1 Introduction

LaCONGA Physics aims to implement 7 specialized HEP and radiation labs in 8 universities across Latin America. according to the equipment labs are divide in two groups: Fundamental and Advanced.

- **Fundamental labs** are equipped with all the necessary to carry on experiments in particle physics, nuclear physics and radioactivity.

- **Advanced Labs** are equipped whit particle detectors where students can work in calibration, optimization, data analysis and developing of data acquisition prototypes.

All the equipment in the labs is going to be connected via LAN to a a local server in order to allow remote access from all the institutions of the Consortium. Per institution distribution of the labs follows:

- **Venezuela:**
    - UCB and UCV will share a Radiation Detection Lab

- **Colombia:**
    - UIS: Data Acquisition Developing Lab + Nuclear Imaging PET
    - UN: Fundamental Lab

- **Ecuador:**
    - YT: Water Cherenkov Detector Lab
    - USFQ: Gas Detector Lab

- **Perú:**
    - UNSM: Radiation Detection Lab
    - UAN: Scintillators Detection Lab

2 Objectives

Three main objectives are foreseen:

- Fundamental experiences in particle physics, nuclear physics and radioactivity.

- Hands on experiences in Cosmic Ray Particle Detectors (WCDs and RPCS)

- Developing and testing of Data acquisition system prototypes for Cosmic Ray detection.

3 Experiments

Fundamental labs are fully equipped to perform:

- γ Spectroscopy

- β Spectroscopy

- Particle Physics

Advanced Labs are divided by detection technique, i.e.

- Water Cherenkov Detetector

- Gas detectors

- Scintillators detectors

- Data Acquisition systems and Nuclear Imaging PET.

A list of the experiments and the equipment needed follows
Each experience is a self-contained 4 hour module and can be performed both through a remote connection or hands-on.

3.1 Nuclear Physics and Radioactivity

- γ Spectroscopy

    - γ-Radiation Detection

    - Poisson and Gaussian Distribution

    - Energy Resolution

    - System Calibration: Linearity and Resolution

    - Photonuclear cross-section / Compton Scattering cross-section

- β Spectroscopy

    - Response of a Plastic scintillating Tile

    - β Spectroscopy

    - β Radiation: Transmission through matter

    - β Radiation as a Method Method to Measure Paper Sheet Grammage and Thin Layer Thickness

Equipment	
Description	Model
Educational Kit - Premium version (*)	CAEN SP5600AN
Emulation Kit	CAEN SP5600EMU
Workstation	DELL Precision Tower

(*) A γ and aβ radioactive source required, if not available choose Emulation Kit.

3.2   Nuclear Imaging PET

A ^{22}Na radioactive source required. Recommended: 1/2 inch disc, 10 μCi

- – γ Spectroscopy and Linearity
- – Positron annihilation detection
- – 2D Reconstruction of a Radioactive source
- – Spatial Resolution

Equipment	
Description	Model
EasyPET	CAEN SP5700
Desktop Multichannel Digitizer	CAEN DT5770
^{22}Na radioactive source	
Workstation	DELL Precision Tower

3.3   Particle Physics

- Cosmic Rays

  - – Muons Detection
  - – Muons vertical Flux on Horizontal Detector

- Photons

  - – Quantum nature of light
  - – Photo Counting Statistics

- Particle Detector Characterization

  - – SiPM Characterisation.
  - – Dependence of the SiPM Properties on the Bias Voltage.
  - – Temperature Effects on SiPM Properties [1]
  - – Study of after pulses in SiPMs

Equipment	
Description	Model
Educational Kit - Premium version	CAEN SP5600AN
Workstation	DELL Precision Tower

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[1] A temperature chamber is needed

3.4 Water Cherenkov Detector

- Fundamental experiences

  - Simulation of CR flux
  - Muon lifetime measurement
  - CR flux analysis

- Advanced activities

  - Characterization of PMTs (ToT, after pulses, pre pulses, Dark counts)
  - PMT response to different light sources
  - Calibration of a WCD
  - Vertical muon studies
  - Space Weather and Solar Physics

Equipment	
Description	Model
WCD detector with PMT	
Digital Detector Emulator	CAEN DT5800D
4 Channel 200MHz Oscilloscope	Keysight DSOX3054T
HV Power Supply	CAEN DT1417ET
Workstation	DELL Precision Tower

3.5 Gas detectors

- Fundamental experiments

  - Characterization of a RPC detector
  - Dependence of mode operation with HV.

