The Cosmic Rays in Peru

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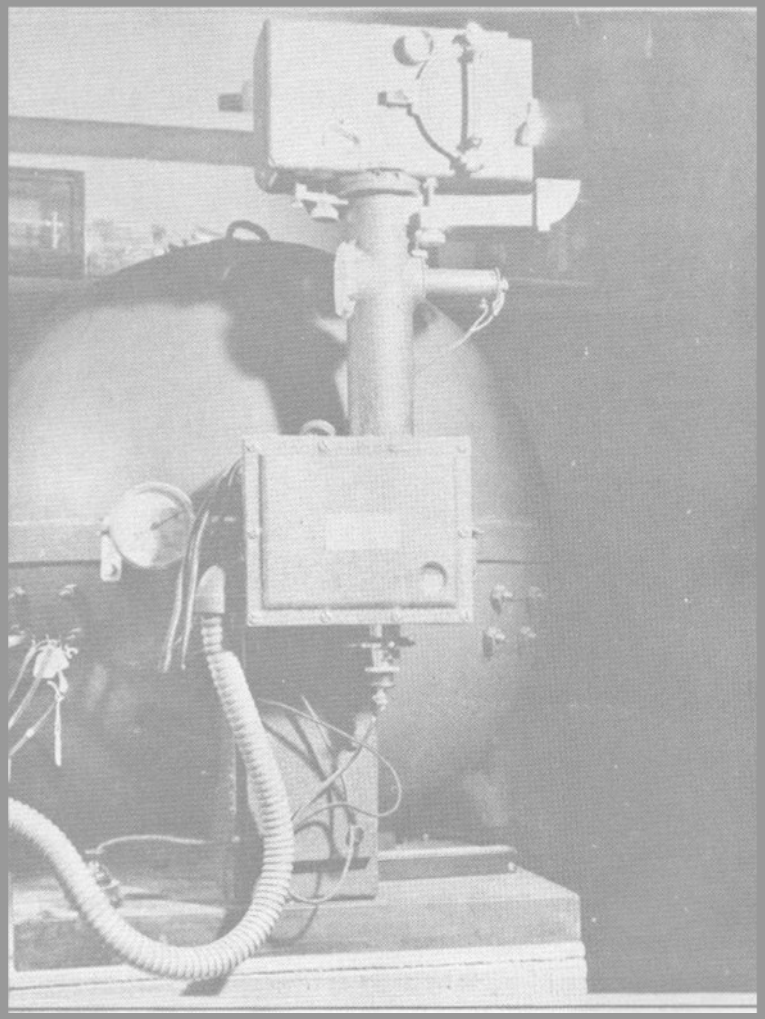
The Junin Region

Aerial view of Huancayo Observatory looking from northwest

Cosmic-ray meter (C2) at Huancayo Observatory



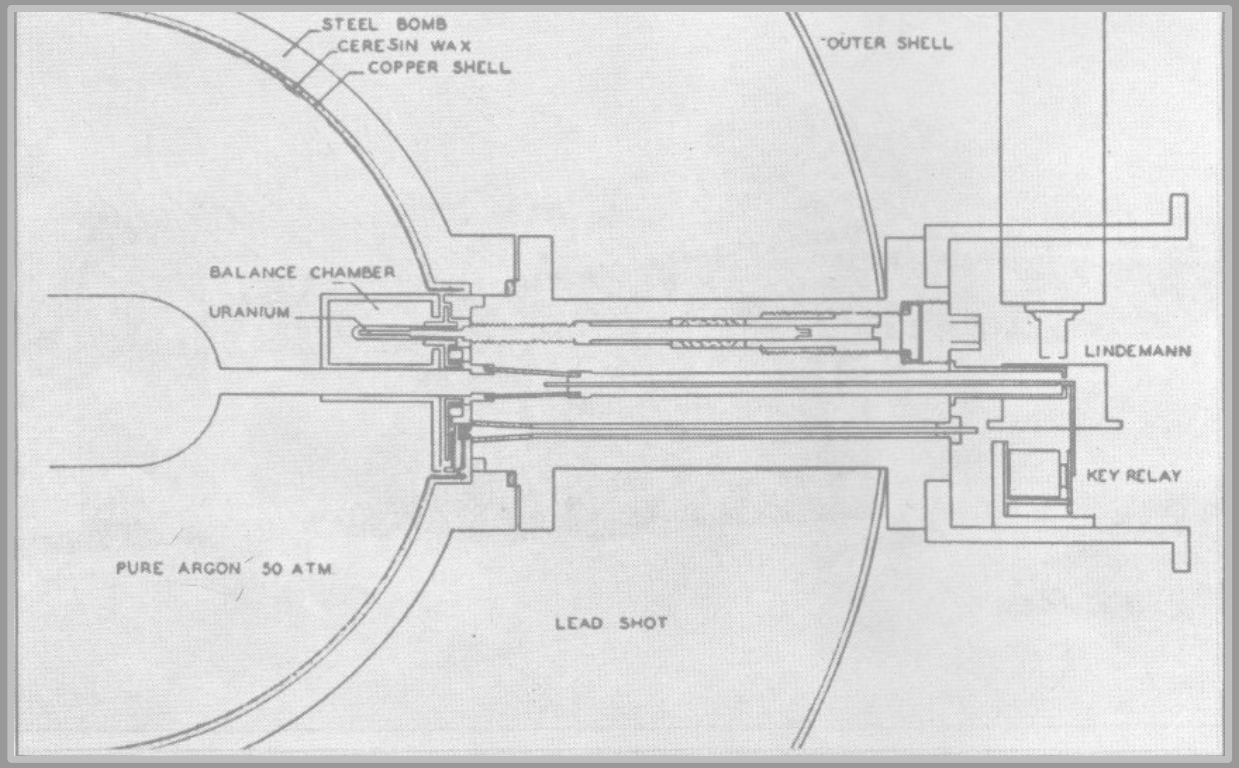
By middle of 1935 five precision recording cosmic-ray meters C model, based on a design developed by Professor R.D. Bennett at MIT and Professor A. H. Compton at Chicago University, were constructed and deployed over the world in order to have simultaneous and continuous records of Cosmic-rays flux.

