# Fermi high energy observation of GRB 090217: the featureless burst

*S. Cutini[1], F. Piron[2], A. von Kienlin[3] on behalf of Fermi LAT and GBM collaborations*

1. *ASI Science Data Center, ASDC c/o ESRIN, via G. Galilei snc I-00044 Frascati, Italy*
2. *Laboratoire de Physique Theorique et Astroparticules, Université Montpellier2, CNRS/IN2P3, Montpellier, France*
3. *Max-Planck Institut Fur extraterrestrische Physik, 85748 Garching, Germany*

***ABSTRACT:***
The Fermi observatory is advancing our knowledge of Gamma-Ray Bursts (GRBs) through pioneering observations at high energies, covering more then 7 decades of energy with the two on-board detectors, the Large Area Telescope (LAT) and the Gamma-ray Burst Monitor (GBM). Here we report on the observation of long GRB 090217 which triggered the GBM and as independently detected by the on-ground blind search algorithm. We present the GBM and LAT observations, including a temporal profile and time-resolved spectral analysis from 8keV up to ~1GeV. GRB 090217 is a firmly LAT-detected burst with featureless high-energy properties. The time-averaged and time-resolved spectra are well reproduced by a Band model, with no substantial spectral evolution.We compare these observations to the other LAT detections of long bursts, and discuss some theoretical implications on GRB high-energy emission.

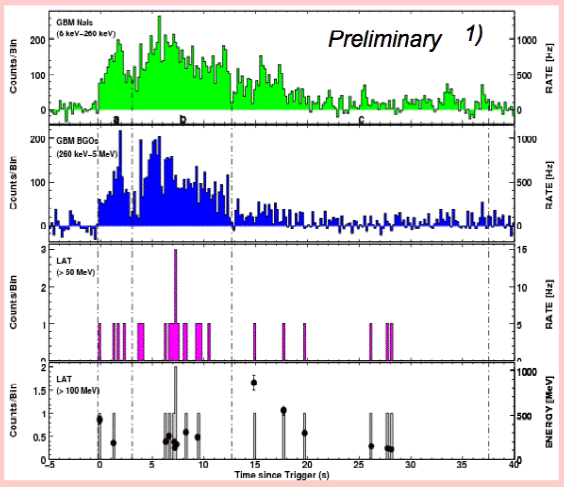
## *LAT OBSERVATION:*

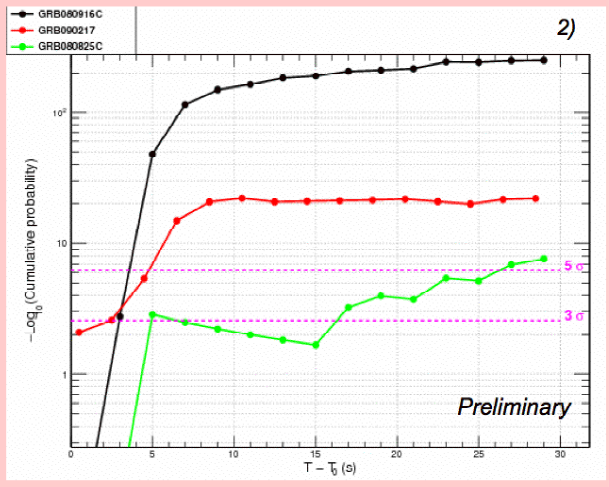
GRB 090217 did not trigger the LAT onboard detection algorithm and was found through a blind search in the LAT data by the onground Automated Science Processing pipeline (see Band et al. 09 for details). Subsequently and independent of the ASP analysis, the detection was confirmed by searches of the GBM location. The best fit position is found to be (RA, Dec) = (204.73°, -8.43°), i.e. only 0.17° away from the one quoted in the LAT GCN circular GCN8903, with a maximum value TS=89, corresponding to a chance probability of $4.7 \times 10^{-20}$ or, equivalently, to a 9.2sigma detection. The TS contours around this position yielded the 68%, 90% and 99% statistical error radii, respectively of 0.37°, 0.54° and 0.80° .

## *GBM OBSERVATION:*

At 04:56:42.56 UTC on February 17th 2009 (T0) the Fermi GBM triggered and located GRB090217 (trigger 256539404 / 090217206) (GCN8902).
The GBM on-ground localization reported by GCN8902 was unusually distant (~9°) from the LAT localization GCN8903.
The final GBM localization is (RA, Dec) = (205.5°, -6.0° ) with a statistical error of ~ 1 degree and a standard systematic uncertainty of 2 to 3 degrees in GBM locations (Briggs 09).Within the above uncertainties, the latter GBM position is consistent with that reported by the LAT and is adopted in this paper.
The angle of GRB090217 to the LAT boresight is 35 degrees placing this bright, hard event firmly in the field of view.
Despite a Swift Target of Opportunity observations of an early LAT localization, no X-ray afterglow was found GCN8907 and hence there is no redshift available for this burst.

