

## 1 Introduction

BAT triggered on GRB 070721A at 10:00:56.4 UT (Trigger 285653) (Ziaeeepour, et al., *GCN Circ.* 6639). This was a 1.02 sec rate-trigger with significance of 6.1 on an intermediate length burst with  $T_{90} = 3.868$  sec. Swift slewed to this burst immediately and XRT began follow-up observations at  $T + 86$  sec, and UVOT at  $T + 69$  sec. Our best position is the XRT location  $\text{RA}(J2000) = 3.16348$  deg ( $00h12m39.24s$ ),  $\text{Dec}(J2000) = -28.55017$  deg ( $-28d22'00.6''$ ) with an error of 2.3 arcsec (90% confidence, including boresight uncertainties).

## 2 BAT Observation and Analysis

Using the data set from  $T - 119$  to  $T + 183$  sec, further analysis of BAT GRB 070721A has been performed by Swift team (Palmer, et al., *GCN Circ.* 6643). The BAT ground-calculated position is  $\text{RA}(J2000) = 3.144$  deg ( $00h12m34.5s$ ),  $\text{Dec}(J2000) = -28.530$  deg ( $-28d31'47''$ )  $\pm 2.3$  arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 72% (the offset angle was 30.63 deg).

The masked-weighted light curves (Fig.1) starts at trigger time  $T - 4$  sec with a single rapidly rising peak, and returns to background at about  $T + 8$  sec.  $T_{90}$  (15 – 350 keV) is  $3.4 \pm 0.2$  (estimated error including systematics).

The time-averaged spectrum from  $T - 0.1$  to  $T + 3.7$  sec is best fitted by a simple power law model. This fit gives a photon index of  $2.46 \pm 0.41$ , ( $\chi^2 = 52.84$  for 57 d.o.f.). For this model the total fluence in the 15 – 150 keV band is  $(7.1 \pm 1.8) \times 10^{-8}$  ergs  $\text{cm}^{-2}$  and the 1-sec peak flux measured from  $T + 0.12$  sec in the 15 – 150 keV band is  $0.7 \pm 0.1$  ph  $\text{cm}^{-2} \text{sec}^{-1}$ . All the quoted errors are at the 90% confidence level.

We note that the fluence ratio in a simple power-law fit between the 25 – 50 keV band and the 50 – 100 keV band is 1.38. This fluence ratio is larger than 1.32 which can be achieved in the Band function of  $\alpha = -1.0$ ,  $\beta = -2.5$ , and  $E_{peak} = 30$  keV. Thus, preliminary analysis shows that  $E_{peak}$  of the burst is very likely around or below 30 keV. Therefore the burst can be classified as an X-ray flash.

## 3 XRT Observations and Analysis

Using all the available data of the XRT for GRB 070721A ( $\sim 14$  ksec in Photon Counting mode), the refined XRT position is  $\text{RA}(J2000) = 3.16348$  deg ( $00h12m39.24s$ ),  $\text{Dec}(J2000) = -28.55017$  deg ( $-28d33'00.6''$ )  $\pm 2.3$  arcsec (90% confidence, including boresight uncertainties). This position is within 3.2 arcsec of the initial XRT position (Ziaeeepour, et al. *GCN Circ.* 6639).

The 0.3 – 10 keV light curve (Fig.2) shows an initial steep decline with a slope of  $2.91_{-0.40}^{+0.49}$ , following by a shallow slope of  $0.70 \pm 0.11$ , beginning at  $T + 327_{-71}^{+116}$  sec. No break in the XRT lightcurve has been observed up to  $\sim T_0 + 3 \times 10^4$  sec.

The Photon-Counting X-ray data can be modeled with an absorbed power-law with spectral index of  $2.30_{-0.32}^{+0.42}$ . The NH column density is  $6.11_{-5.2}^{+7.8} \times 10^{20}$   $\text{cm}^{-2}$ , consistent with the galactic column density,  $6.01 \times 10^{20}$   $\text{cm}^{-2}$ . The average observed (unabsorbed) flux over 0.3 – 10 keV for this spectrum

## 4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 070721A at 10 : 02 : 05 UT, 69 sec after the initial BAT trigger (Schady et al., *GCN Circ.* 6648). No new source was detected within the XRT error circle in the White (156 sec) and V (453 sec) finding exposures, or in the co-added images in any filter down to 3-sigma magnitude. Upper limits are summarized in Table 1. These upper limits are not corrected for Galactic extinction  $E(B - V) = 0.1$ .