- The instrument consist of a spherical steel ionization chamber , the volume is about 19.3 liters, filled with a pure argon at 50 atmospheres.

Because at this pressure the ionization is 67 times more than in the normal pressure.

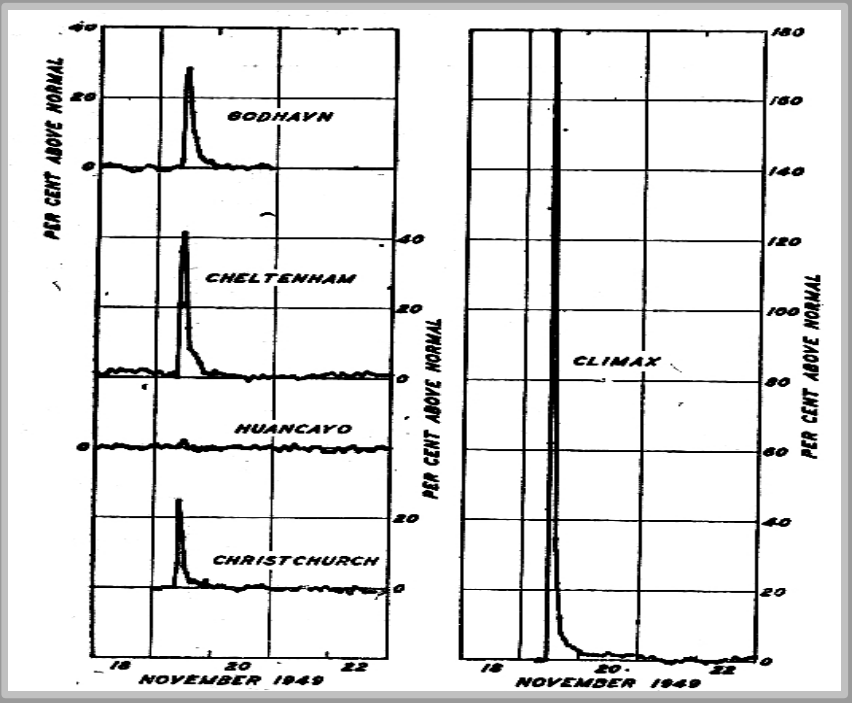
A balancing current is supplied by ionization produced in a small auxiliary chamber, inside sphere by β rays from metallic uranium

Cross-section view of apparatus, showing details of the central electrode, β chamber and micrometer for adjusting the position of uranium



By turning the micrometer rod to which the uranium is attached permits varying the rate of entry of β-rays into the balance chamber as a consequence of changes of amount of shielding.

The balance current can thus be made about equal, and in opposite in sign through choice of sweep field, to the average ionization current produced in the main chamber by cosmic rays.



Increment of cosmic Rays, Nov/19/1949

This unusual increment of Cosmic ray have been produced one hour later the observed solar flare

Annual means:

Sunspot numbers and variability cosmic-ray Intensity at Huancayo Observatory.

