

Swift Observations of GRB 100508A

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1 Introduction

BAT triggered on GRB 100508A at 09:20:42 UT (Trigger 421386) (Margutti *et al.*, *GCN Circ.* 10728). This was an image trigger on a long burst. XRT observations began at $T + 147.5$ s and discovered a fading X-ray afterglow. UVOT began observing at $T + 152$ s and found the optical counterpart of 18.9 ± 0.1 mag (white band).

The ground based, robotic ROTSE-III started unfiltered observations of the burst at $T + 156.8$ s: no credible afterglow candidate was found down to 16.5 mag (Schaefer *et al.*, *GCN Circ.* 10729). The afterglow was later detected by GROND at $T + 13.5$ hrs with the following magnitudes: $g' = 22.0 \pm 0.1$ mag, $r' = 21.8 \pm 0.1$ mag, $i' = 21.5 \pm 0.1$ mag, $z' = 21.7 \pm 0.2$ mag, $J > 21.4$ mag, $H > 20.8$ mag, $K > 20.1$ mag.

Our best position is that given by UVOT at RA(J2000)= 05^h04^m58.99^s, Dec(J2000)= $-20^{\circ}42'14.1''$, with an estimated uncertainty of 0.6 arcsec (radius, 90% confidence).

2 BAT Observations and Analysis

Using the data set from $T - 239$ to $T + 963$ s, the BAT ground-calculated position is RA(J2000) = 76.263 deg (05^h05^m03.1^s), Dec(J2000)= -20.744 deg ($-20^{\circ}44'36.8''$) with an uncertainty of 2.2 arcmin (radius, sys+stat, 90% containment). The partial coding was 70%.

The mask-weighted light curve shows a broad peak starting at $T - 25$ s and ending around $T + 200$ s with a very weak tail out to around $T + 400$ s (see Fig. 1). T_{90} (15–350 keV) is 52 ± 10 s (estimated error including systematics).

The time-averaged spectrum from $T - 8$ to $T + 59$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.23 ± 0.25 . The fluence in the 15–150 keV band is $(7.0 \pm 1.1) \times 10^{-7}$ erg cm⁻². The 1-s peak photon flux measured from $T + 1.70$ s in the 15–150 keV band is 0.4 ± 0.2 ph cm⁻² s⁻¹. All the quoted errors are at the 90% confidence level (Stamatikos *et al.*, *GCN Circ.* 10732).

The results of the batgrbproduct analysis are available at http://gcn.gsfc.nasa.gov/notices_s/421386/BA/.

3 XRT Observations and Analysis

The XRT began observing GRB 100508A in Windowed Timing mode, 132 s after the BAT trigger. The data comprise 40 s in Windowed Timing (WT) mode (the first 9 s were taken while Swift was slewing) with the remainder in Photon Counting (PC) mode. Using 1.3 ks of overlapping XRT and UVOT data, the UVOT-enhanced XRT position was found to be RA(J2000)= 76.24555 deg (05^h04^m58.93^s), Dec(J2000)= -20.71171 deg ($-20^{\circ}42'42.2''$), with an uncertainty of 1.7 arcsec (radius, 90% confidence).

The light curve (Fig. 2) 132 to 3×10^5 s, can be modelled with a double broken power law with the following best-fitting parameters: $\alpha_{x1} = 1.5 \pm 0.2$, $t_{b1} = 650$ s, $\alpha_{x2} = 0.5 \pm 0.1$, $t_{b2} = 23$ ks, $\alpha_{x3} = 2.40_{-0.1}^{+0.3}$ ($\chi^2/\text{dof} = 71.4/63$).

The PC mode spectrum spanning from 100 s to 7.3 ks can be fitted with an absorbed power-law with a photon spectral index of 1.66 ± 0.28 . The best-fitting absorption column is $(1.4 \pm 0.8) \times 10^{21} \text{ cm}^{-2}$ in excess of the Galactic value of $2.4 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al. 2005). Uncertainties are given at 90% c.l. The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 4.7×10^{-11} (5.7×10^{-11}) $\text{erg cm}^{-2} \text{ count}^{-1}$ (Margutti *et al.*, *GCN Circ.* 10733).

Detailed light curves in both count rate and flux units are available in both graphical and ASCII formats at http://www.swift.ac.uk/xrt_products/00421386/.

4 UVOT Observations and Analysis

The UVOT observed the field of GRB 100508A starting at 152 s after the BAT trigger. The afterglow was detected in the white and u filters at the position RA(J2000)= 05^h04^m58.99^s, Dec(J2000)= $-20^{\text{d}}42'41.1''$ (Landsman *et al.*, *GCN Circ.* 10730). Table 1 reports UVOT photometry from individual images (Landsman *et al.*, *GCN Circ.* 10736).

