

Swift Observation of GRB 120724A

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1 Introduction

At 06:39:02 UT, the *Swift* BAT triggered and located GRB 120724A (trigger=528443, D'Avanzo et al. *GCN Circ.* 13510). *Swift* slewed immediately to the burst. The BAT on-board calculated location is RA, Dec (282.045, +61.932) deg, which is:

$$\begin{aligned} \text{RA(J2000)} &= 16^h 20^m 46^s \\ \text{Dec(J2000)} &= +03^\circ 30' 33'' \end{aligned}$$

with an uncertainty of 3 arcmin (radius, 90% containment, including systematic uncertainty). The BAT light curve shows a multi-peaked structure with a duration of about 40 sec. The peak count rate was ~ 2000 counts/s (15 – 350 keV), at ~ 0 s after T_0 .

The XRT began observing the field at $T + 109.1$ seconds after the BAT trigger finding a bright, uncatalogued X-ray source with an enhanced position RA, Dec (245.18020, +3.50793) deg which is:

$$\begin{aligned} \text{RA(J2000)} &= 16^h 20^m 43.25^s \\ \text{Dec(J2000)} &= +03^\circ 30' 28.6'' \end{aligned}$$

with an uncertainty of 1.5'' (radius, 90% containment; Evans et al. *GCN Circ.* 13515) .

UVOT observations started 99.0 seconds after the BAT trigger (settled observations started at $T + 120$ s) finding an afterglow at a position RA, Dec (245.18062, +3.50772) deg which is:

$$\begin{aligned} \text{RA(J2000)} &= 16^h 20^m 43.35^s \\ \text{Dec(J2000)} &= +03^\circ 30' 27.8'' \end{aligned}$$

with an uncertainty of 0.77'' (radius, 90% containment; Holland et al. *GCN Circ.* 13516).

2 BAT Observation and Analysis

Using the data set from $T - 239$ to $T + 963$ s further analysis of BAT GRB 120724A has been performed by the *Swift* team (Krimm, et al., *GCN Circ.* 13517). The BAT ground-calculated position is RA, Dec = (245.193, +3.535) deg, which is

$$\begin{aligned} \text{RA(J2000)} &= 16^h 20^m 46.3^s \\ \text{Dec(J2000)} &= +03^\circ 32' 07.2'' \end{aligned}$$

with an uncertainty of 2.1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 50%.

The mask-weighted light curve shows (Fig.1) a single broad peak starting at roughly $T_0 - 30$ s, peaking at T_0 and extending until $T_0 + 100$ s. $T_{90}(15 - 350 \text{ keV})$ is 72.8 ± 16.4 s (estimated error including systematics).

The time-averaged spectrum from $T_0 - 21.3$ to $T_0 + 64.5$ s is best fit by a power law with an exponential cutoff. This fit gives a photon index 0.53 ± 1.53 , and E_{peak} of 27.6 ± 7.5 keV (chi squared 43.55 for 56 d.o.f.). For this model the total fluence in the 15-150 keV band is $6.8 \pm 1.1 \times 10^{-7}$ ergs/cm² and the 1-sec peak flux measured from $T_0 + 7.51$ sec in the 15-150 keV band is 0.6 ± 0.2 ph/cm²/sec. A fit to a simple power law gives a photon index of 2.45 ± 0.26 (chi squared 50.75 for 57 d.o.f.). All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The *Swift* XRT collected 11.4 ks of data for GRB 120724A, from 115 s to 24.5 ks after the BAT trigger. The data comprise 40 s in Windowed Timing (WT) mode with the remainder in Photon Counting (PC). The enhanced XRT position for this burst was given by Evans et al. (*GCN Circ.* 13515).

The light curve (Fig.2) can be modelled with an initial power-law decay with an index of $\alpha_1 = 2.72^{+0.26}_{-0.16}$, followed by a break at $T + 1010$ s to a decay with $\alpha_2 = 0.34^{+0.21}_{-0.39}$.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of $1.91^{+0.13}_{-0.13}$. The best-fitting absorption column is consistent with the Galactic value of $4.3 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3 – 10 keV flux conversion factor deduced from this spectrum is $3.7 \times 10^{-11} (4.1 \times 10^{-11}) \text{ erg cm}^{-2} \text{ count}^{-1}$.

