

Swift Observations of GRB 111103B

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1 Introduction

At 10:59:03 UT on 2011-11-03, the Swift Burst Alert Telescope (BAT) triggered and located GRB 111103B (trigger=506903). Swift slewed immediately to the burst and found an X-ray counterpart in the XRT (Grupe et al., *GCN Circ.* 12519)

The best *Swift* position of this burst is the XRT position given in Goad et al. (*GCN Circ.* 12525) with RA-2000 = 17h 42m 46.37s, and Dec-2000 = +01° 36′ 36.3″ with an uncertainty of 1.5″.

The burst was also detected by Konus-Wind. Golenetskii et al. (*GCN Circ.* 12532) reported on an spectral slope of $\alpha = -0.97_{-0.18}^{+0.19}$ and an $E_{\text{peak}} = 372_{-69}^{+109}$ keV.

There were a few ground-based optical/NIR follow-up observation reported on this burst. Most notably was the detection by the WIYN 3.5m telescope at Kitt Peak (Kotulla et al. *GCN Circ.* 12531) who reported of a source in the *Swift* XRT error circle with $K=18.6\pm0.4$.

Swift had to stop observing the afterglow of GRB 111103B because it became sun-constrained on November 06th.

2 BAT Observation and Analysis

At 10:59:03 UT on 2011-11-03, the Swift Burst Alert Telescope (BAT) triggered and located GRB 111103B (trigger=506903, Grupe et al., *GCN Circ.* 12519). Using the data set from T-239 to T+418 s, the BAT ground-calculated position is RA, Dec = 265.691, +1.605 deg which is

RA(J2000) = 17h 42m 45.8s

Dec(J2000) = +01° 36′ 19.4″

with an uncertainty of 1.0 arcmin, (radius, sys+stat, 90% containment). The partial coding was 90% (Barthelmy et al. *GCN Circ.* 12524).

The mask-weighted light curve (Figure 1) shows at least 4 overlapping peaks in the first group: starting at T-25 s, with the brightest peak at T+8 s, and ending at T+90 s. The second group of peaks starts at T+100 s and ends at T+250 s. This last group is consistent with a strong flare seeing in the XRT light curve (Figure 2). T_{90} (15-350 keV) is 167 ± 35 s (estimated error including systematics).

The time-averaged spectrum from T-6.55 to T+250 s is best fit by a single power law model. The power law index of the time-averaged spectrum is 1.41 ± 0.05 ($\chi^2 = 50.7$ for 57 d.o.f.). For this model the total fluence in the 15-150 keV band is $8.0 \pm 0.2 \times 10^{-6}$ ergs cm^{-2} . The 1s peak photon flux measured from T+5.48 s in the 15-150 keV band is 7.2 ± 0.3 photons $\text{s}^{-1} \text{cm}^{-2}$. All the quoted errors are at the 90% confidence level.

The results of the batgrbproduct analysis are available at http://gcn.gsfc.nasa.gov/notices_s/506903/BA/

3 XRT Observations and Analysis

The XRT began observing the field of GRB 111103B at 11:00:03 UT, 59.2 seconds after the BAT trigger. Using 1541 s of XRT Photon Counting mode data and 4 UVOT images for GRB 111103B, Goad et al. (*GCN Circ.* 12525) found an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 265.69322, +01.61007 which is equivalent to:

RA (J2000): 17h 42m 46.37s

Dec (J2000): +01° 36' 36.3''

with an uncertainty of $1.5''$ (radius, 90% confidence). The latest position can be viewed at http://www.swift.ac.uk/xrt_positions. Position enhancement is described by Goad et al. (2007, *A&A*, 476, 1401) and Evans et al. (2009, *MNRAS*, 397, 1177).

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of $\Gamma = 1.97_{-0.04}^{+0.05}$. The best-fitting absorption column is $2.90_{-0.15}^{+0.16} \times 10^{21} \text{ cm}^{-2}$, in excess of the Galactic value of $9.1 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al. 2005). The PC mode spectrum has a photon index of $\Gamma = 1.85_{-0.12}^{+0.13}$ and a best-fitting absorption column density of $N_{\text{H}} = 2.7 \pm 0.5 \text{ cm}^{-2}$. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 4.4×10^{-11} (6.3×10^{-11}) $\text{erg cm}^{-2} \text{ count}^{-1}$. Using the excess N_{H} - redshift relation by Grupe et al. (2007, *AJ*, 133, 2216) we can estimate that the redshift of this burst is most-likely less than 4.

