

ANDRE FRANKENTHAL

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EDUCATION**Cornell University (2013 – present)**

Ph.D., Physics, 2020 (expected)

M.S., Physics, 2017

Advisor: Prof. Jim Alexander

Reed College (2009 – 2013)

Phi Beta Kappa, dean's list equivalent all years

B.A., Physics, 2013

Senior thesis: *"The Quantum-Mechanical Dynamics of a Particle in the Anti-de-Sitter Space Central Potential"*

Advisor: Prof. Nelia Mann

SELECTED RESEARCH EXPERIENCE

Inelastic Dark Matter Search at CMS. Lead analyzer and developer of a search for inelastic dark matter at CMS using displaced muon signatures (2018 – present).

- Wrote the analysis framework from the ground up, using both C++ and Python/Jupyter notebooks where most appropriate.
- Generated Madgraph+Pythia signal samples with large displacements with a relatively new method adjusting the Pythia configuration to set the lifetime, instead of replacing LHE information. Introduced the method to collaborators in the CMS generator meeting.
- Studied the trigger and signal object reconstruction efficiencies, and optimized event and object selection based on generated signal and background MC samples.

Reconstruction and Analysis of PADME Data. Contribute to and advise the reconstruction effort of the PADME experiment data, collected at the Laboratori Nazionali di Frascati (LNF), in Italy (2018 – present).

- Created a prototype of template-derived pulse fitting of the electromagnetic calorimeter's signals, in order to extract energy and hit time of multi-particle pulses arriving close in time.
- Advise other young members of the Collaboration (about 10 people) on how to best write the reconstruction software for the different sub-detectors.
- Plan and develop a search for inelastic dark matter and ALPs inside the PADME data.

Detector Characterization at PADME. Characterized the performance of the Small-Angle Calorimeter of the PADME experiment, in Frascati, Italy (2017 – 2018).

- Collected test beam data with a prototype of the detector at LNF.

- Performed analysis of the data, assessing detector characteristics such as energy and time resolution, and peak separation capabilities.
- Simulated the optical physics inside the PbF₂ crystals with the Geant4 MC toolkit, to compare against the data and extract further insights.
- Wrote a paper with the results of the characterization, published in NIM A.

Test Beam of Phase-2 CMS Pixels. Co-leader of US-CMS test beam team assessing the performance of R&D sensors for the next upgrade of the LHC (2017 – present).

- Performed critical role in ensuring the continual success of the test beam effort, day and night, during our assigned weeks-long slots.
- Installed, adapted, and debugged hardware needed to acquire test beam data.
- Wrote software for analysis of the collected data.
- Performed analysis of both non-irradiated and irradiated small-pitch sensors (25x100 μm^2 and 50x50 μm^2 , with PSI46, PROC600, and RD53A readout chips) to compare performance and radiation damage. Among other things, measured pixel hit resolution, efficiency, and charge collection.
- Presented periodic progress reports to CMS sensor and management meetings.
- Developed tutorial sessions to train about 20 other students, postdocs, and faculty on how to perform analysis of test beam data.

CMS Inner Tracker Phase-2 Simulation Studies. Physics simulation of prototypes for the Phase-2 Inner Tracker pixel detector (2017 – present).

- Performed parameterized and full Geant4-based MC simulations of prototypes developed by the mechanical engineering team at Cornell.
- Assessed the physics performance impact of different mechanics and thermal choices, and helped optimize the design with feedback from simulations.
- Wrote code to improve the realism of the simulations compared to the prototypes.

FPGA Development and MMAPS Calorimeter Test Beam. Firmware development for custom digitizer used in the MMAPS calorimeter prototype, followed by test beam at LNF to evaluate performance (2016).

- Wrote Verilog firmware for the FPGA (Xilinx Zynq) in the digitizer.
- Assessed and optimized data throughput rate.
- Assembled the calorimeter prototype, with digitizer, crystals, and PMTs.
- Collected and analyzed physics data from the prototype with a test beam at LNF.

Control and Monitoring System for the Muon g-2 Kicker. Developed from scratch a control and monitoring system for the g-2 kicker at Fermilab, using single-board microcontrollers such as Arduino and Intel Galileo, and a webserver with Javascript handling of real-time control and monitoring information (2015 – 2016).

Kalman Filter for g-2 Trackers. Implemented a Kalman Filter (KF) in C++ for use with g-2 straw trackers. The KF takes the straw hits as input, as well as the non-uniform magnetic field around the g-2 ring, to reconstruct the path of positrons through the tracker (2013 – 2014).

Test Beam Characterization of g-2 Calorimeter. Contributed to the test beam effort at SLAC to characterize the Cherenkov-based PbF_2 calorimeters used in the g-2 experiment, published in NIM A (2014).

- Wrote Geant4 MC simulation to compare against the test beam data.
- Played critical role in DAQ development and debugging during data-taking.

Optical MC Simulation of g-2 Calorimeter. Wrote a Geant4-based MC simulation to understand the optical physics processes inside the g-2 calorimeter and the expected performance of the detector (2013 – 2014).

PMTs at EDELWEISS. Wrote control and monitoring software for PMTs in the EDELWEISS experiment. Used the system to study the single photo-electron behavior of the PMTs to be deployed in the next generation of the experiment, EUREKA (2012).