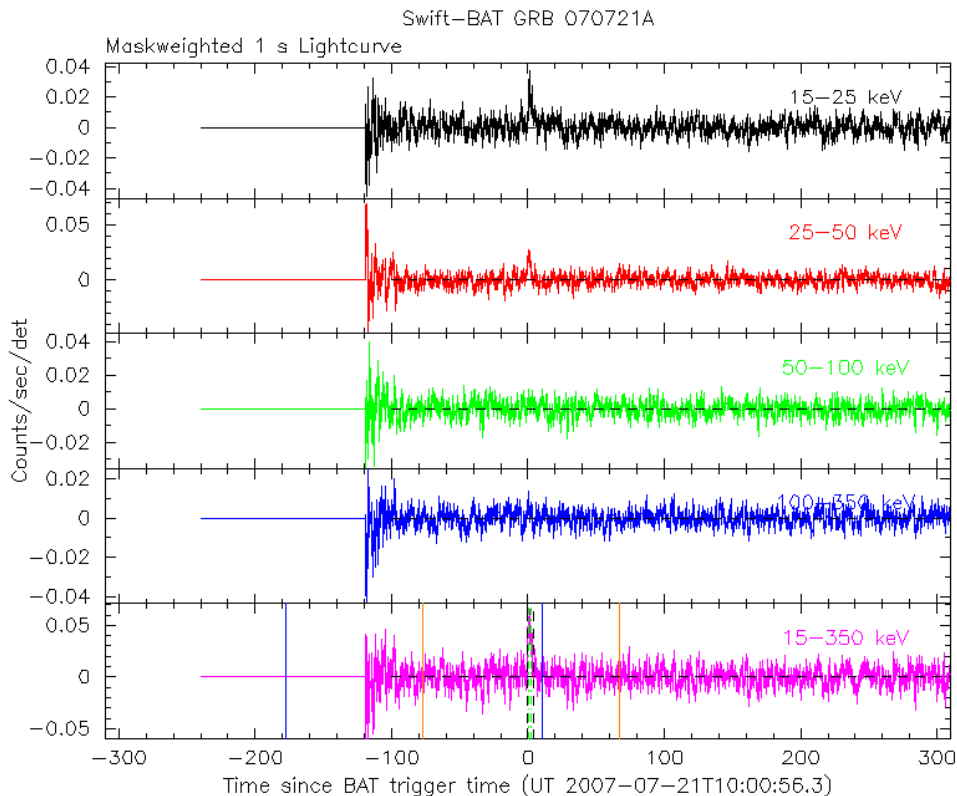


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and  $T_0$  is 10 : 00 : 56.3 UT.

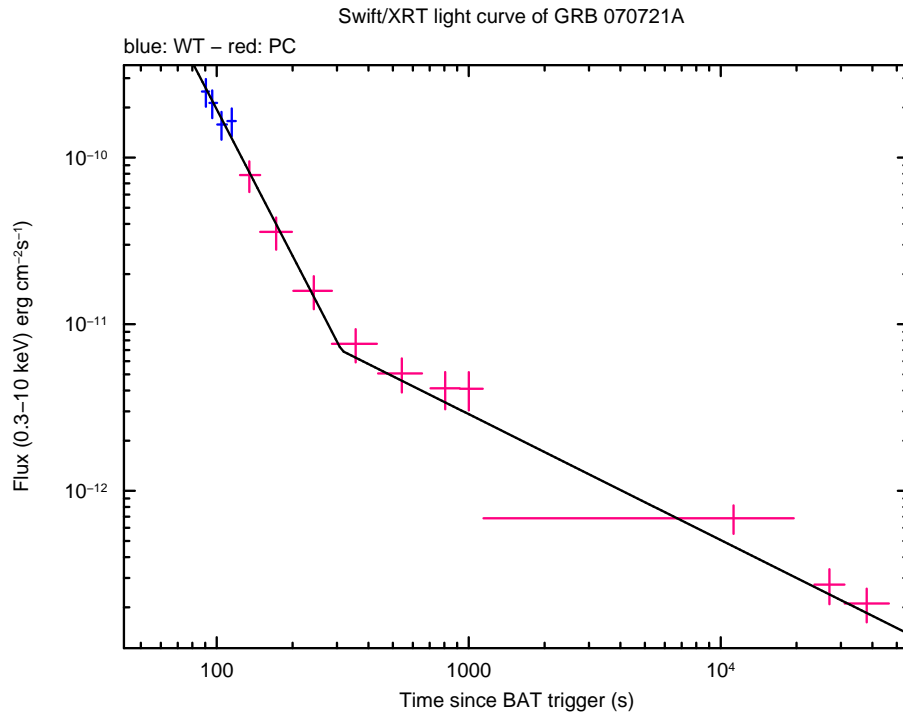


Figure 2: XRT Lightcurve. Absorbed flux in the 0.3 – 10 keV band: Window Timing mode (black), Photon Counting mode (red). The approximate conversion of absorbed flux is 1 count/sec  $\sim 4.267 \times 10^{-11}$  ergs cm $^{-2}$ /sec.

Filter	$T_{mid}$ sec	Exposure (sec)	3-Sigma UL
White	1088	156	> 21.7
V	1194	453	> 20.9
B	1509	97	> 19.5
U	1359	117	> 20.0
UVW1	1334	117	> 19.6
UVM2	1309	117	> 19.2
UVW2	1530	97	> 19.4

Table 1: Magnitude limits from UVOT observations