

Lucas Flores

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Particle physics PhD with 6+ years of experience analyzing big data sets from a fundamental physics experiment utilizing Python, C++, distributed computing, data visualization, statistical analysis, and Git. Eager to bring a first principles approach, project ownership experience, and an analytical and mathematical mindset to a challenging Data Scientist/Machine Learning Engineer role.

EDUCATION

AUG 2015 – DEC 2021 **PhD & MS** – Particle Physics *University of Pennsylvania, Philadelphia, PA*
SEP 2010 – JUN 2015 **BS** – Physics & Applied Mathematics *UC Riverside, Riverside, CA*

- Awards: MARC U STAR Scholar Fellowship, Robert T. Poe Memorial Scholarship for Outstanding Bachelor of Science Graduate, Benjamin C. Shen Memorial Undergraduate Scholarship for Outstanding Academic Achievement

EXPERIENCE

Research Assistant/Physicist, *University of Pennsylvania, Philadelphia, PA* JUL 2015 – DEC 2021
CERN, Geneva, Switzerland

- Investigated petabytes of proton-proton collision data produced by the Large Hadron Collider in search of theorized subatomic particles, furthering the knowledge of fundamental physics
 - Researched, constructed, optimized and implemented two new features used to form control, validation, and signal regions for robust statistical hypothesis tests
 - Built, maintained and documented Python/YAML based git framework for the preservation, re-usability and reinterpretation of a physics analysis
 - Restructured, simplified, upgraded with git submodules and integrated via Docker the analysis into the preservation framework's CI pipeline
 - Processed big data sets utilizing the LHC Computing Grid (AWS analogue), a powerful distributed computing resource, and distributed computing software HTCondor (TORQUE/SLURM analogue), RUCIO (Hadoop analogue), and PanDA (Airflow analogue)
 - Set exclusion limits at a 95% confidence level over a large parameter space scan for the existence of new fundamental particles via a profile likelihood ratio fit
 - Computed experimental acceptance rates for 42 independent particle decay channels over a large parameter scan and compiled values into striking visualizations
 - Created two Python/BASH based internal tools for automating common procedures for creating visualizations and preserving/collating analysis results
 - Presented technical methods and results to the physics community at two international conferences
- Performed model tuning, software development and new user onboarding/mentorship in an expert level role in a major performance division within the collaboration
 - Maintained, developed and documented the Python/C++ based electron identification analysis framework
 - Instructed, mentored and guided four new technical users and developers of the framework
 - Re-optimized 108 independent multivariate likelihood models designed to identify electrons, AKA "the electron likelihood (LH)." This is integrated in nearly every analysis in the 5000+ member collaboration
 - Trained models on a 20% larger, most current, and most representative data set
 - Tuned 324 selection parameters (3 per model), achieving targeted precision/recall benchmarks
 - Transitioned training models from a 25% simulated 75% real data hybrid to 100% real data
 - Investigated a new metric for tuning the *electron LH* to retain desired signal and background rates for different particle detector environments
 - Re-tuned *electron LH* parameter that created a gain in signal rate in 50% busier detector environments

Teaching Assistant, *University of Pennsylvania, Philadelphia, PA* AUG 2015 – MAY 2016

- Responsible for laying out the purpose of each lab and grading bi-weekly homework assignments for physics lecture component of 40+ undergraduate students.
 - Lead lab sections in both classical mechanics and electromagnetism.
 - Guided students to complete each lab with a good understanding of the experimental techniques and physics principles as well as how the lab connected to the lecture component.

Undergraduate Researcher, *University of California, Riverside, Riverside, CA* JUL 2013 – MAY 2015

- By studying direct photon and jet+photon events in simulations of protons on heavy nuclei, we aim to determine how well measurements of the Gluon Structure function can be made by the Muon Piston Calorimeter Extension (MPC-EX) detector. Performed 'jet' studies from simulated data interacting with a simulated MPC-EX detector. Jet momentum resolution of the MPC-EX was studied.

Research Internship, *Brookhaven National Laboratory, Upton, NY* JUL 2012 – SEP 2012

- I worked with the PHENIX collaboration under professor Richard Seto of UC Riverside. For the whole of the summer I worked on describing the properties of 'jets' (conical sprays of particles) emanating from simulated heavy Ion (Au+Au) particle collision event at forward rapidity (nearest to the beamline).

