Swift Observations of GRB 120121A

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1 Introduction

BAT triggered on GRB 120121A at 09:42:19 UT (trigger number 512164; Page et al. GCN Circ. 12885), slewing immediately. Following a short delay caused by a telemetry backlog, an afterglow was detected by the XRT in the downlinked SPER data. The best *Swift* position (Evans et al., GCN Circ. 12888) is that derived by using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue to correct the X-ray location astrometrically: RA, Dec(J2000) = $16^h 37^m 25.03^s$, $-23^o 57' 41.2"$, with an estimated uncertainty of 1.6 arcsec (radius, 90% confidence).

The only reported ground-based follow-up came from the ISON-NM observatory (Elenin et al., GCN Circ. 12887), with no optical counterpart being detected.

2 BAT Observation and Analysis

Using the data set from T-239 to T+963 s further analysis of BAT GRB 120121A has been performed by Swift team (Barthelmy et al., GCN Circ. 12889). The BAT ground-calculated position is RA, Dec = 249.363, -23.963 deg which is equivalent to

RA(J2000) = $16^h 37^m 27.1^s$
Dec(J2000) = $-23^o 57' 45.9"$

with an uncertainty of 1.4 arcmin, (radius, sys+stat, 90% containment). The partial coding was 70%.

The mask-weighted light curve (Fig. 1) shows several overlapping peaks starting at $\sim$ T-10 s, peaking at $\sim$ T$+2$ s, and ending at $\sim$ T$+70$ s. T$_{90}$ (15-350 keV) is 26.1 $\pm$ 3.1 s (estimated error including systematics).

The time-averaged spectrum from T-11.00 to T$+18.33$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is $\Gamma = 1.23 \pm 0.13$. The fluence in the 15–150 keV band is $(1.1 \pm 0.1) \times 10^{-6}$ erg cm^{-2}. The 1-s peak photon flux measured from T$+2.86$ s in the 15–150 keV band is 0.7 ± 0.2 ph cm^{-2} s^{-1}. 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/512164/BA/.

3 XRT Observations and Analysis

The XRT began observing the burst 119.4 s after the trigger (Page, GCN Circ. 12890). Using 1511 s of XRT Photon Counting mode data and 2 UVOT images, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 249.35431, -23.96145 which is equivalent to:

RA(J2000): $16^h 37^m 25.03^s$
Dec(J2000): $-23^o 57' 41.2"$

with an uncertainty of 1.6 arcsec (radius, 90% confidence).

The light curve (Fig. 2) can be modelled with a simple power-law with a decay index of $\alpha = 0.90^{+0.07}_{-0.06}$. A doubly-broken power-law model is only significant at the 98% confidence level.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index, $\Gamma = 2.5^{+0.7}_{-0.6}$. The best-fitting absorption column is $(3.0^{+1.2}_{-1.0}) \times 10^{22}$ cm^{-2}, in excess of the Galactic value of 1.2×10^{21} cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 7.5×10^{-11} (2.0×10^{-10}) erg cm^{-2} count^{-1}.

The results of the XRT-team automatic analysis are available at
http://www.swift.ac.uk/xrt_products/00512164.

4   UVOT Observation and Analysis

The UVOT began settled observations of the field of GRB 120121A 124 s after the BAT trigger (Marshall & Page, GCN Circ. 12891). No optical afterglow consistent with the XRT position is detected in the initial UVOT exposures. 3σ upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc. 1358, 373) for the first finding chart (FC) exposure and subsequent exposures are summarised in Table 1. The magnitudes in the table are not corrected for the Galactic extinction due to the reddening of E(B-V) = 0.87 in the direction of the burst (Schlegel et al. 1998).

