Swift Observations of GRB 121102A

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1   Introduction

The Swift BAT triggered on and located GRB 121102A at 02:27:02 UT (trigger=537266) (D'Elia et al., GCN Circ. 13938). Swift slewed immediately to the burst. XRT and UVOT observations of the field started 47.7 and 57 seconds after the trigger, respectively. The best Swift position is the XRT localization at RA(J2000)= 270.90091 deg, Dec(J2000)= -16.95790 deg, RA(J2000)= $18^h03^m36.22^s$, Dec(J2000)= $-16° 57' 28.4"$, with an error radius of 1.4 arcsec (90% confidence).

The optical afterglow was not detected by UVOT. No ground based facilities reported the detection of the optical afterglow, possibly due to a very small sun angle (52^d). The X-ray afterglow was also detected by INTEGRAL/IBIS (Mereghetti et al., GCN Circ 13939).

2   BAT Observations and Analysis

Using the data set from $T-61$ to $T+243$ s (Baumgartner et al., GCN Circ. 13942), the BAT ground-calculated position is RA, Dec(J2000) = 270.896, -16.951 deg, which is RA(J2000) = $18^h03^m35.1^s$ Dec(J2000) = $-16^d57'03.4"$ with an uncertainty of 1.0 arcmin, (radius, sys+stat, 90% containment). The partial coding was 100%.

The light curve (Figure 1) shows a FRED peak starting at $\sim T-0.2$ s peaking at $\sim T+6$ s and ending at $\sim T+95$ s. T_{90} ($15-350$ keV) is 24.7 ± 3.4 s (estimated error including systematics).

The time-averaged spectrum from $T-0.30$ to $T+35.25$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.88 ± 0.07. The fluence in the $15-150$ keV band is $(1.9 \pm 0.1) \times 10^{-6}$ erg/cm^2. The 1-sec peak photon flux measured from $T+5.68$ s in the $15-150$ keV band is 2.3 ± 0.2 ph/cm^2/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/537266/BA/

3   XRT Observations and Analysis

Swift-XRT began observing the field of GRB 121102A at 02:27:50 UT, 47.7 seconds after the BAT trigger (D'Elia et al., GCN Circ. 13938, Osborne et al., GCN Circ. 13945, Pagani et al., GCN Circ. 13943).

Using 6688 s of XRT Photon Counting mode data and 8 UVOT images for GRB 121102A, the astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA(J2000)= 270.90091 deg, Dec(J2000)= -16.95790 deg, RA(J2000)= $18^h03^m36.22^s$, Dec(J2000)= $-16^d 57' 28.4"$, with an uncertainty of 1.4 arcsec (radius, 90% confidence).

We analyzed 9.0 ks of XRT data for GRB 121102A (Pagani et al., GCN Circ. 13943), from 53 s to 18.8 ks after the BAT trigger. The data comprise 203 s in Windowed Timing (WT) mode with the remainder in Photon Counting (PC) mode. The enhanced XRT position for this burst was given by Osborne et al. (GCN. Circ. 13945).

The 0.3–10 keV light curve (Figure 2) can be modelled with a series of power-law decays. The initial

decay index $\alpha_1 = 3.33^{+0.22}_{-0.24}$. At $T + 111$ s the decay flattens to $\alpha_2 = 1.59^{+0.18}_{-0.11}$ before breaking again at $T + 696$ s to a final decay with index $\alpha_3 = 1.04^{+0.08}_{-0.07}$.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of $\Gamma = 1.74^{+0.23}_{-0.22}$ and a best-fitting absorption column of $N_H = 7.7^{+1.9}_{-1.6} \times 10^{21}$ cm^{-2}, in excess of the Galactic value of $N_H = 5.3 \times 10^{21}$ cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) $0.3-10$ keV flux conversion factor deduced from the PC spectrum is 5.9×10^{-11} (9.6×10^{-11}) erg cm^{-2} count^{-1}.

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

4   UVOT Observation and Analysis

The UVOT observed the field of GRB 121102A settling 130 s after the BAT trigger (Oates & D'Elia, GCN Circ. 13948).