4 UVOT Observation and Analysis

The *Swift* UVOT began settled observations of the field of GRB 120724A 120 s after the BAT trigger (Holland et al., *GCN Circ.* 13516). A faint afterglow was found at a position RA, Dec (245.18062, +3.50772) deg which is equivalent to:

$$\text{RA(J2000)} = 16^h 20^m 43.35^s$$

$$\text{Dec(J2000)} = +03^\circ 30' 27.8''$$

with a 90%-confidence error radius of $0.77''$. This position is slightly outside the UVOT-enhanced XRT error circle (Evans et al. *GCN Circ.* 13515). Preliminary magnitudes for this source, and 3σ upper limits for the finding charts (FC) and the co-added images, are reported in Tab. 1. The UVOT light curve is shown in Fig.3.

Filter	$T_{Start}(s)$	$T_{Stop}(s)$	Exposure (s)	Mag	Sigma
WHITE (FC)	118	267	147	> 21.3	
U (FC)	330	580	246	> 20.5	
WHITE (FC)	609	629	19	> 20.0	
V	660	18059	1370	20.92 ± 0.40	2.7
B	585	24556	1166	21.56 ± 0.36	3.1
U	330	23837	2290	21.74 ± 0.40	2.7
UVW1	709	22924	2046	> 21.7	
UVM2	684	18782	1924	> 21.6	
UVW2	635	17146	1376	> 21.6	
WHITE	118	6740	761	21.55 ± 0.23	4.7

Table 1: Magnitude and 3σ upper limits from UVOT observations of GRB 120724A . The values quoted above are not corrected for the Galactic extinction due to the reddening of $E_{B-V} = 0.05$ in the direction of the burst (Schlegel et al. 1998). Errors are at 1σ .

