Advantages of Andes mountains to high energy cosmic studies

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OBSERVATORIO ASTRONÓMICO QUITO
ESCUELA POLITÉCNICA NACIONAL

Ecuador and the Andes

México
Guatemala
Honduras
Costa Rica
Nicaragua
Venezuela
Colombia
Ecuador
Perú
Bolivia
Chile
Argentina

Huascarán 6768 m
Chimborazo 6310 m
Aconcagua 6960 m

Cotopaxi (5897 m) and the milky way

Astronomy in Ecuador

1890

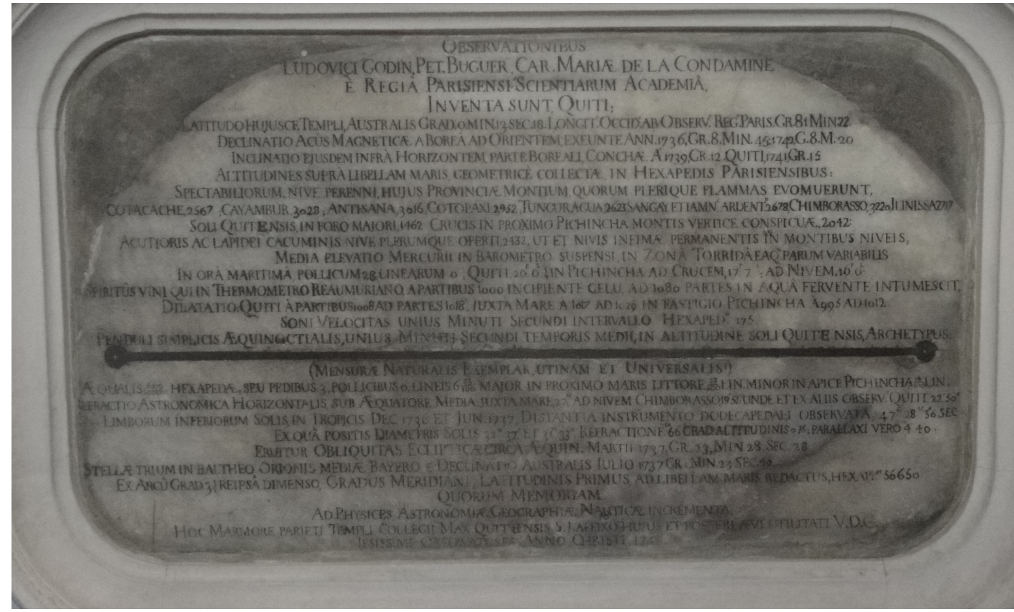
2012

