

## Swift Observations of GRB 100802A

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### 1 Introduction

The Swift/BAT triggered and located GRB 100802A (Trigger 430603) at 05:45:36 UT (Troja, *et al.*, *GCN Circ.* 11031). This was a rate trigger on a burst with  $T_{90} = 487$  sec. Swift slewed immediately to the burst, XRT and UVOT began follow-up observations at  $T + 69$  sec and  $T + 88$  sec respectively.

Our best position is the UVOT position (Siegel, *et al.*, *GCN Circ.* 11032): RA( $J2000$ ) = 2.46862 deg (00h09m52.47s), Dec( $J2000$ ) = +47.75531 deg (47d45'19.1") with an uncertainty of 0.8 arcsec (radius, 90% confidence).

### 2 BAT Observation and Analysis

Using the data set from  $T - 239$  sec to  $T + 963$  sec, further analysis of BAT GRB 100802A has been performed by the Swift team (Baumgartner, *et al.*, *GCN Circ.* 11035). The BAT ground-calculated position is RA( $J2000$ ) = 2.482 deg (00h09m55.6s), Dec( $J2000$ ) = 47.752 deg (47d45'05.5") with an uncertainty of 1.1 arcmin (radius, sys+stat, 90% containment). The partial coding was 84%.

The mask-weighted light curve (Fig. 1) shows a FRED peak starting at  $\sim T - 7$  sec and peaking at  $\sim T + 1$  sec. There is a second peak on the tail of the first at  $\sim T + 90$  sec and a long peak starting around  $\sim T + 250$  sec, peaking at  $\sim T + 450$  sec, and ending at  $\sim T + 700$  sec.  $T_{90}$  (15-350 keV) is  $487 \pm 30$  sec (estimated error including systematics).

The time-averaged spectrum from  $T - 3.3$  to  $T + 531.7$  sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is  $1.85 \pm 0.10$ . The fluence in the 15-150 keV band is  $(3.6 \pm 0.2) \times 10^{-6}$  ergs/cm<sup>2</sup>. The 1-sec peak photon flux measured from  $T - 0.08$  sec in the 15-150 keV band is  $0.9 \pm 0.1$  ph/cm<sup>2</sup>/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 100802A 69 sec after the BAT trigger (Troja, *et al.*, *GCN Circ.* 11031). The dataset consists of 9 s of Windowed Timing (WT) settling mode, 795 s of WT mode, and 133.8 ks of Photon Counting (PC) mode observations.

Using 794 sec of XRT PC mode data and 2 UVOT images for GRB 100802A, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA( $J2000$ ) = 2.46489 deg (00h09m52.44s), Dec( $J2000$ ) = +47.75479 deg (47d45'17.3") with an uncertainty of 2.0 arcsec (radius, 90% confidence; Evans, *et al.*, *GCN Circ.* 11036).

The 0.3-10 keV light curve (Fig. 2) shows an initial power-law decay with an index of  $\alpha = 1.64 \pm 0.03$  and a large flare peaking at  $T + 515$  sec, which is consistent with a BAT peak (Baumgartner, *et al.*, *GCN Circ.* 11035). After the first orbit the light curve flattens to an index of  $0.23 \pm 0.23$  and breaks at  $\sim T + 34$  ks to a final decay index of  $0.69 \pm 0.08$ .

A spectrum formed from the WT mode data can be fit with an absorbed power-law with a photon index of  $1.88 \pm 0.03$  and a column density  $N_H = (1.93 \pm 0.09) \times 10^{21}$  cm<sup>-2</sup>, in excess of the Galactic value of  $9.7 \times 10^{20}$  cm<sup>-2</sup> (Kalberla *et al.* 2005). The PC mode spectrum spanning from 4.1 ksec to