Cosmic-ray intensity at Huancayo in the period 1937-1955 is least in the years on minimum solar activity, and increases near sunspot maximal

FIG. 5.—Annual means: sunspot numbers and variability, cosmic-ray intensity at Huancayo.

• CONTRIBUTIONS OF HUANCAYO OBSERVATORY

- The quasi-persistent 27-day variation of intensity;
- The diurnal variation of intensity;
- The absence of a detectable sidereal diurnal variation of intensity;
- The sporadic emission of very energetic (up to several GeV) charged particles by solar flares;
- Worldwide impulsive decreases (Forbush decreases) of intensity followed by gradual recovery;
- The 11-year cyclic variation of intensity and its anticorrelation with the solar activity cycle as measured by sunspot numbers; and
- The 22-year cycle in the amplitude of the diurnal variation.

Huancayo Neutron Monitor

Latitude: -12.03S.

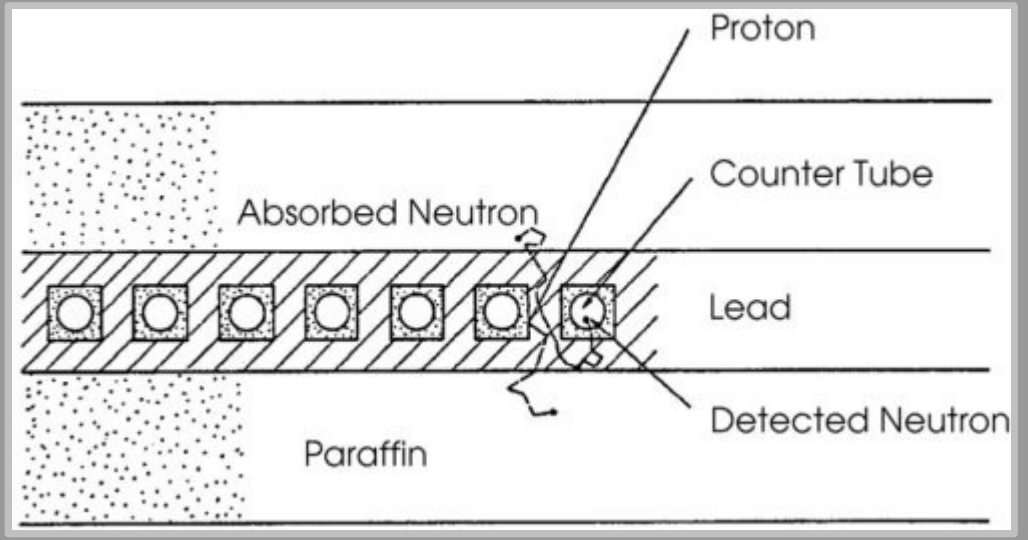
Longitude: -75.33W.

Altitude: 3400 m.

Rigidity (1965): 12.92 GeV

12 (2x6) IGY tubes.

Run 1951-1992 (replaced for Haleakala).



And that's all … for 16 years!

Until 3rd School of cosmic rays

National Service of Meteorology and Hydrology Base in Marcapomacocha

The LAGO-Project in Perú

The **LAGO** (Large Aperture GRB Observatory) goal is to observe high energy component of Gamma Ray Bursts (GRB's) by using Water Cherenkov Detectors (WCD) in high mountain sites.

Why Cherenkov Thanks?:

They detect 99% of particles of atmospheric showers of HECR

Why high mountain sites?

To improve the aceptance due to the strong absortion of the atmosphere.

The LAGO sites

Sierra Negra (Mexico)
- 4550 m.s.n.m
- 3x4m² Tanques

Bariloche (Argentina)
- 1400 m.s.n.m.
- Prototipo "Nahuelito"

