

## Swift Observation of GRB 070612B

*D. Grupe (PSU), S. D. Barthelmy (GSFC), P. A. Evans (U Leicester), N. Gehrels (NASA/GSFC), S. T. Holland (CRESST/GSFC/USRA), J. A. Kennea (PSU), W. B. Landsman (NASA/GSFC), C. B. Markwardt (CRESST/GSFC/UMD), D. M. Palmer (LANL), J. L. Racusin (PSU), P. Romano (Univ. Bicocca & INAF-OAB) and M. C. Stroh (PSU) for the Swift Team*

### 1 Introduction

BAT triggered on GRB 070612B at 06:21:17 UT (Trigger 282073) (Grupe, *et al.*, *GCN Circ.* 6511). This burst is a long burst with an observed  $T_{90} = 13.5 \pm 1$  s. Because of Earth constraint, *Swift* did not slew immediately to the burst. XRT began follow-up observations at  $T + 3239$  s, and UVOT at  $T + 3256$  s. Our best position of the afterglow is the XRT location  $\text{RA}(J2000) = 261.7267 \text{ deg}$  ( $17\text{h}26\text{m}54.4\text{s}$ ),  $\text{Dec}(J2000) = -08.7524 \text{ deg}$  ( $-08\text{d}45'08.7''$ ) with a 90% confidence statistical error of  $4.7''$  as given in Grupe & Evens (*GCN Circ.* 6514).

### 2 BAT Observation and Analysis

Using the data set from  $T - 240$  s to  $T + 962$ s, further analysis of BAT GRB 070612B has been performed by the Swift team (Cummings, *et al.*, *GCN Circ.* 6523). The BAT ground-calculated position is  $\text{RA}(J2000) = 261.716 \text{ deg}$  ( $17\text{h}26\text{m}51.8\text{s}$ ),  $\text{Dec}(J2000) = -8.474 \text{ deg}$  ( $-08\text{d}44'48''$ ) with an uncertainty of  $1.1'$ , (radius, systematic and statistical, 90% containment). The partial coding was 17%.

The masked-weighted light curves (Fig.1) shows a single roughly symmetrical peak starting at  $T - 5$ , and ending at  $T + 12$ s.  $T_{90}(15 - 350 \text{ keV})$  is  $13.5 \pm 1$  s (estimated error including systematics).

The time-averaged spectrum from  $T - 6.4$ s to  $T + 10.3$ s is best fitted by a single power law model. This fit gives a photon spectral index of  $\Gamma = 1.55 \pm 0.11$ , ( $\chi^2 = 46.1$  for 57 d.o.f.). For this model the total fluence in the  $15 - 150 \text{ keV}$  band is  $(1.7 \pm 0.1) \times 10^{-6} \text{ ergs cm}^{-2}$  and the 1-s peak flux measured from  $T + 10.84$ s in the  $15 - 150 \text{ keV}$  band is  $2.6 \pm 0.4 \text{ photons cm}^{-2} \text{ s}^{-1}$ . All the quoted errors are at the 90% confidence level.

### 3 XRT Observations and Analysis

The refined XRT position is  $\text{RA}(J2000) = 261.7271 \text{ deg}$  ( $17\text{h}26\text{m}54.49\text{s}$ ),  $\text{Dec}(J2000) = -8.7517 \text{ deg}$  ( $-08\text{d}45'06.3''$ ) ( $4.0''$  error circle, 90% confidence) This position is  $2.7''$  away from the initial XRT position reported by Grupe & Evens *et al.*, *GCN Circ.* 6514.

The  $0.3 - 10 \text{ keV}$  light curve (Fig.2) shows a decaying source. While the afterglow is clearly detected in the first orbit, it is only marginally detected at a  $2\sigma$  level during the second orbit. GRB 070612B was observed as a ToO starting at 2007 June 12 18:39 UT for 2.2ks. Only an upper limit at a level of  $3.6 \times 10^{-3}$  can be given. From the data of the first two orbits a decay slope of  $\alpha = 3.3 \pm 0.3$  was calculated.

The X-ray spectrum can be fitted by an absorbed single power law with a photon spectral index  $\Gamma = 1.7 \pm 0.8$  and an absorption column density fixed to the Galactic value of  $N_{\text{H}} = 1.68 \times 10^{21} \text{ cm}^{-2}$  (Dickey & Lockman 1990).

