

# CHELSEA BARTRAM

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## Education

### **University of North Carolina, Chapel Hill**

Ph.D. in Nuclear Physics *2019*

Thesis: A Search for *CPT*-violation in ortho-Positronium.

Advisor: Reyco Henning

### **Boston University**

B.A. in Physics, *cum laude*, with Honors *2011*

Thesis: Neutrino Oscillation Studies with GLoBES and the T2KK Proposal.

Advisor: Ed Kearns

## Awards & Fellowships

- Panofsky Fellow, 2022
- DNP Travel Award, 2018
- UNC Dissertation Completion Fellowship, 2017
- 3rd Place Poster Prize TAUP, Spring 2017
- Full Forum on Graduate Student Affairs Travel Award, Fall 2016
- Eugen Merzbacher Fellowship, 2012

## Research

### **Axion Dark Matter Experiment (ADMX)**

*March 2019-Present*

Advisor: Leslie Rosenberg

University: University of Washington

- Commissioned the ADMX detector on-site and led data-taking operations for Run-1C.
- Performed the analysis for ADMX Run-1C, providing input to data-taking operations.
- Developed scripts for automation of the main cavity data-taking process, including optimization of quantum amplifiers, automated antenna coupling, tuning, and synthetic axion injections and more.
- Designed and developed the controls code for the full automation of the sidecar cavity, including automated transmission/reflection measurements, TWPA bias optimization code, rod motion, digitization and more.
- Designed, developed and built RF electronics for a project to inject resonant feedback into the sidecar cavity using reprogrammable narrowband filters on an FPGA board with the idea of generating multiple resonances in parallel on a cavity to speed up an axion search.
- Created interactive webpage for monitoring and controlling data-taking operations for sidecar; also developed aspects of the main cavity data acquisition webpage.

### **CALIOPE: Fundamental Symmetries Experiment**

*January 2014-February 2019*

Advisor: Reyco Henning

University: UNC Chapel Hill

- Wrote and performed ROOT-based data-analysis for a *CPT*-violation search. Characterized sensitivity-limiting systematics.
- Designed and evaluated several source holder designs for the experiment.

- Optimized the DAQ by proposing and evaluating different designs. Demonstrated the different capabilities of digitizers vs QDCs and TDCs.
- Constructed the DAQ for CALIOPE, which consisted of hooking up 96 channels, soldering PC boards, and assembling components to be mounted in the DAQ.
- Performed characterization measurements for the detector and DAQ system.
- Estimated sensitivity for CALIOPE (CP(T) Aberrant Leptons in ortho-Positronium Experiment) and ability to improve over previous searches for  $CP$ - and  $CPT$ -violation.
- Developed full Geant4 and toy Monte Carlo systematics studies for  $CP$ - and  $CPT$ -violation searches.

### **Experimental Nuclear Astroparticle Physics (ENAP) Group**

*January 2014-February 2019*

Advisor: Reyco Henning and John Wilkerson

University: UNC Chapel Hill

- Assisted in lab maintenance at Kimballton Underground Research Facility.

### **Triangle Universities Nuclear Laboratory (TUNL) Experience**

*January 2014-February 2019*

Advisor: Mohammad Ahmed

University: UNC Chapel Hill

- Beam shifts at TUNL's HIGS facility for nucleon spin polarizability experiment.

### **Biological Physics Research**

*August 2012-December 2014*

Advisor: Rich Superfine

University: UNC Chapel Hill

### **MiniCLEAN, Super-K Experiment and LBNE**

*January 2010-August 2012*

Advisor: Ed Kearns

University: Boston University

- Designed electronics board layouts for the MiniCLEAN DAQ. Calculated signal significance using GLOBES for LBNE using different Super-K likelihood efficiencies for an on-axis beam for both neutrinos and anti-neutrinos.

