

Swift Observations of GRB 100522A

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1 Introduction

The Swift/BAT triggered and located GRB 100522A (Trigger 422783) at 03:45:52 UT (Troja, *et al.*, *GCN Circ.* 10784). This was a rate trigger on a burst with $T_{90} = 35.3$ sec. Swift slewed immediately to the burst, XRT and UVOT began follow-up observations at $T + 65.4$ sec and $T + 73$ sec respectively.

Our best position is the XRT enhanced position (Osborne, *et al.*, *GCN Circ.* 10787): RA($J2000$) = 6.98662 deg (00h27m56.79s), Dec($J2000$) = $+9.40184$ deg (09d24'06.6'') with an uncertainty of 1.5 arcsec (radius, 90% confidence).

2 BAT Observation and Analysis

Using the data set from $T - 80$ sec (when the source entered the BAT field of view during a prior slew) to $T + 963$ sec, further analysis of BAT GRB 100522A has been performed by the Swift team (Barthelmy, *et al.*, *GCN Circ.* 10788). The BAT ground-calculated position is RA($J2000$) = 6.990 deg (00h27m57.6s), Dec($J2000$) = 9.397 deg (09d23'50.1'') with an uncertainty of 1.0 arcmin (radius, sys+stat, 90% containment). The partial coding was 71%.

The mask-weighted light curve (Fig. 1) shows a complex structure. There are two main episodes of emission, starting at $T - 0.5$ sec and $T + 25$ sec, respectively. The first episode starts with a broad multi-peaked structure 2.5 sec long followed by three short (~ 0.3 sec long) peaks. Then the emission returns to background levels before rising in a second, less intense and softer two peak structure approximately 15 sec long. T_{90} (15-350 keV) is 35.3 ± 1.8 sec (estimated error including systematics).

The time-averaged spectrum from $T - 0.5$ to $T + 40.2$ sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.89 ± 0.08 . The fluence in the 15-150 keV band is $(2.1 \pm 0.1) \times 10^{-6}$ ergs/cm². The 1-sec peak photon flux measured from $T + 0.04$ sec in the 15-150 keV band is 7.1 ± 0.3 ph/cm²/sec. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The Swift/XRT began follow-up observations of the field of GRB 100522A 65.4 sec after the BAT trigger (Troja, *et al.*, *GCN Circ.* 10784). The dataset consists of 7 s of Windowed Timing (WT) settling mode, 80 s of WT mode, and 56.7 ks of Photon Counting (PC) mode observations.

Using 3778 sec of XRT PC mode data and 6 UVOT images for GRB 100522A, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA($J2000$) = 6.98662 deg (00h27m56.79s), Dec($J2000$) = $+9.40184$ deg (09d24'06.6'') with an uncertainty of 1.5 arcsec (radius, 90% confidence; Osborne, *et al.*, *GCN Circ.* 10787).

The 0.3-10 keV light curve (Fig. 2) shows an initial steep power-law decay with an index of $\alpha = 4.85 \pm 0.04$. At $T + 130$ sec the lightcurve flattens to an index of 0.57 ± 0.03 and breaks again at $T + 18$ ks to a final decay index of 1.23 ± 0.08 .

A spectrum formed from the WT mode data can be fit with an absorbed power-law with a photon index of $2.82^{+0.32}_{-0.28}$ and a column density $N_H = (4.0^{+0.8}_{-0.7}) \times 10^{21}$ cm⁻², in excess of the Galactic value of

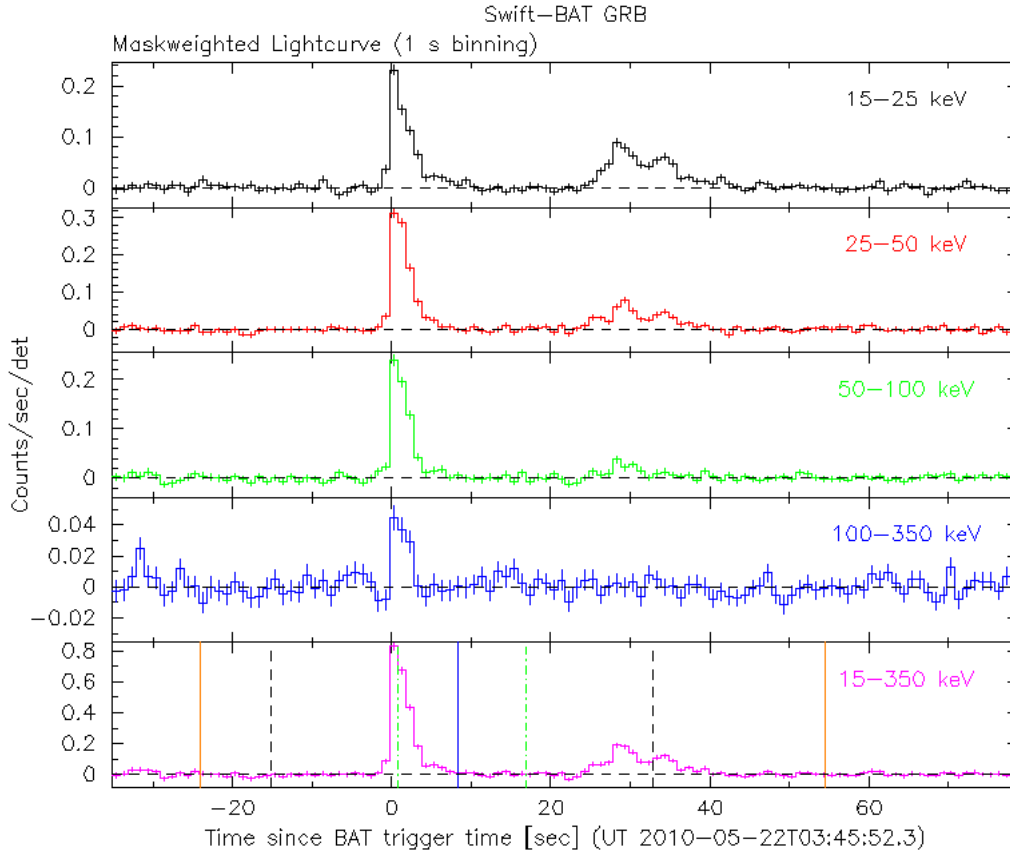


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector.

