

Ecuadorian HECAP Groups Update to LASF4RI

III LASF4RI for HECAP Symposium: Update of the Strategic Plan

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August 27, 2024

Outline

- Introduction
- Ecuador's Contributions to HECAP
- Student Involvement Growth
- Events and Educational Initiatives
- Challenges Faced by Ecuadorian HECAP Groups
- Strategic Objectives for Ecuadorian HECAP
- Ecuador's Commitment to HECAP
- Conclusion and Recommendations

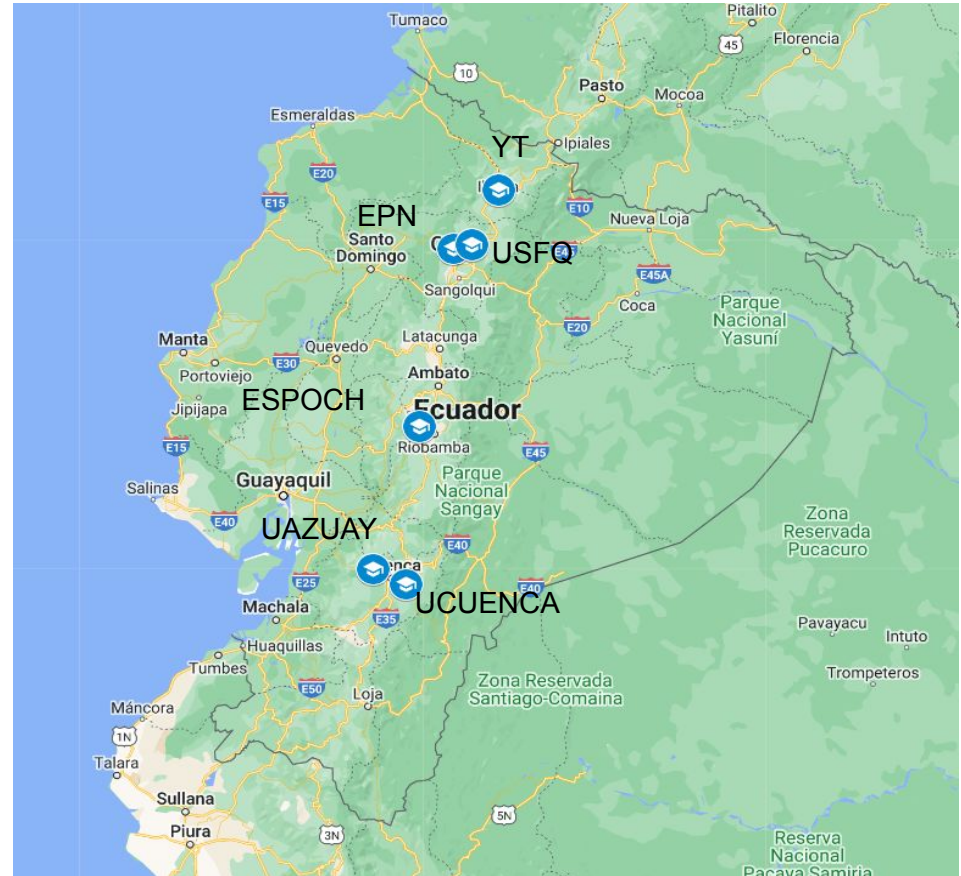
Ecuador country profile

- A small country but densely populated (17.5M)
- Rather a **newcomer** in HECAP
- Funding agency: SENESCYT
- A **rather small HECAP** community grew fast (~10 years) but has slowed down
- Some **experimental efforts** and several niches of research in **theoretical cosmology** and general relativity



