the invitation of Prof. Khabat Heshami).

Skills

Technical: Mathematical and Statistical Modelling, Videographic Analysis Techniques (Particle Image Velocimetry), Quantum System Simulation, Technical Writing, Data Analysis & Visualization, Literature Review, Machine Learning, Error Analysis, Quantum Circuit Programming,

Software and Programming Languages: Python (numpy, scipy, matplotlib, Pennylane), Mathematica, Julia, R, Git, Anaconda, Adobe Suite, MATLAB, Tableau, LaTeX, Markdown, Microsoft Office, Google Workspace

Languages: English (Native), French (Intermediate), Hindi (Native), Gujarati (Native)

Awards

University of Toronto International Scholar Award University of Toronto
A merit-based scholarship worth $100,000 CAD. Jan 2020

Canadian Senior Mathematics Contest University of Waterloo
School champion in the CSMC. Apr 2019

Certifications

COSS Certifications SciNet/Compute Ontario
Apr 2023
ARC (Advanced Research Computing), HPC (High Performance Computing) in Python, Linux Shell Utilization, Machine Learning, HPC in C, GPU Programming (CUDA), ARC in Julia, and Artificial Neural Networks.