Looking for the high energy component of GRBs at the Large Aperture Grb Observatory

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Detecting Gamma Ray Bursts with the Single Particle Technique

During a GRB a high flux of HE photons reaches the Earth. They produce a cascade in the atmosphere and some secondaries reach the ground.

For a 5 GeV primary photon – maximum energy of a GRB photon seen by EGRET is 16 GeV – on average one secondary photon reaches ground at 5300 m a.s.l., altitude of the Chacaltaya Cosmic Ray Observatory, in Bolivia.

$\Longrightarrow$ A high flux of photons above 1 GeV produced by a GRB could be seen as an increase of background particles at ground level, for a detector at high altitude. This detection method is called Single Particle Technique.

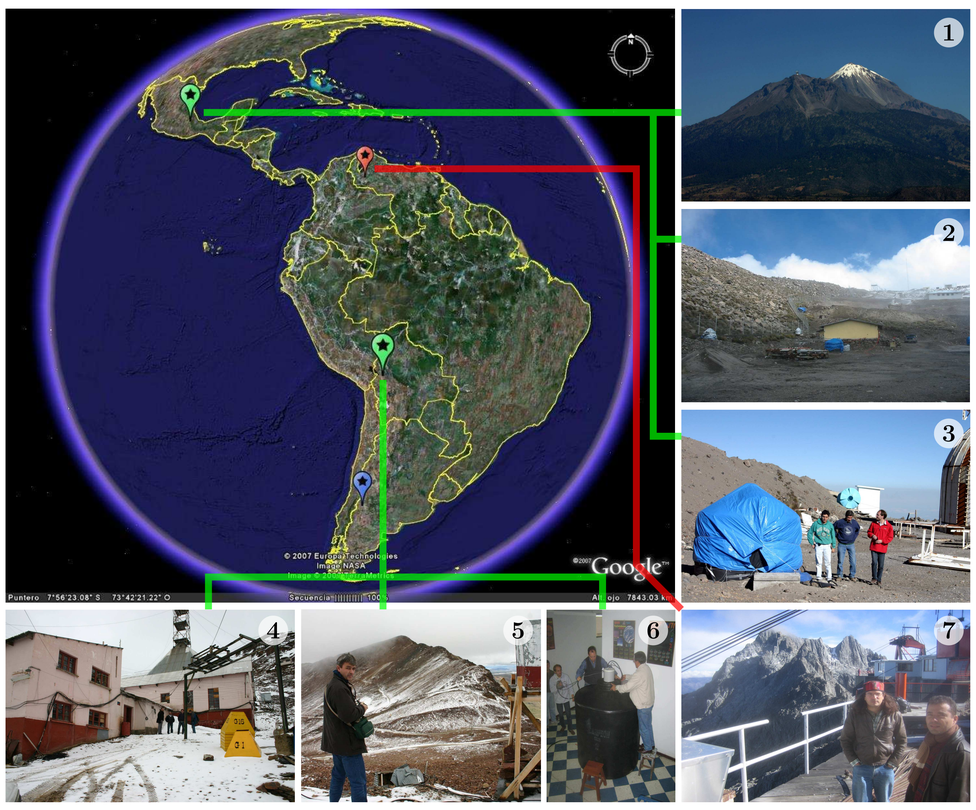
LAGO design

$\Rightarrow$ Use Water Cherenkov Detectors in order to detect all secondaries (photons represent 80-90% of secondaries)

$\Rightarrow$ Instrument large enough surface at high altitude, in various sites within a few thousands of km one from another to be able to detect a GRB in coincidence

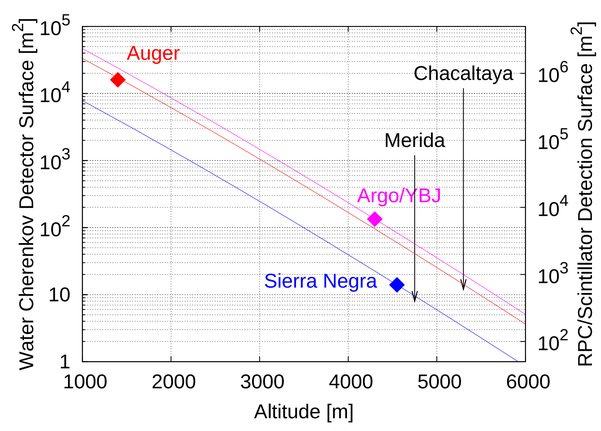
$\Rightarrow$ Count particles in the detectors with good time resolution (5 ms) to derive time structure of the bursts