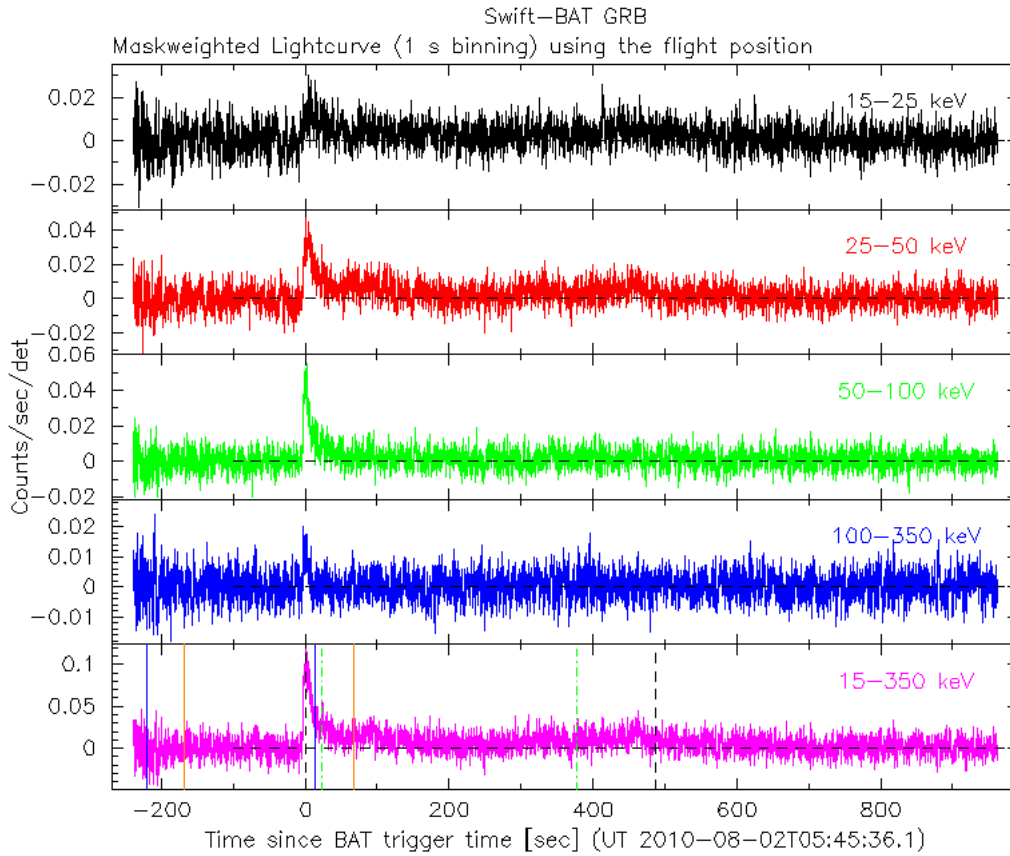


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector.

24 *ksec* has a photon index of  $2.21^{+0.23}_{-0.33}$  and a column density of  $1.39^{+0.82}_{-0.42} \times 10^{21} \text{ cm}^{-2}$ . The counts to observed (unabsorbed) flux conversion factor deduced from this spectrum is 1 count/sec =  $3.5 \times 10^{-11}$  ( $5.2 \times 10^{-11}$ ) *ergs/cm<sup>2</sup>/sec*.

## 4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 100802A 88 *sec* after the BAT trigger (Troja, *et al.*, *GCN Circ.* 11031). UVOT took a finding chart exposure of 150 seconds with the White filter starting 88 seconds after the BAT trigger and a finding chart exposure of 250 seconds with the U filter starting 301 seconds after the BAT trigger.

A new optical source was found by UVOT (Siegel, *et al.*, *GCN Circ.* 11032) in the early White and U filter exposures. The position of the source is: RA(*J*2000) = 2.46862 *deg* (00h09m52.47s), Dec(*J*2000) = +47.75531 *deg* (47d45'19.1") with an uncertainty of 0.8 arcsec (radius, 90% confidence). The UVOT magnitudes of the detections and  $3\sigma$  upper limits are reported in Table 1.

The quoted values have not been corrected for the expected Galactic extinction along the line of sight, corresponding to a reddening of  $E_{B-V} = 0.12$  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).