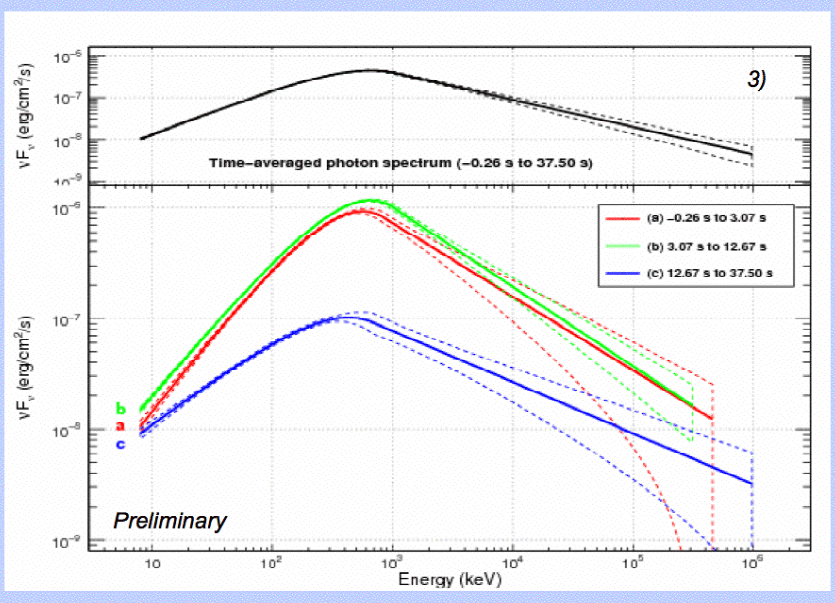
## *LIGHT CURVE AND TEMPORAL PROFILE*




The lightcurves of the GBM and LAT detectors are shown in Figure 1) sorted from top to bottom in order of increasing energy.
The first panel shows the sum of the counts of the three NaI detectors (N6, N8 and N9) with the highest signal in he 8-260keV band.
The second panel shows the corresponding plot for the sum of both BGO detector counts, between 260keV and 5MeV.
The third panel of this figure displays the LAT lightcurve for `transient' events above 50MeV.
The fourth panel was obtained above the energy threshold of 100MeV, and it also displays the event energies as a function of time.
These panels show a LAT count rate increase which is temporally coincident with the GBM emission, with no apparent delay. A 447MeV event is detected at T0 while the LAT event with the highest energy (866MeV) arrives at T0+14.8s.

## *JOINT GBM-LAT SPECTRAL ANALYSIS*




Simultaneous spectral fits of the GBM and LAT data were performed for each of the three time bins (a to c) shown in Figure 3).
The first time bin (a) starts 0.256 s before the GBM trigger time in order to include the first LAT (447 MeV) event, and lasts up to T0+3.072s. The central time bin (b) starts at T0+3.072s up to T0+12.672s, i.e. until the end of the main LAT emission.
The last bin (c) starts at T0+12.672s and ends at T0+37.504s, covering the tail of the LAT and GBM emission.

## *DISCUSSION & COMPARISON WITH OTHER LAT BURSTS:*

This burst does not exhibit any noticeable spectral feature, other than the common Band spectral shape, similarly to the first two long bursts detected by the LAT, GRB 080825C and GRB 080916C. In all three bursts, no significant excess in the form of an additional spectral component, or a deficit in the form of a spectral cut off, was required to fit the broad-band data. In combination with correlate temporal behavior of the low and high energies, this is suggestive of one responsible emission mechanism. Beyond these obvious similarities, GRB 090217 does not share several of the high-energy properties observed in the other two bursts. First of all, no delay is observed in the high-energy emission of GRB 090217 with respect to the ~100 keV radiation. The Figure 2) represents the time history of detection probability. This figure confirms that GRB 080916C has a sharp rise at ~5s after the trigger time while GRB 090217 has a smoother evolution. GRB 090217 does not show any delayed onset at the highest energies and its emission does not last longer than the low-energy emission. Finally, no strong spectral evolution was observed in GRB 090217, especially no evolution at the highest energies, unlike GRB 080916C which underwent a strong soft-hard-soft evolution. GRB 090217 is a firmly LAT-detected burst with featureless high-energy properties. The similarity of the temporal history of its gamma-ray emission over more than five decades in energy and the agreement, within the observational errors, between measured spectra with the Band model suggest that a unique mechanism is responsible for the broad-band observed emission. More complicated scenarios are possible but not required by the present observations. Observations of more, and brighter, GRBs with both GBM and LAT in the near future will certainly help to assess what fraction of high-energy emitting bursts share similar properties, and to clarify the dominant emission mechanisms as well as the particle acceleration and cooling processes occurring in GRB jets.

*References:*

Band, D., et al. 2009, ApJ, 701, 1673
Briggs, M. S., et al. 2009, American Institute of Physics Conference Series, Vol. 1133, 40
O. Godet 2009, GCN 8907
A. von Kienlin 2009, GCN 8902
M. Ohno, J. McEnery & V. Pelassa 2009, GCN 8903