Ecuadorian HECAP Groups Roadmap

II Latin American Strategy Forum for Research Infrastructure: an Open Symposium for HECAP

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on behalf of most of the Ecuadorian HECAP community

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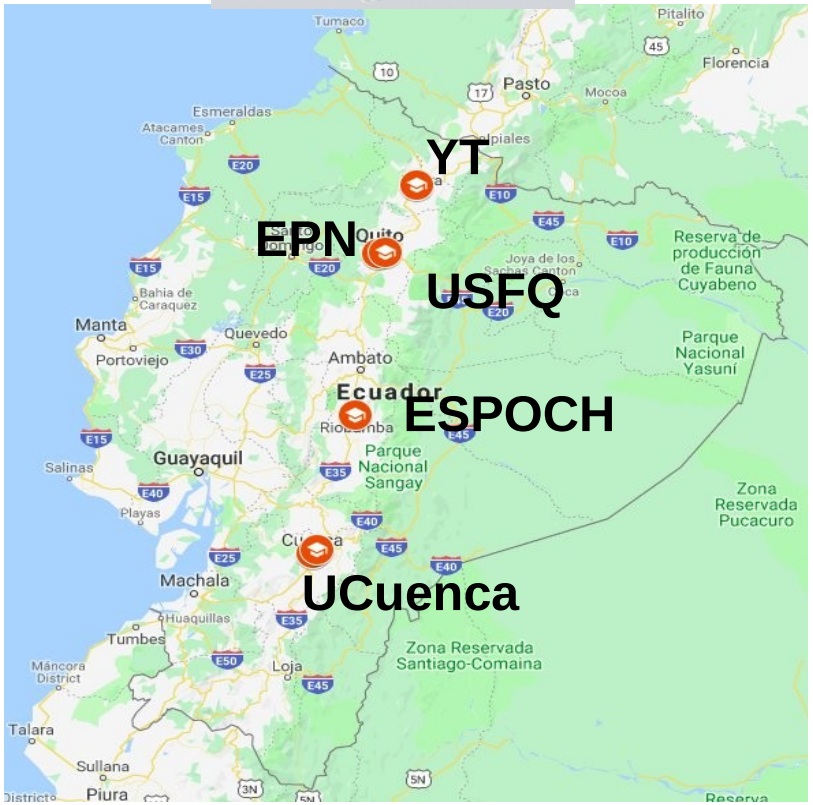
Outline

- Overview of HECAP
- Current Projects
- Future plans
- Summary

Overview of HECAP in Ecuador

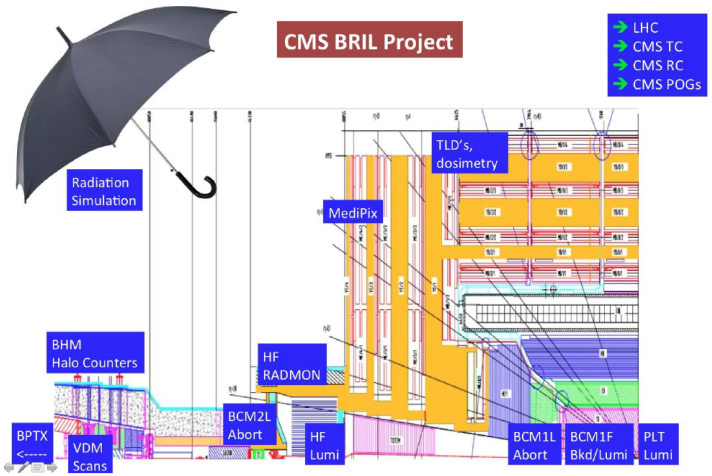
- HECAP involvement:
  - Escuela Politécnica Nacional (EPN)[Quito]: CMS, LAGO, Theory
  - Escuela Superior Politécnica de Chimborazo (ESPOCH) [Riobamba] LAGO
  - Universidad de Cuenca (UCuenca) [Cuenca]: LAGO
  - Universidad San Francisco de Quito (USFQ) [Quito]: CMS, LAGO, Theory
  - Yachay Tech University (YT) [Urcuquí]: KM3NeT, Theory
- Currently only one graduate program in HEP, which started last January. But another master program in the LA-CoNGA program context to be opened in YT.
- No strong tradition in physics research overall (or science in general) but individual and important involvement/efforts.
- Spectacular growth in interest and involvement over the last decade (also brain drain of students).
- Planning to expand involvement in the next 30 years: **Energy frontier**, **Intensity frontier**, **Cosmic frontier**
- Funding agency: Secretaría de Educación Superior, Ciencia, Tecnología e Innovación (SENESCYT)



Current projects in Ecuador

The CERN's CMS Experiment: Multipurpose/multisystem LHC partcile physics detector.

- Membership: 2015
- Institutions involved: EPN, USFQ.
- 3 Permanent Researchers: Edy Ayala (EPN), Edgar Carrera (USFQ), Dennis Cazar (USFQ)
- Students: 5 undergrads, potential master students soon.

