

Swift Observation of GRB 110530A

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1 Introduction

At 15:31:02 UT, the *Swift* BAT triggered and located GRB 110530A (trigger=454473, D'Avanzo et al. *GCN Circ.* 12046). *Swift* slewed after 7 minutes because of an observing constraint. The BAT on-board calculated location is RA, Dec (282.045, +61.932) deg, which is

$$\begin{aligned} \text{RA(J2000)} &= 18^h 48^m 11^s \\ \text{Dec(J2000)} &= +61^\circ 55' 54'' \end{aligned}$$

with an uncertainty of 3 arcmin (radius, 90% containment, including systematic uncertainty). The BAT light curve shows a single peak with a duration of about 20 sec. The peak count rate was ~ 2000 counts/s (15 – 350 keV), at ~ 2 s after T_0 .

The XRT began observing the field at $T + 434.0$ seconds after the BAT trigger finding a bright, uncatalogued X-ray source with an enhanced position RA, Dec (282.06843, +61.92897) deg which is equivalent to:

$$\begin{aligned} \text{RA(J2000)} &= 18^h 48^m 16.42^s \\ \text{Dec(J2000)} &= +61^\circ 55' 44.3'' \end{aligned}$$

with an uncertainty of 1.4'' (radius, 90% containment; Evans et al. *GCN Circ.* 12055)

UVOT took a finding chart exposure of 150 seconds with the White filter starting 438.0 seconds after the BAT trigger finding an afterglow with magnitude ~ 20.3 at a position consistent with the enhanced XRT error circle. No correction has been made for the expected extinction corresponding to E_{B-V} of 0.06.

2 BAT Observation and Analysis

Using the data set from $T - 61$ to $T + 242$ s further analysis of BAT GRB 110530A has been performed by the *Swift* team (Baumgartner, et al., *GCN Circ.* 12049). The BAT ground-calculated position is RA, Dec = (282.045, +61.953) deg, which is

$$\begin{aligned} \text{RA(J2000)} &= 18^h 48^m 10.8^s \\ \text{Dec(J2000)} &= +61^\circ 57' 11.2'' \end{aligned}$$

with an uncertainty of 2.3 arcmin, (radius, sys+stat, 90% containment). The partial coding was 98% (the bore sight angle was 16.0 deg).

The mask-weighted light curve shows (Fig.1) a single pulse starting at $\sim T - 50$ s with a slow rise, peaking at $\sim T + 2$ s, and ending at $\sim T + 15$ s. $T_{90}(15 - 350 \text{ keV})$ is 19.6 ± 3.1 s (estimated error including systematics).

The time-averaged spectrum from $T - 4.5$ to $T + 17.4$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 2.06 ± 0.24 . The fluence in the 15 – 150 keV band is $(3.3 \pm 0.5) \times 10^{-7}$ ergs/cm². The 1-sec peak photon flux measured from $T + 1.01$ s in the 15 – 150 keV band is 0.4 ± 0.1 ph/cm²/sec. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

We have analysed 84.9 ks of XRT data for GRB 110530A in Photon Counting (PC) mode, from 446 s to 707.7 ks after the BAT trigger. The enhanced XRT position for this burst was given by Evans et al. (*GCN Circ.* 12055).

The light curve (Fig.2) can be modelled with an initial power-law decay with an index of $\alpha_1 = 0.63_{-0.09}^{+0.10}$, followed by a break at $T + 7834$ s to a decay with $\alpha_2 = 1.14_{-0.07}^{+0.09}$.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of $2.30_{-0.17}^{+0.09}$. The best-fitting absorption column is $(2.8 \pm 0.5) \times 10^{21} \text{ cm}^{-2}$, in excess of the Galactic value of $5.6 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is $3.7 \times 10^{-11} (7.0 \times 10^{-11}) \text{ erg cm}^{-2} \text{ count}^{-1}$.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 110530A 438 s after the BAT trigger (Marshall et al., *GCN Circ.* 12057). A fading source consistent with the enhanced XRT position (Evans et al., *GCN Circ.* 12055) is detected in the initial UVOT exposures at the following coordinates RA, Dec (282.06833, +61.92913) which is equivalent to:

$$\text{RA(J2000)} = 18^h 48^m 16.40^s$$

$$\text{Dec(J2000)} = +61^\circ 55' 44.9''$$

with a 90%-confidence error radius of $0.65''$.