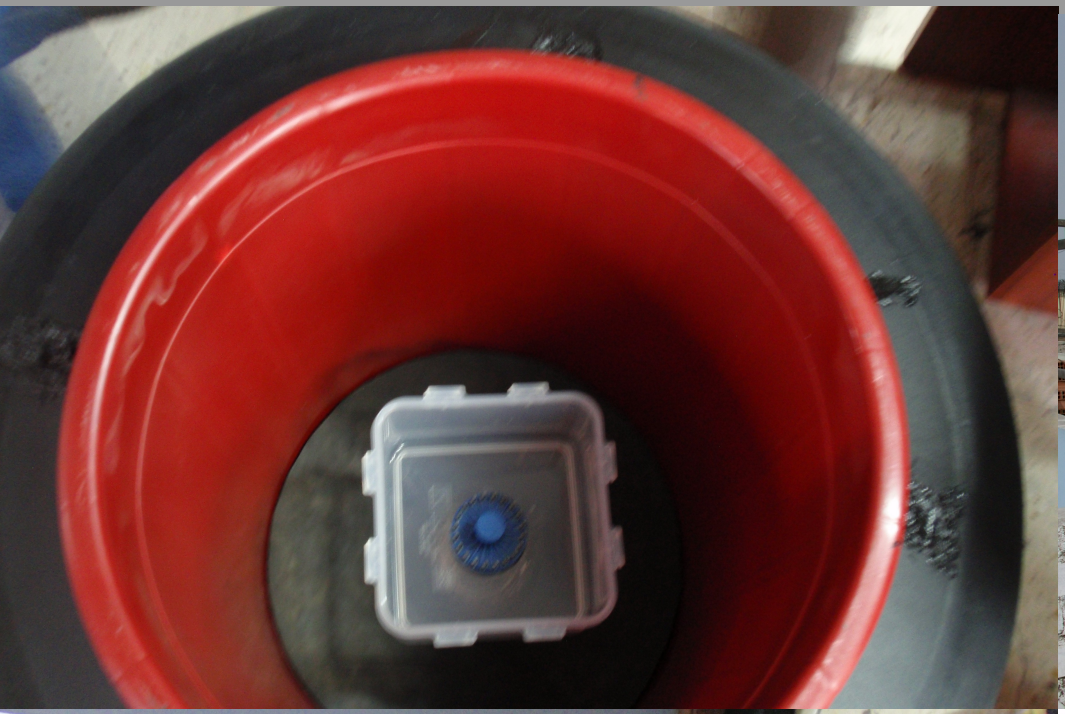
Pico Espejo (Venezuela)
- 4765 m.s.n.m.
- ???

Chacaltaya (Bolivia)
- 5200 m.s.n.m.
- 2x4m² + 1x2m2 tanques

Prototype Construction

Some requirements of the tank

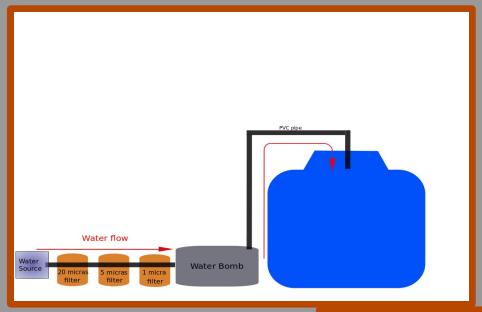
- To isolate the tank from external light sources:aluminized asphalt membrane + polyetilene plastic.
- To cober the inner surface with a difusive-reflective material: Banner attached to a PVC frame.
- To protect the electronics from humidity.



Water Treatment

Four steps

- ✓ Prefiltration: Up to 1 micra.
- ✓Decantation , 1 week, after adding aluminium sulfate and one day of recircultation.
- ✓Filtrate: Up to 1 micra + Activated Carbon
- ✓Recirculation with all the filters



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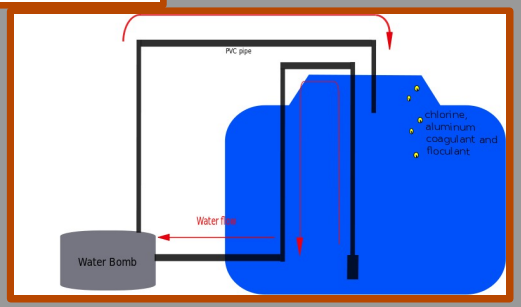

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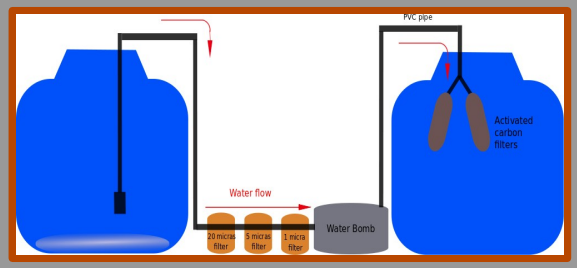

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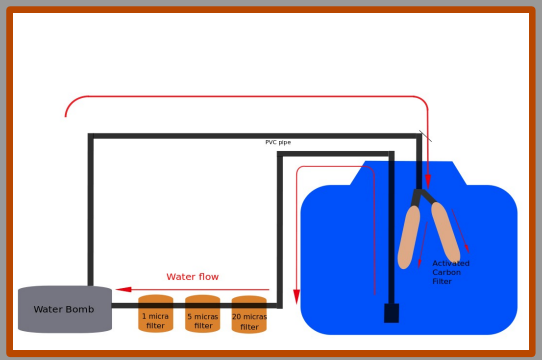

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Acquisition

The LAGO project is reusing acquisition electronics and photomultipliers tubes (PMT) from the engineering array of the Pierre Auger Observatory.

