

## Swift Observations of GRB 100305A

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### 1 Introduction

The Swift/BAT triggered and located GRB 100305A (Trigger 414905) at 09:05:38 UT (Troja, *et al.*, *GCN Circ.* 10470). This was an image trigger on a burst with  $T_{90} = 69.7$  sec. Swift slewed immediately to the burst, XRT and UVOT began follow-up observations at  $T + 139.3$  sec and  $T + 144$  sec respectively.

Our best position is the XRT enhanced position (Osborne, *et al.*, *GCN Circ.* 10474): RA( $J2000$ ) =  $168.36691$  deg ( $11h13m28.06s$ ), Dec( $J2000$ ) =  $+42.40393$  deg ( $42d24'14.1''$ ) with an uncertainty of 1.7 arcsec (radius, 90% confidence).

A faint optical afterglow was identified by Gemini-N observations (Cucchiara, *et al.*, *GCN Circ.* 10473, *GCN Circ.* 10478).

### 2 BAT Observation and Analysis

Using the data set from  $T - 239$  to  $T + 963$  sec, further analysis of BAT GRB 100305A has been performed by the Swift team (Krimm, *et al.*, *GCN Circ.* 10479). The BAT ground-calculated position is RA( $J2000$ ) =  $168.373$  deg ( $11h13m29.5s$ ), Dec( $J2000$ ) =  $42.381$  deg ( $42d22'50.7''$ ) with an uncertainty of 1.9 arcmin (radius, sys+stat, 90% containment). The partial coding was 22%.

The mask-weighted light curve (Fig. 1) shows a broad structure of two overlapping peaks beginning at  $T + 0$  sec and continuing to  $T + 80$  sec with the highest peak at  $T + 60$  sec. There is soft, low-level emission extending to  $\sim T + 200$  sec.  $T_{90}$  (15-350 keV) is  $69.7 \pm 8.7$  sec (estimated error including systematics).

The time-averaged spectrum from  $T - 9.2$  to  $T + 70.3$  sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is  $1.27 \pm 0.23$ . The fluence in the 15-150 keV band is  $(1.5 \pm 0.2) \times 10^{-6}$  ergs/cm<sup>2</sup>. The 1-sec peak photon flux measured from  $T + 62.72$  sec in the 15-150 keV band is  $0.9 \pm 0.3$  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 100305A 139.3 sec after the BAT trigger (Troja, *et al.*, *GCN Circ.* 10470). The dataset consists of 8 s of Windowed Timing (WT) settling mode, 74 s of WT mode, and 69 ks of Photon Counting (PC) mode observations.

Using 2448 sec of XRT PC mode data and 6 UVOT images for GRB 100305A, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA( $J2000$ ) =  $168.36691$  deg ( $11h13m28.06s$ ), Dec( $J2000$ ) =  $+42.40393$  deg ( $42d24'14.1''$ ) with an uncertainty of 1.7 arcsec (radius, 90% confidence; Osborne, *et al.*, *GCN Circ.* 10474). This position lies 4.5 arcsec from the optical afterglow (Cucchiara, *et al.*, *GCN Circ.* 10473).

The 0.3-10 keV light curve (Fig. 2) shows an initial steep power-law decay with an index of  $\alpha=5.1 \pm 0.5$ . After the first orbit, the lightcurve flattens to an index of  $0.70 \pm 0.10$  and breaks at  $T + 13500$  sec to a steeper decay index of  $2.14 \pm 0.17$ .

