LUC BARRETT

Experimental Physics Student - Amherst, MA

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EDUCATION

Master of Science - Computer Science, University of Massachusetts - Amherst GPA: 4.0 <i>Bay State Fellow</i>	May 2025
Bachelor of Science - Physics, University of Massachusetts - Amherst GPA: 3.94 <i>Cum Laude, Commonwealth Honors Scholar with Greatest Distinction, Phi Beta Kappa, Phi Kappa Phi</i> <i>Thesis</i> : Characterization of Drifting Charge Clusters in Gaseous Xenon Produced by a Laser-Driven Photocathode <i>Advisor</i> : Prof. Krishna Kumar	Sept 2024
Bachelor of Science - Computer Science, University of Massachusetts - Amherst GPA: 3.94 Cum Laude Bachelor of Science - Mathematics, University of Massachusetts - Amherst GPA: 3.94 Cum Laude	Sept 2024 Sept 2024

POSTERS & PRESENTATIONS

Chroma Optics Measurements	Oct 2024	
L. Barrett (Speaker)	nEXO Light Simulation Workshop, Montreal, Qubec	
Photo-induced Charge Calibration for nEXO	Jun 2024	
D. Cesmecioglu (Presenter), J. Bane, L. Barrett, K.S. Kumar, M. Loscar, A. Nolan, J. Zh	u Neutrino 2024, Milan, Italy	
Program to Identify Secondary Background Sources in the MOLLER Experiment	Nov. 2023	
L. Barrett (Presenter), J. Mott, K.S. Kumar	APS DNP 2023, Waikoloa, HI	

RESEARCH EXPERIENCE

Optimizing Quantum Communication Protocols with Machine Learning	Sept 2024 -
UMass Amherst College of Information and Computer Science	Amherst, MA
PI: Prof. Gayane Vardoyan, Prof. Stefan Krastanov	Full-time

Working on applications of machine learning to quantum computing hardware design and protocols

- Using reinforcement learning to optimize link generation between quantum memory devices
- Applying optimizations (tensor-network based MDP representations, tucker decomposition) to allow learning over general state spaces with large numbers of qubits

nEXO Experiment: Optical Simulations for Measuring Reflective Properties of Materials	May 2023 - Sept 2024
UMass Amherst Department of Physics, nEXO Collaboration	Amherst, MA
PI: Prof. Andrea Pocar	Full-time

Working on understanding the optical properties at $\lambda = 178$ nm of various materials that will be present in the nEXO time projection chamber. To support this effort I worked on:

- Running GPU-accelerated optical simulations using Chroma to understand the behavior of photons in the cell
 - Running large amounts of these simulations, we can apply constraints on the values of important parameters (reflectance, specular properties) to
- Presented results at internal nEXO light collaboration meeting (October '24)

nEXO Experiment: Characterization of Electron Transport in Xenon UMass Amherst Department of Physics, nEXO Collaboration

PI: Prof. Krishna Kumar

As part of the nEXO Collaboration, we are working towards developing an in-situ electron lifetime monitoring system as a component of the time projection chamber. My projects included:

- Characterization of electron transport properties in gaseous xenon through our drift stack
- Including development of toolchain to analyze data as we become able to identify signals in liquid
- Calibration of the signal processing chain (mainly charge sensitive preamplifier and shaper units)Work towards improving the fidelity of our configuration to measure a stronger signal in liquid

Development of a Julia Package to Simulate Gaussian Quantum Optics

UMass Amherst College of Information and Computer Science PI: Prof. Stefan Krastanov May 2023 - Sept 2023 Amherst, MA Full-time/Independent Study Development of a package written in Julia that includes tools to simulate gaussian quantum systems, designed to be publicly available upon completion. The package supports the creation of arbitrary multi-mode Gaussian states and many common gaussian operations (displace, rotate, squeeze, beam-splitting, Homodyne/heterodyne detection).

MOLLER Experiment: Software to Identify Secondary Background Sources	
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University of Massachusetts - Amherst Department of Physics PI: Prof. Krishna Kumar

As part of the MOLLER Collaboration, we worked on various projects related to the research & development for the MOLLER experiment. My projects here have included:

- Designing an algorithm to smooth a rough simulation-generated contour curve without losing critical details
- Used to generate a 3D profile of the electron signal that could be used by engineers in CAD
- Creation of a tool to simulate path-traced rays of light/radiation that could cause the creation secondary background sources
 - Recieved travel award to present this work in a poster session at the Fall 2023 joint meeting of the APS and JPS divisions of nuclear physics
 - "Program to Identify Secondary Background Sources in the MOLLER Experiment"
- Set up and configure a compute cluster running Ubuntu and Slurm for lab members to run batch simulation and data analysis tasks

TEACHING & MENTORING EXPERIENCE

Graduate Teaching Assistant

University of Massachusetts - Amherst Supervisor: Prof. Stefan Krastanov

Graduate teaching assistant for CS648: Quantum Information Systems, our graduate course on quantum computing, algorithms, and error correction. I ran regular office hours, wrote practice problem sets to work on and discuss in weekly discussions, ran exam review sessions, graded homework assignments and exams, and designed a homework assignment providing an introduction to simulations using QuTiP.

Undergraduate Teaching Assistant	2021-2024
University of Massachusetts - Amherst	Amherst, MA
Four semesters of experience as an undergraduate TA. I held office hours, ran exam review session exercises, and graded homework assignments. I assisted with the following courses:	s, provided guided help on in-class
PHYS181 - Intro to Mechanics (Under Prof. Menon)	Fall '21
PHYS281 - Computational Physics (Under Prof. Wilocq, Prof. Tewari)	Spring '22 & Fall '23
CS490Q - Quantum Information Science (Under Prof. Krastanov)	Spring '24
Peer Mentor	2022-2024

University of Massachusetts - Amherst

Both my Junior and Senior year, I was invited by faculty from both the Physics and CS departments to serve as a peer mentor. Each year, I was assigned 3-4 new physics majors and 1 new CS major to provide academic and social support as they navigated the challenging programs.

HONORS & AWARDS

Bay State Fellowship: Competitive fellowship awarding a teaching assistantship position, providing a full tuition waiver, health waiver, and stipend for a masters degree in computer science. (Awarded S24)

Kandula Sastry Undergraduate Award: To encourage and recognize outstanding undergraduates in Physics, this award is given annually to the outstanding undergraduate student in the UMass Amherst Physics Department. (S24)

LeRoy F. Cook Jr. Memorial Award: Presented by the UMass Amherst Department of Physics to 1-2 undergraduate Physics majors for academic excellence, particularly those with involvement in teaching or outreach. (S23)

APS DNP 2023 Meeting: Awarded funding to travel to and attend the 2023 joint APS DNP / JNP meeting to present work as part of the MOLLER Collaboration. Link to poster. (F23)

Dean's List: Awarded 7x, all my full-time semesters, for obtaining a semester GPA of 3.5 or greater

EXTRA-CURRICULAR ACTIVITIES

Society of Physics Students: Ambassador

University of Massachusetts - Amherst

I was elected in Fall of 2021 to serve as the '24 class Ambassador for the local chapter of the Society of Physics Students. My roles mainly included helping run and advertise events, as well as collecting feedback and interest from the general student body.

April 2022 - Jun 2023 Amherst, MA Full-time/Independent Study

> 2022-2024 Amherst, MA

Fall 2021 - May 2024

Amherst, MA

Fall 2024

Amherst, MA