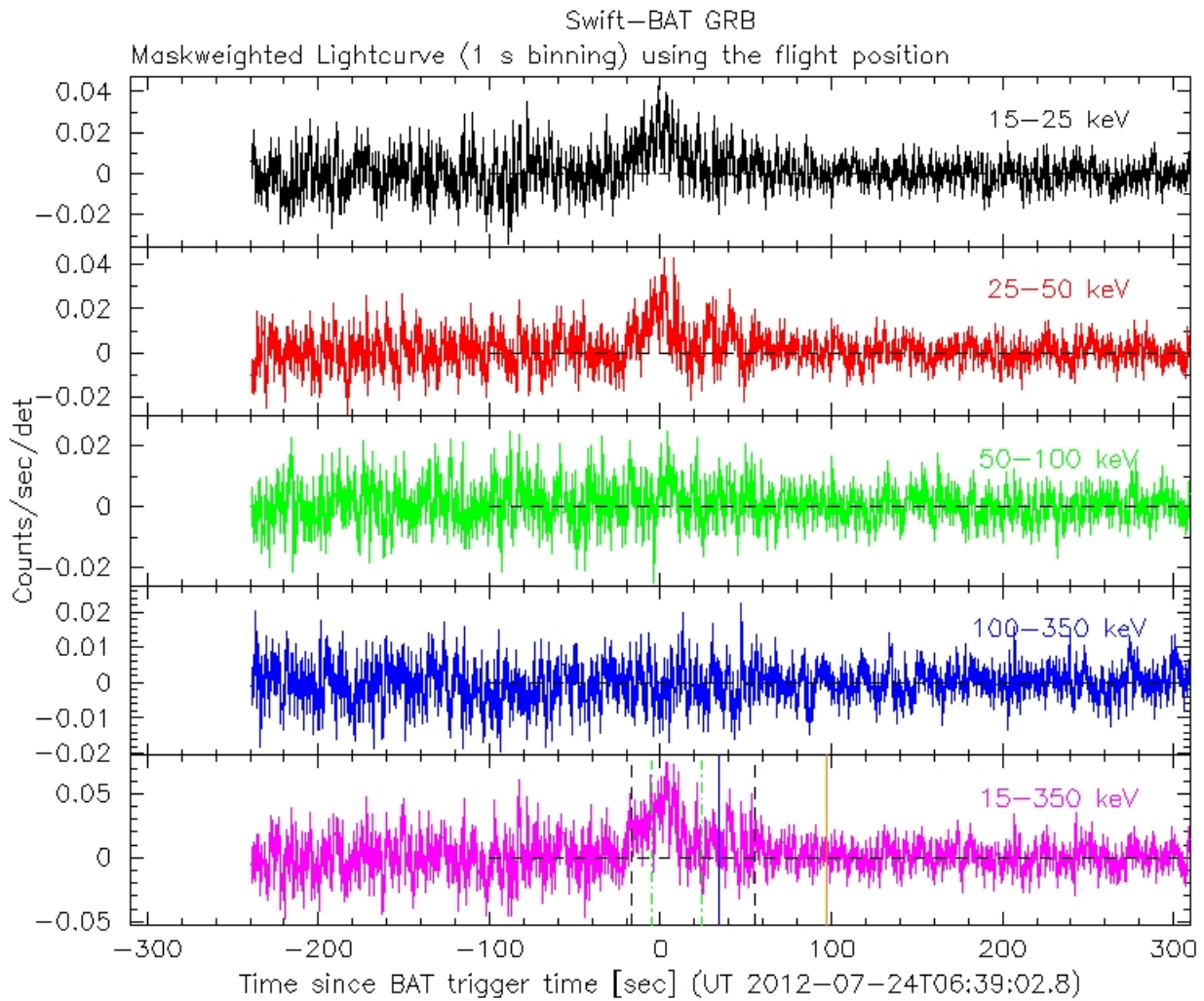


Figure 1: BAT Light curve of GRB 120724A. The mask-weighted light curve in the 4 individual plus total energy bands (15 - 25, 25 - 50, 50 - 100, 100 - 350 and 15 - 350 keV).

