

# Swift Observations of GRB 121001A

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## 1 Introduction

The Swift BAT triggered on and located GRB 121001A at 18:23:02 UT (trigger=535026) (D'Elia et al., GCN Circ. 13831). Swift slewed immediately to the burst. XRT and UVOT observations of the field started 111 and 130 seconds after the trigger, respectively. The best Swift position is the XRT localization at RA(J2000)= 276.03227 deg, Dec(J2000)=  $-5.66587$  deg, RA(J2000)=  $12^{\text{h}}24^{\text{m}}7.74^{\text{s}}$ , Dec(J2000)=  $-05^{\text{d}}39'57.1''$ , with an error radius of 1.8 arcsec (90% confidence).

The optical afterglow was not detected by UVOT. Ground based facilities reported the afterglow detection and fading (Andreev et al., GCN Circ. 13833, Tello et al., GCN Circ. 13835, Schmidl et al., GCN Circ. 13840).

## 2 BAT Observations and Analysis

Using the data set from  $T - 60$  to  $T + 243$  s (Sakamoto et al., GCN Circ. 13836), the BAT ground-calculated position is RA, Dec(J2000) = 276.029,  $-5.667$  deg, which is RA(J2000) =  $18^{\text{h}}24^{\text{m}}09.9^{\text{s}}$  Dec(J2000) =  $-05^{\text{d}}40'01.0''$  with an uncertainty of 3.0 arcmin, (radius, sys+stat, 90% containment). The partial coding was 100%.

The light curve (Figure 1) shows a FRED-like profile starting at  $\sim T - 25$  s rising to a maximum at  $\sim T + 15$  s and gradually decaying to background near  $\sim T + 130$  s.  $T_{90}$  (15 – 350 keV) is  $147 \pm 24$  s (estimated error including systematics).

The time-averaged spectrum from  $T - 30$  to  $T + 143$  s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is  $1.34 \pm 0.15$ . The fluence in the 15 – 150 keV band is  $(1.7 \pm 0.2) \times 10^{-6}$  erg/cm<sup>2</sup>. The 1-sec peak photon flux measured from  $T + 3.27$  s in the 15 – 150 keV band is  $0.5 \pm 0.1$  ph/cm<sup>2</sup>/s. All the quoted errors are at the 90% confidence level.

The results of the batgrbproduct analysis are available at [http://gcn.gsfc.nasa.gov/notices\\_s/535026/BA/](http://gcn.gsfc.nasa.gov/notices_s/535026/BA/)

## 3 XRT Observations and Analysis

Swift-XRT began observing the field of GRB 121001A at 18:24:53 UT, 111 seconds after the BAT trigger (D'Elia et al., GCN Circ. 13831, Evans, GCN Circ. 13837, D'Elia & Evans, GCN Circ. 13838).

Using 2340 s of XRT Photon Counting mode data and 3 UVOT images for GRB 121001A, the astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA(J2000)= 276.03227 deg, Dec(J2000)=  $-5.66587$  deg, RA(J2000)=  $18^{\text{h}}24^{\text{m}}7.74^{\text{s}}$ , Dec(J2000)=  $-05^{\text{d}}39'57.1''$ , with an uncertainty of 1.8 arcsec (radius, 90% confidence).

We analyzed 9.1 ks of XRT data for GRB 121001A (D'Elia & Evans, GCN Circ. 13838), from 111 s to 59.6 ks after the BAT trigger. The data comprise 93 s in Windowed Timing (WT) mode (the first 8 s were taken while Swift was slewing) with the remainder in Photon Counting (PC) mode. The enhanced XRT position for this burst was given by Evans (GCN. Circ. 13837).

The 0.3–10 keV light curve (Figure 2) can be modelled with a power-law decay with a decay index of  $\alpha_1 = 1.29 \pm 0.04$ .

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of  $\Gamma = 1.28^{+0.25}_{-0.24}$  and a best-fitting absorption column of  $N_H = 3.5^{+3.1}_{-2.5} \times 10^{21} \text{ cm}^{-2}$ , in excess of the Galactic value of  $N_H = 4.5 \times 10^{21} \text{ cm}^{-2}$  (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from the PC spectrum is  $7.6 \times 10^{-11}$  ( $9.9 \times 10^{-11}$ )  $\text{erg cm}^{-2} \text{ count}^{-1}$ .

All the quoted errors are at the 90% confidence level.

## 4 UVOT Observation and Analysis

The UVOT observed the field of GRB 121001A settling 130 s after the BAT trigger (Marshall & D’Elia, GCN Circ. 13839).

No optical afterglow consistent with the enhanced XRT position (Evans, GCN Circ. 13837) is detected in the initial UVOT exposures. Preliminary 3-sigma upper limits for detecting a source in the finding charts and in the following exposures are listed 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  $E_{(B-V)} = 1.36 \text{ mag}$  (Schlegel, et al., 1998, ApJS, 500, 525). All photometry is on the UVOT photometric system described in Breeveld et al. (2011, AIP Conf. Proc. 1358, 373).

