

Swift Report on GRB 091104

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1 Introduction

At 08:49:22 UT, the Swift Burst Alert Telescope (BAT) triggered on and located GRB 091104 (trigger=374875; Curran et al., GCN 10130). The BAT light curve (Figure 1) shows a sharp rise at $\sim T+2$ s and a rather flat top, ending at $\sim T+120$ s. T_{90} (15-350 keV) is (99.3 ± 20) s. Swift slewed immediately to the burst and the narrow field instruments started observing 132s after the BAT trigger. The XRT produced an enhanced position of RA, Dec = 208.75624, 47.41054, which is equivalent to RA (J2000) = 13:55:01.5

Dec(J2000) = 47:24:37.9

with an uncertainty of 1.6 arcsec (radius, 90% confidence Osborne et al., GCN 10131). Neither UVOT, nor ground based observations, detected any credible afterglow candidate at the XRT position.

2 BAT Observation and Analysis

The analysis of BAT GRB 091104 has been performed by the Swift team, using the data set from T-239 to T+903 sec (Cummings et al., GCN 10136). The BAT ground-calculated position is RA, Dec = 208.723, 47.391 which is equivalent to

RA(J2000) = 13:54:53.6

Dec(J2000) = 47:23:25.8

with an uncertainty of 2.6 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 82%.

The mask-weighted light curve (Figure 1) shows a sharp rise at $\sim T+2$ s and a rather flat top, ending at $\sim T+120$ s. T_{90} (15-350 keV) is (99.3 ± 20) s (estimated error including systematics). The time-averaged spectrum from T-1.5s to T+120.5s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.74 ± 0.24 . The fluence in the 15-150 keV band is $7.7 \pm 1.2 \times 10^{-7}$ erg cm $^{-2}$. The 1-sec peak photon flux measured from T+83.34 sec in the 15-150 keV band is 0.4 ± 0.1 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_s/374875/BA/

3 XRT Observations and Analysis

The XRT began observing the field of GRB 091104 at 08:51:34.2 UT, 131.5s after the BAT trigger, and found a faint uncatalogued X-ray source. Using 677s of XRT Photon Counting mode data, the Swift team found an enhanced X-ray position of RA, Dec = 208.75624, 47.41054, equivalent to

RA (J2000) = 13:55:01.5

Dec(J2000) = 47:24:37.9

with an uncertainty of 1.6 arcsec (radius, 90% confidence; Osborne et al., GCN 10131).

2.7 ks of data were analysed, from 137s to 16.5 ks after the BAT trigger. The data comprise 162s in Windowed Timing (WT) mode with the remainder in Photon Counting (PC) mode. The X-ray light-curve (Figure 2) shows a faint, fading source that can be modelled with a series of power-law decays: an initial decay index of $\alpha = 0.55^{+0.24}_{-0.27}$ which steepens at ~ 230 s to $\alpha = 4.86^{+0.35}_{-0.29}$ before breaking again at ~ 520 s to a final decay of $\alpha = 1.5^{+1.2}_{-0.3}$.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of $\Gamma = 2.30 \pm 0.10$. The best-fitting absorption column density is $1.09 \pm 0.20 \times 10^{21} \text{cm}^{-2}$ in excess of the Galactic value of $1.7 \times 10^{20} \text{cm}^{-2}$ (Kalberla et al., 2005). The PC mode spectrum has a photon index of $\Gamma = 2.31_{-0.15}^{+0.22}$ and a best-fitting absorption column density consistent with the Galactic value. The counts to observed (unabsorbed) flux conversion factors are $2.9 \times 10^{-11} (4.3 \times 10^{-11}) \text{erg cm}^{-2} \text{count}^{-1}$ for WT mode and $3.2 \times 10^{-11} (3.5 \times 10^{-11}) \text{erg cm}^{-2} \text{count}^{-1}$ for PC mode.

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

4 UVOT Observation and Analysis

The UVOT began settled observations of the field of GRB 091104 139 s after the BAT trigger. No optical afterglow consistent with the XRT position was detected in the UVOT exposures (Curran et al., GCN 10134). The 3σ upper limits in the UVOT photometric system (Poole et al., 2008) for the first finding chart (FC) exposures and subsequent co-added exposures, using a 4 arcsec aperture, are given in Table 1.

