

Swift Observation of GRB 080703

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1 Introduction

BAT triggered on GRB 080703 at 19:00:13.6 UT (Trigger 315819) (Ziaepour, et al., *GCN Circ.* 7936). This was a 1.024 sec rate-trigger with significance of 11.78 on an apparently short burst with $T_{90} = 3.4$ sec in 15 – 350 keV band. Swift slewed to this burst immediately. The XRT began its observations at $T + 100$ sec, and UVOT started its finding chart exposure at $T + 102$ sec. They both found a varying afterglow (Godet & Ziaepour *GCN Circ.* 7942, Ward & Ziaepour *GCN Circ.* 7941). The optical counterpart was relatively bright and fast decaying. The position of this source is: RA ($J2000$) = 101.8027 deg (06h47m12.64s), Dec($J2000$) = -63.2192 deg ($-63d13'08.96''$). The optical afterglow was also detected by the ROTSE-III (E.S. Rykoff, et al. *GCN Circ.* 7935) and by the VLT (D. Malesani, et al. *GCN Circ.* 7940).

2 BAT Observation and Analysis

Using the data from $T - 120$ to $T + 183$ sec, further analysis of BAT GRB 080703 has been performed by Swift team (Sakamoto, et al., *GCN Circ.* 7938). The BAT ground-calculated position is RA($J2000$) = 101.822 deg (06h47m17.2s), Dec($J2000$) = -63.211 deg ($-63d12'40.7''$) ± 1.1 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 53% (the offset angle was 21.42 deg).

The mask-weighted 64-msec binned light curves (Fig.1) show a single peak started at about $\sim T - 5$ sec, peaking at $\sim T + 0$. sec, and ending at $\sim T + 4$ sec. T_{90} in (15 – 350 keV) is 3.4 ± 0.8 sec (estimated error including systematics).

A power-law fit of the time-averaged spectrum from $T - 1.7$ to $T + 2.1$ sec gives a photon index of 1.53 ± 0.22 ($\chi^2 = 70.28$ for 56 d.o.f.). For this model the total fluence in the 15 – 150 keV band is $(2. \pm 0.3) \times 10^{-7}$ ergs cm^{-2} and the 1-sec peak flux measured from $T + 0.04$ sec in the 15 – 150 keV band is $1. \pm 0.2$ ph $\text{cm}^{-2} \text{sec}^{-1}$. A fit to a Band model gives $\alpha = 0.47$, $\beta = -2.$, $E_{peak} = 47.11$ keV ($\chi^2 = 68.1$ for 55 d.o.f.), and total fluence in the 15 – 150 keV band $(1.88 \pm 0.3) \times 10^{-7}$ ergs cm^{-2} . All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using 3392 sec of overlapping XRT Photon Counting (PC) mode and UVOT data for GRB 080703, the enhanced Swift-XRT position is RA ($J2000$) = 101.8018 deg (06h47m12.43s), Dec($J2000$) = -63.2189 deg ($-63d13'08.2''$) ± 1.4 arcsec (90% confidence) (Osborne, et al., *GCN Circ.* 7939). This position is within 1.6 arcsec of the UVOT position (Ward & Ziaepour *GCN Circ.* 7941).

The 0.3 – 10 keV light curve (Fig.2) shows an initial rise of the X-ray emission before $T + 106$ sec to a maximum at $\sim T + 200$ sec. Then it decays with a slope of ~ 1.2 . From $T + 700$ sec to $T + 2000$ sec, the XRT light curve shows some flaring activities. A shallow slope regime or flaring continues until $\sim T + 10^4$ sec where the light curve breaks to a steeper slope of 1.57 ± 0.21 . This continues until the end of the XRT observations at $\sim T + 10^5$ sec.

The hardness ratio does not show any significant spectral variation from $\sim T + 106$ sec to $T + 10^5$ sec.

The PC spectrum from $T + 106$ sec to $T + 3.1 \times 10^4$ sec is well fitted by an absorbed power-law with a photon index of 1.7 ± 0.1 and an absorption column of $8.9_{-3.3}^{+3.9} \times 10^{20} \text{ cm}^{-2}$, in excess with respect to the Galactic N_H of $5.2 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al.2005). The observed 0.3 – 10 keV flux over this time interval is $8.2_{-1.2}^{+0.8} \times 10^{-12} \text{ ergs cm}^{-2} \text{ sec}^{-1}$.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 080703 about 102 sec after the initial BAT trigger (Ward & Ziaeeepour, *GCN Circ.* 7941). A quickly fading candidate afterglow was found in the XRT error circle in White and V filters. The UVOT position of the optical afterglow is: RA ($J2000$) = 101.8027 deg (06h47m12.64s), Dec($J2000$) = -63.2192 deg ($-63d13'08.96''$) with a 1-sigma error radius of about 0.5 arcsec. Between $\sim T + 100$ and $\sim T + 1000$ sec the light curve decays with an index of 1.30 ± -0.08 obtained from White and V bands combined light curve. The source was not observed in B and shorter wavelengths. This puts a lower limit on its redshift $z \gtrsim 2.5$. The observed magnitude and 3-sigma upper limits are given in Table 1. They are not corrected for the Galactic extinction in the line of sight, corresponding to a reddening of $E(B-V) = 0.798$ mag (Schlegel et al., *ApJS*. **500** (1998) 525). The photometry is based on the UVOT photometric system (Poole, et al., *MNRAS* **383** (2008) 627).