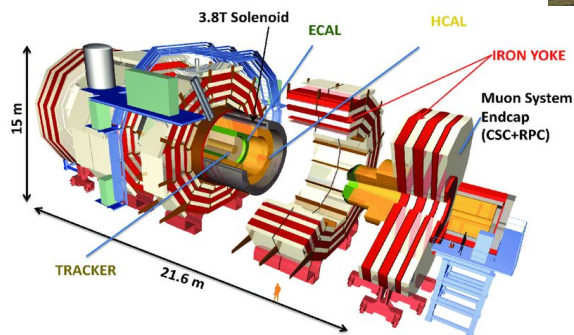
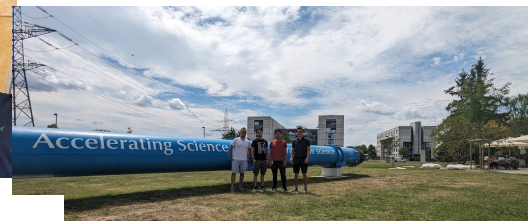
HECAP in Ecuador

- 6 institutes participate in HECAP:
 - Escuela Politécnica Nacional (EPN)(Quito)
 - Escuela Superior Politécnica de Chimborazo (ESPOCH)(Riobamba)
 - Universidad del Azuay (UAZUAY)(Cuenca)
 - Universidad San Francisco de Quito (USFQ)(Quito)
 - Yachay Tech (YT)(Ibarra)
- Participation in large scale projects:
 - CMS (EPN, USFQ)
 - LAGO (EPN, USFQ, ESPOCH)
 - CTA (UAZUAY)
- About 2 dozen scientists working in the area
- Significant increase in number of students
- A masters program at USFQ recently opened (2019) and growing
- Expansion is challenging due to financial constraints and the constant threat of funding cuts, especially for participation in large experimental infrastructure.



Ecuador in CMS

- EPN and USFQ members of the **CMS Experiment (2015)**
 - 2 group leaders (faculty)
 - 1 engineering faculty
 - Usually ~4 undergrad students
 - Currently 1 new masters student
- **Physics analyses:**
 - top physics
 - higgs physics
 - exotic searches
- **Service work:**
 - Detector operation (BRIL)
 - Maintenance (BRIL, PPD)
- **Upgrade work for HL-LHC:**
 - BRIL subsystem: new luminometry from front end devices like muon DT
- Students active participation in the **CERN Summer Program and OpenLab**



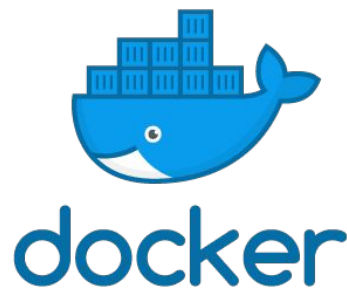
CMS: BRIL subsystem

- Beam Radiation, Instrumentation and Luminosity (BRIL)
- In 2020-2021, crucial in-situ **engineering** contributions to ensuring the CMS experiment was optimally prepared for Run 3 during Long Shutdown 2.
- Three engineers **on-site**
- BRIL **BPTX electronics** and **BRILDaq software** tasks
- **PPD (Physics performance and datasets) group** software engineer contributing on-site 2020-2024
- Ecuadorian groups actively involved in future luminometry using **DT muon system (BRILDAQ software)**
- During Run 3, active ongoing participation in operations (**detector on-call duties**) and **BRIL shifts** (remote ones to be tested soon)



CMS: Computing and Open Data

- One of our engineers spent 2 years at Fermilab for **Grid computing support/operations**
- Co-coordination of **Data Preservation and Open Access (DPOA)** (until 2021)
 - Develop **tools** for data preservation, reproducibility
 - **Open** data
 - Usage of **scalable** technologies
 - Several **external publications** already
 - Workshops and **training**
- Active exploration of ML with CMS Open Data



kubernetes

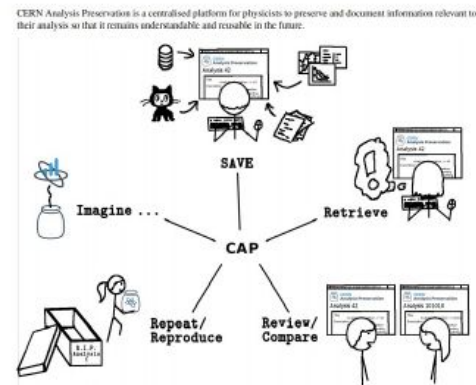


CMS Open Data workshop 2022!