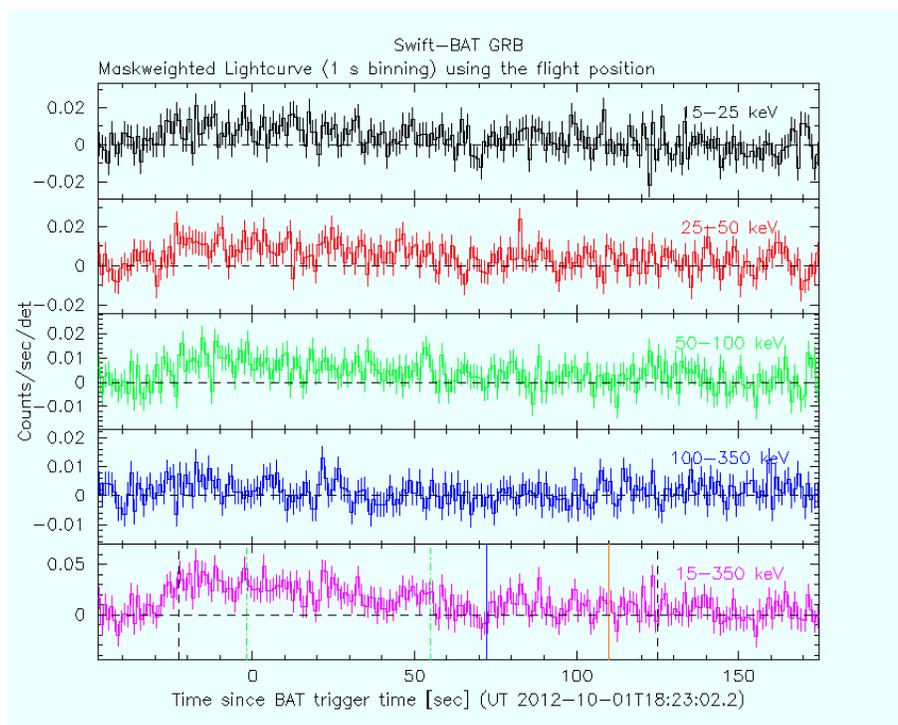


Figure 1: BAT light-curve. The mask-weighted light curve in the 4 individual plus total energy bands. Green dashed lines:  $T_{90}$ . Black: Slew start/stop. The units are  $\text{counts s}^{-1} \text{ illuminated-detector}^{-1}$  (note illum-det =  $0.16 \text{ cm}^2$ ).

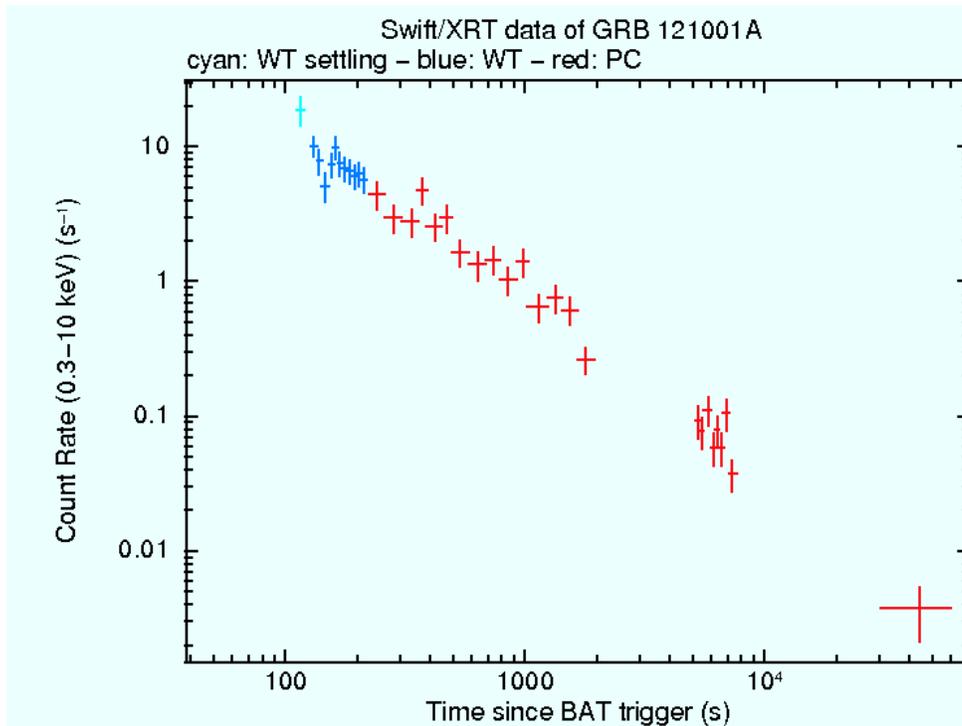


Figure 2: XRT Light curve. Count rate in the 0.3 - 10 keV band is plotted with Window Timing (WT) Settling data in light blue, WT mode data in blue and Photon Counting (PC) mode data in red. The approximate conversion is  $1 \text{ count/s} \sim 9.9 \times 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1}$ .

Filter	T_start (s)	T_stop (s)	Exp (s)	Mag
white (fc)	130	280	147	> 21.0
U (FC)	288	538	246	> 20.0
white	130	7415	824	> 22.4
v	618	6390	352	> 20.2
b	544	7210	526	> 21.2
u	288	7005	756	> 20.7
uvw1	668	6800	529	> 20.4
uvw2	767	7608	439	> 21.1

Table 1: 3-sigma upper limits from UVOT observations.