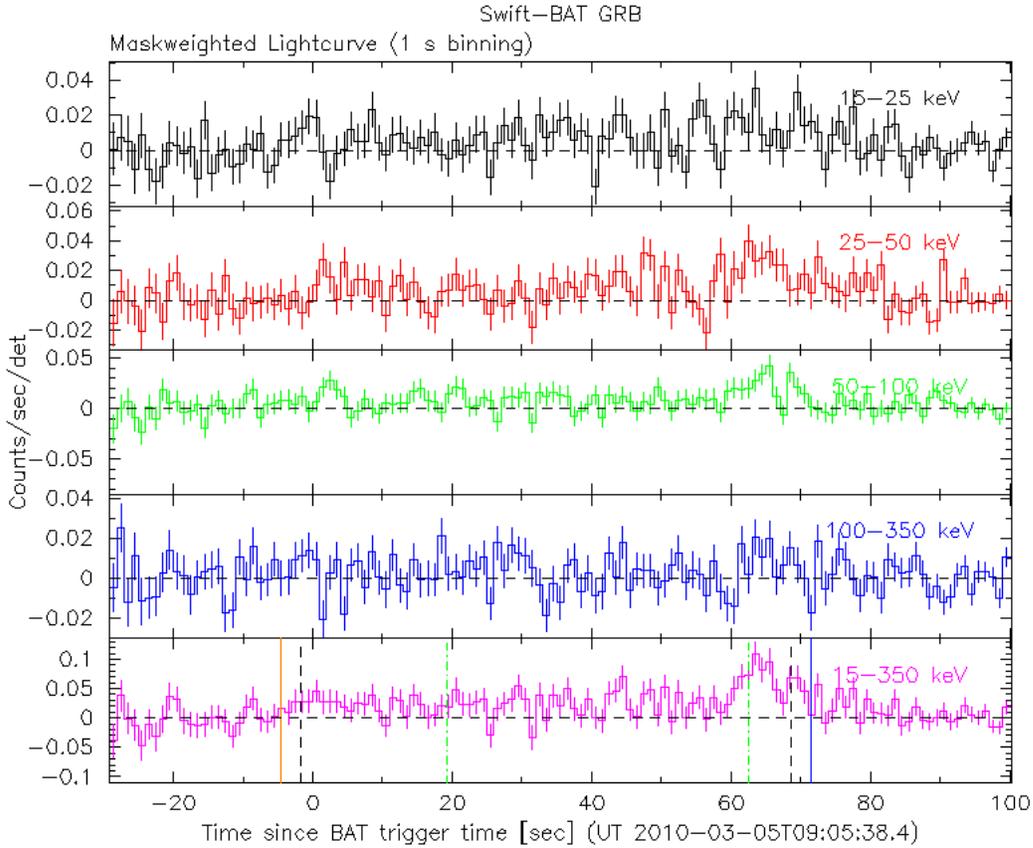


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector.

A spectrum formed from the WT mode data can be fit with an absorbed power-law with a photon index of  $1.96^{+0.21}_{-0.20}$  and a column density  $N_H = (1.7 \pm 0.5) \times 10^{21} \text{ cm}^{-2}$ , in excess of the Galactic value of  $2.1 \times 10^{20} \text{ cm}^{-2}$  (Kalberla et al. 2005). The PC mode spectrum has a photon index of  $2.14^{+0.24}_{-0.20}$  and a column density of  $1.7^{+0.6}_{-0.3} \times 10^{21} \text{ cm}^{-2}$ . The approximate counts to observed (unabsorbed) flux conversion factor is  $1 \text{ count/sec} = 3.8 \times 10^{-11} \text{ (} 5.8 \times 10^{-11} \text{) ergs/cm}^2\text{/sec}$ .

## 4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 100305A 144s after the BAT trigger (Siegel, *et al.*, *GCN Circ.* 10477). Data summed from the first and second orbits do not reveal a source at the enhanced position of the X-ray afterglow (Osborne, *et al.*, *GCN Circ.* 10474) or at the position of the optical afterglow (Cucchiara, *et al.*, *GCN Circ.* 10473). UVOT  $3\sigma$  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  $E_{B-V} = 0.01 \text{ mag}$  (Schlegel et al. 1998, *ApJ*, 500, 525). All photometry is on the UVOT photometric system described in Poole et al. (2008, *MNRAS*, 383, 627).

