

Please visit my website (linked above) for detailed project descriptions, and attached reports.

Key Qualifications:

- 10 (of 18) months in experimental nonlinear quantum photonics research (Prof. Amr Helmy).
- 10 (of 12) months as an Optical Verification Engineer at Lumentum, automating experiments and characterizing optical communication devices.
- 12 months research experience in adjacent fields (quantum machine learning, dark matter).
- Strong machine learning background from research experience and personal projects.

EDUCATION

University of Toronto, HBS *Physics Major, Computer Science Minor* **Sept. 2020 - May 2025 (Expected)**

- **Cumulative GPA:** 3.68/4.00
- **Relevant Courses:** Quantum Mechanics I, Quantum Information, Electromagnetic Theory, Fundamentals of Optics (January 2025), Electrical Circuits, Machine Learning, core physics courses.

2024 Optica Siegman International School on Lasers @ Stanford University **June 2024**

- Selected among 100 graduate students to attend a one-week summer school involving lectures from leading researchers.
- **Key Lectures:** Quantum Optics & Photonic Inverse Design, Programmable Photonics, Optical Communication, Ultrafast Lasers, Synthetic Dimensions in Photonics.

AWARDS

- Undergraduate Research Fellowship - \$5000 **May 2023**
- Natalia Krasnopol'skaia Summer Undergraduate Research Fellowship - \$3300 **Apr. 2023**
– Awarded, declined to pursue other opportunities.
- The Victoria College Faculty Award (Dean's List Scholar) - \$1000 **Aug. 2022**
- The Elizabeth (Eastlake) Vosburgh Scholarship (Dean's List Scholar) - \$1000 **Sept. 2021**

PUBLICATIONS & THESES

- B. Janjua, Z. M. Leger, J. Atkinson, M. L. Iu, A. Khan, J. H. Schmid, P. Cheben, and A. S. Helmy, "Difference Frequency Generation in Edge Emitting Photonic Crystal Lasers," *IEEE Journal of Lightwave Technology*, Vol. 42, no. 17, Sept 1, 2024. [Publication link](#).
- A. Khan, "Expanding Quantum Horizons: Monolithically Integrated C+L-Band Entangled Photon Source for Next-Gen Optical Networks", BSc thesis, The Edward S. Rogers Sr. Department of Electrical and Computer Engineering, University of Toronto, Dec 2023.
- A. Khan, "Neural Networks for Improved Dark Matter Detection: Advances in SNOLAB SuperCDMS Detector Resolution", Undergraduate Research Project, Department of Physics, University of Toronto, Apr 2024.

CONFERENCES & TALKS

- "Improving Dark Matter Detection w/ Deep Learning", Arsalan Khan, at UofT Undergraduate Physics Conference (April 2024).
- "QuSparse: Quantum Approaches to Sparse Signal Reconstruction", Asad Khan, Arsalan Khan, Ian Lu, at [CUCAI 2024](#) (October 2023).
- "Towards an integrated self-pumped source of hyperentangled photon pairs", Arsalan Khan, Zacharie M. Leger, Meng Lon Iu, Trevor J. Stirling, Amr S. Helmy, at [CUPC 2023](#) (October 2023).
- "Development of an Open, Wearable Optical Spectral Irradiance Sensor" Alstan Jakubiec, Sadi Wali, Arsalan Khan, at the [CORM CIE 2022](#) (November 2022).

RELEVANT EXPERIENCE

Undergraduate Quantum Photonics Researcher **May — Dec. 2023, Sept. 2024 — Present**
University of Toronto, Supervisor: Amr S. Helmy

- **Deliverables:** Completed an undergraduate thesis on broadband SPDC photons, co-authored a published paper on broadband difference frequency generation, and presented time-energy entanglement research at [CUPC 2023](#). Project details on [my website](#).
- Involved in multiple independent and collaborative **experimental nonlinear quantum photonics** experiments. Most experiments involved manipulation of **entangled photons from SPDC**.
- **Independently set up free-space experiments** involving probing stations, and spectrum analyzers to conduct characterization and testing of waveguide properties, supporting the development of Bragg Reflection Lasers (BRL) for nonlinear optics applications.
- **Gained theoretical understanding of** nonlinear optics, entangled photon generation and manipulation, interferometry, quantum communication protocols, bragg-reflection waveguides, and fundamentals of quantum mechanics.

