

**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 PbF<sub>2</sub> 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  $\mu\text{m}^2$  and 50x50  $\mu\text{m}^2$ , 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<sub>2</sub> 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](https://arxiv.org/abs/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](https://doi.org/10.1016/j.nuclinstr.2019.08.001), 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](https://doi.org/10.1016/j.nuclinstr.2016.07.001), 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 PbF<sub>2</sub> Cherenkov crystals with large-area SiPM readout*”, [Nucl Instrum Methods Phys Res A](https://doi.org/10.1016/j.nuclinstr.2015.12.001), 783 (2015), 12-21.

J. Grange et al. Muon  $g-2$  Collaboration, “*Muon ( $g-2$ ) Technical Design Report*”, [arXiv:1501.06858](https://arxiv.org/abs/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.*” [Fuentes 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).