- PermaLost** — github.com/lucasflores/PermaLost  [Project] JUL 2022
- Engineered predictive permafrost loss tool in application to vulnerable “soft” artifact decay in Greenland using Python, pandas, scikit-learn, and matplotlib
- Web-based PhD Thesis** — lucasflores.com/thesis/  [Project] JAN 2022
- Built a Python and BASH based \LaTeX \rightarrow *HTML/CSS/JavaScript* conversion framework that compiles, converts, stylizes, implements a Wikipedia-like hover glossary, and publishes website to github pages.
- Search for chargino pair-production and chargino-neutralino production with R-Parity Violating decays in pp collisions at $\sqrt{s} = 13$ TeV with ATLAS** [Talk] JUL 2021
indico.cern.ch/event/1034469/contributions/4427253/ 
- Presented thesis research at the Meeting of the Division of Particles and Fields of the American Physical Society (APS)
- Identifying Electrons and Searching for Electroweak R-Parity Violating Supersymmetry at ATLAS** — lucasflores.com/thesis/ , repository.upenn.edu/dissertations/AAI28722112/  [Pub.] DEC 2021
- PhD thesis covering algorithms and methods for identifying electrons and a search for new fundamental particles in the context of a R-Parity violating SUSY Model
- Search for trilepton resonances from chargino and neutralino pair production in $\sqrt{s}=13$ TeV pp collisions with the ATLAS detector** — PhysRevD.103.112003  [Pub.] JUN 2021
- Primary thesis research paper searching for new fundamental particles in the context of a R-Parity violating Supersymmetric Model
- The Large Google Maps Collider** — lucasflores.com/blogfolio/LGMC/  [Project] APR 2020
- Animated an educational illustration of the LHC within google maps using JavaScript and Google Maps Platform API
- ATLAS electron and photon reconstruction and energy calibration with 2015-2017 data** — [2019 JINST 14 P12006](https://2019.JINST.14.P12006)  [Pub.] DEC 2019
- Contributed to the construction and optimization/tuning of a likelihood based electron identification algorithm (Section: 6 Electron Identification)
- Electron reconstruction and identification in the ATLAS experiment using the 2015 and 2016 LHC proton-proton collision data at $\sqrt{s} = 13$ TeV** [Pub.] AUG 2019
doi.org/10.1140/epjc/s10052-019-7140-6 
- Contributed to the construction and optimization/tuning of a likelihood based electron identification algorithm
- Search for chargino pair-production and chargino-neutralino production with R-Parity Violating decays in pp collisions at $\sqrt{s} = 13$ TeV with ATLAS** [Talk] AUG 2019
indico.cern.ch/event/782953/contributions/3459978/ 
- Presented pre-publication thesis research work at the 2019 Meeting of the Division of Particles & Fields
- The ATLAS Electron and Photon Trigger Performance in Run 2** [Poster] AUG 2019
indico.cern.ch/event/688643/contributions/3429780/ 
- Presented poster covering an overview of the trigger system at ATLAS, its performance, and its most recent new features at the 29th International symposium on Lepton and Photon Interactions at High Energies
- keypacitance** — lucasflores.com/blogfolio/keypacitance/  [Project] JAN 2018
- PennApps XVII Hackathon, Adds a capacitive touch layer input to keyboard. [Unity (VR), Arduino, C#]
- cryptoino** — lucasflores.com/blogfolio/cryptoino/  [Project] JAN 2017
- In identifying need for secure IoT devices, Implemented Tree Parity Machine neural nets into a lightweight symmetric key exchange protocol between two Arduinos in Python/C#
- Electron Identification with the ATLAS detector** [Talk] JAN 2017
meetings.aps.org/Meeting/APR17/Session/R9.2 
- Presented work describing the current state of electron identification (ID) at ATLAS as well as the investigation of a new performance metric for tuning the ID algorithm at the APS April Meeting 2017
- eyeHUD** — lucasflores.com/blogfolio/eyeHUD/  [Project] SEP 2016
- Built an eye-tracking transparent window ‘smart heads-up display’ out of a deconstructed monitor, two webcams and Python/OpenCV
- Jet Studies on the MPC-EX pre-shower detector upgrade to the PHENIX experiment** [Poster] SEP 2014
- Presented a poster at the Department of Nuclear Physics Conference of studies on the momentum resolution of direct photon and jet+photon events from simulated proton-heavy nuclei collisions

HONORS & AWARDS

- Third place overall & Best Public Safety or Video Processing App.** [Award] SEP 2016
• PennApps XIV Hackathon – “eyeHUD” is a smart eye-tracking transparent window ‘heads-up’ display, lucasflores.com/blogfolio/eyeHUD/
- MARC U STAR Scholar Fellowship** [Honor] 2014-2015
• The University of California, Riverside
- The Robert T. Poe Memorial Scholarship Award for Outstanding Bachelor of Science Graduate”** [Award] 2015
• The University of California, Riverside
- Benjamin C. Shen Memorial Undergraduate Scholarship Award for Outstanding Academic Achievement by a 3rd Year Undergraduate Student** [Award] 2014
• The University of California, Riverside

SKILLS

LANGUAGES: Python, C++, BASH, SQL, HTML, CSS, YAML, JavaScript
SOFTWARE/TOOLS: UNIX, Git, CI, ~~TEX~~TEX, matplotlib, scikit-learn, pandas, Docker, HTCondor, NumPy
OTHER SKILLS: Hypothesis testing, statistics, machine learning, regression analysis, data visualization, JIRA, Jupyter, web design, scraping