

Swift Observations of GRB 091130B

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1 Introduction

BAT triggered on GRB 091130B at 17:59:04 UT (Trigger 377487) (Racusin, *et al.*, *GCN Circ.* 10214). This was a rate-trigger on a long burst with $T_{90} = 112.5 \pm 17.1$ sec. Swift slewed to this burst immediately and XRT began follow-up observations at $T+85.4$ sec, and UVOT at $T+95$ sec. Our best position is the XRT enhanced location $RA(J2000) = 203.14852deg$ ($13h32m35.64s$), $Dec(J2000) = +34.08856deg$ ($+34d05'18.8''$) with an error of 1.4 arcsec (radius, 90% confidence).

2 BAT Observation and Analysis

Using the data set from $T - 60$ to $T + 243$ sec, further analysis of BAT GRB 091130B has been performed by Swift team (Ukwatta, *et al.*, *GCN Circ.* 10221). The BAT ground-calculated position is $RA(J2000) = 203.149deg$ ($13h32m35.8s$), $Dec(J2000) = +34.068deg$ ($+34d05'11.0''$) with an error of 1.3 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 77%.

The masked-weighted light curves (Fig.1) shows several broad, irregular, overlapping peaks starting at $T - 25$ sec, peaking at T and ending at $T + 120$ sec. $T_{90}(15 - 350keV)$ is 112.5 ± 17.1 sec (estimated error including systematics).

The time-averaged spectrum from $T - 4.7$ to $T + 127.4$ sec is best fit by a simple power law model. This fit gives a photon index of 2.15 ± 0.15 . For this model the total fluence in the $15 - 150$ keV band is $(1.3 \pm 0.1) \times 10^{-6} ergs/cm^2$ and the 1-sec peak flux measured from $T - 0.06$ sec in the $15 - 150$ keV band is 1.1 ± 0.2 ph/cm²/sec. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using 35 ks of XRT Photon Counting mode data and 54 UVOT images for GRB 091130B, the astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is $RA(J2000) = 203.14852deg$ ($13h32m35.64s$), $Dec(J2000) = +34.08856 deg$ ($+34d05'18.8''$) with an error of 1.4 arcsec (radius, 90% confidence). This position is within 1.1 arcsec of the initial XRT position.

The $0.3 - 10$ keV light curve (Fig.2) shows an initial step decline with a slope of $3.60_{-0.18}^{+0.19}$ with super-imposed flares, following by a shallow slope of 0.34 ± 0.08 , beginning at $T + 1800 \pm 400$ sec. At $(5.2_{-0.9}^{+1.9}) \times 10^4$ sec the light curve breaks with a slope of 1.13 ± 0.07 .

Three segments of the X-ray lightcurve can be modeled with an absorbed power-law with spectral indices of 2.27 ± 0.07 , 2.60 ± 0.17 , and $2.46_{-0.21}^{+0.13}$, respectively. The measured N_H column density is in excess of the galactic column density ($8.0 \times 10^{19} cm^{-2}$) with values of $(2.3 \pm 0.2) \times 10^{21} cm^{-2}$, $(2.0_{-0.4}^{+0.3}) \times 10^{21} cm^{-2}$, and $(2.1_{-0.5}^{+0.2}) \times 10^{21} cm^{-2}$, respectively. The average observed (unabsorbed) fluxes over $0.3 - 10$ keV for these spectra (spanning a times of 85-300 seconds, 3 - 52ks, and 52 ks - 2 Ms after the trigger) are 4.8×10^{-9} (8.5×10^{-9}) $ergs/cm^2/sec$, 1.5×10^{-12} (3.2×10^{-12}) $ergs/cm^2/sec$, and 1.8×10^{-13} (3.4×10^{-13}) $ergs/cm^2/sec$, respectively.