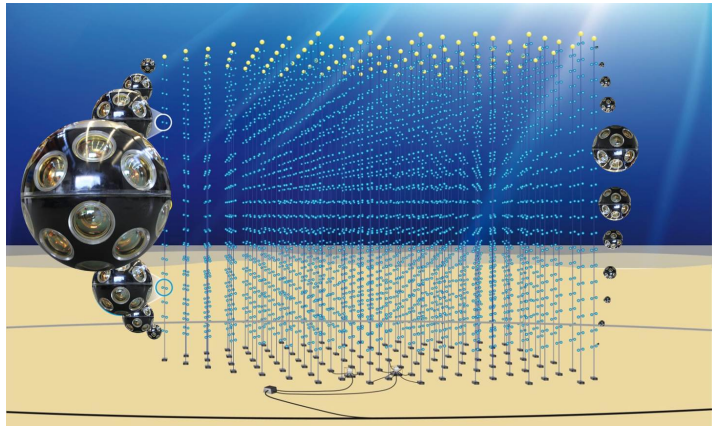


- Main scientific drivers:
  - Contribue to understanding the Higgs field/particle and use it as a portal to search for new physics
  - Top properties and physics.
  - New phenomena and dark matter searches
  - Expand involvement in engineering and technical fields.
- Infrastructure responsibilities and status:
  - Beam Radiation, Instrumentation and Luminosity system (BRIL): On-site operations and data taking; Electronics upgrades (phase I); deciding involvement for upgrades phase II (focus on engineering); two new engineers ready to go to CERN when possible.
  - Software, computing and trigger system: Data preservation and open access (DPOA); software infrastructure (new engineer ready to fly to CERN when possible); DPOA deputy management responsibilities; high level trigger timing software. Preparing for Run 3
  - Hadronic Calorimeter (HCAL): Calibration of upgraded system; FPGA electronics contribution (work completed); simulation studies of cooling system of RBX for phase II upgrades (work in progress)

Current projects in Ecuador

The KM3NeT Experiment (Multidisciplinary neutrino observatory in the abyss of the Mediterranean Sea):

3D array of light sensor modules distributed over large volumes of the transparent water in the deep Mediterranean sea. ARCA (two sparser layouts, optimized for astrophysical neutrinos) and ORCA (one denser layout, optimized for atmospheric neutrinos), same detector technology, different granularities.



- Membership: 2019
- Institutions involved: YT
- Permanent Researchers: José Ramírez (YT), Harold Yepes Ramírez (YT) (IP, IB rep)
- Students: 7 undergrads

- Main scientific drivers:
  - Calibration: positioning subsystems (digital compasses, acoustic positioning system), time and optical system (PMTs, Light sources).
  - Physics: oscillations (Neutrino Tomography), sources (TXS 0506+056 Blazar).
- Infrastructure responsibilities and status:
  - Preliminary design of the prototype of the Optical Calibration System for KM3NeT Phase-II.
  - PMT testing lab being mounted for the purpose, along with work for P-II (upgrade).
  - Implementation of KM3NeT remote control room in YT is ongoing.

Current projects in Ecuador

The LAGO Project (High altitude cosmic rays physics and space weather):

