Gabriel Rabanal Bolaños

(617) 899-3739 ◇ Mount Vernon, OH ◇ grabanal@g.harvard.edu

EDUCATION

Harvard University   Cambridge, MA
Ph.D. in Physics   2023
M.A. in Physics   2020
Advisor: Melissa Franklin

National University of Engineering   Lima, Peru
Bachelor of Science in Physics   2016
Advisor: Orlando Pereyra

RESEARCH EXPERIENCE

Harvard University ATLAS Experiment Group   Cambridge, MA / Geneva, Switzerland
Graduate researcher

Measurement of triboson production   2021 — 2023
Based at Harvard University and at CERN

- Thesis: main analyzer in the four-lepton decay channel of the measurement of the production of **three massive vector bosons** (VVZ, where $V = W, Z$) in proton-proton collisions
- Optimized Deep Neural Networks and Boosted Decision Trees models on kinematic properties of leptons from particle collision simulations in order to target signal processes, boosting measurement power
- Developed a system to quantify the performance of the machine learning models on Monte Carlo events, and pruned redundant variables, and fixed issues with the Neural Network training
- Optimized analysis selections (signal regions) to improve rejection of non-prompt leptons taking advantage of new lepton quality and isolation working points
- Created control regions to test the Monte Carlo background prediction with data
- Performed statistical analysis using the TRExFitter framework and implemented treatment of systematic uncertainties in the fit to data
- Trained and mentored undergraduate and high school researchers and integrated them into the Harvard ATLAS research group

New Small Wheel Upgrade   2019 — 2021
Based at CERN

- Authorship task: Commissioning of the first Micromegas chambers (gaseous particle detectors) for the New Small Wheel, an upgrade to the ATLAS forward end-cap muon spectrometers
- Worked at the cosmic ray test stand based in building BB5 at CERN
- Collaborated in C++ software development for Micromegas detectors by implementing the full detector geometry of each Micromegas chamber
- Collected data from cosmic muon hits in order to measure the response of the detector (hits) which were used to fit tracks

- Measured the spatial resolution (directly related to momentum resolution) and tracking efficiency of the first-ever complete Micromegas chambers
- Analyzed the performance of different spatial sectors of each detector under different high voltage conditions after the voltages needed to be lowered in order to stop high spark rates
- Characterized the electronic noise (which produced spurious readings reconstructed as hits) as a function of the electronic baseline with noise runs
- Debugged readout timing issues where the recorded data was not associated to the proper triggers
- Mentored other graduate students in the use of the analysis software

Measurement of $WWW \to \ell\nu\ell\nu\ell\nu$ $\hspace{4cm}$ 2018
Based at CERN

- Made cutflows and measured efficiency of lepton requirements and trigger selections in the signal regions

Yale University $\hspace{8cm}$ New Haven, CT
Undergraduate researcher $\hspace{8cm}$ 2016

- Analyzed data from prototypes of liquid scintillator cells in the development of the PROSPECT reactor antineutrino experiment in Python
- Made simulations of a Compton scattering test setup with GEANT4

Peruvian Institute of Nuclear Energy $\hspace{6cm}$ Lima, Peru
Undergraduate researcher $\hspace{8cm}$ 2015

- Calibrated high-purity germanium (HPGe) detectors with radioactive sources
- Measured the neutron flux density in the RP-10 nuclear reactor core with neutron activation analysis

PUBLICATIONS

- ATLAS Collaboration. *Measurement of VVV production in pp collisions at $\sqrt{s} = 13$ TeV* (forthcoming)
- Rabanal Bolaños, G. on behalf of the ATLAS Collaboration. *Cosmic results with the final Micromegas sectors for the ATLAS Muon upgrade.* In *Proceedings of 40th International Conference on High Energy Physics* — PoS(ICHEP2020), volume 390 (pp. 773-778)
- ATLAS Collaboration. *Evidence for the production of three massive vector bosons with the ATLAS detector.* Phys. Lett. B 798 (2019) 134913. arXiv:1903.10415 [hep-ex]

PUBLIC TALKS

- **Search for production of Standard Model VVZ in proton-proton collisions at $\sqrt{s} = $ 13 TeV with the ATLAS detector**
  Elementary Particle Experiment (EPE) Seminar, University of Washington (virtual), May 4, 2023
- **Search for the production of three massive vector bosons in proton-proton collisions using data at $\sqrt{s} = $ 13 TeV recorded with the ATLAS detector at the Large Hadron Collider**
  Laboratory for Particle Physics and Cosmology Student Seminar, Harvard University, August 25, 2022
- **Cosmic results with the final Micromegas sectors for the ATLAS Muon upgrade**
  40th International Conference on High Energy Physics (ICHEP), virtual meeting, July 28, 2020

ADDITIONAL TRAINING

- **US ATLAS Machine Learning Training Event** — Remote
  Lawrence Berkeley National Laboratory (LBNL) — 2022
- **Signals in Particle Detectors** — Geneva, Switzerland
  CERN Academic Training Lectures — 2019
- **US ATLAS CAMPFIRE** — Lemont, IL, USA
  Argonne National Laboratory — 2019
- **First Peruvian School on High-Energy Physics and Cosmology** — Lima, Peru
  National University of Engineering — 2015
- **Nuclear Energy and Radiological Protection** — Lima, Peru
  Peruvian Institute of Nuclear Energy — 2015

TEACHING EXPERIENCE

Harvard University — Cambridge, MA

- **Introductory Mechanics and Relativity** — 2023
  Teaching fellow
  Undergraduate-level course aimed at students in physics/engineering
  Held two theory sections, worked through examples, reviewed topics
  from lectures and helped their understanding
- **Electromagnetism, Circuits, Waves, Optics, and Imaging** — 2019
  Teaching fellow
  Undergraduate-level course aimed at students in life sciences and medicine
  Held two lab sections and taught students to code in Python to perform
  basic data analysis, and taught to use Arduino kits
- **Electromagnetism** — 2018
  Teaching fellow
  Undergraduate-level course aimed at students in science and engineering
  Held two lab sections and taught students to code in Python to perform
  basic data analysis

National University of Engineering — Lima, Peru

- **Mathematical Methods for Physicists** — 2015
  Teaching assistant
  Undergraduate-level course for advanced physics students
  Assisted in reviewing quizzes, exams, and answering students questions

AWARDS

National University of Engineering — Lima, Peru

- Class of 2015 valedictorian (physics) and salutatorian (all majors) — 2015
- Undergraduate award for academic excellence, Manuel Pardo y Lavalle Award — 2013
- First place in the national entrance exam for the physics major — 2010

OUTREACH EXPERIENCE

- **Panelist on EducationUSA's webinar on higher education in the USA** 2020
  Invited to offer expert advice in a webinar organized in conjunction with
  the US Embassy in Lima to assist Peruvians seeking to study in the USA

- **Host for underprivileged Peruvian students researching at Harvard** 2017 — 2018
  Provided lodging free of charge to Peruvian students in need

SKILLS

Programming

- Languages: Python, C++/ROOT (Proficient), Julia (Prior experience)
- Tools: Tensorflow, Keras, XGBoost, Pandas, NumPy, SciPy, Seaborn, Scikit-learn, Jupyter
- Techniques: Machine learning algorithms (DNN, BDT), data visualization, statistical modeling

Natural Languages

- Fluent: English, Spanish (native)
- Advanced: French, Akkadian, Sumerian
- Basic: Quechua, Mandarin, German