The Fermi and Suzaku/WAM Observations of GRB 081024B and GRB 090217

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Abstract

We report on the observations of the high energy (>100 MeV) emission from gamma-ray bursts (GRBs), including the first short GRB with GeV photons 081024B and the featureless long GRB 090217 by the Large Area Telescope (LAT) onboard the Fermi Gamma-ray Space Telescope. The high energy photons observed by the LAT from GRB 081024B is delayed with respect to the trigger time of Gamma-Ray Burst Monitor (GBM) onborad Fermi and they extend after the low energy emission of GBM as well as other LAT GRBs. Conversrsely, we found no special feature from GRB 090217: there is no delay for high energy photons, no distinct spectral component. These interesting features and differences for high energy emission observed by the LAT could help to investigate the emission mechanism of GRBs at high energy. Some of these LAT GRBs are also detected by the Suzaku Wide-band All-sky Monitor (WAM) simultaneously. The largest effective area of the WAM from 300 keV to 5000 keV could be of a good assistance for the Fermi data.

Key words: The Energetic Cosmos, from Suzaku to Astro-H: proceedings

1. Introduction

Gamma-ray Burst (GRB) is the most energetic explosion in the Universe. Although recent observational progresses brought by HETE-2 and Swift close to the progenitor of GRBs, there are still many issues to be understood, such as gamma-ray emission mechanism, physical condition of relativistic jet, differences between short and long GRB classes, etc. One of the most poorly-understood problem is the high-energy emission properties of GRBs. Energetic Gamma-Ray Experiment Telescope (EGRET: Dingus et al. 1995) and Astro-rivelatore Gamma a Immagini LEggero (AGILE: Giuliani et al. 2008) have detected high energy photons above 100 MeV from several GRBs, and found a distinct spectral and temporal component compared with the well-observed traditional Band function component (Band et al. 1993) around 0.1-1 MeV (Hurley et al. 1994, Gonzaletz et al. 2003). This high-energy component could be explained by the emission from accelerated proton. In this case, GRBs could be a candidate of the UHECRs. Furthermore, detection of such high energy photons from cosmological distance source should be useful to constrain some quantum gravity models (Amerlino-Camelia et al. 1998). Therefore, observation of high-energy emissions from GRBs is very important not only for understanding the nature of GRB but also for developing in particle physics. However, because the sample number of GRBs with detection of high-energy photon was very limited, little was known about high energy emission from GRB before the Fermi era. GRB observations with Fermi can realize more sensitivity and larger Field-of-View (FoV) and thus we can expect the detection of high energy photons from many GRBs with much statistics by Fermi. Here, we present the current status of GRB observations with Fermi, including the first short GRBs with GeV photon GRB 081024B and another long Fermi-LAT GRB 090217 without any notable features, and then we report on the status of the synchronous detection with Wide-band All-sky Monitor onboard Suzaku satellite.

2. GRB Observations with Fermi

The Fermi Gamma-ray Space Telescope was launched by NASA on 2008 Jun 11, from Cape Canaveral, Florida. The Large Area Telescope (LAT: Atwood et al. 2009), which is the main instrument onboard Fermi is a pair-conversion telescope covering an energy range from 20 MeV to more than 300 GeV with large FoV (2.4 sr at 1 GeV) and large effective area (~8000cm^2 at more than 1 GeV). Fermi also has the Gamma-ray Burst Monitor (GBM). The GBM is composed of 12 sodium iodide (NaI) detectors, which covers an energy range from 8 keV to 1 MeV and 2 bismuth germanate (BGO) detectors covering higher energy range from 150 keV to 40

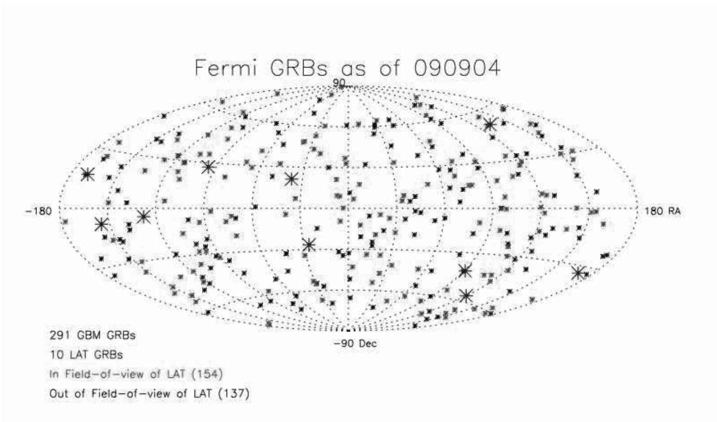

Fig. 1. The GRB skymap as of September 4th, 2009. Small asterisks show the GRBs detected by Fermi-GBM (Red: Inside LAT FoV, Black: outside LAT FoV). Large blue asterisks show the GRBs that high-energy (>100 MeV) photons are detected by the Fermi-LAT.

MeV. Combination of the LAT and the GBM enables us to obtain the GRB spectrum with more than 7 energy decades from many GRBs. Figure 1 shows the skymap of GRBs detected by Fermi as of September 2009. Fermi has detected 291 GRBs by the GBM in this period. The LAT has detected the high energy (> 100 MeV) photons from 10 GRBs, and three of these LAT GRBs were very bright enough to detect more than 10 photons in the energy range of >1 GeV (GRB080916C: Tajima et al. 2008, GRB090510: Ohno et al. 2009, GRB090902B: de Palma et al. 2009). These LAT GRBs includes both short and long duration GRBs. GRB081024B (Omodei et al. 2008) was the first short GRB detected GeV emission. These results mean the very strong GRB detection rate of the LAT of about 10 GRBs for all burst and a few GRBs for bright (>10 photons for >1 GeV) bursts. This GRB detection rate is comparable to that of our estimation before the launch (Band et al. 2009). We find the significant evidence of the extra power-law component against to the simple Band function from two bursts so far (GRB090510 and GRB090902B). For short GRB 090510, this is the first clear detection of this extra component from short GRB. A hint of the extra component can be seen also from GRB 080916C but it was not strong evidence (Abdo et al. 2009). Interestingly, the emission observed by the LAT above 100 MeV is often delayed with respect to the GBM trigger, and significantly extends after the low-energy emission. Furthermore, sometimes the high-energy emission lasts up to hundreds seconds like the afterglow. Conversely, GRB 090217 (Ohno et al. 2009) does not show any special feature; there is no time delay between low and high energy photons, and the spectrum can be represented by a simple Band function. After the 1-year operation of Fermi, the sample number of GRB with high-energy emission is already far superior to that of EGRET and we found various features of high energy emission of GRBs. This helps us to investigate the nature of high-energy emission of GRB with Fermi in the near future.

3. Combination between Fermi and Suzaku/WAM

The Suzaku Wide-band All-sky Monitor (Suzaku/WAM: Yamaoka et al. 2008) is also powerful GRB detector in keV-MeV energy band with the largest effective area between 300 keV to 5 MeV. Such large effective area of the WAM could help to constrain the spectral parameter or time variability of the sub-MeV component by combination with the Fermi-GBM. About 100 events are coincident between Suzaku/WAM and Fermi/GBM so far, and 4 LAT GRBs (GRB 081024B, 090217, 090510, and 090902B) are also detected by the Suzaku/WAM. Therefore, about 30 % of Fermi GRB will be detected by the WAM. Thus, theq WAM data could be a good assistance to the Fermi data in the future observations.

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