Detections and upper limits using the UVOT photometric system (Poole et al. 2008, MNRAS, 383, 627) are reported in Tab. 1. The UVOT light curve is shown in Fig.3.

Filter	$T_{Start}(s)$	$T_{Stop}(s)$	Exposure (s)	Mag
WHITE	438	586	147	20.30 ± 0.14
WHITE	865	1013	147	20.32 ± 0.14
WHITE	7071	8424	1091	21.48 ± 0.20
WHITE	12527	14211	1414	22.07 ± 0.25
WHITE	18287	35783	3953	> 22.88
WHITE	35787	43138	2461	> 22.83

Table 1: Magnitude and 2σ upper limits from UVOT observations of GRB 110530A . The values quoted above are not corrected for the Galactic extinction due to the reddening of $E_{B-V} = 0.06$ in the direction of the burst (Schlegel et al. 1998). Errors are at 1σ .

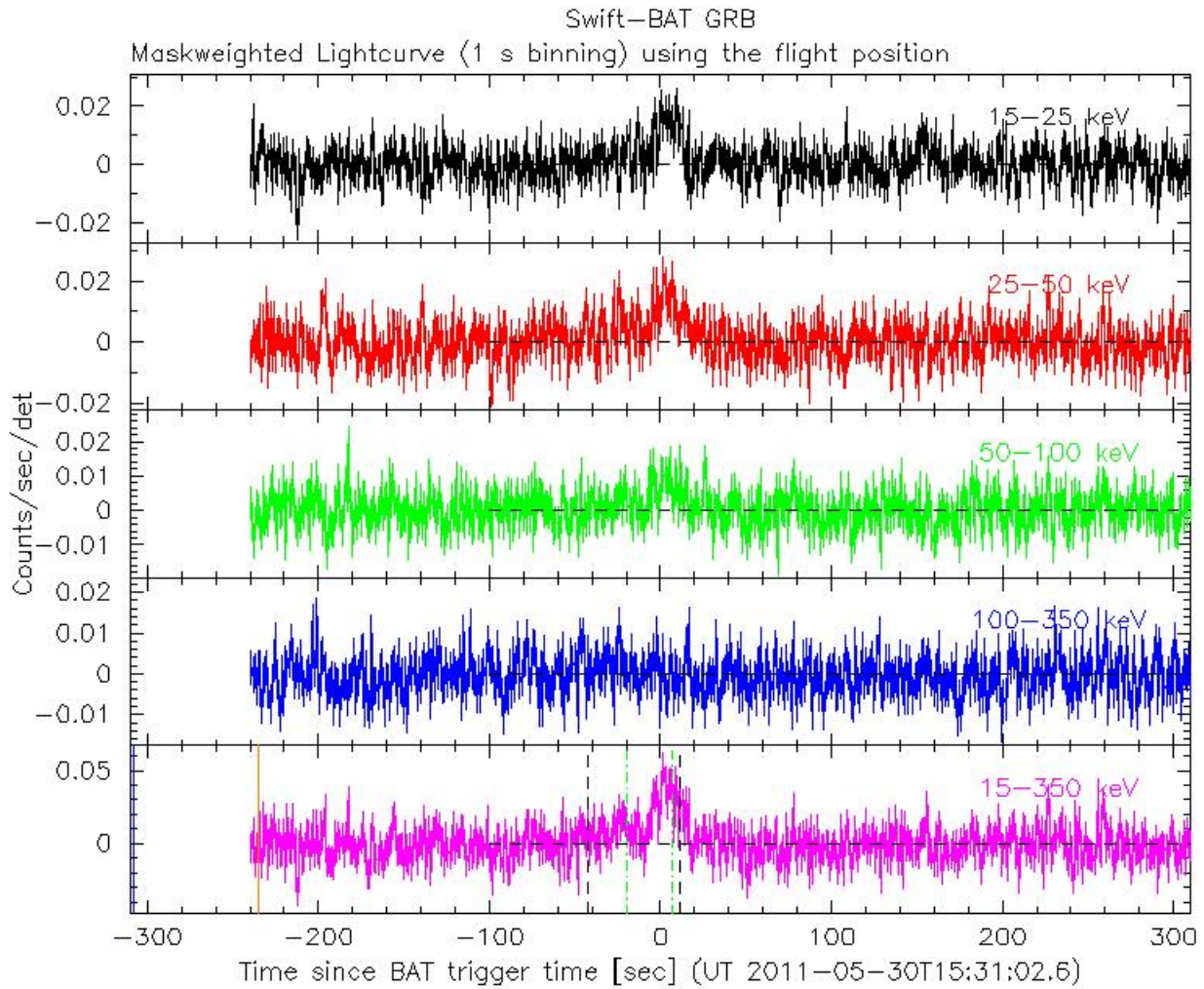


Figure 1: BAT Light curve of GRB 110530A. The mask-weighted light curve in the 4 individual plus total energy bands (15 - 25, 25 - 50, 50 - 100, 100 - 350 and 15 - 350 keV).