Observatorio Astronómico de Quito

Latitude: 0°12'53.72"S

Longitude: 78°30'9.16"O

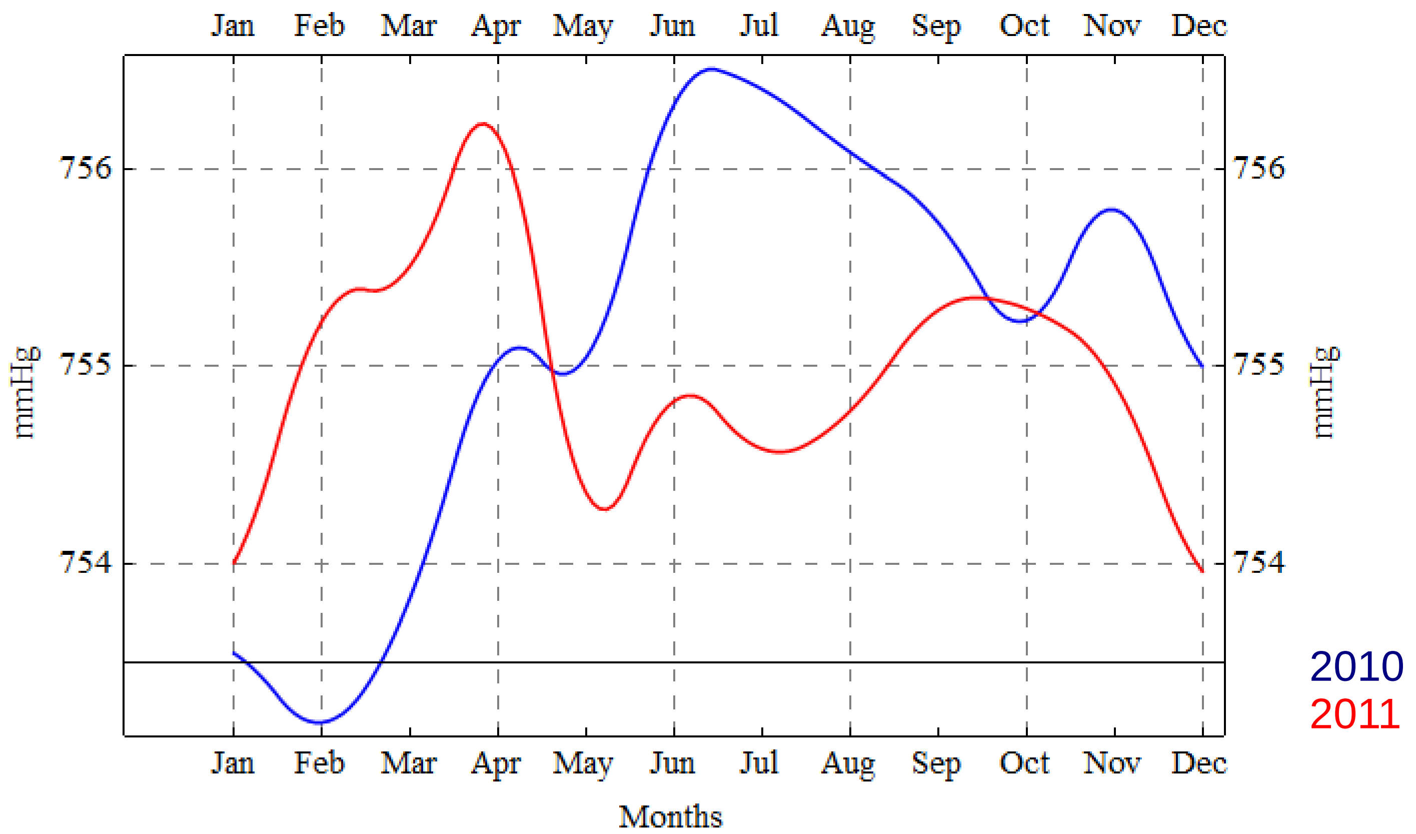
Altitude: 2815.25 m



1741 (Nowadays the marble slab is inside the OAQ)

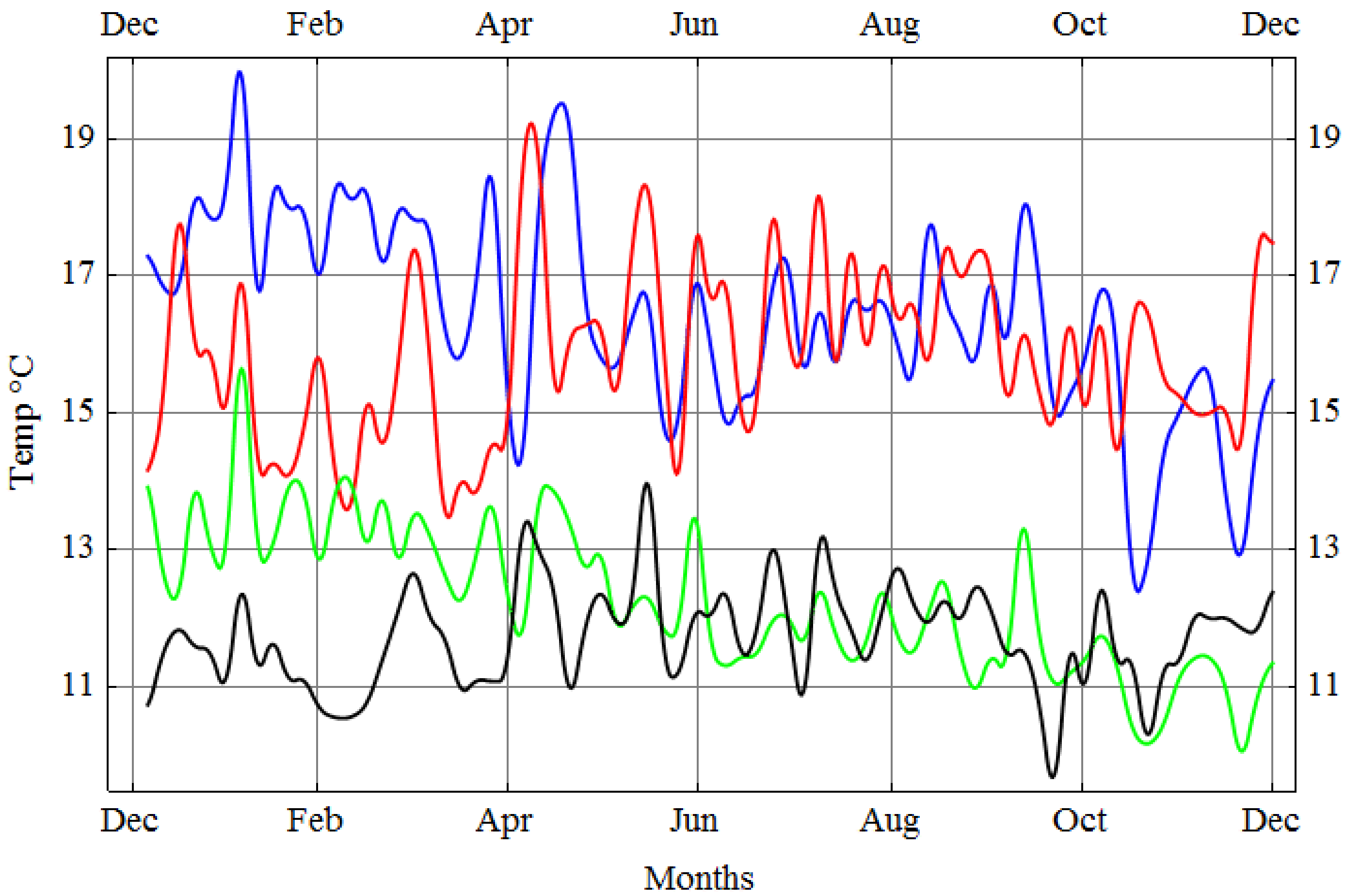
Among the scientists of the first french Geodesic Mission; Charles M. de La Condamine, Pierre Bouger and Louis Godin measured a pendule which period is 1 s on the equatorial line. This mission gave born to the astronomy in the country