LAGO Sites



Pictures: [1,2,3]: Sierra Negra, México, 4550 m a.s.l.. [4,5]: Chacaltaya, Bolivia, 5300 m a.s.l.. [6]: La Paz protoype detector. [7]: Mérida, Venezuela, 4750 m a.s.l. (site under preparation).
The Pierre Auger Observatory (blue marker, Argentina, 1450 m a.s.l.) is also operating in scaler mode.
Two extra sites in northeastern Argentina and southern Peru and under investigation.

Influence of Altitude on sensitivity

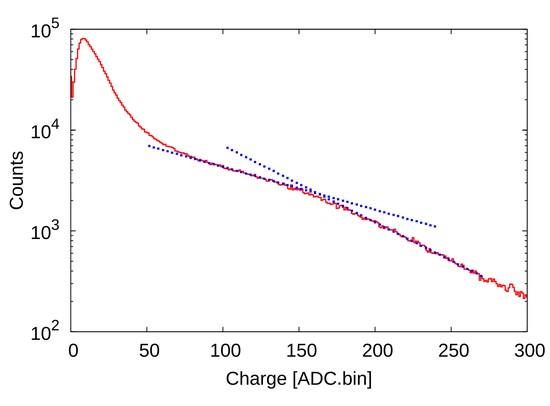


Lines of equal sensitivity for experiments of different size and altitude, neglecting geolatitude cutoff and assuming similar scaler threshold. A few tens of m^2 of WCD at high altitude are as efficient as currently running experiments for the SPT.

Setups and Status

Bariloche, Argentina: A 1 m^2 prototype detector has been set up early 2006 and is used for calibration studies and software development.
La Paz, Bolivia: Another 1 m^2 prototype is being operated at Universidad Mayor de San Andres. Deployment of three 4 m^2 detectors at Chacaltaya is foreseen for late 2007.
Sierra Negra, Mexico: 14 m^2 of WCD are in operation since late 2006. They have been in stable data acquisition since January 2007.
Mérida, Venezuela: A 3.5 m^2 prototype detector has been set up at Universidad de Los Andes in September 2007. Deployment of two 4 m^2 WCD at Pico Espejo station is foreseen for early 2008.

Operation and Preliminary Results for Sierra Negra site



Three 4 m^2 and two 1 m^2 WCD are in operation at Sierra Negra. They are connected to a prototype acquisition board of the Pierre Auger Observatory running LAGO specific software. Calibration is done with the muon "shoulder" as shown on the plot above.

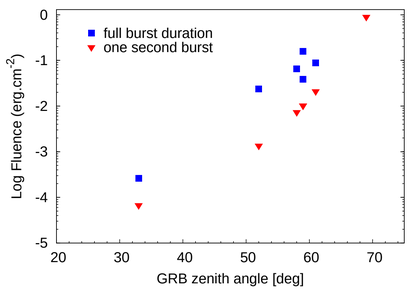
$\Longrightarrow$ 3 full months of data available since January 2007

Data analysed using most stable 4 m^2 WCD
Look at data with 5 ms timing
- Search for 3 consecutive bins at 6 σ

$\Longrightarrow$ one event but not present in others WCD
- Search for 8 (resp. 9, 11) spikes of 5 σ in a period of 500 ms (resp. 1 s, 2 s)

$\Longrightarrow$ no event
- Search for burst in coincidence with satellites

$\Rightarrow$ 9 GRB in field of view to check
$\Rightarrow$ Look for a 1 s burst within 100 s of each GRB
$\Rightarrow$ burst with same duration as seen by the satellite.
$\Longrightarrow$ no event, derive a fluence limit



5-σ fluence limits in the 1 GeV - 1 TeV energy range, assuming a spectral index (at Earth) of $\alpha = -2$.