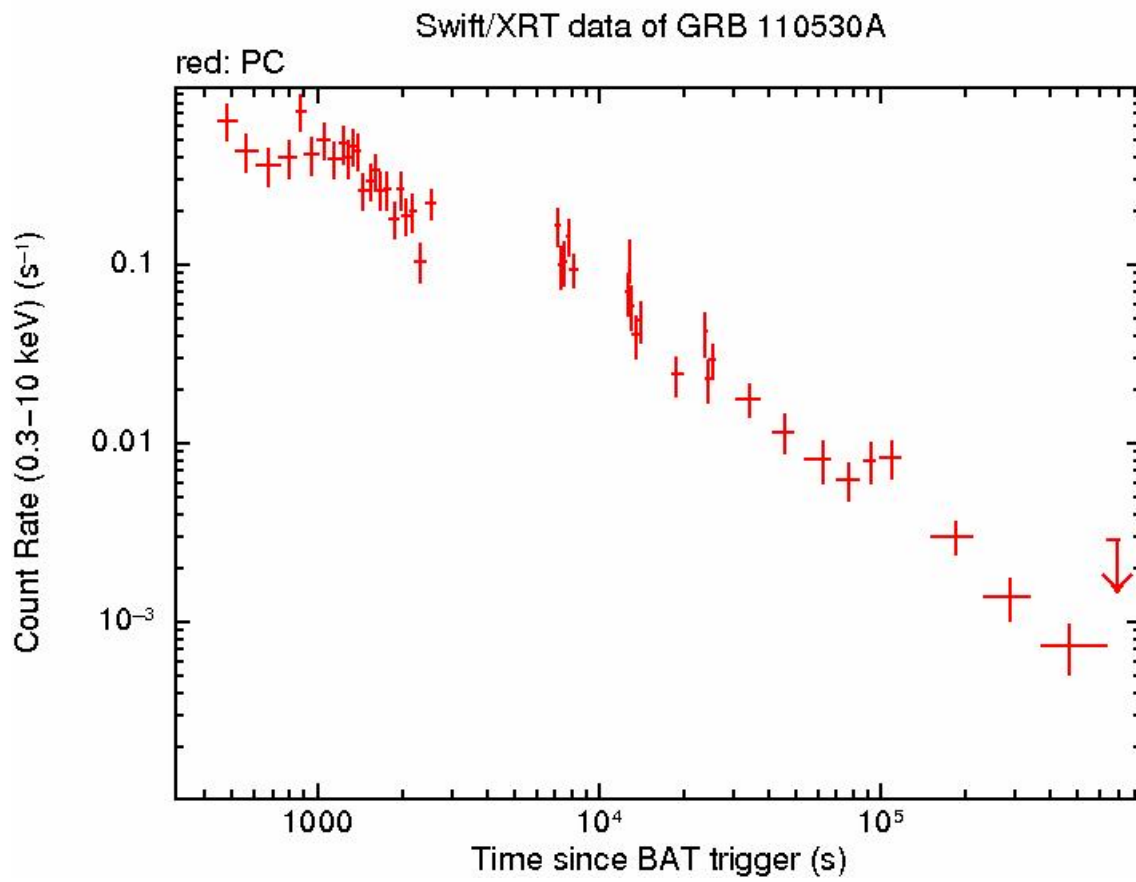


Figure 2: XRT Lightcurve of GRB 110530A. Data are from PC mode.

