LANA BOZANIC

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EDUCATION

University of Waterloo   **September 2020 - April 2025**
Bachelor of Mathematics - **Mathematical Physics** - Pure Mathematics Minor

RESEARCH EXPERIENCE

Undergraduate Researcher. *Holography & Quantum Information*   **May 2024 – August 2024**
Perimeter Institute for Theoretical Physics   *Waterloo, ON*

- **Supervisor**: Prof. Alex May
- An interesting resolution to the blackhole information paradox involves introducing the notion that computational complexity is a fundamental aspect of physics. I studied certain AdS geometries that are conjectured to have large restricted computational complexity associated to them, also known as Python's Lunch geometries. Using the AdS/CFT correspondence, we developed a CFT perspective of these geometries.
- We found that Python's lunch geometries in the bulk correspond to hard Markov Chain states in the boundary. Furthermore, we connected the boundary picture to the cryptographic problem of two parties sharing a computationally (but not informationally) secure message.

Undergraduate Researcher. *Open Quantum Systems*   **September 2023 – April 2023**
Institute for Quantum Computing   *Waterloo, ON*

- **Supervisor**: Prof. Raymond Laflamme
- <u>Project 1</u>: I characterized the noise in a 2-qubit NMR quantum computer through quantum state and process tomography in effort to analyze possible non-Markovian effects.
- <u>Project 2</u>: Non-Markovian noise has yet to be understood in real quantum systems. By implementing quantum comb tomography, a type of tomography that is able to fully characterize non-Markovian noise in quantum systems, on real quantum hardware and benchmarking its performance against quantum process tomography, we can better understand if real quantum systems are non-Markovian. This project is still on-going, with experimental results being collected.

Undergraduate Researcher. *Quantum Information in Curved Spacetime*   **January 2023 – August 2023**
University of Waterloo, Department of Physics   *Waterloo, ON*

- **Supervisor**: Prof. Robert B. Mann
- We investigated the entanglement harvesting protocol along a general class of accelerated trajectories. The entanglement harvesting protocol is a well-known phenomenon that shows two (even space-like separated) particles in a quantum field can become entangled through local interactions with the field.
- Found that particles cannot be space-like separated and harvest entanglement if they are accelerating. However, even when particles are in each others lightcones, they may extract "pure" entanglement from the protocol, i.e. no entanglement came from communication between detectors.
- Published a paper with our results in Phys. Rev. D. in November 2023.

Undergraduate Researcher. *Experimental Particle Physics*   **September 2022 – December 2022**
University of Toronto, Department of Physics   *Waterloo, ON*

- **Supervisor**: Prof. Miriam Diamond
- A new detector (MATHUSLA) focused on finding long-lived particles has recently been proposed to be built at CERN. I worked on one of the first prototypes of this detector.
- I characterized potential detector components to determine which ones would be most suitable for the final detector.
- Built data-processing libraries to bulk-process laser pulse data, imitating signals the future detector will process.

Co-op Fellow. *Experimental Quantum Optics* **January 2022 – April 2022**
University of Ottawa, Department of Physics *Waterloo, ON*

- **Supervisor**: Prof. Ebrahim Karimi
- We found that OAM-carrying entangled photons had pixel-by-pixel correlations. That is, although their overall phase portraits might not be entangled, certain pixels are entangled with one-another. The orbital angular momentum (OAM) degree of freedom of photons open an new avenue for encoding quantum information in the form of qudits. I focused on characterizing entanglement between OAM-carrying beams.
- Built a python library to process lab data and perform quantum state tomography on n qudits for the above experiments.
- Characterized orbital angular momentum carrying photons and the spatial correlations that arise from entangled pairs through spatial quantum state tomography.

Quantum Optics and Outreach Assistant **May 2021 – August 2021**
Institute for Quantum Computing *Waterloo, ON*

- **Supervisor**: Dr. John Donohue
- Built a single-photon Michelson-style quantum eraser experiment from scratch that was to be used in experimental graduate classes at the IQC.
- Built a Bell test experiment using single-photons.

PUBLICATIONS

Bozanic, L., Naeem, M., Gallock-Yoshimura, K., and Mann, R.B., "Correlation harvesting between particle detectors in uniform motion", Phys. Rev. D 108, 105017 – Published 27 November 2023

CONFERENCES

Theory Canada 16 **May 2024**
University of Waterloo *Waterloo, ON*

Oral Presentation: "Entanglement harvesting between particle detectors in uniform motion".

RQI Circuit: Waterloo Wing **October 2023**
Institute for Quantum Computing *Waterloo, ON*

Oral Presentation: "Entanglement harvesting between particle detectors in uniform motion".

Canadian Undergraduate Physics Conference (CUPC) **November 2022**
University of Guelph *Guelph, ON*

Poster Presentation: "MATHUSLA: The search for long-lived particles". Won a second place prize in poster presentation category.

AWARDS

- NSE Research Council of Canada **Undergraduate Student Research Award** 2024. **($6,000)**
- NSE Research Council of Canada **Undergraduate Student Research Award** 2023. **($6,000)**
- University of Waterloo **President's Scholarship** 2020. **($2,000)**

COMMUNITY

Conference Program Developer **July 2022-Oct 2023**
Q-SITE

- Developed the program for Canada's first undergraduate conference in quantum science, information, technology and engineering (Q-SITE), hosted at the University of Toronto, funded by the Centre for Quantum Information and Quantum Control (CQIQC). The program reached over 500 undergraduate and graduate students in Canada.

Quantum Cryptography School for Young Students (QCSYS) Co-Host **July 2021**
Institute for Quantum Computing

- Co-hosted the annual Quantum Cryptography School for Young Students (QCSYS) at the Institute for Quantum Computing, a high school summer program that introduces over 200 young students to quantum physics and quantum cryptography. I hosted problem solving sessions, where I helped students with their weekly problem sets.

"Quantum Mentorship Program" Organizer **June 2019-Jan 2023**
Quantum Open Source Foundation

- Organized four cohorts of QOSF's Quantum Mentorship Program, a program that was created to pair industry and academic experts with quantum computing enthusiasts. The program specifically targeted individuals with less access to quantum computing education resources, to help lower the barrier entry to the field.

Summer Schools

Undergraduate School in Experimental Quantum Information Processing (USEQIP) **July 2021**
Institute for Quantum Computing (IQC)

Quantum information; quantum algorithms; quantum computing architectures, quantum error correction.

Celestial Holography Summer School **July 2024**
Perimeter Institute for Theoretical Physics

Introduction to Celestial Holography; scattering amplitudes; Carrollian physics; twistors; twisted holography.