## 4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 070612B 3256 s after the BAT trigger (Landsman & Grupe, *GCN Circ.* 6519). The afterglow was not detected in any of the UVOT observations inside the XRT error circle. The  $3\sigma$  upper limits are listed in Table 1. These magnitudes are not corrected for Galactic extinction  $E(B-V) = 0.838$  (Schlegel et al. 1998).

## 5 Other Observations

The field of GRB 070612B was observed by several ground-based observatories. However, none of them could detect the optical afterglow and only upper limits could be given. Li et al. *GCN Circ.* 6516 reported on observations with the 0.76 Katzman Automatic Imaging Telescope at Lick Observatory in V, I, and clear starting 44s after the BAT trigger. Cenko et al. *GCN Circ.* 6517 gave upper limits of 21.0 in i and 20.5 in z beginning 12 minutes after the burst using the Palomar 60cm telescope. Upper limits in R were reported by Jelinek et al. *GCN Circ.* 6518 using the FRAM telescope and Updike et al. *GCN Circ.* 6524 using the SARA 0.9m telescope at Kitt Peak.

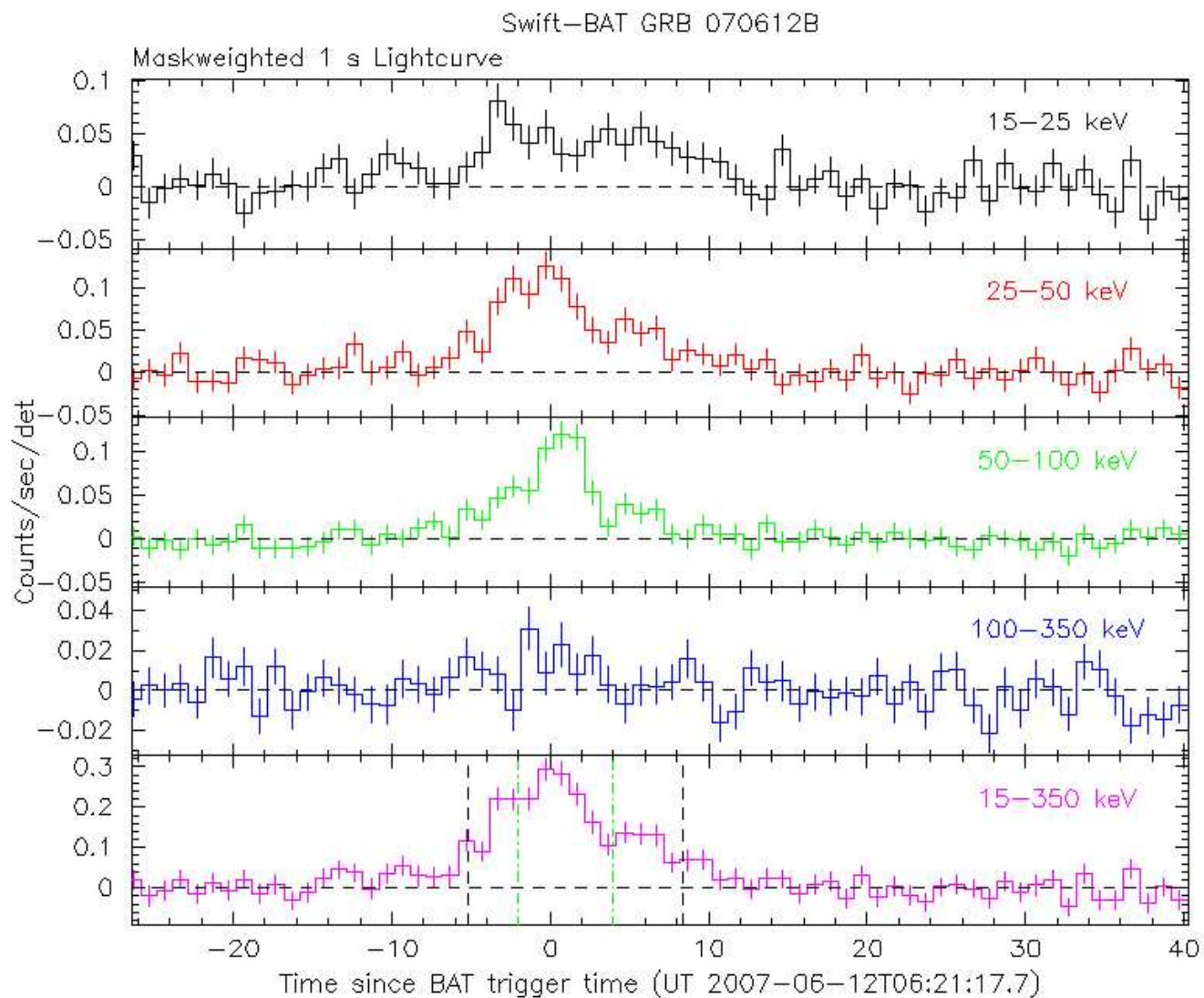


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts  $s^{-1}$  illuminated-detector $^{-1}$  and  $T_0$  is 2007-June-12 06:21:17 UT.

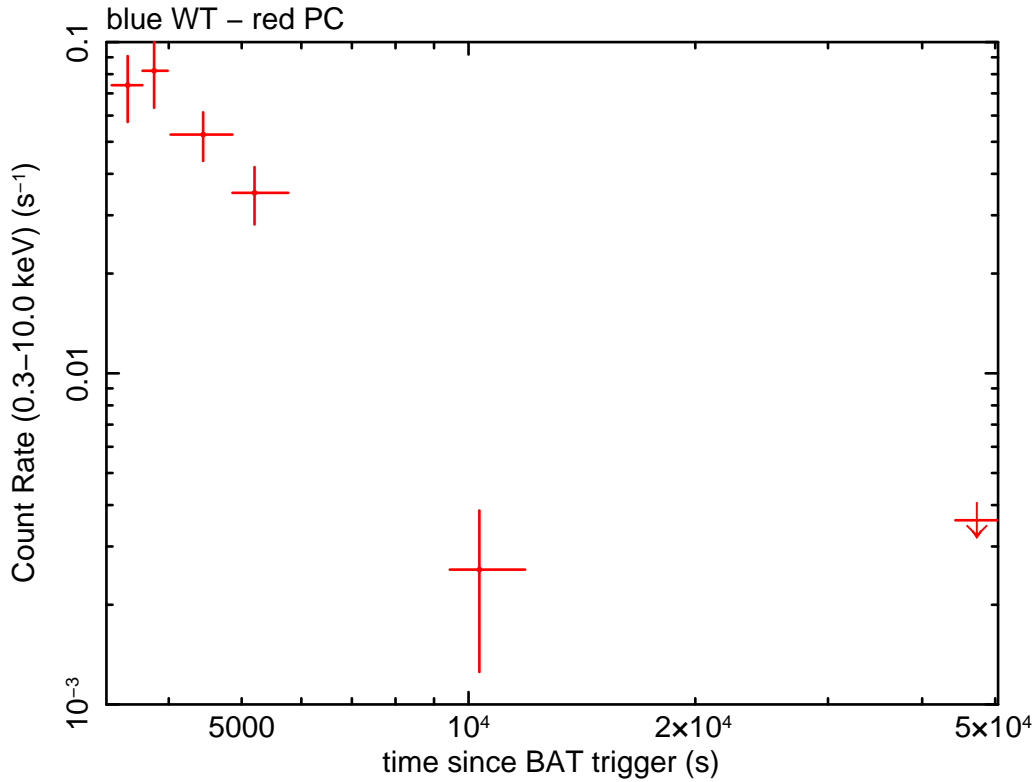


Figure 2: XRT Lightcurve. Counts  $s^{-1}$  in the 0.3-10 keV band: Windowed Timing mode is blue and Photon Counting mode is red. The approximate conversion is  $1 \text{ count } s^{-1} = \sim 1.63 \times 10^{-10} \text{ ergs } s^{-1} \text{ cm}^{-2}$  for an unabsorbed flux corrected for photon pileup.

Filter	$T_{\text{Start}}$	$T_{\text{Stop}}$	Exposure	Mag ( $3\sigma$ UL)
Wh (FC)	3256	3356	98	>20.3
Wh	3256	9882	1201	>21.7
V	3238	11624	1113	>20.0
B	4180	5813	393	>20.4
U	3975	5608	393	>20.1
UVW1	3772	5404	393	>20.1
UVM2	3567	5199	393	>20.0
UVW2	4590	10888	1082	>20.9

Table 1: Magnitude from UVOT observations. The start, stop, and exposure times are given in s.