- Advanced activities

  - Dependence of signals due to gases & mixtures
  - Development of RPC detectors for CR detection

Equipment	
Description	Model
RPC detector	
HV Power supply	CAEN DT1570ET
16 channel digitizer	CAEN DT5742
4 Channel 200MHz Oscilloscope	Keysight DSOX3054T
Workstation	DELL Precision Tower

3.6 Data Acquisition for Particle Detectors

- Fundamental experiments

  - DAQ fundamentals
  - Data Acquisition
  - Data Analysis

- Advanced activities

  - Development and testing of DAQ Systems
  - Advanced Data Analysis
  - Simulations of DAQ response

Equipment	
Description	Model
Digital Detector Emulator	CAEN DT5800D
8 channel digitizer	CAEN DT5725B
4 Channel 200MHz Oscilloscope	Keysight DSOX3054T
6 1/2 Digits Voltmeter	Keysight 34461A
3 output Power Supply	Keysight E36312A
Workstation	DELL Precision Tower

4 Laboratory list and setup

4.1 Electronic prototyping Lab

1. Equipment

   - Digital 4 Channel 200MHz 5GS/s Oscilloscope
   - 6 1/2 Digit Multimeter
   - 2 Channel DC power supply
   - Digital Detector Emulator
   - 8-Channel Digitizer
   - EasyPET Kit
   - Worksation with Orcad Spice, Matlab, LabView

2. Materials

   - DAQ Board RedPitaya STEMlab 125-14
   - Components Kit
   - DAQ boards
   - BNC, SMA, LEMO cables and connectors

4.2   Water Cherenkov Lab

1. Equipment

   - Digital 4 Channel 1GHz 5GS/s Oscilloscope
   - 4 Channel HV power supply
   - Digital Detector Emulator
   - DAQ boards and controllers
   - Worksation with Orcad Spice, Matlab, LabView

2. Material

   - Photomultiplier tubes
   - PMT bases and HV modules
   - BNC, SMA, LEMO signal cables
   - BNC, SMA HV cables

4.3   Gas Detector Lab

1. Equipment

   - Digital 4 Channel 200MHz 5GS/s Oscilloscope
   - 4 channel 8kV DC power supply
   - 16-Channel Digitizer
   - Mixing gas station
   - Worksation with Orcad Spice, Matlab, LabView

2. Materials

   - RPCs gaps
   - LEMO connectors cables
   - BNC, SMA HV cables
   - Mass flow meters

4.4   Scintillators Detection Lab

1. Equipment

   - Digital 4 Channel 200MHz 5GS/s Oscilloscope
   - Educational Kit Premium Version
   - Radiation Emulation
   - DC Power supply
   - Dual Timer with trigger generator
   - Worksation with Matlab, LabView

2. Materials

   - SiPMs (matrix and stand alone)
   - LEMO connectors cables
   - BNC, SMA HV cables

4.5   Radiation Detection Lab RaDLab

1. Equipment

   - Educational Kit Premium Version
   - Radiation Emulation
   - Worksation with Matlab, LabView

2. Materials

   - γ β radiation sources (optional)

5   Further information

- Educational Kit -Premium version

- Emulation Kit

- EasyPET Kit

- Desktop Digital Emulator

- 16 Channel 5GS/s Digitizer

- 8 Channel 250MS/s Digitizer

- +85V/10mA Power supply

- 4 Channel 5.5kV/330μA Power supply

- 2 Channel 15kV/1mA Power Supply