Luis Felipe Gutierrez Zagazeta

+1 (714) 873-2906 | luis.felipe.gutierrez.zagazeta@cern.ch

Education

University of Pennsylvania

PH.D. IN PHYSICS (EXPECTED COMPLETION DATE MAY 2025) — *August 2018 - Present*

University of California, Irvine

B.S. IN PHYSICS, SUMMA CUM LAUDE — *September 2014 - June 2018*

Experience

University of Pennsylvania

RESEARCH ASSISTANT - SUPERVISOR PROF. I. JOSEPH KROLL — *June 2019 - Present*

- ATLAS ITk Strip Detector AMAC testing: functionality, radiation hardness, probing.
- Model independent regression/classification and electroweak SUSY studies.

Brookhaven National Laboratory

RESEARCH ASSISTANT - SUPERVISOR DR. DAVID LYNN — *August 2021 - August 2022*

- ATLAS ITk Strip Detector GaNFET testing, ATLAS ITk Strip Detector Module and Stave testing
- Development of ATLAS ITk Detector Production Database resources for BNL

University of Pennsylvania

TEACHING ASSISTANT — *August 2018 - December 2020*

- Principles of Physics: Mechanics and Wave Motion - *Fall 2018 with Prof. Josh Klein, Spring 2019 with Prof. I. Joseph Kroll*
- Electronics Laboratory - *Fall 2019 and Fall 2020 with Prof. I. Joseph Kroll*

University of California, Irvine

RESEARCH ASSISTANT - SUPERVISOR PROF. DANIEL WHITESON — *June 2015 - August 2018*

- Compositeness and three-body final state searches.

Awards and Honors

July 2024 — **US ATLAS Outstanding Graduate Student Award** — *University of Pennsylvania*
"Broad contributions to the ITk Strip project for the ATLAS upgrade for the HL-LHC, in particular, for leading efforts in establishing the prototype and production wafer probing of the AMAC ASIC and studies of single-event errors in this ASIC; radiation tests, including developing a GEANT4-based simulation of the GaNFET switches; and work in module and stave testing and the development of ITk Strip Production Database resources for BNL."

April 2022 — **Arnold M. Denenstein Prize** — *University of Pennsylvania*
"For his leadership in testing the AMAC ASIC and his work on module and stave assembly of the ATLAS ITk Strip Phase 2 tracker upgrade."

August 2021 — **US ATLAS Center (ATC) Award** — *Brookhaven National Laboratory*
ATLAS ITk Strip Detector testing and assembly at BNL.

June 2017 — **Summer Undergraduate Research Program Honorary Fellowship** — *University of California, Irvine*
LHC three-body resonance survey.

February 2017 — **Undergraduate Research Opportunity Program Fellowship** — *University of California, Irvine*
LHC three-body resonance survey.

June 2016 — **Summer Undergraduare Research Program Fellowship** — *University of California, Irvine*
Spin-3/2 lepton search.

Featured Publications

- F. Capocasa et al., *Radiation tolerance studies of the HV-mux GaNFETs for the HL-LHC ATLAS ITk Strip detector*, JINST 18 C04006 (2023)
- J.R. Dandoy et al., *Testing of the HCC and AMAC functionality and radiation tolerance for the HL-LHC ATLAS ITk Strip Detector*, JINST 18 C03017 (2023)
- J.R. Dandoy et al., *Irradiation testing of ASICs for the HL-LHC ATLAS ITk Strip Detector*, JINST 18 C02044 (2023)
- T.C. Gosart et al., *Quality control testing of the AMAC ASIC for the HL-LHC ATLAS ITk Strip Detector*, JINST 18 C02013 (2023)
- F. Capocasa et al., *Electrical performances of pre-production staves for the ATLAS ITk Strip Detector Upgrade*, JINST 18 C01036 (2023)
- T. Dethe et al., *Causality and dispersion relations*, American Journal of Physics 87, 279 (2019)
- M. Abdullah et al., *Searching for spin-3/2 leptons*, Phys. Rev. D 95, 035008 (2017)

Contributed Publications

- J.R. Dandoy et al., *Quality control testing of the HCC ASIC for the HL-LHC ATLAS ITk Strip Detector*, JINST 18 C02026 (2023)

Research Interests

Physics: Dark matter, Higgs, SUSY and model independent searches. Machine learning in particle physics

Instrumentation: Radiation hard electronics, detector ASICs, 3D-trench silicon sensors

Research Experience

Since the beginning of my undergraduate studies, my research has heavily relied on experimental particle physics. I started my journey in physics at UC Irvine with Prof. Daniel Whiteson contributing to a search for spin-3/2 vector-like leptons to probe lepton compositeness. From 2017 to 2018, as part of my undergraduate thesis, I surveyed 3-body final state searches performed at ATLAS and CMS to set limits on generic resonance models to uncover unexplored phase-space interesting for various theoretical models.