Atmospheric pressure in Quito



Quito's weather shows high precipitations during the period characterized by low atmospheric pressures, from October to February
And during the dry season, the night sky is clear, as well as the day. During this season night and solar observations are favorable.

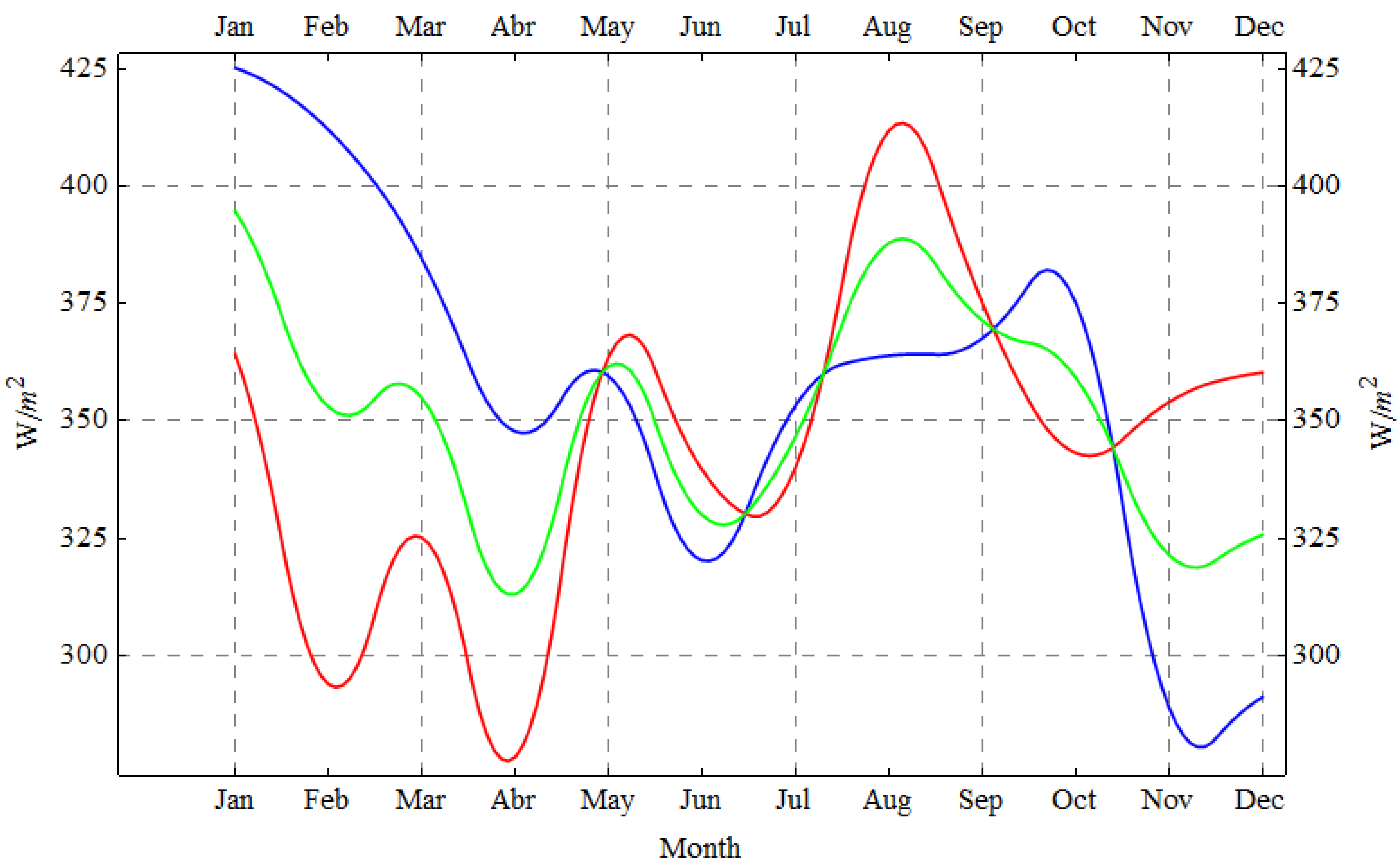
Temperature in Quito



2010 day	16,45
2011 day	15,88
2010 night	12,28