The 0.3 – 10 keV light curve given below (Fig.2) displays a canonical light curve (as described by Nousek et al. 2006, *ApJ*, 642, 389) with a very strong flare at T+110s and an initial decay slope $\alpha = 3.1_{-0.3}^{+0.4}$ with a break at T+94±2 s followed by a flattening of the decay slope to $\alpha = 0.59_{-0.07}^{+0.05}$. The light curve breaks again at T+8600 $_{-1370}^{+1690}$ s and continues with a normal decay slope of $\alpha = 1.30 \pm 0.04$.

The results of the XRT-team automatic analysis are available at http://www.swift.ac.uk/xrt_products/00506903.

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 111103B 68 s after the BAT trigger (Grupe et al., *GCN Circ.* 12519) with the finding chart in white filter. Oates & Grupe (*GCN Circ.* 12528) reported that no optical counter part was found at the XRT position (Goad et al, *GCN Circ.* 12525).

The 3σ upper limits for the summed images are listed in Table 1.

Filter	T_{Start}	T_{stop}	Exposure	Mag
white_FC	68	218	147	>20.6
white	68	5055	344	>21.1
v	5266	5466	197	>19.1
b	4650	6161	270	>20.0
u	281	6081	297	>20.2
w1	5677	5876	197	>19.9
m2	5471	5670	197	>19.8
w2	5061	5261	197	>20.3

Table 1: 3σ upper limits from UVOT observations of GRB 111103B. The quoted values have not been corrected for the expected Galactic extinction along the line of sight of $E_{B-V} = 0.29$ mag. All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627) and Breeveld et al. (2011, AIP Conf. Proc., Vol. 1358, 373)