As a graduate student at Penn, I got involved in the ATLAS ITk Strip detector upgrade under the constant supervision of Prof. I. Joseph Kroll. I started working with the ATLAS ITk Strip detector ASIC, the Autonomous Monitoring and Control (AMAC) chip. The AMAC monitors important detector voltages, currents and temperatures, controls the front-end ASICs (ABC and HCC), DC/DC converter (bPOL12V) and the silicon sensor high voltage bias, and could be autonomous via a programmable interlock mechanism. Penn was in charge of designing and testing the AMAC. The testing of AMAC included design verification tests and functionality tests. Together with fellow graduate student Sicong Lu, we were in charge of testing AMAC with the help of senior graduate student Joseph Reichert.

One of the many design verification checks are radiation hardness tests such as AMAC exposure to gamma irradiation to understand current leakage effects like the total ionizing dose (TID) current increase, exposure to heavy ion and proton beams to study single event upsets (SEUs), and exposure to X-rays to test the end-of-life performance. I was in charge of setting up the testing software needed for constant monitoring and functionality testing of AMACv2a and AMACStar for all four radiation testing campaigns. Also, I was responsible for the respective offline data analysis of each irradiation campaign.

In terms of functionality testing, every AMAC on detector needs to be thoroughly tested with the help of a probe station. With probing in mind, Sicong Lu and I had the task of extending the AMAC testing routine to thoroughly test all of the AMAC's functionality. Specifically, I was in charge of fully developing the digital functionality tests like the full interlock mechanism which allows AMAC to perform autonomous monitoring and control. In parallel to the design verification tests and the extension of the testing routine, I was in charge of setting up the protocols, methods and software for performing on-wafer AMACv2a testing using a newly acquired probe station. Moreover, the test suite was too long to be practical, so I was in charge of optimizing the testing procedure with minimal effects on the data quality. In 2019 and 2020, we successfully probed AMACv2a prototype wafers and the developed infrastructure related to the interaction with the probing equipment laid the foundation for successfully probing HCCStarV0 on-wafers at Penn. From 2020 to 2021, I was in charge of making the AMACv2a testing software compatible with AMACStar, making the testing more robust like performing pre-calibration and post-calibration checks, adding a low operating voltage test, and extending the testing routine to cover the new functionality such as the AMAC internal current measurement. Furthermore, I implemented various modifications in wafer layout, probing methods and probe-card cleaning protocols. In 2022, I completed the final version of the AMACStar wafer probing software with which we probed AMACStar pre-production wafers. Finally, I helped newer graduate student Thomas Gosart get familiar with AMAC and the various softwares, which are currently being used to probe the final AMACStar production wafers.

In mid-2021, I had the desire to understand how AMACs were used in larger systems and how the ATLAS ITk Strip detector was manufactured. I got the opportunity to expand my understanding of the detector assembly and testing at Brookhaven National Laboratory (BNL). At BNL, Dr. David Lynn is in charge of the ATLAS ITk Strip detector GaNFETs, which are gallium nitride transistors used for switching on and off the sensor bias high voltage. Unfortunately, Phillip Kuczweski who developed the GaNFETs' characterization and irradiation hardware and software passed away. With the supervision of Dr. David Lynn, I had the task of understanding the various hardware and software pieces used for performing these tests. I managed to improve and optimize the characterization and irradiation softwares, which were successfully used to test a subset of the GaNFETs production batch. Furthermore, I developed more GaNFET irradiation monitoring tools and performed the offline analysis of the data collected during the gamma irradiation and heavy ion beam campaigns performed at BNL. In parallel to the GaNFET work, due to my expertise with AMAC, I was in charge of expanding and updating the AMAC functionality in the ITk Strip Detector Module and Stave testing software. Also, I setup the temperature monitoring environment of the stave test station to perform thorough thermal studies of the stave test station at BNL. Additionally, with the help of Dr. Stefania Stucci and Dr. Peter Phillips, we fully tested the first stave assembled at BNL with the latest version of every ASIC (PPB stave) for its successful design review. Finally, with the supervision of Dr. Stefania Stucci, I was in charge of developing the resources needed to efficiently interact with the ATLAS ITk Detector Production Database at every step of the assembly chain. The various developments were placed in an easy to access website, which helps optimize and streamline the BNL assembly and testing chain from reception of various components to assembly and registration of newly built subsystems to uploading of tests for different components. This project required the understanding of all the production chain from ASICs to modules for stave assembly.

Although most of my time has been spent on the ATLAS ITk Strip Detector upgrade, in parallel I have been involved in various physics studies. In 2019, with the supervision of Penn post-doc Dr. Joanna Machado Miguens, I studied the effects of a chargino mass assumption on the acceptance of the 2 lepton final-state compressed electroweak SUSY search. Additionally, by the end of 2020 with the supervision of post-doc Dr. Shion Chen, I got heavily involved in the beginning of the second-wave compressed electroweak SUSY search, specifically in the optimization of the 1L+1Track e-channel signal region. I performed various studies on a cut based optimization which was shown to be non-optimal. Kaito Sugizaki took over the optimization task with a machine learning approach using deep neural networks. Finally, since February 2023 with the supervision of post-doc Dr. Jeff Shahanian, then post-doc Prof. Shion Chen, and Prof. I. Joseph Kroll, I have been exploiting the use of graphic neural network regression and (semi-)adverserial neural

network classification to perform model independent searches of beyond the Standard Model signatures. The development of this novel technique is still a work in progress, as well as its use to search for compressed gluinos in the context of r-parity conserving SUSY.