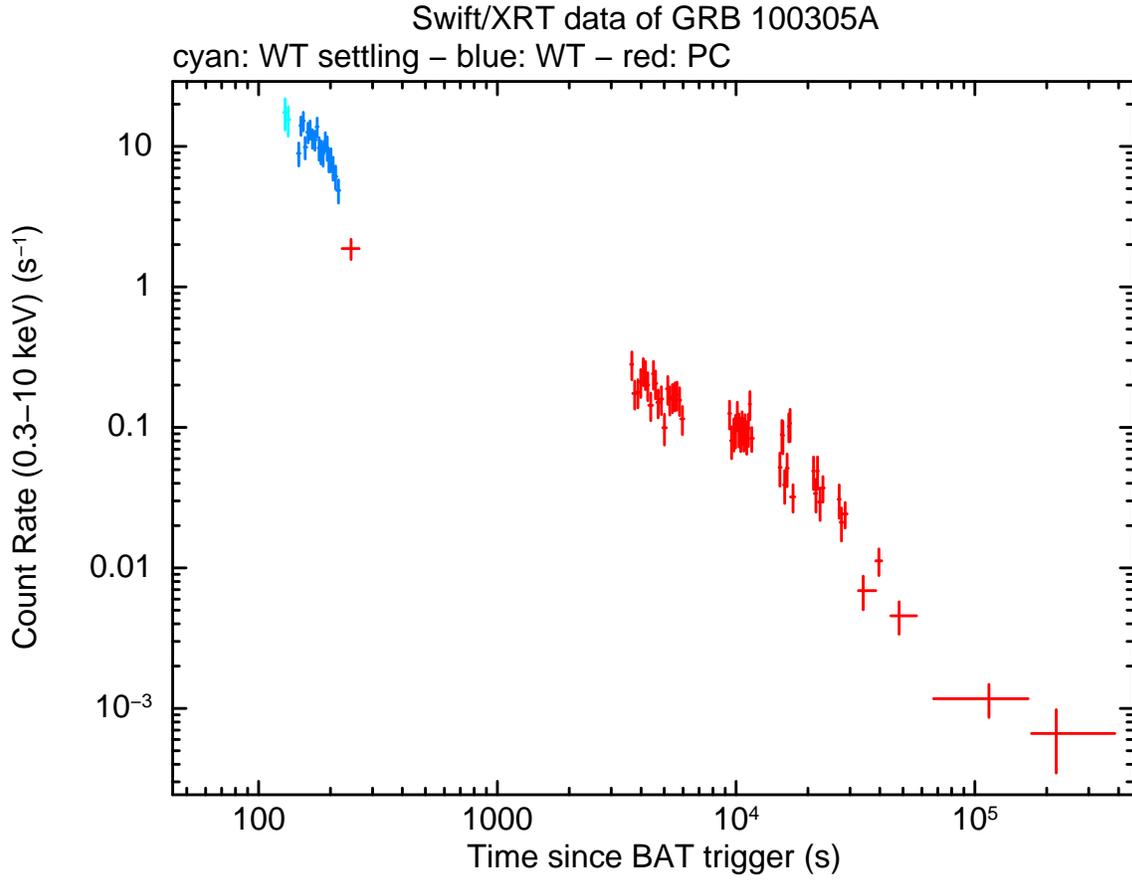


Figure 2: XRT light curve. Counts/sec in the 0.3-10 keV band: Windowed Timing settling mode (cyan), Windowed Timing mode (blue), Photon Counting mode (red). The approximate counts to observed (unabsorbed) flux conversion factor is 1 count/sec =  $3.8 \times 10^{-11}$  ( $5.8 \times 10^{-11}$ ) *ergs/cm<sup>2</sup>/sec*.

Filter	Start	Stop	Exposure	$3\sigma$ UL
white (FC)	144	266	120	> 20.60
white	4636	4836	196	> 21.10
v	3612	5247	393	> 19.85
b	4432	6048	373	> 20.68
u	4227	5863	393	> 20.45
uvw1	4022	5656	393	> 20.46
uvm2	3817	5451	393	> 20.2
uvw2	4842	5042	196	> 20.17

Table 1: Magnitude limits from UVOT observations