700 Views • 1 month ago

CMS Experiment

We ended the third edition of the CMS Open Data workshop with the aim to teach how to access and analyze open data! Watch ...



reana

Reproducible research data analysis platform

Flexible

Run many computational workflow engines:



Scalable

Support for remote compute clouds:



Reusable

Containerise on-premise, reusable elsewhere: Cloud-native:



Free

Open Software: MIT license. Made with ❤️ at CERN.



Ecuador in LAGO

- Latin American Giant Observatory (**LAGO**): Array of WCDs at different latitudes from Mexico to Antarctica
- Involves active, independent groups across Latin America
- Since 2011: **EPN, USFQ, ESPOCH**
- 4 permanent researchers and a few graduate students
- Recently master's students interest is allowing a palpable boost
- Detectors placed at **high altitudes** to capture cosmic ray showers and study GRBs
- Advanced to provide **new avenues for research** and education
- Recent adaptations for **space weather** studies
- **Historical issues**: detector size, electronic noise, and limited funding for components.
- Ongoing efforts improving stability, supported by **LA-CoNGA**
- Growing involvement of **master's level graduate students**



PROVINCIAS ▾ ECONOMÍA POLÍTICA DEPORTES CRÓNICA NACIONAL MUNDO

MULTIMEDIA ACTUALIDAD

Instalan un detector de rayos cósmicos en el Chimborazo

Redacción Diario Los Andes agosto 18, 2024 7:18 pm Sin Comentarios



PROYECTO

La Escuela Superior Politécnica de Chimborazo (ESPOCH) ha dado un paso significativo en el campo de la astrofísica con la instalación de un detector de rayos cósmicos en las faldas del volcán Chimborazo.



Ecuador in CTA

- **Active Collaboration:**
 - Part of CTA through the High Energy Group at the Universidad Complutense de Madrid (UCM).
 - Focus on developing the **analysis chain for LST telescopes** and optimizing the data processing cluster in La Palma.
- **Key Contributions:**
 - Involved in data reduction, AGN analysis, and LST telescope calibration.
 - Second affiliation with **Universidad del Azuay** for publications, working on projects in collaboration with UCM.
- **Challenges and Opportunities:**
 - Unable to officially involve Universidad del Azuay students due to CTA's closed collaboration policy.
 - Potential for Ecuador to join CTA officially, leveraging the CTA-South construction in Chile.
 - Funding is a challenging task

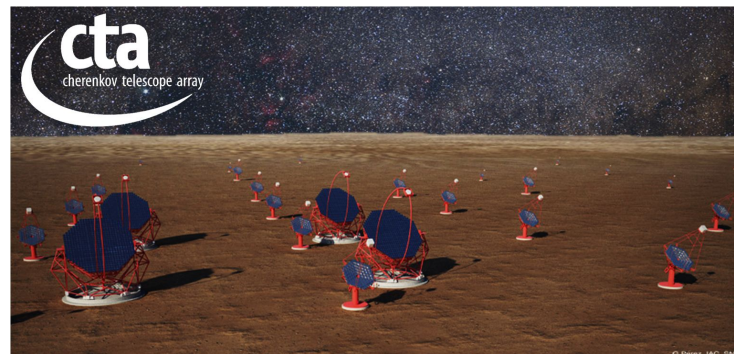
On-site analysis pipeline for the LST-1

version: 0.10.15.dev58+gc1c1039 Date: Aug 07, 2024



`lstosa` is the on-site data processing pipeline of the CTA Large-Sized Telescope prototype (LST-1) making use of the [cta-lstchain](#) analysis library.