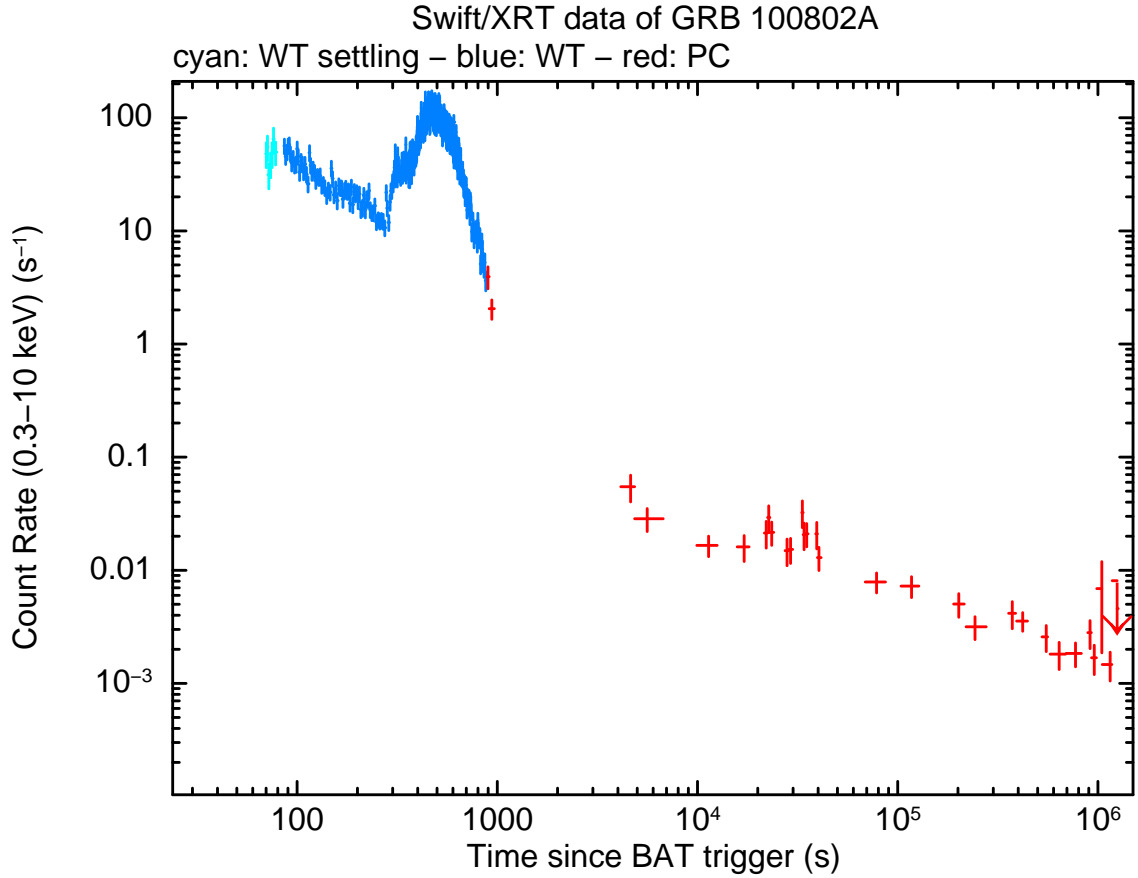


Figure 2: XRT light curve. Counts/sec in the 0.3-10 keV band: Windowed Timing settling mode (cyan), Windowed Timing mode (blue), Photon Counting mode (red). The approximate counts to observed (unabsorbed) flux conversion factor is  $1 \text{ count/sec} = 3.5 \times 10^{-11}$  ( $5.2 \times 10^{-11}$ )  $\text{ergs/cm}^2/\text{sec}$ .

Filter	Start	Stop	Exposure	Mag
white (FC)	89	238	147	$20.7 \pm 0.24$
u (FC)	301	551	246	$19.57 \pm 0.22$
white	581	5566	327	$21.85 \pm 0.48$
v	632	5977	432	$>20.6$
b	557	6754	388	$>21.2$
u	706	6593	412	$>20.92$
w1	682	6388	432	$>20.9$
m2	657	6183	432	$>20.6$
w2	608	5772	432	$>21.0$

Table 1: Magnitudes from UVOT observations