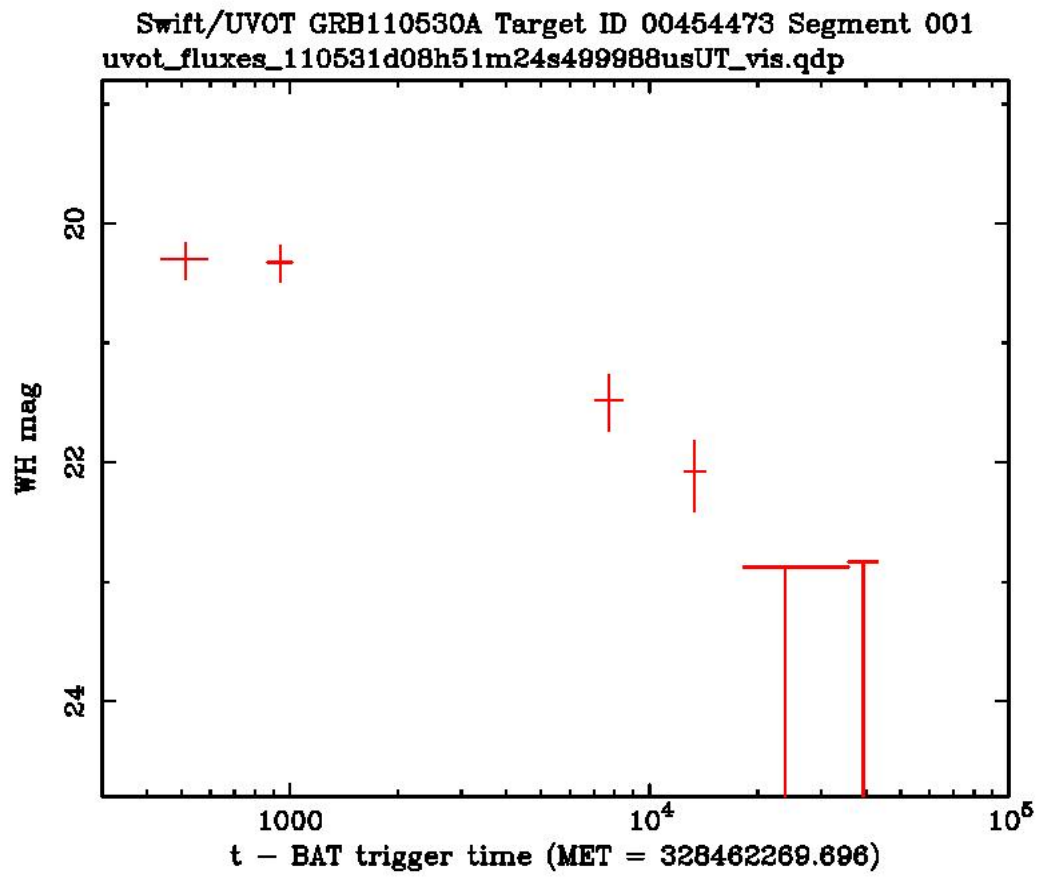


Figure 3: UVOT white band light curve of GRB 110530A