Board:
Six analog channels sampled at 40 Mhz allowing to control six Water Cherenkov tanks.

Software rewrited
- 4 scalers (amplitude of the signal)
- 5 ms sampling

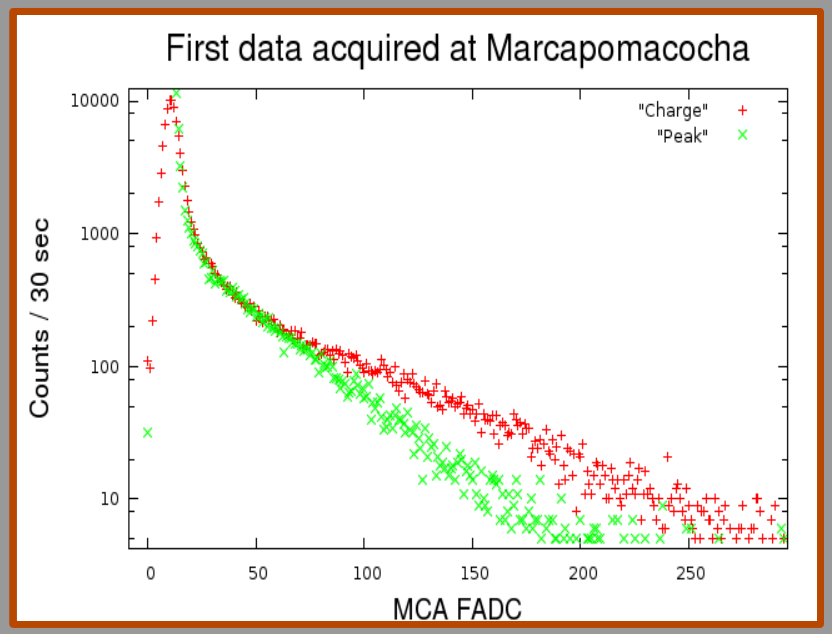
A low power consume ARM computer for communication and data storage.

Deployment at High altitude

- 4,50 hours from Lima (highest global atmospheric watch).
- Reachable by car.
- Marcapomacocha lake near for water supply.
- Permanent staff.

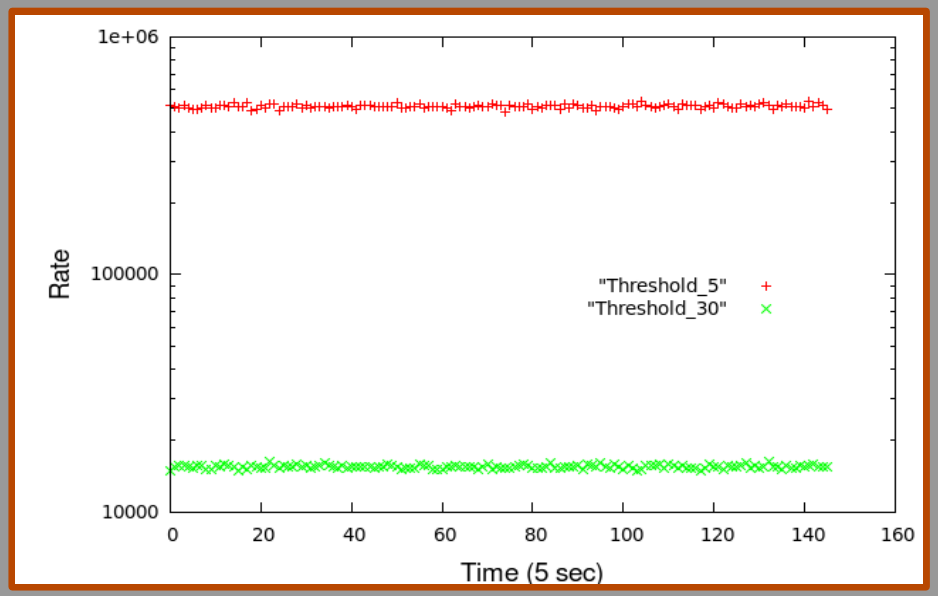
Deployment at High altitude

First Data Acquired



← Histograms

Sample of Data →



Conclusions

- Peru has a rich history on cosmic rays experimentation.
- Also some infraestructure especially at high altitude.
- We are restaring a very rich researc area.

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Thanks

- Organization
- IGP
- LAGO colaboration