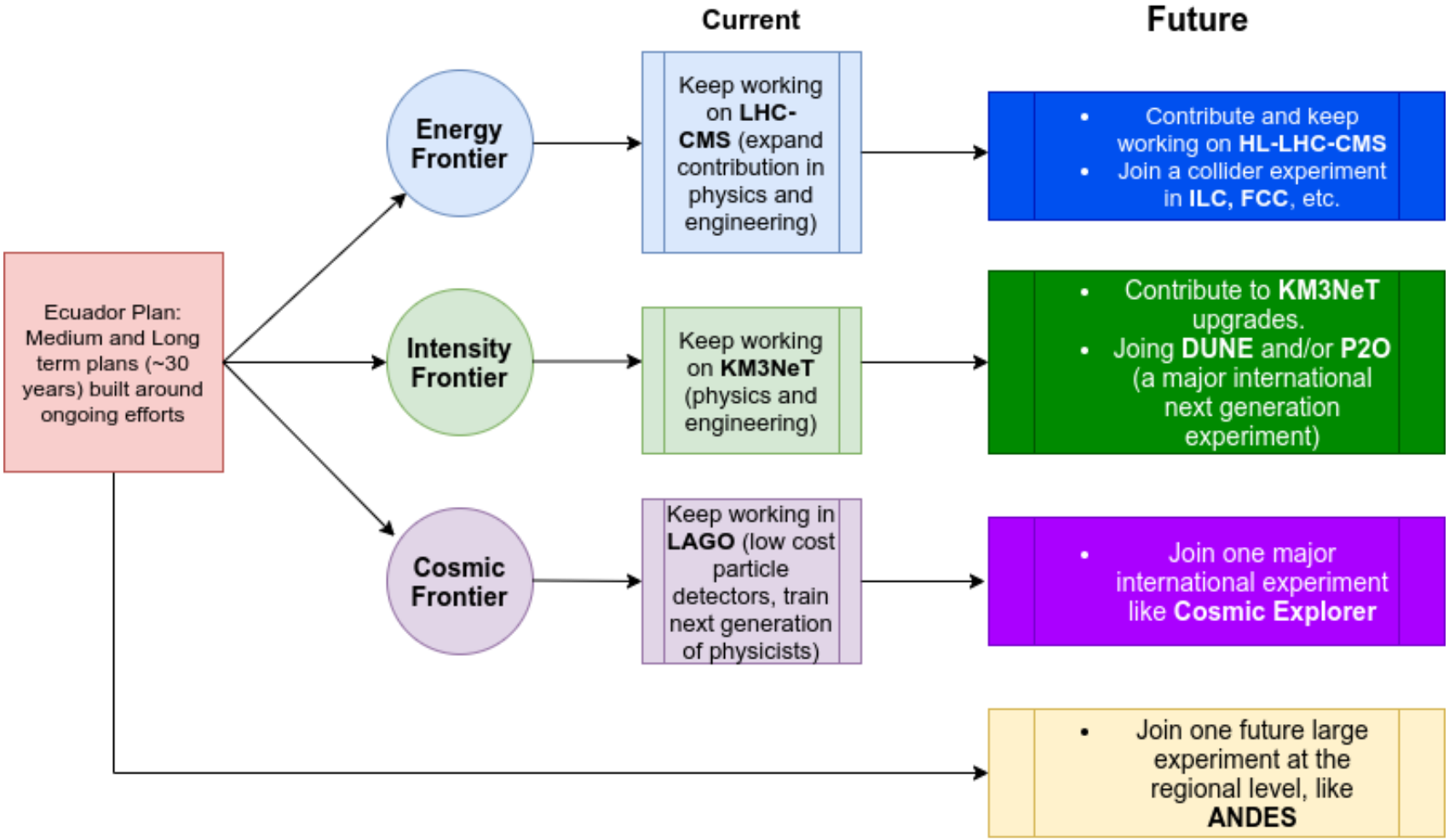
Array of WCDs at different latitudes from Mexico to Antarctica.

- Membership: 2011
- Institutions involved: EPN, ESPOCH, UCuenca (observer), USFQ
- Permanent Researchers: Mario Audelo (ESPOCH)[Country rep.], Edgar Carrera (USFQ), Dennis Cazar (USFQ) (LAGO detectors responsible), Christian Mejía (UCuenca), Nicolás Vásquez (EPN).
- Students: 7 undergrads
- Main scientific drivers: Study high energy cosmic ray events (GRBs); perform cosmic rays, magnetic rigidity and space weather studies.
- Infrastructure responsibilities and status: Each institution responsible for development, construction and operation of their own WCDs for cosmic ray studies; new electronics (mixed of commercial and custom) are being developed.

Other Theoretical Efforts and Capabilities

- **Black hole physics and gravitation** (EPN, USFQ, YT), 4 researchers; **cosmological models** (USFQ, YT), 2 researchers; **Imaging and detector technology** (YT, USFQ), 2 researchers; **"Quinde" supercomputing cluster** (YT); **Particle and radiation labs** (EPN, USFQ, YT(IAEA)), 4 researchers.

Future plans



Summary and Conclusions

- Ecuadorian HECAP groups have expanded considerably and several physicists are being trained at the highest level either locally or abroad.
- There are now groups working formally with the CMS Collaboration at the LHC, the KM3NeT Collaboration and the LAGO project.
- We recommend that the strategy of Ecuadorian groups working on HECAP builds around these ongoing efforts and expand to include presence in experimental cosmology and/or astroparticle physics at the international level.
- We strongly support the continuity of the LHC and HL-LHC program at CERN, in particular that of the CMS experiment.
- Likewise, we endorse the active participation of Ecuadorian groups in the KM3NeT and LAGO experiments.
- In the medium/long term future, we recommend joining the experimental program of one of the next-generation accelerators, like ILC, CLIC or FCC, etc.; one of the main future experiments in the intensity frontier, like DUNE at Fermilab and/or comple- mentary long base line future experiments (side-project within KM3NeT); an experimental program in the cosmic frontier, like CTA, LIGO or VIRGO, COSMIC EXPLORER, etc.; and a regional large collaboration, like ANDES.
- We encourage active participation in all related aspects of engineering, in particular software and computing, especially those related to the development and/or application of data science algorithms, and open data and open science.
- We will need projects based on the know-how and knowledge transfer from above activities, as well as strengthen relations with government institutions and links to the private sector.
- Challenges: lack of stable funding scheme in the Country, shortage of person-power and research-oriented rules.

Invitation to the XIII SILAFAE

Covid-19 prevented us from organizing the XIII SILAFAE this year, but you are all invited to visit USFQ in Quito, Ecuador in 2021!