Fermi
Gamma-ray Space Telescope

The first 100 LAT Gamma-ray Bursts: a new detection algorithm and pass 8

G.Vianello on behalf of the Fermi/LAT collaboration
The mystery of the missing GRBs:
Optimistic predictions?
New GRB physics?

Expected: 12 GRB/y
Observed: 9.5 GRB/year

(1st GRB catalog, Ackerman et al., 2013)
Pass 8 is a major review of the event analysis

Tracker module ("tower")

Fermi/LAT

Calorimeter module

ACD
Pass 8: much improved science performance

See P. Bruel talk in the Analysis splinter
GRBs & Pass 8: lower flux threshold

(simulated 100 s GRBs on true background, Transient classes)
GRBs & Pass 8: more detections

Which fraction of GRBs with a given flux are we able to detect at a given off-axis angle?

(simulated GRBs on true background, Transient classes)
What is the solid angle within which we have a 50% detection efficiency for a GRB with a given flux?

(simulated GRBs on true background, Transient classes)
Another recent development: new GRB detection algorithm

\[ \text{Cumulative number of announced GRBs} \]

- \( \sim 9.5 \) GRB/year
- \( \sim 15 \) GRB/year
- Pass 7
- New algorithm

(GCN circulars, no Pass 8 here!)
Put the two together:

→ 50% increase in detections
New algorithm + Pass 8

86 detections* (Pass 8 dataset, from 08/08 to 04/14)

+ > 6 detections (predictions, based on Pass 7 analysis between April and today)

+ > 15 LAT Low-Energy (LLE) detections (counting analysis between ~20 MeV and 100 MeV)

> 100 LAT detected GRBs!

* for likelihood detections, TS threshold of 28
Now exceeding expectations

(Standard likelihood detections, no LLE)

Observed: 16 GRB/y
Expected: 12 GRB/y
Old catalog: 9.5 GRB/year

(1st GRB catalog, Ackerman et al. 2013)
What's new in the algorithm?
Lesson 1, from 1st GRB catalog:
LAT signal duration $\gg$ prompt emission

(First LAT GRB Catalog, Ackermann et al. 2013)
Lesson 1 learned:
10 time scales

Source class

- 10000 s: 59
- 3881.53 s: 64
- 1506.63 s: 62
- 584.8 s: 56
- 226.99 s: 49
- 88.11 s: 43
- 34.2 s: 34
- 13.27 s: 24
- 5.15 s: 21
- 2 s: 14

This is the number of bursts above the TS threshold for this time scale, among the 86 detections.

GRB may enter the field of view at any time, even if it starts outside of it!
Lesson 2, from the GBM team: systematic error in GBM localizations

[Diagram showing a scatter plot with a preliminary graph indicating inside and outside error circles.]
Lesson 2 learned:
30° x 30° finding map (TS map)

NOTE: now the GBM team releases localization contours which take into account systematic errors.
The algorithm

GBM trigger catalog → 30 x 30 TS map → Likelihood analysis on maximum TS

Results → Likelihood analysis on best localization → Localization

Database of results

(independently repeated for the 10 time scales)
More sensitive: more mid- and low-flux GRBs

(Ackerman et al. 2013)

(this work)
Pass 8
newDetectionAlgorithm

First 100 GRBs
missing GRBs mystery
More GCNs
change Predictions For VHE