2011 night	11,73

Temperatures varies considerably from dry to rainy season.
The absence of low temperatures are associated with the constant presence of water vapor clouds .

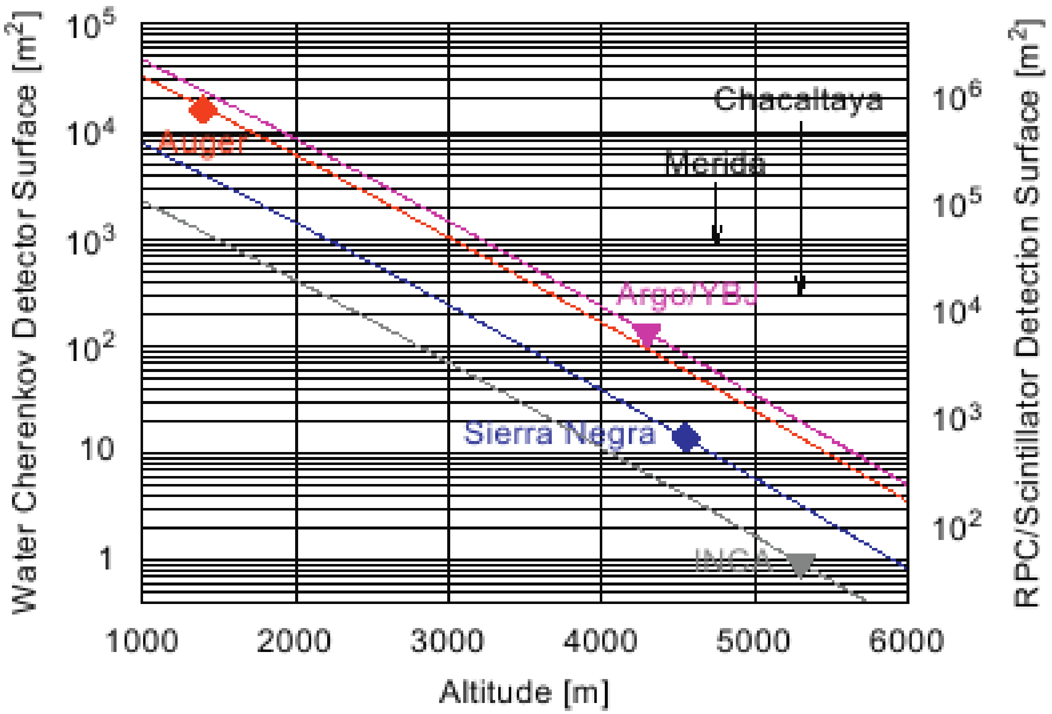
Solar Radiation



2010 357 W/m²
2011 346 W/m²
average

Most of the year the day time is characterized by high solar irradiation.
This fact makes Quito an ideal location to perform solar observations.