Filter	Start (s since trigger)	Stop (s since trigger)	Exposure (s)	3σ UL
white FC	124	273	147	>20.2
u FC	336	585	246	>19.7
white	124	6777	673	>21.1
v	664	7188	510	>18.9
b	591	13219	1160	>20.2
u	336	18998	2078	>20.2
w1	714	18281	2108	>20.4
m2	16474	17374	886	>20.1
w2	1020	23198	1298	>21.1

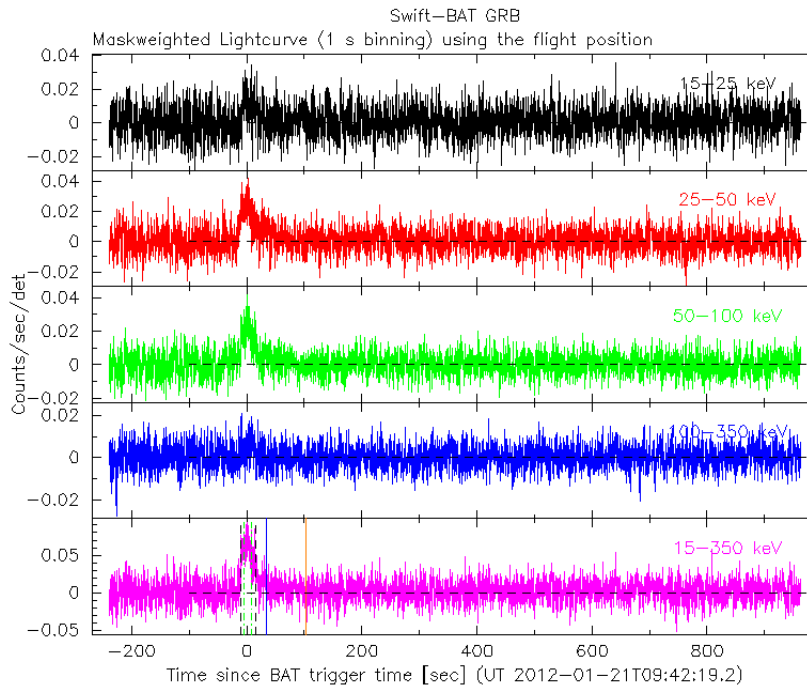Table 1: Magnitude limits from UVOT observations

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 (note illum-det = 0.16 cm^2) and T_0 is 09:42:19 UT.
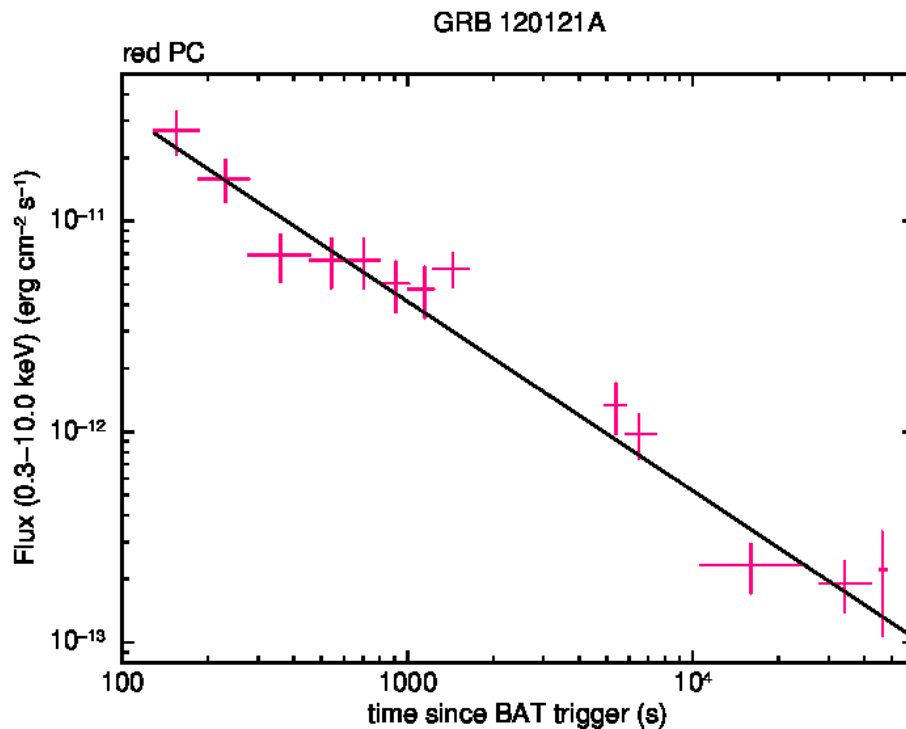

Figure 2: XRT light curve. Count rate light curve in the 0.3-10 keV band; all the data were collected in Photon Counting mode. The approximate conversion is 1 count s^{-1} = $\sim 7.5 \times 10^{-11}$ erg cm^{-2} s^{-1}.