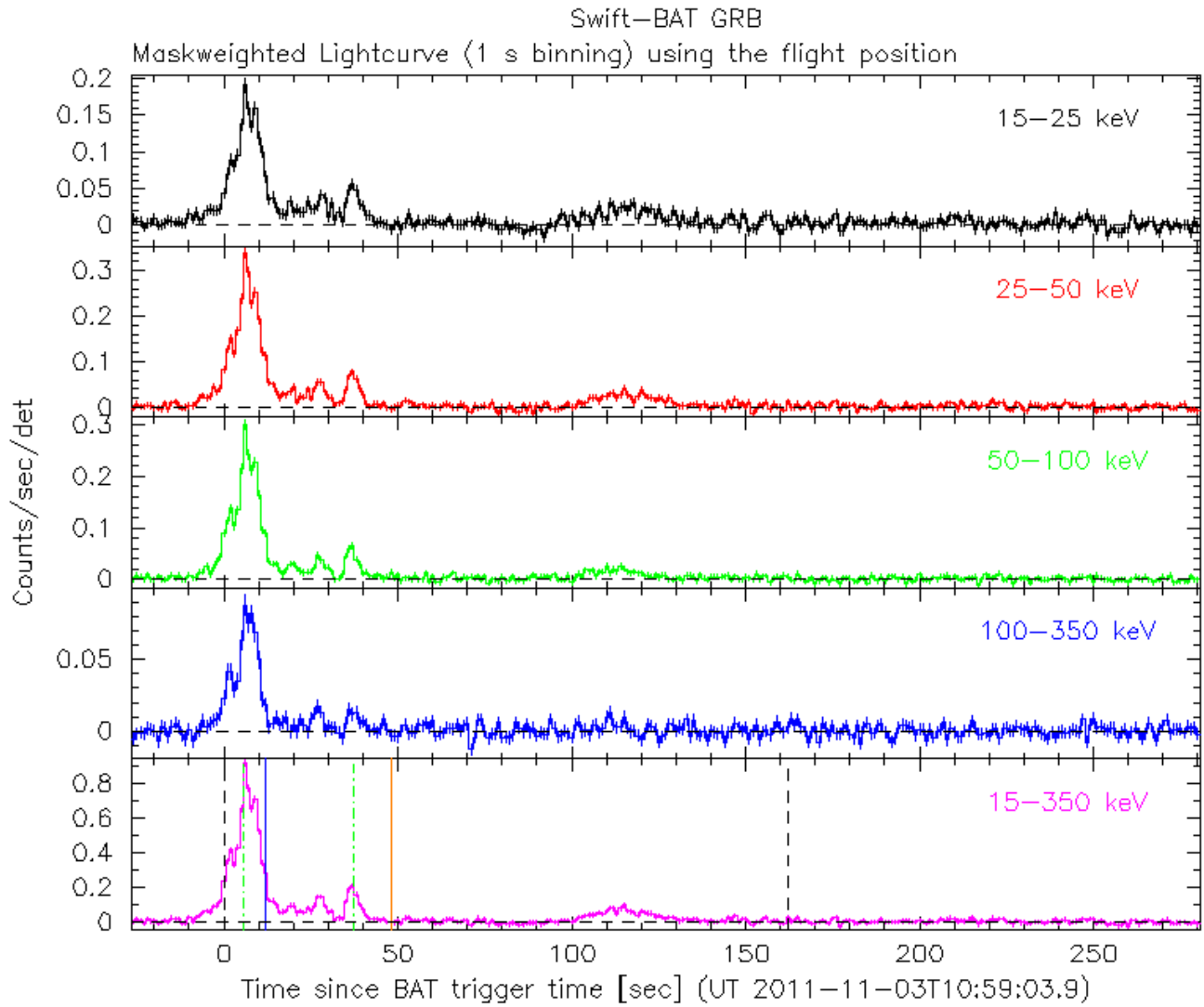


Figure 1: BAT Light curve of GRB 111103B.

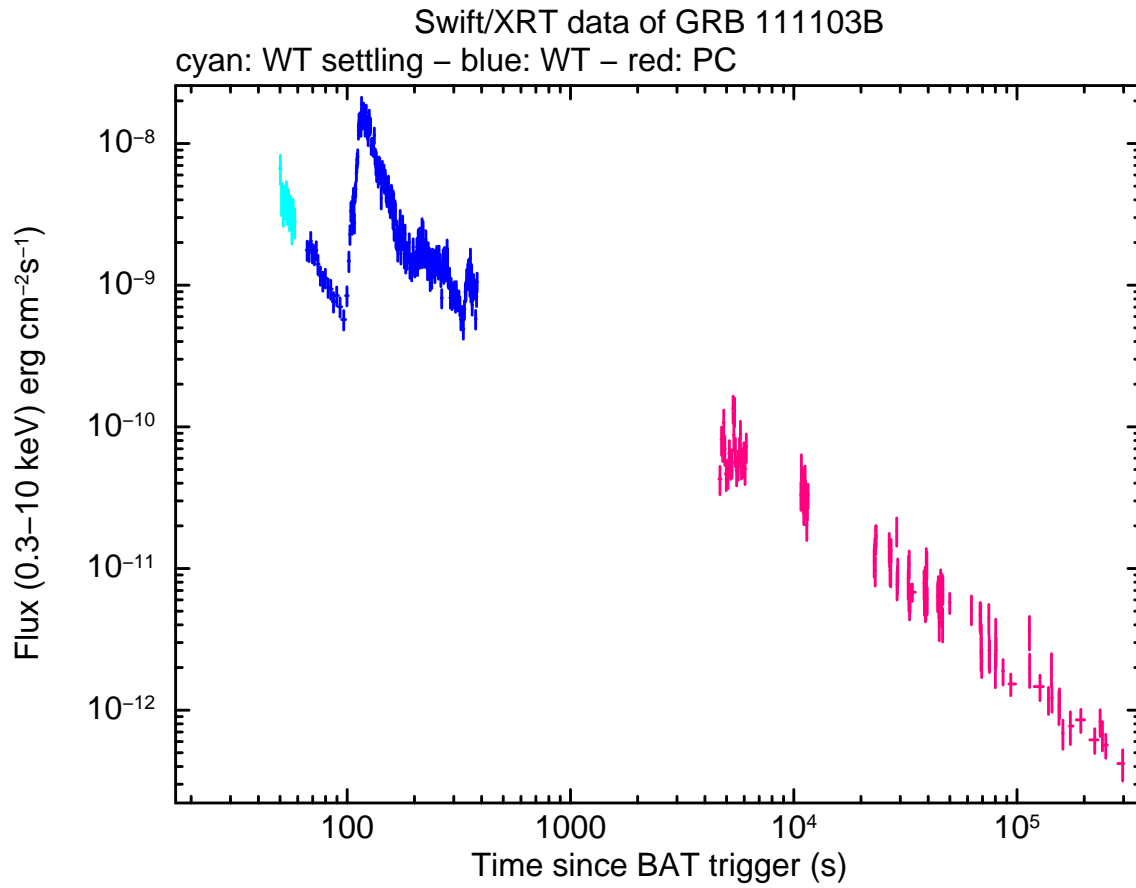


Figure 2: XRT flux light curve of GRB 111103B in the 0.3-10 keV band. The approximate conversion is $1 \text{ count s}^{-1} = \sim 4.4 \times 10^{-11} \text{ ergs s}^{-1} \text{ cm}^{-2}$.