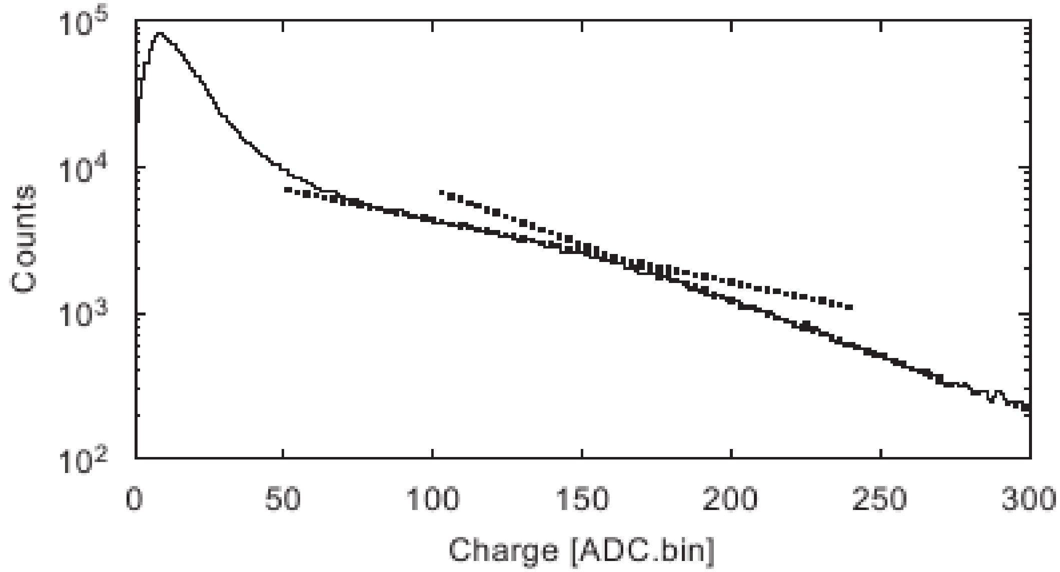
Detector size and efficiency at high altitudes



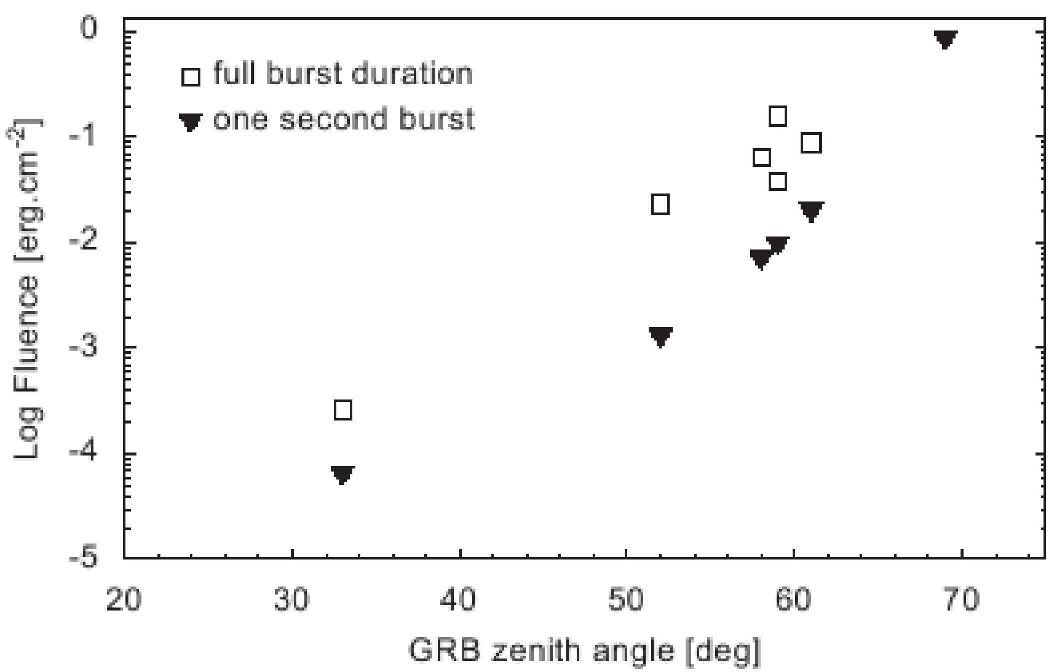
D. Allard et. al. Nuclear Instruments and Methods in Physics Research A 595 (2008) 70–72

Lines of equal sensitivity for experiments of different size and altitude, neglecting geolatitude cutoff and assuming similar scaler threshold.
A few tens ofm2 of Water Cherenkov Detector (WCD)) at high altitude are as efficient as currently running experiments for the Single Particle Technique (SPT).