HONORS AND AWARDS

Fermilab LPC Guests & Visitors Award (2018 – 2019)

Graduate Resident Fellow (2018 – present)

Cornell Albert Silverman Memorial Award (2018)

URA Visiting Scholars Program Award, declined (2016)

Excellence in Physics Teaching Award, Physics 1101 (2013)

Reed College Commendation for Excellence in Scholarship (2010 – 2013)

Brazilian University Entrance Exams, first of thousands of applicants at CEFET (2009)

Three silver medals in the Brazilian Programming Olympiad (2006 – 2009)

TEACHING AND OUTREACH

ParticleBites. Writer and contributor to ParticleBites, a blog dedicated to explaining recent HEP results to the lay public (2019 – present)

Fuertes Observatory. Give lectures and engage students at the Fuertes Observatory on the Cornell campus (2019 – present)

HEPMAP. Developer of an educational website to introduce the public to the different ongoing high-energy physics experiments worldwide (2019 – present)

Arduino Series. Developed introductory Arduino mini-courses for Cornell undergraduate

students highlighting both practical and fun applications of the Arduino stack, meant for students with no prior programming experience (2018 – present)

Undergraduate resident advising. Resident advisor of over 150 undergraduate students at Cornell (2018 – present)

Physics Teaching. Teaching Assistant in Physics (2013 – 2017).

- Introductory physics for physics majors
- Introductory physics for non-majors
- Electronics laboratory
- Computational physics (grader)
- Standard Model (grader)

Math Tutoring. Math tutor at the Reed Tutoring Center (2011 – 2012)

Physics Grading and Tutoring. Physics grader and tutor at the Reed Physics department (2011 – 2013)

SELECTED PUBLICATIONS

A. Frankenthal. PADME Collaboration, “*Searching for Dark Photons with PADME*”, arXiv:1910.00764.

A. Frankenthal, J. Alexander, et al., “*Characterization and Performance of PADME’s Cherenkov-Based Small-Angle Calorimeter*”, Nucl Instrum Methods Phys Res A, 919 (2019), 89-97.

L. P. Alonzi, et al., “*The calorimeter system of the new muon $g-2$ experiment at Fermilab*”, Nucl Instrum Methods Phys Res A, 824 (2016), 718-720.

A.T. Fienberg, L.P. Alonzi, A. Anastasi, R. Bjorkquist, D. Cauz, R. Fatemi, C. Ferrari, A. Fioretti, A. Frankenthal, et al., “*Studies of an array of PbF₂ Cherenkov crystals with large-area SiPM readout*”, Nucl Instrum Methods Phys Res A, 783 (2015), 12-21.

J. Grange et al. Muon $g-2$ Collaboration, “*Muon ($g-2$) Technical Design Report*”, arXiv:1501.06858.

For all publications please see <https://inspirehep.net/author/profile/A.Frankenthal.1>

SELECTED SEMINAR, WORKSHOP, AND CONFERENCE PRESENTATIONS

“*Dark Matter in the Lab: Searching for the Dark Sector with Accelerators.*” Cornell Physics Department Lunch Talk. September 30, 2019. Cornell University, Ithaca, NY, USA.

“How to Search for Dark Matter.” [Fuertes Observatory Lecture Series](#). September 13, 2019. Cornell University, Ithaca, NY, USA.

“Search for Inelastic Dark Matter with the CMS Detector.” Oral presentation. [Dark Matter at the LHC 2019](#). August 13-16, 2019. University of Washington, Seattle, WA, USA.

“Searching for Dark Photons with PADME.” Oral presentation. 2019 [Meeting of the Division of Particles and Fields of the American Physical Society](#). July 29 – August 2, 2019. Northeastern University, Boston, MA, USA.

“Search for Dark Photons with CMS and Fixed-Target Experiments.” Oral presentation. [New Perspectives 2019](#). June 10-11, 2019. Fermilab, Batavia, IL, USA.

“The Dark Side of the Force: Searching for Dark Sector Physics.” Weekly Colloquium. April 18, 2019. Union College, Schenectady, NY, USA.

“Thesis Seminar”, Reed College Physics Colloquium. April 2013. Reed College, Portland, OR, USA.

SCHOOLS AND OTHER WORKSHOPS ATTENDED

Computational and Data Science for High-Energy Physics (CoDaS-HEP) Summer School. July 22-26, 2019. Princeton University, Princeton, NJ, USA.

Current Trends in Particle Theory III. June 16, 2019. University of Illinois at Chicago, Chicago, IL, USA.

CMS Data Analysis School at the LPC. January 8-12, 2018. Fermilab, Batavia, IL, USA.

Future of Collider Searches for Dark Matter. July 27-28, 2017. Fermilab, Batavia, IL, USA.

International School of Trigger and Data Acquisition (ISOTDAQ). January 28 – February 5, 2015. Brazilian Center for Research in Physics, Rio de Janeiro, RJ, Brazil.

Raya Cowan ORT International Summer School. August 2008. WIS Plasma Lab, Weizmann Institute of Science, Rehovot, Israel.

STUDENT SUPERVISION

- Tres Reid (Cornell – graduate student). Inelastic Dark Matter at CMS (2018 – present)
- Aditi Kabra (Cornell – undergraduate student). PADME data reconstruction (2017 – present)
- Neil Minet (Cornell – undergraduate student). CMS pixel thermal studies (2018 – present)

- Arthur Campello (Cornell – undergraduate student). CMS pixel thermal studies and MMAPS accelerator studies (2018 – present)
- Kyle Fitzgerald (Cornell – undergraduate student). CMS pixel mechanics simulation studies (2018 – present)
- Connor Daly (Cornell – undergraduate student). g-2 DAQ development and testing (2013 – 2014).