- Source repository: [cta-observatory/lstosa](https://github.com/cta-observatory/lstosa)
- License: BSD-3
- Python: >=3.9
- Authors: Daniel Morcuende, Lab Saha, José Enrique Ruiz, José Luis Contreras, Andrés Baquero, María Lláinez



Growing critical mass

- **Strong Talent Pipeline:**
 - Robust flow of undergraduate and graduate students
 - Active engagement in research projects and training programs
- **Enhanced Research:**
 - Young talent boosts current research endeavors
 - Promotes innovation in fundamental physics and technology
- **Sustainable Future:**
 - Ensures continued growth for HECAP in Ecuador
 - Maintains momentum despite financial challenges and funding risks
- **Challenges:**
 - Inevitable brain drain
 - Need better policies to retain some of the talent

2021 Mitsuyoshi Tanaka Dissertation Award in Experimental Particle Physics Recipient

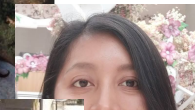
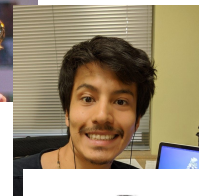
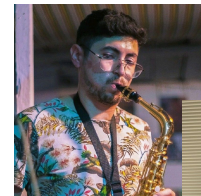
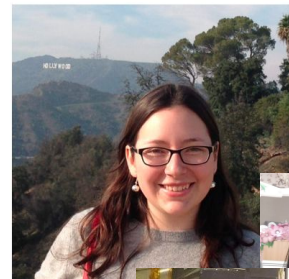
Cristina Mantilla Suarez
Fermi National Accelerator Laboratory

Citation:

"For thesis topic, "Probing New Physics Using Initial State Radiation Jets at the Large Hadron Collider."

Background:

Cristina Mantilla Suarez is a Lederman Fellow at Fermi National Accelerator Laboratory. She completed her undergraduate degree in physics at the National Polytechnic School in Quito, Ecuador, in 2016 and received her Ph.D. from Johns Hopkins University in 2020, under the supervision of Prof. Petar Maksimovic. As a graduate student she was supported by the URA Visiting Scholars program (2017) and the LHC Physics Center Graduate Scholars program at Fermilab (2019). Her research focuses on measuring



updates > news > Meet the talented recipients of the ATLAS PhD Grant

News

Meet the talented recipients of the ATLAS PhD Grant

16 February 2017 | By Katarina Anthony

Topic: students



Santiago Paredes Saenz (Image: S. Biondi/ATLAS Experiment)

Santiago Paredes Saenz (University of Oxford)

When looking for funding for his PhD, Santiago Paredes Saenz found limited opportunities for students from Latin America. "My university suggested that apply for the ATLAS PhD Grant, which has no such nationality restrictions," says Paredes Saenz, who is from Ecuador. "To be honest, I thought it was a long-shot. I was very honoured to be selected"

He will be carrying out a di-Higgs search within the ATLAS Exotics group for his thesis, and is also working on the jet missing-energy trigger for his qualification task. "It is quite challenging work, but I'm really enjoying it," he concludes.



Global Grads Featured Scholar – David Hervas

Tuesday, September 24, 2019

David Hervas Aguilar, a doctoral student in physics and astronomy, completed his bachelor of science degree in physics at Universidad San Francisco de Quito (USFQ), in his home country of Ecuador. He has served as a high school teacher in Ecuador and as a teaching assistant at UNC-Chapel Hill and USFQ. In addition, he has taught physics and mathematics in locations including the Galapagos Islands and Canada.

What made you choose UNC-Chapel Hill when deciding on a program/place to study?

