

# Swift Observation of GRB 070306

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## 1 Introduction

BAT triggered on GRB 060306 at 16:44:28.0 UT (Trigger 263361) (Pandey, *et al.*, *GCN Circ.* 6169). This was a 12.1 sec rate-trigger on a fairly long duration burst with  $T_{90} = 210.0$  sec. Swift slewed to this burst immediately and XRT began follow-up observations at  $T + 153$  sec, and UVOT at  $T + 162$  sec. Our best position is the XRT location  $RA(J2000) = 148.0968deg$  ( $09h52m23.24s$ ),  $Dec(J2000) = 10.4821deg$  ( $10d28'55.5''$ ) with an error of 1.22 arcsec (90% confidence), corrected by matching the UVOT images with the USNO-B1 catalogue, and is consistent with IR afterglow candidate (Rol *et al.*, *GCN Circ.* 6174) within 1.1 arcsec error radius.

## 2 BAT Observation and Analysis

Using the data set from  $T - 240.0$  to  $T + 962.0$  sec, further analysis of BAT GRB 070306 has been performed by Swift team (Barthelmy, *et al.*, *GCN Circ.* 6173). The BAT ground-calculated position is  $RA(J2000) = 148.097deg$  ( $09h52m23.3s$ ),  $Dec(J2000) = 10.477deg$  ( $10d28'37.2''$ )  $\pm 2.4$  arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 28%

The masked-weighted light curves (Fig.1) starts at trigger time  $T$  with a single mildly rapid rise, and returns to background at about  $T + 50$  sec.  $T_{90}(15 - 350keV)$  is  $210 \pm 10$  (estimated error including systematics).

The time-averaged spectrum from  $T + 118.8$  to  $T + 186.5$  sec is best fitted by a simple power law model. This fit gives a photon index of  $1.72 \pm 0.10$ , ( $\chi^2 = 61.49$  for 57 d.o.f.). For this model the total fluence in the  $15 - 150$  keV band is  $(5.5 \pm 0.3) \times 10^{-06} ergs/cm^2$  and the 1-sec peak flux measured from  $T + 98.27$  sec in the  $15 - 150$  keV band is  $4.2 \pm 0.2$  ph/cm<sup>2</sup>/sec. All the quoted errors are at the 90% confidence level.

## 3 XRT Observations and Analysis

Using the data from the first three orbits of XRT data of GRB 070306 (3.3 ksec in Photon Counting mode), the refined XRT astrometry-corrected position (by matching the UVOT images with the USNO-B1 catalogue) is  $RA(J2000) = 148.0972deg$  ( $09h52m23.24s$ ),  $Dec(J2000) = 10.4822 deg$  ( $10d28'55.5''$ )  $\pm 1.22$  arcsec (90% confidence). This position is within 3.6 arcsec of the initial XRT position, and 1.1 arcsec from the IR afterglow candidate, reported by Rol *et al.*, *GCN Circ.* 6174.

The  $0.3 - 10$  keV light curve (Fig.2) shows an initial steep decline with a slope of  $6.3 \pm 0.2$ , following by a shallow slope of  $0.20 \pm 0.05$ , beginning at  $T + 422 \pm 13$  sec. At  $(2.5_{-0.3}^{+0.2}) \times 10^4$  sec the light curve breaks with a slope of  $1.42 \pm 0.14$ . If  $T_0$  for the light-curve fits were to be referenced to the main peak of the burst, around 100 seconds later, this initial XRT decay slope would not be so steep.

Three segments of the X-ray lightcurve can be modeled with an absorbed power-law with spectral indices of  $2.30 \pm 0.04$ ,  $2.30 \pm 0.43$ , and  $2.22 \pm 0.12$ , respectively for the WT, PC pre-break and PC plateau phase.. The fitted NH column density for the spectra is significantly in excess ( $4.2 \times 10^{21} cm^{-2}$ ) of the Galactic one in the direction of burst. The average observed (unabsorbed) flux over  $0.3 - 10$  keV for this spectrum (spanning a time of 153-309 seconds after the trigger) is  $1.73 \times 10^{-09}$  ( $3.48 \times 10^{-09}$ ) ergs/cm<sup>2</sup>/sec.

