

The Pierre Auger Observatory and GRB Notification Services

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I propose that the Auger Observatory subscribe to the available gamma ray burst (GRB) notification system to allow for near-real-time detection of GRBs. Especially interesting to the GRB community would be any sort of rapid time-scale tentative identification of a GRB from the Auger data. The flow of information might be as follows: the notification service sends a message out over the network, within a few seconds it is received by Auger CDAS, a process could be spawned to look for single particle rate excesses for the previous few tens of seconds and continue looking for the next few minutes, an entry would be made in the Auger database, and any tentative signal would be forwarded to the scientists involved. If the tentative signal generated an automated message back onto the GRB notification system (with a low rate of false positives) it could be useful for those looking at GRB afterglow (any GRB with $> \text{GeV}$ photons would be an interesting observational target). If we aren't comfortable with an automated response leaving the collaboration, then it would be important for a procedure to be in place for human verification of the signal and a decision on whether or not to notify the GRB community.

GCN Notification System

The notification system, the GRB Coordinates Network (GCN), is run out of the high-energy astrophysics lab at NASA-Goddard. It incorporates three parts: the original GRB notification system (BACODINE, the BATSE COordinates DIstribution NETwork) along with a notification service from other spacecraft detections, and an email distribution of follow-up reports from ground-based optical, radio, TeV, and particle detectors. The initial message distribution (the first two parts of the network) propagates detection information around the world within a few seconds using direct socket connection over the Internet or tens of seconds using email. (Dialed or permanent phone connections, and pager messaging are also supported, but are significantly less useful for us.)

Information format and availability

The primary pieces of information being transmitted are GRB position information along with the "burst now underway" status flag. The position typically has a worst-case burst location error circle of about 20 degrees (irrelevant for us except in regards to the horizon determination). Only events within the Auger field of view would be transmitted to us if we so chose.

Auger Burst Detection

As several groups within Auger have described, GRB detection in an extensive air shower detector occurs when the integrated singles rate over the entire array increases on a timescale of seconds. For example, if we store the detector singles rates every second, we could then construct a running average singles rate and measure each second's singles rate in N sigma from the average. This is the analysis used by EAS-TOP to successfully detect a single GRB event in an array of surface particle detectors. With the running average maintained at CDAS and the GCN notification flags, preliminary determinations of GRB sightings with Auger could be automated (as described above) or reserved for human analysis. Depending on the trigger settings for reading singles hits, the array may have a rather significant GRB rate (perhaps as high as several per week).

Summary

GRB observations at a few GeV with the Auger surface array are minor, but interesting, scientific investigations which require relatively few assets on the observatory end. Rapid confirmation of the GRB event at different energy ranges is useful to the broader GRB community but would have to be reconciled with our data analysis policy.

GCN web page:

http://lheawww.gsfc.nasa.gov/docs/gamcosray/legr/bacodine/gcn_main.html

Detection technique:

S. Vernetto, "Detection of gamma-ray bursts in the 1 GeV—1 TeV energy range by ground based experiments," *Astro-ph/9904324v2*

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M. A. DuVernois and J. J. Beatty, "Gamma-ray burst detection with the Auger surface array," *GAP Note 1997-068* (has additional references of interest)

New possible detection:

T. F. Lin et al., "Possible detection of gamma ray air shower in coincidence with BATSE gamma ray bursts," *26th ICRC (SLC), OG 2.3.12*