Sierra La Negra WCD (4550 m)



Charge histogram for one minute of data of a 4 m2 detector at Sierra Negra.
While there is no characteristic muon peak at this altitude, a change in the slope can be determined and used for calibration.



5-sigma fluence limits in the 1 GeV–1 TeV energy range for the bursts in the field of view of Sierra Negra, for a single second burst or for a burst of same duration as detected by the satellite, assuming a spectral index of -2.

LAGO project

LARGE APERTURE GRB OBSERVATORY

- Argentina
- Bolivia
- Colombia
- Ecuador
- Guatemala
- México
- Perú
- Lima
- Venezuela

APC, CNRS et Université Paris 7. France

Centro Atómico Bariloche, Instituto Balseiro. Argentina

Universidad Autonoma de Chiapas, UNACH. México

Universidad de San Carlos de Guatemala. Guatemala

Universidad de Los Andes, ULA, Mérida. Venezuela

ESPOCH. Ecuador

Laboratorio de Física Nuclear, Universidad Simón Bolívar, Caracas. Venezuela

Instituto Nacional de Astrofísica, Óptica y Electrónica. México

Universidad San Francisco de Quito, Quito. Ecuador

UNACH. Ecuador

Facultad de Ciencias Físico-Matemáticas de la BUAP. México

Michigan Technological University. USA

Instituto de Astronomía y Física del Espacio. Argentina

School of Physics, University of Sidney. Australia

Universidad Central de Venezuela, Facultad de Ciencias, Departamento de Física. Venezuela

Universidad de Granada. Spain

Comisión Nacional de Investigación y Desarrollo Aeroespacial, CONIDA, Lima. Perú

Universidad Nacional de Ingenieria, UNI, Lima. Perú

Instituto de Investigaciones Físicas, UMSA. Bolivia

Universidad Industrial de Santander, Bucaramanga. Colombia

Universidad Politécnica de Pachuca. México

Dipartimento di Fisica Generale and INFN, Torino. Italy

Escuela Politécnica Nacional- Observatorio Astronómico, Quito. Ecuador

Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolas de Hidalgo. México

Universidad Nacional San Antonio Abad del Cusco. Perú

Sites

The LAGO projects has detectors in many different sites:

Mount Chacaltaya (Bolivia) →

5300 m

Sierra Negra (Mexico 4600 m)

Pico Espejo (Venezuela 4765 m)

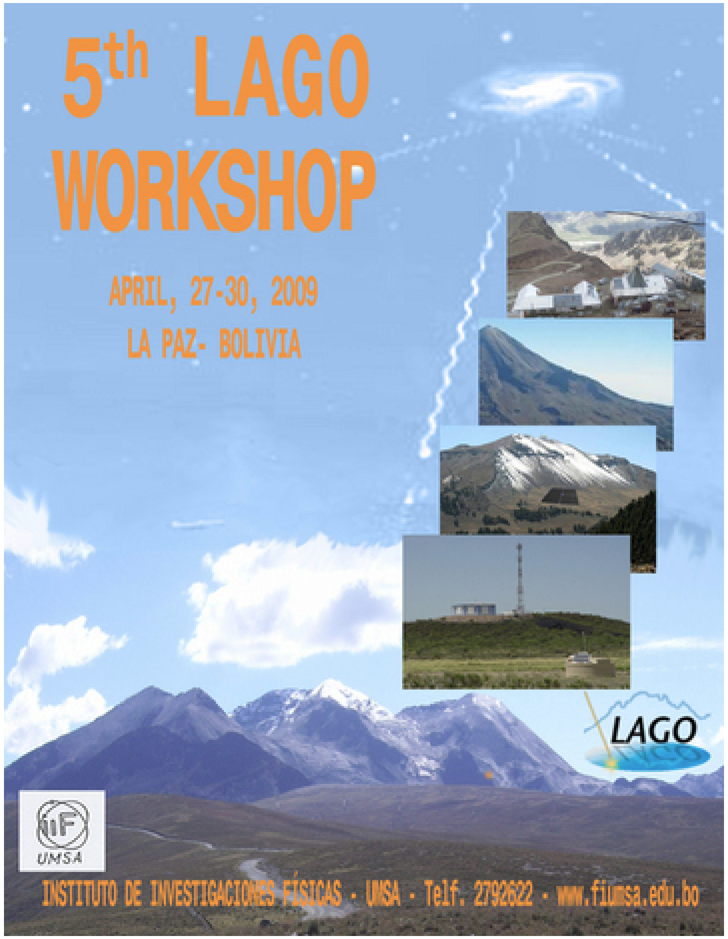
Marcapomacocha (Peru 4450 m)