### **Graphene Research**

*September 2008-December 2009*

Advisor: Bennett Goldberg

University: Boston University

## Talks

- CMD Manchester (Invited)2022:  
Exploring the real of the axion with quantum devices in ADMX
- Yale Wright Lab Seminar (Invited)2022:  
"A Bird's Eye View of Wave-Like Dark Matter"
- Recontres de Moriond (Invited)2022:  
"Axion Dark Matter eXperiment"
- Joint INPA – RPM Seminar at LBL (Invited)2022:  
"Combing the cosmos: A deep dive into dark matter and fundamental symmetries"
- Keynote Address: Joint Workshop Session for the Australian Research Council

Centre of Excellence for Engineered Quantum Systems and Dark Matter Particle Physics  
2021: “To see 85% of the world in a grain of sand: search for wave-like dark matter in the ADMX Run 1C dataset”

- Rising Stars Symposium (Invited) 2021:  
“Winds of change in wave-like dark matter”
- QAFP UK Workshop (Invited) 2021:  
“Axions and Wave-like Dark Matter”
- Fermilab Users Meeting 2021:  
“Dark Matter New Horizons”
- Cambridge High Energy Workshop 2021:  
“Venturing a glimpse at the dark matter halo with ADMX”
- PATRAS 2021:  
“(Halo) Scoping out the Axion Parameter Space”
- University of Sydney, Invited Talk 2021:  
“Matter, matter everywhere, but not enough, we think”
- Axions Beyond Gen 2 Invited Talk 2021:  
“Wave-like Dark Matter on the Horizon”
- UC Santa Barbara Invited Talk 2020:  
“Searching for the QCD Axion with the ADMX Receiver”
- Rice University Invited Talk 2020:  
“Finding the signal in the noise: an exploration of the Axion Dark Matter eXperiment analysis”
- Rutgers Invited Talk 2020:  
“Searching for Axion Dark Matter with the ADMX Haloscope”
- ICHEP Invited Plenary Talk 2020:  
“Wave-like dark matter and Axions”
- Lake Louise 2020:  
“Staying Tuned for Axions: ADMX Run 1B Results”
- Yale Invited Talk 2019:  
“The Unexpected World of Discrete Fundamental Symmetries, from Positronium to Axions”
- UW Physics Slam 2019:  
“Searching for Dark Matter Axions with ADMX”
- CENPA Seminar, Invited Talk 2019:  
“A Search for  $CPT$ -Violation in Positronium”
- APS April Meeting Talk, Columbus 2018:  
“A Search for  $CPT$ -Violation in Ortho-Positronium”
- SESAPS Invited Talk 2017:  
“CALIOPE: A Test of  $CPT$ -invariance in o-Ps Decay”
- TAUP Conference Poster 2017:  
“A Search for  $CPT$ -Violation in o-Ps”
- APS Division of Nuclear Physics Meeting Talk, Vancouver 2016:  
“Evaluation of Systematic Effects and Data Acquisition System for CALIOPE, an Experimental Search for  $CP$ -violation in o-Ps”
- APS April Meeting Talk, Baltimore 2015:  
“Search for  $CP$ -Violation in Positronium”
- APS Division of Nuclear Physics Meeting Talk, Hawaii 2014:  
“Search for  $CP$ -Violation in Positronium Decay”

## Publications

- Recently accepted by PRL: Bartram, C., et al. "Search for 'Invisible' Axion Dark Matter in the 3.3–4.2  $\mu\text{eV}$  Mass Range." arXiv preprint arXiv:2110.06096 (2021).
- Submitted to PRL: **Bartram, C.**, et al. "Dark Matter Axion Search Using a Josephson Traveling Wave Parametric Amplifier." arXiv preprint arXiv:2110.10262 (2021).
- Li, X. et al. "Proton Scattering from Linearly Polarized Gamma Rays".
- Khatiwada, R., et al. "Axion dark matter experiment: Detailed design and operations." Review of Scientific Instruments 92.12 (2021): 124502. *Contribution: Wrote multiple sections, provided feedback and editing.*
- **Bartram, Chelsea**, et al. "Axion dark matter experiment: Run 1B analysis details." Physical Review D 103.3 (2021): 032002. *Contribution: Wrote original draft.*
- **Bartram, Chelsea**, Reyco Henning, and Daniel Primosch. "Demonstration of o-Ps detection with a cylindrical array of NaI detectors." Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 966 (2020): 163856. *Contribution: Designed and built experiment, performed formal analysis, developed simulation, wrote original draft.*
- Li, X., et al. "Compton scattering from He 4 at the TUNL HIGS facility." Physical Review C 101.3 (2020): 034618. *Contribution: Participated in beam shifts, provided input at analysis meetings.*
- Sikora, M. H., et al. "Compton scattering from He 4 at 61 MeV." Physical Review C 96.5 (2017): 055209. *Contribution: Participated in beam shifts, provided input at analysis meetings.*