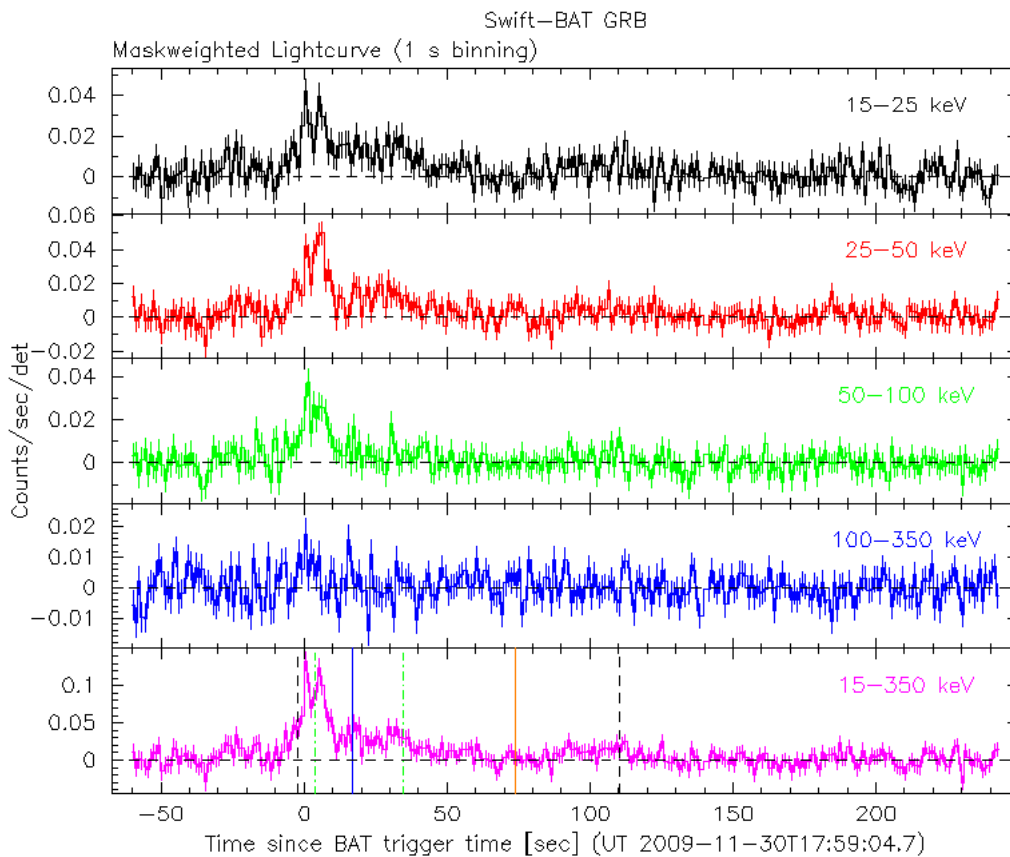


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 17:59:04 UT.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 091130B at 18:00:39 UT, 95 *sec* after the initial BAT trigger (Racusin *et al.*, *GCN Circ.* 10214). No new source was detected within the XRT enhanced error circle. Upper limits are summarized in Table 1. These upper limits are not corrected for Galactic extinction $E(B - V) = 0.01$ mag (Schlegel *et al.* 1998). All photometry is on the UVOT photometric system described in Poole *et al.* (2008, *MNRAS*, 383, 627).

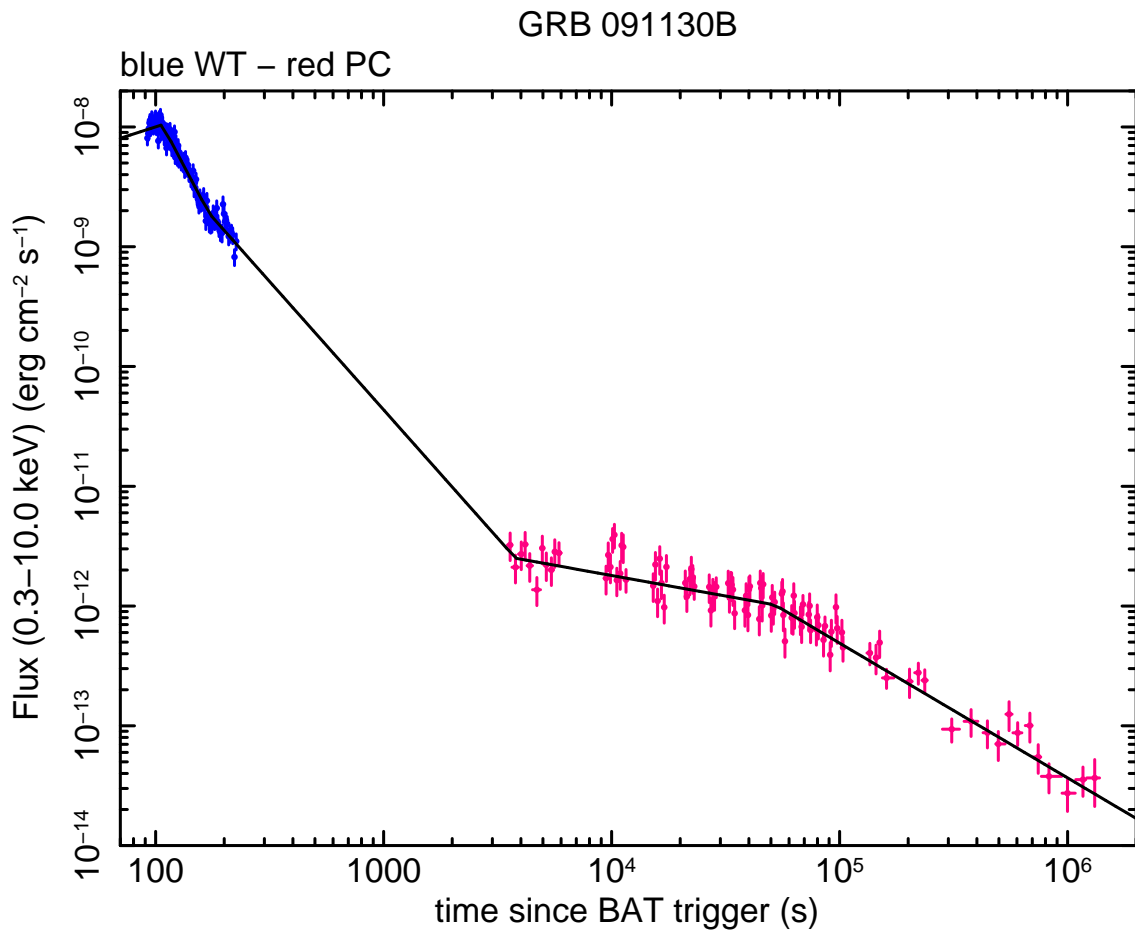


Figure 2: XRT Lightcurve. Flux in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate observed (unabsorbed) conversion from count rate to flux is $1 \text{ count/sec} = \sim 3.2 \times 10^{-11} (6.6 \times 10^{-11}) \text{ ergs/cm}^2/\text{sec}$.

Filter	Start	Stop	Exposure	3-Sigma UL
white	95	230	132	> 20.20
white	4517	4717	196	> 20.97
v	3492	3692	196	> 19.38
b	4313	4512	196	> 20.31
u	4107	4307	196	> 19.91
uvw1	3903	4102	196	> 19.88
uvm2	3697	3897	196	> 19.76
uvw2	4723	4923	196	> 19.98

Table 1: Magnitude limits from UVOT observations