Filter	T_{start} (sec)	T_{stop} (sec)	Exposure (sec)	Mag/UL
White	101	200	99.8	17.40 ± 0.03
White	857	956	99.8	20.27 ± 0.35
White	5905	6102	196.6	21.29 ± 0.49
White	5905	19222	869.5	> 21.77 (1.9-sigma)
V	207	606	399.8	18.02 ± 0.10
V	963	1362	399.8	19.06 ± 0.27
V	6315	6512	196.6	> 19.65 (0.2-sigma)
V	6315	12021	1081.7	> 20.83 (0.9-sigma)
B	687	1788	78.9	> 19.48 (1.8-sigma)
B	663	1764	99.0	> 19.33 (1.5-sigma)
UVW1	638	1885	99.9	> 19.55 (0.1-sigma)
UVM2	613	1878	118.7	> 19.67 (1.7-sigma)
UVW2	718	1829	79.1	> 19.55 (0.9-sigma)

Table 1: Magnitude and upper limits from the UVOT observations.

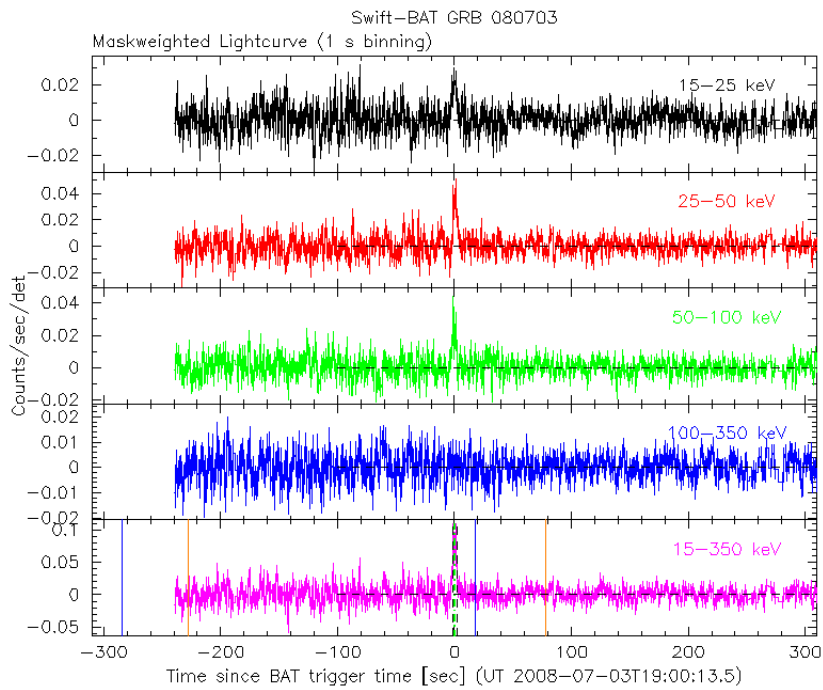


Figure 1: BAT light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 19 : 00 : 13.6 UT.

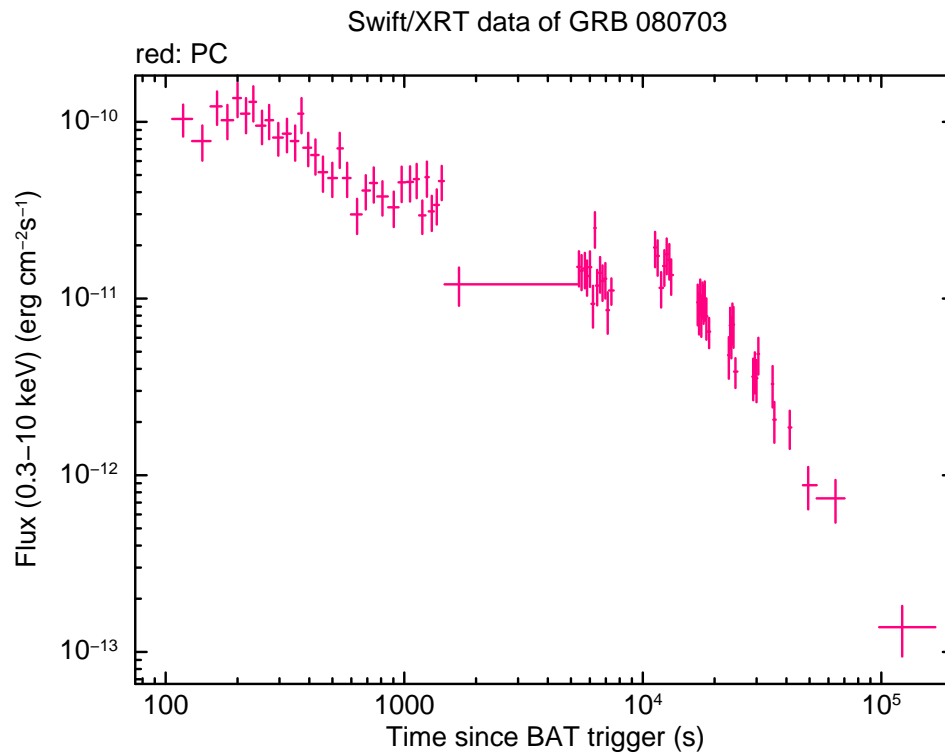


Figure 2: XRT light curve in the 0.3 – 10 keV band: Photon Counting (PC) mode (red). The conversion factor from count rate to absorbed flux is 1 count/sec $\sim 5.1 \times 10^{-11}$ ergs cm $^{-2}$ sec $^{-1}$.