No optical afterglow consistent with the enhanced XRT position (Osborne et al., GCN Circ. 13945) 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 $E_{(B-V)} = 1.48$ 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).
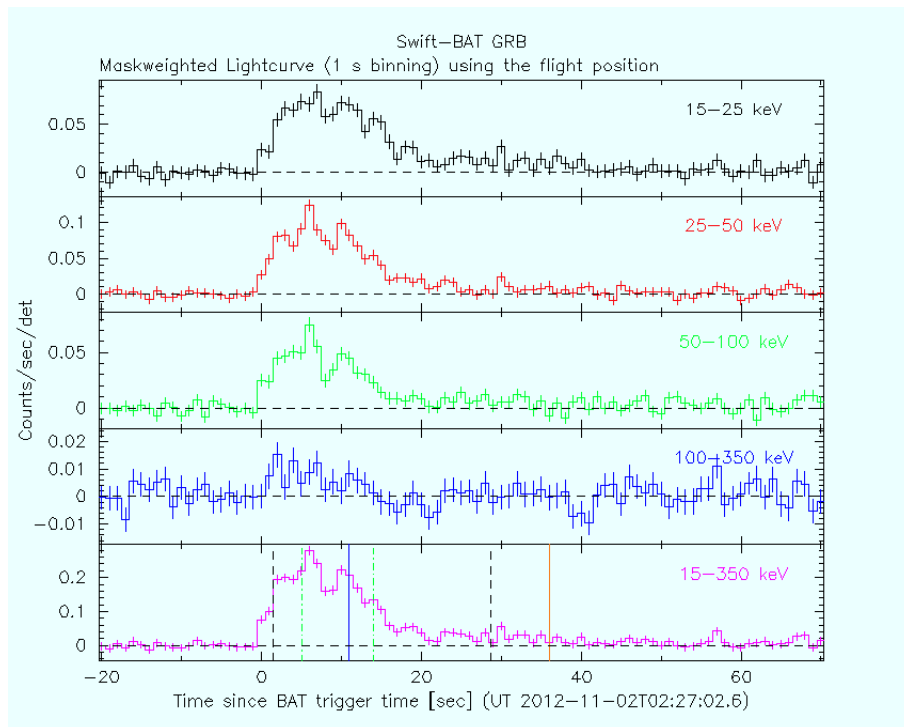

Figure 1: BAT light-curve. The mask-weighted light curve in the 4 individual plus total energy bands. Green dashed lines: T_{90}. Black: Slew start/stop. The units are counts s^{-1} illuminated-detector^{-1} (note illum-det = 0.16 cm^2).
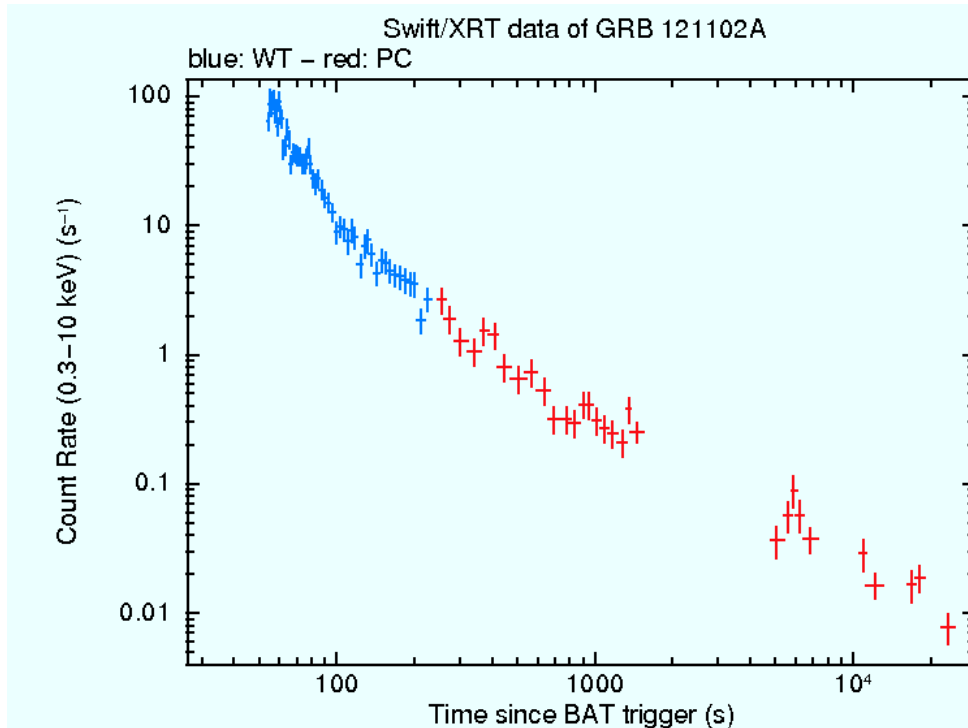
Figure 2: XRT Light curve. Count rate in the 0.3 - 10 keV band is plotted with Window Timing (WT) Settling data in light blue, WT mode data in blue and Photon Counting (PC) mode data in red. The approximate conversion is 1 count/s $\sim 9.9 \times 10^{-11}$ erg cm^{-2} s^{-1}.

Filter	T_start (s)	T_stop (s)	Exp (s)	Mag
white (fc)	58	207	147	> 20.1
U (FC)	270	519	246	> 19.6
white	58	24618	2113	> 21.4
v	4994	17253	1278	> 20.0
b	5814	23858	2022	> 21.4
u	270	22945	1524	> 20.9
uvw1	5404	18848	1066	> 20.8
m2	5200	18158	1279	> 21.1
uvw2	4789	13077	1073	> 21.2

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