Standard UVOT products are available at:
http://gcn.gsfc.nasa.gov/swift_gnd_ana.html

Filter	T _{start} (s)	T _{stop} (s)	Exp(s)	Mag
<i>white</i> (FC)	139	289	147	>20.56
<i>white</i>	139	993	301	>20.84
<i>white</i>	28382	57769	2451	>22.17
<i>v</i>	628	6155	87	>18.53
<i>v</i>	6503	6703	197	>19.01
<i>b</i>	553	746	39	>18.88
<i>u</i> (FC)	297	547	246	>19.69
<i>u</i>	297	721	265	>19.74
<i>u</i>	27244	57244	4493	>21.50
<i>w1</i>	677	870	39	>18.45
<i>m2</i>	652	845	39	>18.26
<i>m2</i>	6708	22594	1535	>21.15
<i>w2</i>	776	4636	151	>19.71

Table 1: 3σ limits using the UVOT photometric system (Poole et al., 2008) from UVOT observations. The values quoted above are not corrected for the expected Galactic extinction corresponding to a reddening of $E(B-V) = 0.01$ mag in the direction of the burst (Schlegel, Finkbeiner & Davis, 1998).

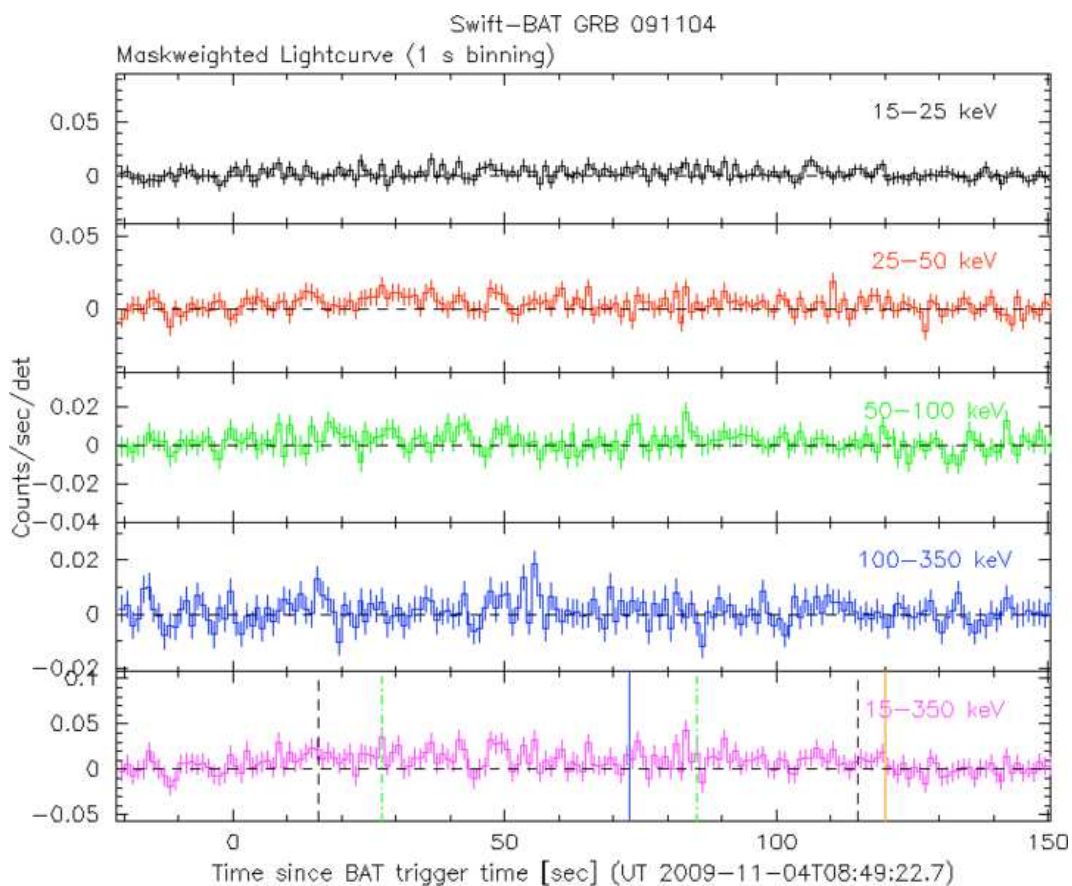


Figure 1: The BAT mask-weighted light curve in the 4 individual plus total energy bands with units of counts/sec/illuminated-detector, from $T_{100\text{start}} - 20\text{s}$ to $T_{100\text{stop}} + 30\text{s}$. The vertical lines correspond to following: green dotted lines are T_{50} interval, black dotted lines are T_{90} interval, blue solid line(s) is a spacecraft slew start time, and orange solid line(s) is a spacecraft slew end time.