And low altitude detectors in Argentina, Colombia, Guatemala and Ecuador

RIOBAMBA 2600 m prototype tank

Chimborazo and Riobamba city

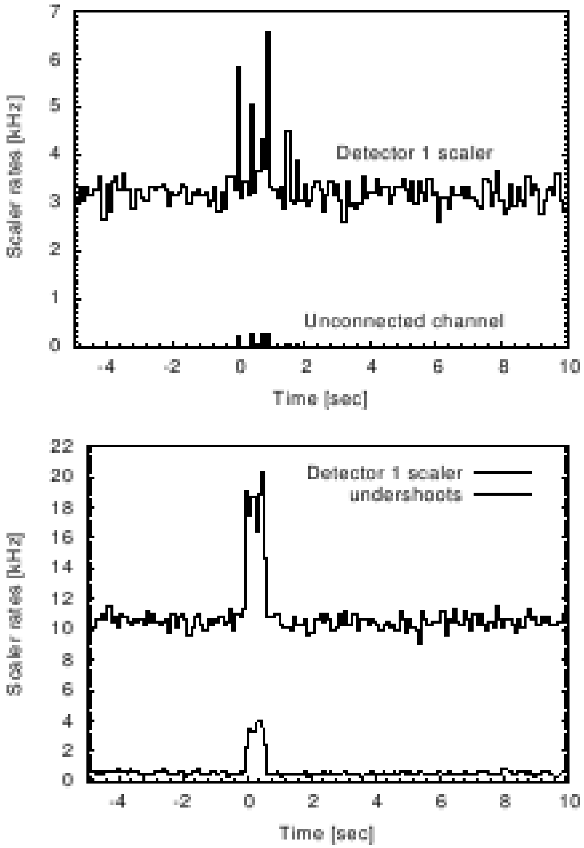
LAGO activities



8th Workshop LAGO 4, 5, 6 de july de 2012

Riobamba ECUADOR

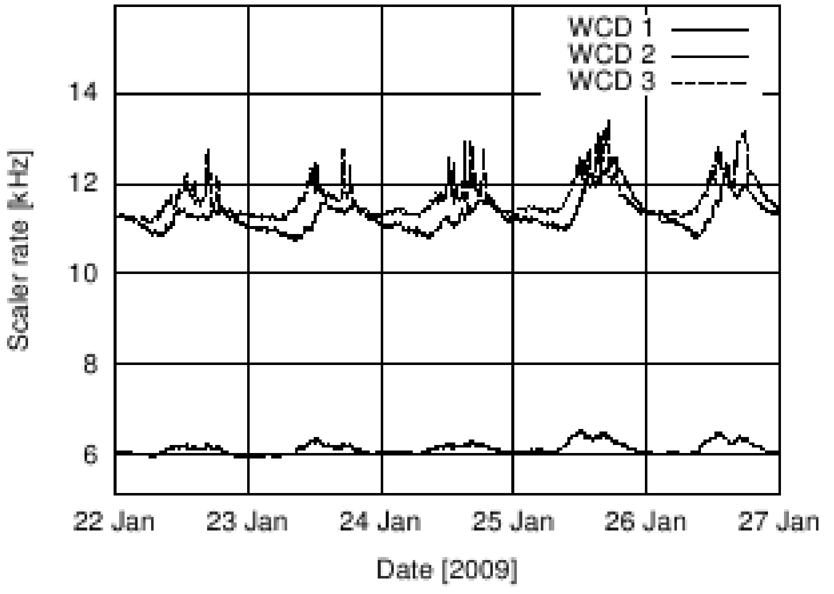
LAGO results



Example of noisy counting rates for Chacaltaya and Sierra Negra.
In both cases, signals in the other counter indicate the burst is due to noise.