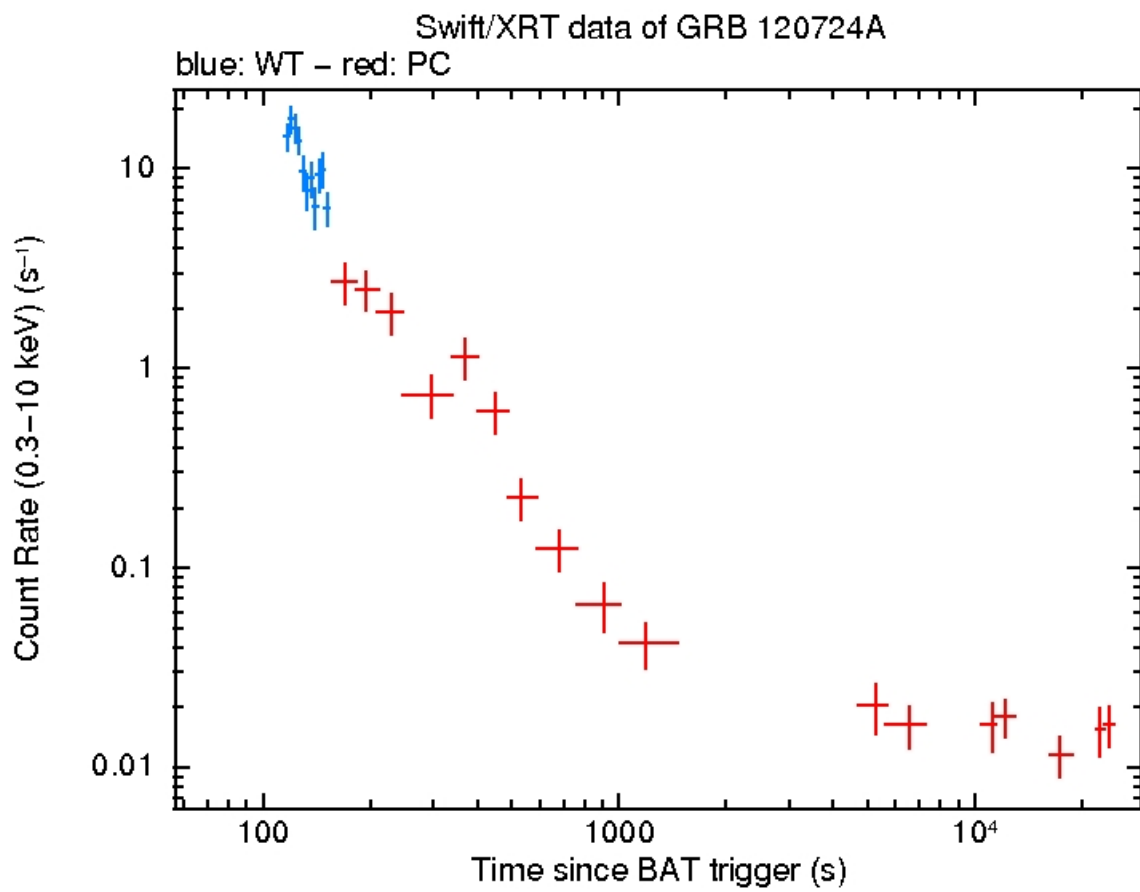


Figure 2: XRT Lightcurve of GRB 120724A.

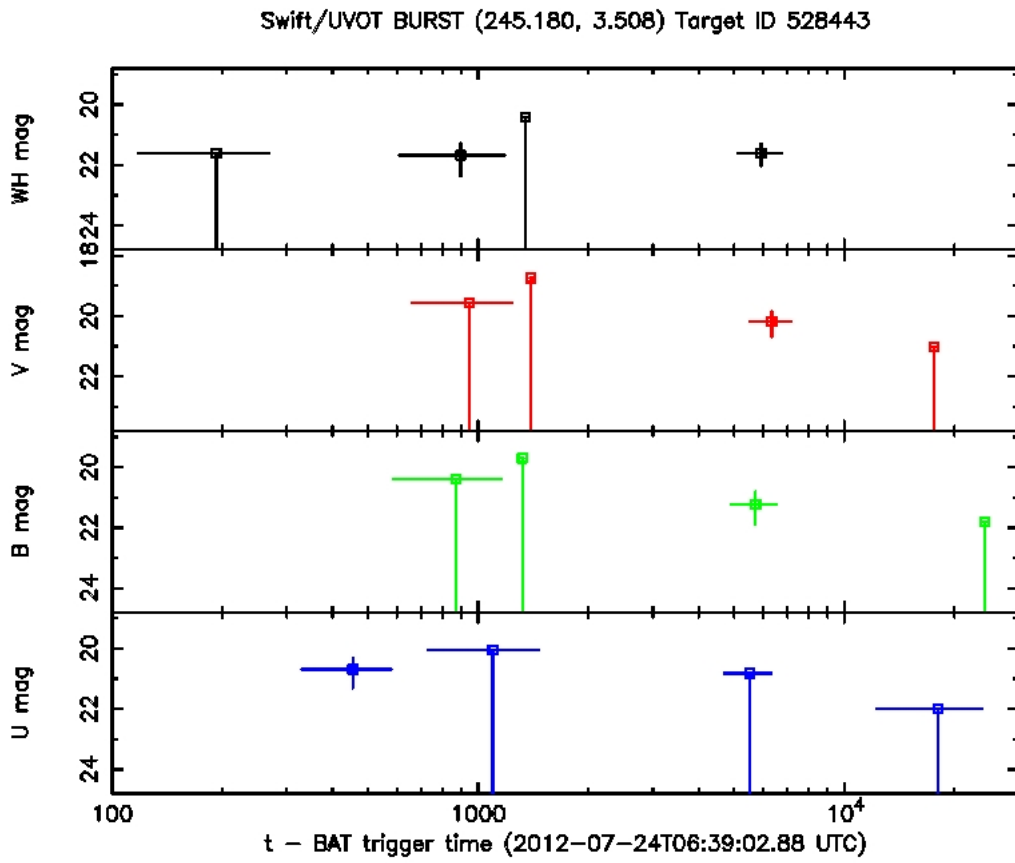


Figure 3: UVOT light curves of GRB 120724A