## Mentorship

- Shaun Lee (2021): Supervising hi-res multi-resolution search project.
- Preston Dicks (2020): Partially supervised data quality project.
- Hima Korandla (2020, now at University of Hawaii): Supervised DAQ checklist and synthetic axion projects.
- Elijah Burns (2020): Supervised mode-crossing and data quality projects.
- Daniel Primosch (2019-2020, now at UCSB): Supervised CALIOPE data recalibration project and ADMX hidden photon project.
- Catriona Thomson (2019): Supervised JPA Rebiasing project.
- Nicole Man (2019, now at PNNL): Supervised mode-map project.
- Michaela Guzetti (2019, now at UW): Supervised candidate-verification study.
- Jake Murphy (2016-2018): Supervised CALIOPE systematics study.
- Chiara Salemi (2015-2017, now at MIT): Supervised CALIOPE systematics study.
- Ryan Petersberg (2015-2016, now at Yale): Supervised the simulation and design of an electromagnet for the CALIOPE experiment.
- Kadeem Nibbs (Summer 2015, now software engineer at Opendoor): Provided mentorship for REU program project to characterize VME digitizers for CALIOPE DAQ.
- Baird Howland (Spring 2014): Supervised a project to using Geant4 simulation.

## Teaching

- Presented TUNL Informal Lunch Talks for REU students at TUNL 2015-2017
- Digital Electronics TA, Spring 2013: two 3 hr labs/week. 10-20 students/session.
- Intro Electromagnetism TA, Spring 2013: three 1.5 hr labs per week.
- Analog Electronics TA, Fall 2012: four 3 hr labs/week. 10-20 students/session.

## Computing Skills & Hardware

- Proficient in: C++, C, ROOT, Python, Linux OS, L<sup>A</sup>T<sub>E</sub>X, Geant4, bash scripting, ORCA, ORCAROOT, Coda, Arduino, Raspberry Pi, Git, Jupyter Notebooks
- Familiar with: PHP, MySQL, HTML, ExpressPCB, Radia, Mathematica, SVN, Apache/Webservers, CSS, JQuery, KiCAD, OpenSCAD, Autodesk Fusion, COMSOL, Fortran 77, MATLAB, Kubernetes, Lua, VHDL

Other  
Professional  
Activities

- Served as PRD reviewer *2021*
- Served on hiring committee for new lab manager *2021*
- Session chair for TIPP *2021*
- Assisted in the writing of two ADMX DOE Grants *2021*
- Grant reviewer for proposal for the National Science Center of Poland *2020*
- Snowmass Early Career Cosmic Frontier Leadership *2020*
- Lead Snowmass Community Planning Meeting Session #74 *2020*
- Coordinated and wrote the 4–10 GHz white paper for Snowmass *2020*
- Wrote for the UNC Science Blog (The Pipette Pen)
- Organized UNC Nuclear Seminar *Fall 2016-Spring 2017*
- Women in Science and Engineering Outreach Planning Officer *2017*
- Proficient in French: Took physics courses in French at Université de Genève
- Attended Nuclear Analytic Techniques at UC Davis Summer School *2015*.
- Attended National Nuclear Physics Summer School at Lake Tahoe *2015*.