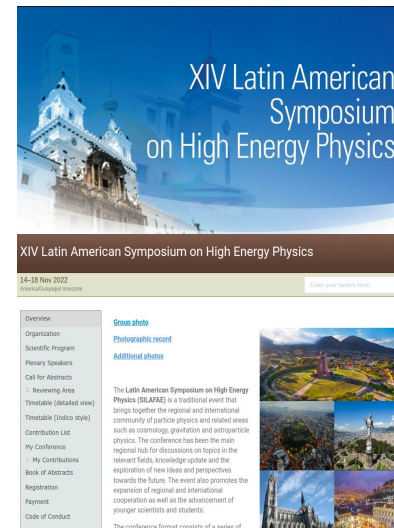
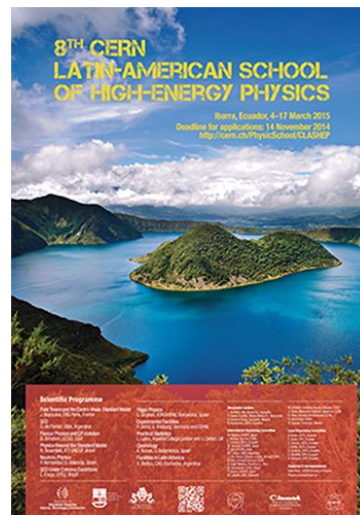
After three changes to my major, I found myself lost. To my fortune, the physics department of Universidad San Francisco de Quito (USFQ) – my undergraduate institution in Ecuador – reached out to me with the option to pursue physics. For the first time in my academic career, I finally felt at home. It didn't take me long to learn that the founder of USFQ obtained his degree in nuclear physics from UNC. Because of this, I feel that UNC and USFQ share many of the same values and virtues and strive for innovation. I cannot be more thankful for my academic upbringing at USFQ; thus, it was only natural that I come to an institution that helped forge that vision. My decision was solidified once I learned about the groundbreaking research that my now-advisor, John F. Wilkerson, and his team were conducting at UNC.



David Hervas

Regional events and educational initiatives

- CLASHEP 2015
- XIV SILAFAE 2022
- School of Programming for Scientific Research (EPIC)
- LA-CoNGA Physics (future EL-BONGO Physics) (UE Erasmus+)
- CMS International Masterclasses on Particle Physics



IV Escuela de Programación para Investigación Científica (EPIC)

“EPIC 4: Harnessing Data for Scientific Discovery - A Deep Dive into Data Analysis and Machine Learning for Physical and Life Sciences”

Physics Without Frontiers (PWF) jointly with Grupo de Investigaciones Lattitud Cero, the School of Physical Sciences and Nanotechnology of Yachay Tech Universidad Internacional del Ecuador (UIDE), the Physics Department of Escuela Politécnica Nacional, and UNESCO-Quito are pleased to announce our upcoming summer “School of Programming for Scientific Research - EPIC 4: Harnessing Data for Scientific Discovery - A Deep Dive into Data Analysis and Machine Learning for Physical and Life Sciences”.

Indico page of the School
<https://indico.cern.ch/event/1417411/>

General Information
 The 4th edition of EPIC will focus on introductory computational techniques for the analysis of scientific data and

Latin American alliance for Capacity Building in Advanced physics
 LA-CoNGA physics

Home What do we want? About us How do we do it? Master's Degrees Involved

Our policies Academic Offering

3 LA-CoNGA physics International Network School

11 - 15 diciembre 2023

LPNHE Université Paris Cité
 Laboratoire de physique nucléaire et des hautes énergies
 Paris, France



Challenges and Limitations in Ecuador's HECAP Research

- **SENESCYT** has been pivotal in boosting Ecuadorian participation in HEP. However, many challenges are faced.
- **Funding Instability:** Projects like **KM3NeT** faced setbacks; potential disruptions in high-impact research.
- **Financial Constraints:** Limited resources for large-scale and cutting-edge projects. Difficulties in joining major international projects.
- **Academic and Research Constraints:** Regulatory challenges and funding cuts affecting research participation and productivity. Limited student involvement in CMS, recently solved.
- **Technical Challenges in Experiments:** Operational and maintenance issues in experiments like LAGO. Data quality concerns; limitations in instrument functionality. Recently improved.
- **Political and Economic Volatility:** Political instability and economic fluctuations affecting funding stability. Risk of project discontinuation; uncertainty in long-term research planning.
- **Recruitment and Retention Issues:** Difficulty in attracting and retaining skilled personnel. Scarcity of expertise in complex computing and/or scientific engineering.
- **Educational and Training Gaps:** Need for expanded educational programs and hands-on training. Limited development of next-generation scientists and engineers.