$4.0 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al. 2005). The PC mode spectrum spanning from 156 sec to 13.6 ksec has a photon index of $2.14_{-0.28}^{+0.30}$ and a column density of $4.0_{-1.0}^{+1.2} \times 10^{21} \text{ cm}^{-2}$. The counts to observed (unabsorbed) flux conversion factor deduced from this spectrum is 1 count/sec = 4.4×10^{-11} (8.1×10^{-11}) $\text{ergs/cm}^2/\text{sec}$.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 100305A 73 sec after the BAT trigger (De Pasquale, *et al.*, *GCN Circ.* 10791). No optical afterglow within the enhanced XRT position (Osborne, *et al.*, *GCN Circ.* 10787) is detected in the UVOT exposures. UVOT 3σ upper limits for this field are reported in Table 1.

The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight, corresponding to a reddening of $E_{B-V} = 0.06 \text{ mag}$ (Schlegel et al. 1998, *ApJ*, 500, 525). All photometry is on the UVOT photometric system described in Poole et al. (2008, *MNRAS*, 383, 627).

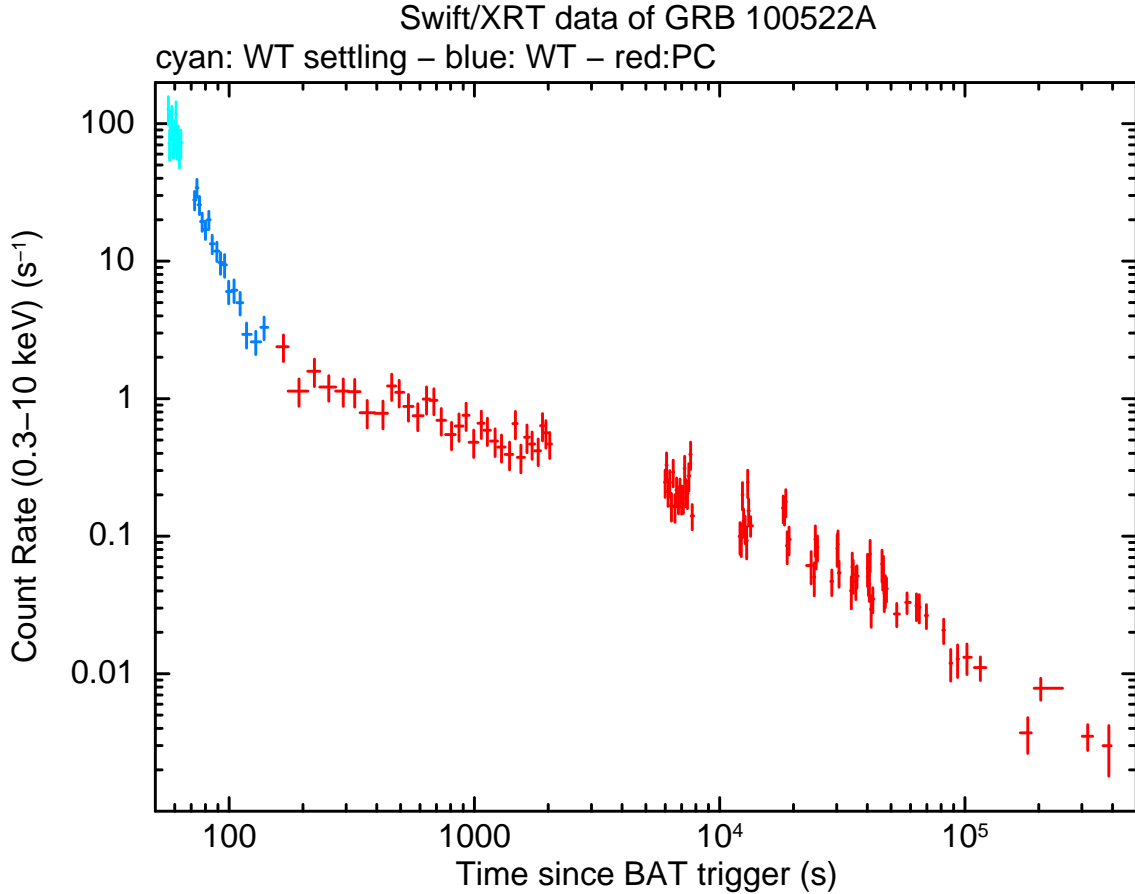


Figure 2: XRT light curve. Counts/sec in the 0.3-10 keV band: Windowed Timing settling mode (cyan), Windowed Timing mode (blue), Photon Counting mode (red). The approximate counts to observed (unabsorbed) flux conversion factor is $1 \text{ count/sec} = 4.4 \times 10^{-11}$ (8.1×10^{-11}) $\text{ergs/cm}^2/\text{sec}$.

Filter	Start	Stop	Exposure	3σ UL
white (FC)	73	233	147	> 20.1
white	73	7223	569	> 20.9
v	614	6199	352	> 19.0
b	541	7018	352	> 19.9
u	285	13630	1243	> 20.1
uvw1	663	12939	1242	> 20.5
uvm2	639	7838	549	> 20.2
uvw2	590	7429	363	> 20.1

Table 1: Magnitude limits from UVOT observations