Filter	T_{start} (s)	Exposure (s)	Mag
White (FC)	152	147	18.91 ± 0.07
White	864	147	20.70 ± 0.31
White	11708	295	21.22 ± 0.30
u	310	246	19.16 ± 0.15
u	6860	197	20.12 ± 0.36
b	5634	197	> 20.7
v	6250	197	> 19.7

Table 1: Magnitudes from UVOT observations.

These magnitudes are not corrected for the Galactic extinction corresponding to a reddening of $E_{B-V} = 0.87 \text{ mag}$ (Schlegel *et al.*, 1998). 3σ upper limits are listed when the afterglow is not detected. The photometry is on the UVOT flight system described in Poole *et al.* (2008, MNRAS, 383, 627).

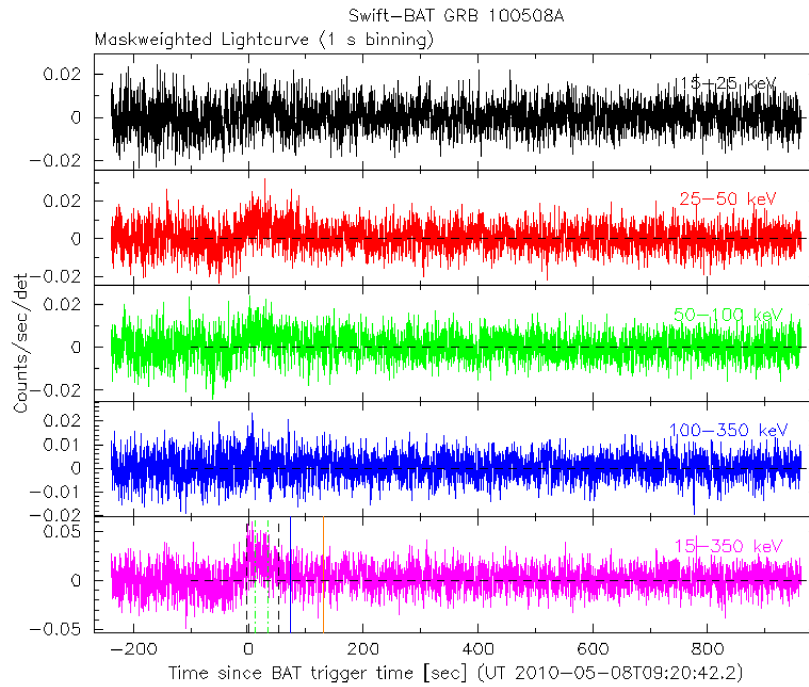


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/s/illuminated-detector (note illum-det = 0.16 cm^2) and T_0 is 19:53:02 UT.

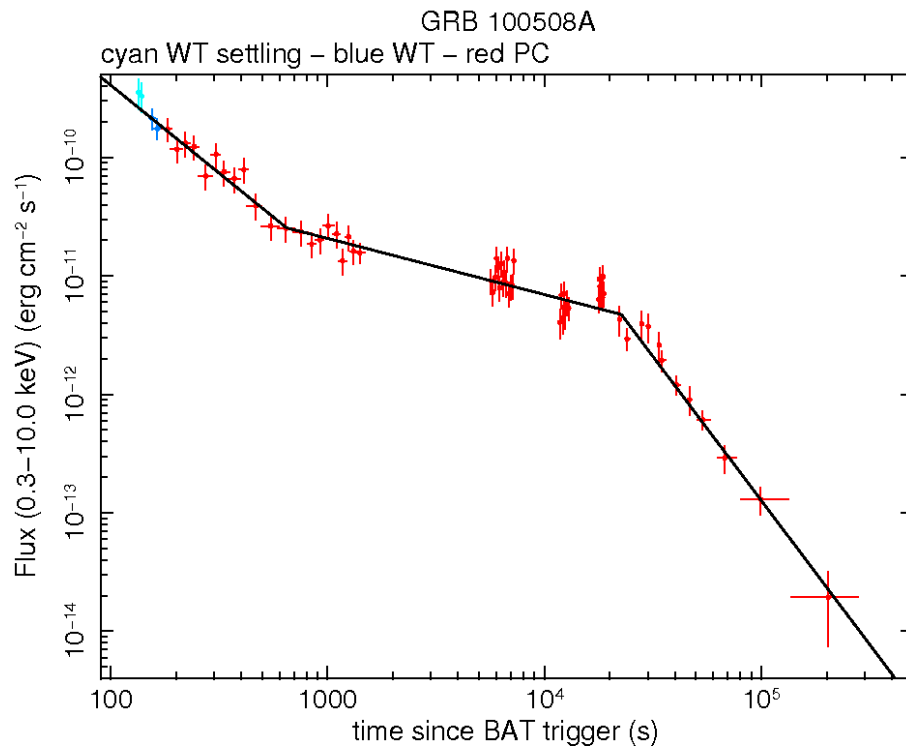


Figure 2: XRT Lightcurve. Flux in the 0.3-10 keV band: Settling Windowed Timing (cyan), Windowed Timing (blue) and Photon Counting (red) modes.