Bertou X et. al. PROCEEDINGS OF THE 31st ICRC,2009

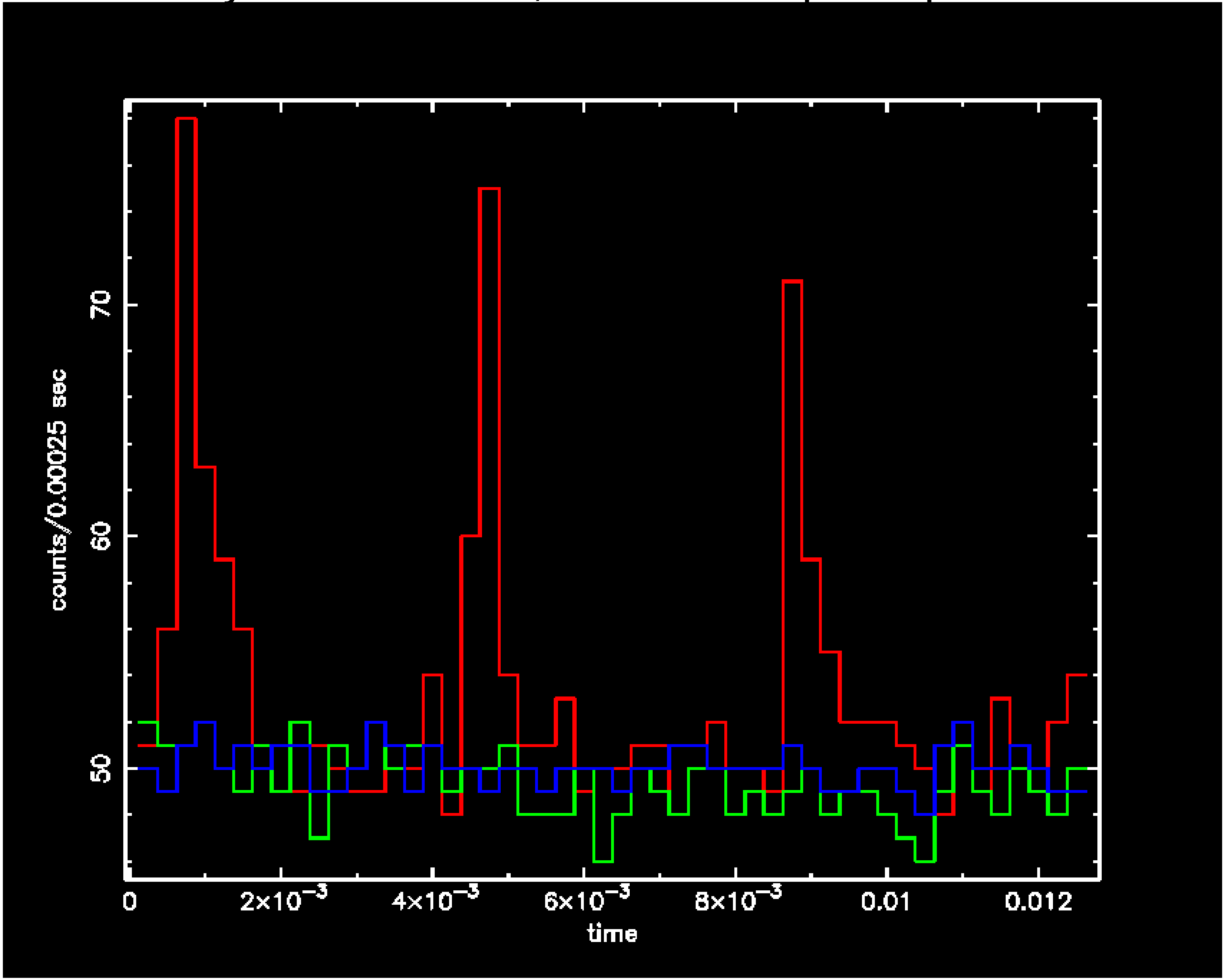
Signal and some problems...



Five minutes average rate for the detectors at Chacaltaya corresponding to lower threshold. All three detectors are at about 3 kHz/m^2 since WCD 1 is only 2 m^2 while WCD 2 and 3 are 4 m^2. WCD 3 exhibits some peaks in daytime indicating light leaks.

Bertou X et. al. PROCEEDINGS OF THE 31st ICRC,2009

Preliminary Ecuador data, a small sample september 2012



Conclusions

- Quito's sky is not favorable for optical observations, the weather variations make difficult to obtain good exposures. On the other hand the solar observations could provide good results in the future due to the clear sky during the day.

- The 0^0 latitude and high altitude of the Andes, offer a unique opportunity to develop detection of high energy radiation using Cherenkov telescopes.

-Currently the OAQ is involved in the Large Aperture Gamma-ray Observatory (LAGO) , project of Gev- TeV detection in collaboration with other latinamerican countries.