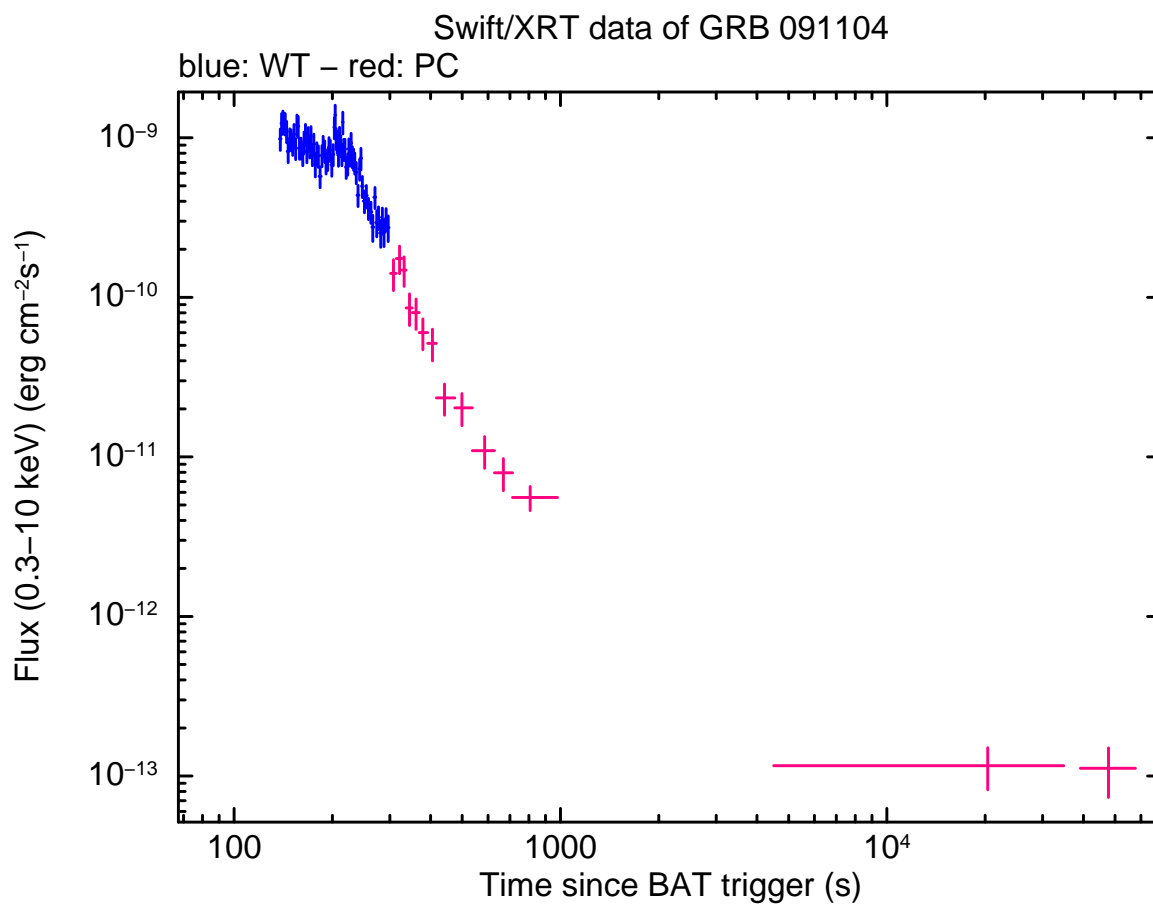


Figure 2: XRT light curve in the 0.3-10 keV band (WT mode in red, PC mode in blue). The counts to observed (unabsorbed) flux conversion factors are 2.9×10^{-11} (4.3×10^{-11}) $\text{erg cm}^{-2} \text{count}^{-1}$ for WT mode and 3.2×10^{-11} (3.5×10^{-11}) $\text{erg cm}^{-2} \text{count}^{-1}$ for PC mode.