

Swift Observation of the Fermi-detected GRB 080916C

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1 Introduction

At 00:12:45 UT on 16 September 2008, the Fermi Gamma-Ray Burst Monitor (GBM) triggered and located this GRB (trigger 243216766 / 080916.009) (Goldstein et al., GCN Circ. 8245). The on-ground calculated location, using the GBM trigger data, is RA = 121.8, Dec = -61.3 (J2000 degrees, equivalent to J2000 RA = $8^h 07^m$, Dec. = $-61^d 18'$), with a statistical uncertainty of less than 1 degree (radius, 1-sigma containment) and an additional systematic error which is currently estimated to be 2 to 3 degrees. This GRB has several peaks, with T90 (50-300 keV) = 66 s and T50 (50-300 keV) = 33 s and it is detected up to several MeV.

The angle of the GBM best position with respect to the LAT boresight was 52 degrees at the time of the trigger, which is close the edge of our field of view. The data from the Fermi LAT shows a significant increase in the event rate within 10 degrees of the GBM location after the GBM trigger that is spatially and temporally correlated with the GBM emission with high significance. More than 10 photons are observed above 1 GeV during this time. The best LAT on-ground localization is found to be (RA = 119.88^h , Dec. = -56.59^d) with a 90% containment radius of 0.13 deg (statistical; 68% containment radius: 0.09 deg, preliminary systematic error is less than 0.1 deg) which is consistent with the GBM localization (Tajima et al. 2008, GCN Circ. 8246).

This GRB was also observed by AGILE (MCAL, SuperAGILE, and ACS -but not localized), RHESSI, INTEGRAL (SPI-ACS), Konus-Wind, and MESSENGER. Using the RHESSI data between 100 keV and 17 MeV, the time-integrated spectrum for the 62-second interval beginning at 00:12:46 UT can be described by a cutoff power law with $\alpha = -1.2 \pm 0.3$, $E_{peak} = 1100 \pm 500$ keV, and fluence of $(9.0 \pm 1.6) \times 10^{-5}$ ergs cm^{-2} (100 keV - 10 MeV) (Hurley et al. GCN Circ. 8251).

2 XRT Observations and Analysis

The Swift XRT started observing the field of GRB 080916C at 2008-09-16 17:11:28 UT, about 17 hours after the FERMI trigger. The X-ray source reported by Kennea (GCN Circ. 8253) is confirmed to be the afterglow of the GRB.

Using 2614 s of XRT Photon Counting mode data and 2 UVOT images, the astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching to the USNO-B1 catalogue) is: RA, Dec = 119.84684 deg, -56.63801 deg, which is equivalent to RA (J2000): $07^h 59^m 23.24^s$ and Dec (J2000): $-56^d 38' 16.8''$ with an uncertainty of 1.9 arcsec (90% confidence).

The X-ray flux decay from T+61 ks to T+1306 ks can be fit with a double broken power-law model with decay indexes $\alpha_{X,1} \sim 2.3$, $\alpha_{X,2} \sim 0.2$ and $\alpha_{X,3} \sim 1.4$ and temporal breaks at about 2 and 4 days after the trigger (Figure 1).

A 7.6 ks exposure X-ray spectrum from T+61 ks to T+102 ks can be well fit by an absorbed power-law model with a photon index of $2.1^{+0.9}_{-0.7}$ and a column density of $3.7^{+3.3}_{-2.1} \times 10^{21}$ cm^{-2} . We note that the Galactic column density value in the direction of the burst is 1.5×10^{21} cm^{-2} . The observed 0.3-10.0 keV flux is 8.6×10^{-13} erg cm^{-2} s^{-1} which corresponds to an unabsorbed flux of 1.5×10^{-12} erg cm^{-2} s^{-1} (Perri et al. GCN Circ. 8261).

3 UVOT Observation and Analysis

The Swift/UVOT began observations of the field of this burst 17.0 hours after the Fermi GBM detection. No afterglow is detected within the XRT error circle in any of the observed UVOT filters.

UVOT magnitude 3-sigma upper limits are reported in Table 1. The quoted upper limits have not been corrected for the large expected Galactic extinction along the line of sight of $E_{B-V} = 0.32$ mag (Schlegel et al., 1998). All photometry is on the UVOT flight system described in Poole et al. (2008, MNRAS, 383, 627).

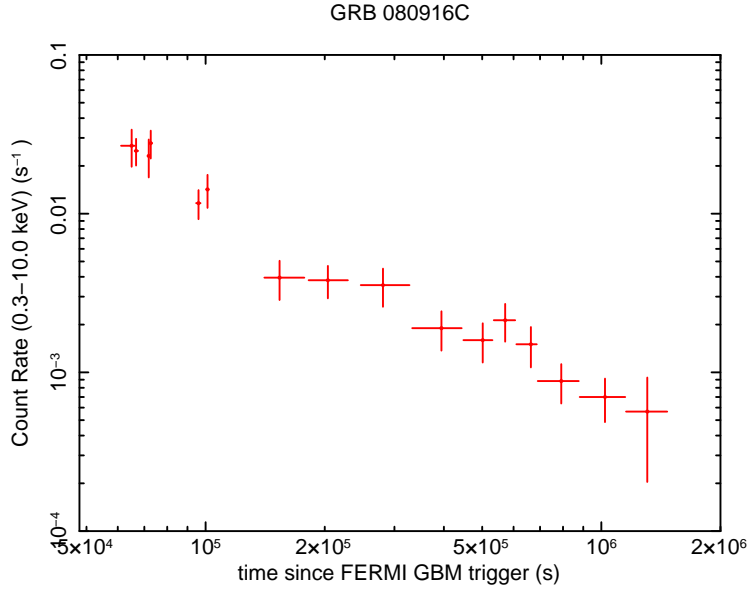


Figure 1: XRT Lightcurve. Counts s^{-1} in the 0.3-10 keV band taken in Photon Counting mode. The approximate conversion is $1 \text{ count s}^{-1} \sim 4.3 \times 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1}$.

Filter	T_start (s)	T_stop (s)	Exp (s)	3-sigma UL mag
v	101253	101857	590	> 19.75
u	96469	97132	645	> 19.99
uvw1	66675	67517	829	> 20.34
uvw1	95562	96462	886	> 20.38
uvm2	61130	66667	1090	> 20.31
uvm2	94655	95555	886	> 20.20
uvw2	100347	101246	886	> 20.43

Table 1: Magnitude limits from UVOT observations.