Optical Verification Engineer Intern

Jan. 2024 — Present

Lumentum Operations LLC, Part of Design Verification and Testing team in Ottawa, ON

- Developing and performing various tests to **characterize and validate optical properties** of Lumentum's newest multiplexers and switches: **Polarization dependent loss, spectral behavior, back-reflection, crosstalk**, etc.
- **Automated all testing procedures** by writing lab equipment drivers and testing scripts (Python, C#, VB.NET), minimizing time spent in lab collecting data.
- Took initiative to plan and **perform experiments beyond team's scope** to satisfy scientific curiosity and provide significant insights into troubleshooting efforts: **Water spectroscopy, wavelength-dependent bending loss, fiber coupling variability**. Invaluable discoveries of design and testing flaws were made.
- Attended executive, customer, and supplier meetings, gaining valuable insight into the dynamics of the fast-evolving telecommunications industry.

Undergraduate Researcher (Dark Matter + ML)

Sept. 2023 — Apr. 2024

University of Toronto, Part of SNOLAB's SuperCDMS Collaboration, Supervisor: Pekka K. Sinervo

- **Deliverables:** Comprehensive (thesis-style) report covering background, methods, and findings. Presented results at UofT Undergraduate Conference.
- **Implemented various neural network architectures (TensorFlow, Python)** to explore phonon measurements taken on Si and Ge dark matter detectors, with training data generated through various simulation techniques.
- Unique, unexpected trends and limitations were identified in simulated data, **providing key insights to future improvements** to the simulation pipeline essential to the collaboration.

Quantum Machine Learning Developer

Sept. 2023 — Apr. 2024

QuSparse: A collaborative research project w/ UofT Machine Intelligence Student Team (UTMIST) ([link](#))

- **Deliverables:** Presented research at Canadian Undergraduate Conference in AI [CUCAI 2024](#).
- Utilized **Python, Xanadu's PennyLane, and Tensorflow** to implement quantum generative models such as Quantum Circuit Born Machines to improve the efficiency of classical sparse signal recovery.

Research Assistant (Spectrometry for Lighting)

May 2022 — Dec. 2022

University of Toronto, Daniels Faculty of Architecture, Landscape and Design, Supervisor: Alstan Jakubiec

- **Deliverables:** Presented results at the Council for Optical Radiation Measurements Conference [CORM CIE 2022](#).
- Engineered and **built a compact, wearable spectrometer** using off-the-shelf components to collect lighting data for architectural research on circadian rhythms, programming the device in C++.
- Conducted comprehensive **testing and benchmarking** of the device and developed a Python-based data calibration algorithm to enhance measurement accuracy and reliability.

STUDENT TEAMS

Optics Team Member

May 2023 — Sept. 2023

University of Toronto Aerospace Team (UTAT), Part of FINCH – a satellite mission for crop residue mapping.

- Developed testing plans for signal-to-noise ratio and stray light for the optical block on FINCH.
- Assessed the data budget of the mission by organizing meetings with team leads and compiling requirements for data storage and communication.

Electrical Team Member

May 2022 — Sept. 2022

UofT Robotics for Space Exploration Club (RSX)

- Contributed to the development of a rover for the Canadian International Rover Challenge competition in 2023.
- Programmed motors in C++ using Arduino boards, enhancing the rover's functionality and performance.

PERSONAL PROJECTS

Machine Unlearning, Machine Learning Project

Dec. 2023

- **Deliverables:** Documented literature review, methods, and results in a comprehensive report (see [website](#) for report).
- Developed and implemented a method to enable machine learning models to "forget" specific training data points.
- Conducted extensive testing on CIFAR-10 and MNIST datasets with various neural network architectures, exploring integration with ensemble methods to enhance overall model performance.

Tunable FM Transmitter Circuit, Electronics Hardware Project

Apr. 2023

- **Deliverables:** Documented theoretical background, methods, and results in a comprehensive report (see [website](#) for report).
- **Designed and constructed an FM transmitter circuit** using an electret condenser microphone, LC oscillator, and frequency modulator based on 2N2222 transistors.
- **Successfully tested** the circuit by wirelessly transmitting audio over a short range of frequencies via a wire antenna, showcasing practical knowledge of **frequency modulation principles and circuit design**.