Swift Observations of GRB 111204A

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1   Introduction

BAT triggered on GRB 111204A on 2011 December 4 at 13:37:28.0 UT (Trigger 509018) (Sonbas, *et al.*, 2011, *GCN Circ.* 12612). This was a double peaked burst with $T_{90} = 48.0 \pm 22.6$ sec. The BAT mask weighted light curve showed two peaks. First peak started at the trigger time and lasted until $\sim$ T+10. The second peak that is broader than the first peak started $\sim$T+43 sec and ended $\sim$T+90 sec. Swift slewed to this burst immediately and XRT began follow-up observations at T+159.7 sec, and UVOT at T+143.0 sec after the trigger.

The best Swift position is that derived from the promptly downlinked event data, using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue: RA, Dec (J2000) = 22h 26m 30.81s , -31d 22′ 29.3″, with an estimated uncertainty of 1.9" (radius, 90% confidence).

Ground based observations of the field of GRB 111204A were also reported by MASTER (Parhomenko et al. *GCN Circ.* 12616), GROUND (Kann et al. *GCN Circ.* 12622) and TNG (Fugazza et al. *GCN Circ.* 12624) with upper limits.

2   BAT Observation and Analysis

Using the data set from T-239.0 to T+963.0 sec, analysis of BAT GRB 111204A has been performed by the BAT team (Markward, *et al.*, *GCN Circ.* 12620). The BAT ground-calculated position is RA(J2000) = 336.651° (22h26m36.2s), Dec(J2000) = -31.414° (-31d24′49.4″)±2.2′, (radius, systematic and statistical, 90% containment). The partial coding was 75% and the bore sight angle was 31.5 deg.

The mask-weighted light curve shows two peaks (Fig.1). The first peak started at the trigger time and lasted until $\sim T + 10$ sec. The second and broad peak lasts from $\sim$ T+43 to T+90 sec and peaks at $\sim$ T+48 sec. T_{90} (15-350 keV) is 48.0± 22.6 sec (estimated error including systematics).

The time-averaged spectrum from $T - 33.0$ to $T + 81.0$ sec is best fit by a simple power law. This fit gives a power law index 1.83 ± 0.30. For this model the total fluence in the 15-150 keV band is 4.7 $\pm 0.9 \times 10^{-7}$ erg cm^{-2} and the 1-sec peak flux measured from T+56.6 sec in the 15-150 keV band is 0.3 ± 0.2 ph cm^{-2} sec^{-1}. 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/509018/BA/`.

3   XRT Observations and Analysis

15.9 ks of Photon Counting (PC) data were analysed of GRB 111204A from 157 s to 87 ks after the BAT trigger. The enhanced XRT position is RA(J2000) = 22h 26m 30.81s, Dec(J2000) = -31d 22′ 29.3″± 1.9″ (90% confidence).

The $0.3 - 10$ keV light curve (Fig.2) can be modelled with a decay index of α=1.85 $(^{+0.17}_{-0.12})$.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of 1.38 $(^{+0.35}_{-0.36})$. The best-fitting absorption column is $1.1(^{+1.7}_{-1.1}) \times 10^{21}$ cm^{-2}, in excess of the Galactic value of 1.1×10^{20} cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is $5.6 \times 10^{-11} (6.2 \times 10^{-11})$ erg cm^{-2} count^{-1}.
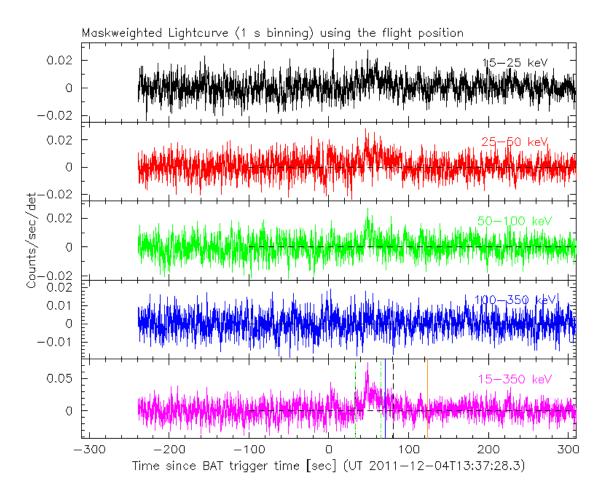
Maskweighted Lightcurve (1 s binning) using the flight position

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts sec^{-1}illuminated-detector^{-1} and T_0 is 13:37:28.3 UT.

The results of the XRT-team automatic analysis are available at;
http://www.swift.ac.uk/xrt_products/00509018.

4   UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 111204A, 143 s after the BAT trigger (Sonbas *et al.*, *GCN Circ.* 12612).

No optical afterglow consistent with the XRT position (Beardmore et al., *GCN Circ.* 12614) is detected in the initial UVOT exposures. Preliminary 3-sigma upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc. 1358, 373) for the first finding chart (FC) exposure and subsequent exposures are shown in the Table 1.
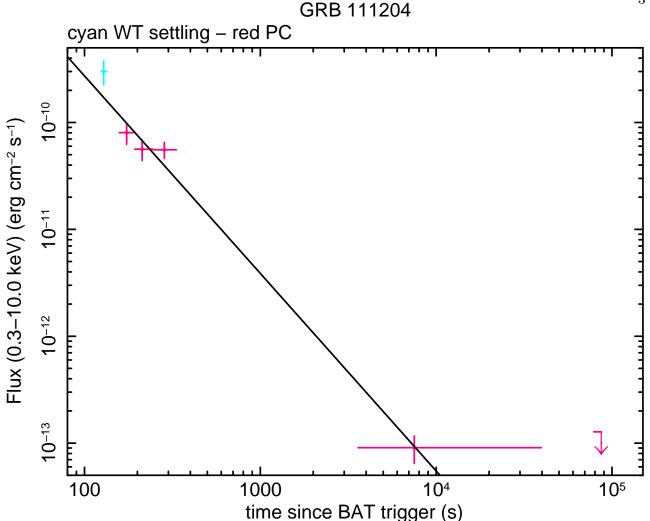
GRB 111204

Figure 2: XRT Lightcurve in the 0.3-10 keV band: Window Timing mode (cyan), Photon Counting mode (red). The conversion factor for this burst is 1 count = 6.0×10^{-11} erg cm^{-2}.

References

[1] Beardmore, A. P. et al. 2011, GCN Circ. 12614

[2] Breeveld, A. A. et al. 2011, AIP Conf. Proc. 1358, 373

[3] Fugazza, D. et al. 2011, GCN Circ. 12624

[4] Kalberla, P. M. et al. 2005, A&A 440, 775

[5] Kann, D. A, et al. 2011, GCN Circ. 12622

[6] Markward, C. B. et al. 2011, GCN Circ. 12620

[7] Parhomenko, A. V. et al. 2011, GCN Circ. 12616

[8] Schlegel, D. J. et al. 1998, ApJ. v.500, p.525

[9] Sonbas, E. et al. 2011, GCN Circ. 12612

Filter	T_{Start}	T_{Stop}	Exposure (s)	Mag.
WHITE$_{FC}$	143	293	147	> 20.4
WHITE	143	5439	541	>21.6
v	4214	5851	393	>19.6
b	3599	11889	1054	>20.8
u	302	11204	1116	>21.3
w1	4624	10291	1133	>20.7
m2	4419	15631	869	>21.1
w2	4009	5646	393	>20.8

Table 1: Magnitude limits from UVOT observations . The magnitudes in the table are not corrected for the Galactic extinction due to the reddening of E(B-V) = 0.01 in the direction of the burst (Schlegel et al. 1998).