Medium/long term scientific/academic goals

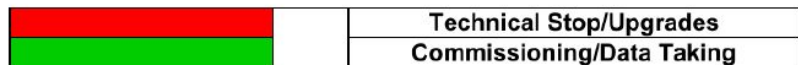
- Continue collaborating to study the properties of SM and the Higgs boson
- Continue research on new phenomena in particle physics
- Continue cosmic rays research
- Study the properties of neutrinos
- Engage in emerging fields, such as multi-messenger astronomy and advanced astroparticle physics projects
- Strengthen engineering capabilities
- Develop and build particle detectors beyond educative purposes
- Enhance software development and open data tools
- Enhance data sharing and open science practices
- Strengthen educational programs at all levels
- Organize more frequent educational events and academic conferences
- Secure funding and foster global partnerships for HECAP activities, while engaging the general public to raise awareness of its importance.

Strategic objectives and collaborative endeavors

- Continue working in the CMS experiment at the LHC, contributing to knowledge generation in collider particle physics, detector building, software development, and engineering.
- Continue contributing to the upgrades of the CMS experiment towards the HL-LHC phase.
- Expand and motivate groups working in the CMS experiment, emphasizing software and open data efforts.
- Continue working in the LAGO project, emphasizing the development of low-cost particle detectors to train the next generation of scientists and engineers.
- Prepare to join future collider experiments in the energy frontier, such as the ILC or FCC.
- Collaborate in future experiments in the intensity frontier, such as DUNE.
- Continue working on contributions for future projects in the cosmic frontier such as the CTA Consortium and preparing to join long-term projects such as the Cosmic Explorer.
- Prepare to join CTA formally.
- Prepare to join a large future regional experiment, such as ANDES
- Reinforce participation in developing computing tools, data science algorithms, data preservation, and open science, leveraging these efforts to boost local research.

Timeline

Projected Timeline of HECAP Large-Scale Infrastructure Experiments for Potential Ecuadorian Participation																			
Experiment	Year																		
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042 – beyond
LHC/CMS	Green	Green																	
HL-LHC/CMS			Red	Red	Red	Green	Green	Green	Green	Red	Green	Green	Green	Green	Red	Green			?
LAGO	Green	Green	Green	Green	Green	Green	Green								?				
FCC ee (as example)	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	?
DUNE (as example)	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	?
ANDES (as example)	Grey	Grey	?	Grey	Grey	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	?
CTA	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
COSMIC EXPLORER (as example)	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	?



We acknowledge the challenges in securing Ecuadorian State support for HECAP research groups and their participation in international experiments, but recognize that the scientific and technological benefits often outweigh the investment.

Conclusions

- Significant advancements driven by strategic partnerships in projects like CMS, LAGO, and CTA.
- SENESCYT has been instrumental in supporting international scientific experiments like CMS
- HECAP projects have enhanced Ecuador's critical mass in the area by fostering high-level research skills and collaborative opportunities for local scientists and students.
- Ecuadorian students have shown strong participation in HECAP research, contributing meaningfully to projects despite facing significant challenges
- The expansion of events, educational outreach activities, and training initiatives has significantly enhanced opportunities for knowledge dissemination, skills development, and capacity building in Ecuador's scientific community.
- Funding remains a critical hurdle.

Recommendations

- **Stable Funding:** Secure long-term investment in HECAP research.
- **Expanded Collaborations:** Strengthen and diversify global partnerships.
- **Enhanced Education:** Develop further programs for hands-on physics and technology training.
- **Computational Resources:** Improve access to high-speed data infrastructure.
- **Open Science:** Encourage data sharing and collaboration.
- **Diversity & Inclusion:** Promote inclusivity in the HECAP community.
- **Strategic Initiatives:** Focus on targeted scientific and technological challenges.
- Implementing these strategies will solidify Ecuador's impact in HECAP and contribute to global scientific progress.