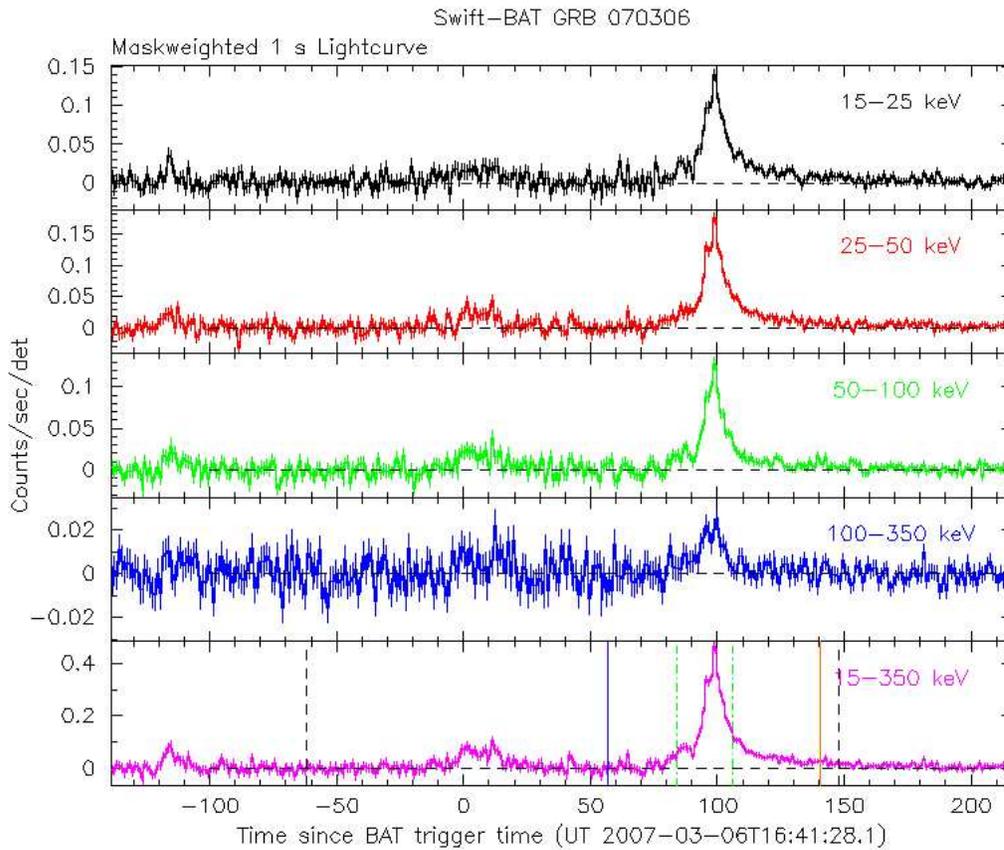


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector (note illum-det =  $0.16\text{cm}^2$ ) and  $T_0$  is 16:41:28.0 UT.

## 4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 070306 at 16:44:10 UT, 162 sec after the initial BAT trigger (Pandey *et al.*, *GCN Circ.* 6169). No new source was detected within the XRT error circle in the white (98 sec) finding exposure, 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  $E(B-V) = 0.03$  mag.

## GRB 070306

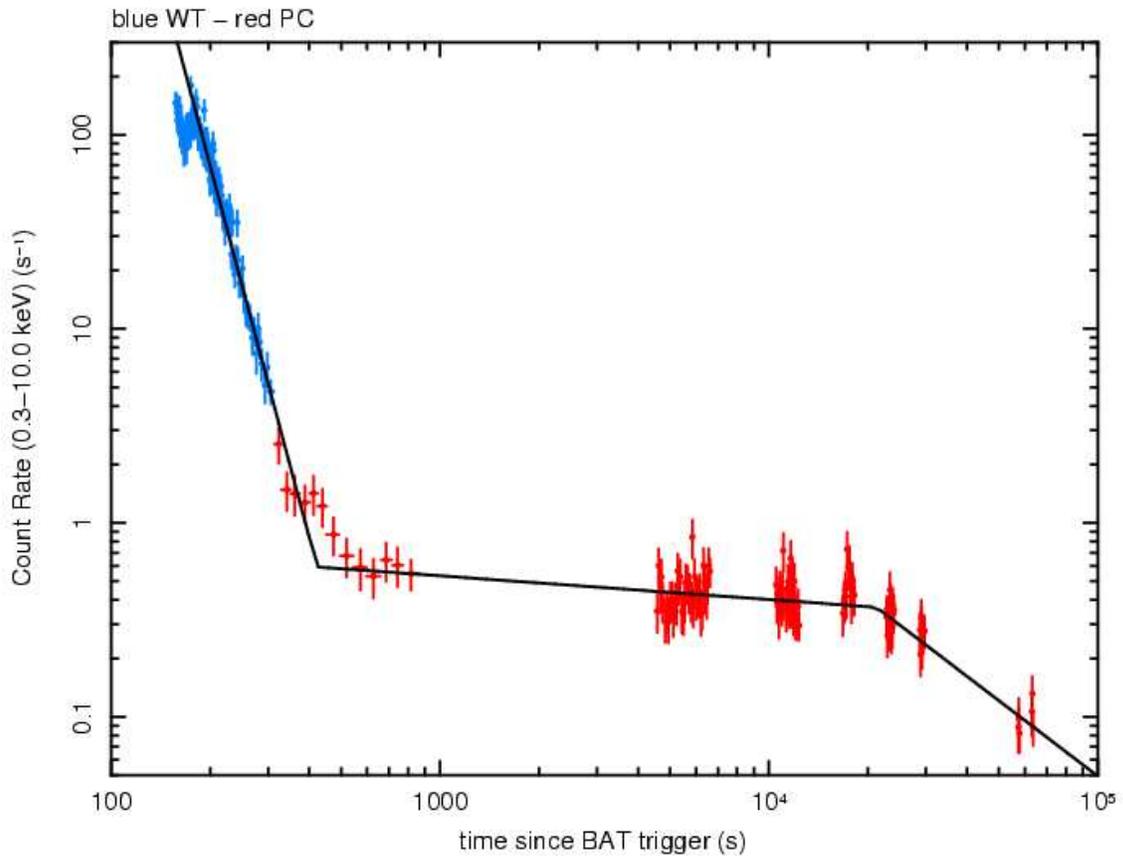


Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is  $1 \text{ count/sec} = \sim 4.3 \times 10^{-11} \text{ ergs/cm}^2/\text{sec}$ .

Filter	Start	Stop	Exposure	3-Sigma UL
WHITE (finding)	162	262	98	19.8
V	267	11158	1259	20.5
B	745	6257	403	21.5
U	721	6053	413	21.0
UVW1	697	5848	236	19.0
UVM2	673	5633	236	18.7
UVW2	773	6651	397	19.5
WHITE	162	6462	512	20.7

Table 1: Magnitude limits from UVOT observations