

Swift Observations of GRB 081128

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1 Introduction

BAT triggered on GRB 081128 at 17:18:44 UT (Trigger 335895) (Margutti *et al.*, *GCN Circ.* 8571). This was a 88.0-s image-trigger on a long burst. XRT observations began at $T + 197.5$ s and discovered a bright and fading X-ray afterglow. UVOT began observing at $T + 206$ s: no credible afterglow candidate was found in the initial data products.

A number of robotic, ground based telescopes promptly detected it: e.g., TNT (Xin *et al.* *GCN Circ.* 8572), Lulin telescope (Lin *et al.* *GCN Circ.* 8575), Z-600 telescope (Andreev *et al.* *GCN Circ.* 8576), Liverpool telescope (Guidorzi *et al.* *GCN Circ.* 8577), Stara Lesna telescope (Volkov *et al.* *GCN Circ.* 8584), AZT-8 telescope (Sergeev *et al.* *GCN Circ.* 8594), NainiTal telescope (Kumar *et al.* *GCN Circ.* 8628), NOT (Malesani *et al.* *GCN Circ.* 8639).

Our best position is the UVOT-enhanced XRT position: RA(J2000)= 20.8041 deg (01^h23^m12.98^s), Dec(J2000)= +38.1271 deg (+38^d07'37.5"), with an uncertainty of 1.8 arcsec (radius, 90% confidence), (Evans *et al.*, *GCN Circ.* 8573).

2 BAT Observations and Analysis

Using the data set from $T - 239$ to $T + 303$ s the BAT ground-calculated position is RA(J2000) = 20.800 deg (01^h23^m12.0^s), Dec(J2000)= 38.123 deg (+38^d07'23.8") with an uncertainty of 1.0 arcmin (radius, sys+stat, 90% containment). The partial coding was 74%.

The mask-weighted light curve shows two overlapping peaks (see Fig. 1). The first starts probably before the object comes into the BAT FOV at $T - 95$ s and peaks at $\sim T + 18$ s. The second one peaks at $\sim T + 35$ s and ends at $\sim T + 90$ s. T_{90} (15–350 keV) is 100 ± 11 s (estimated error including systematics).

The time-averaged spectrum from $T - 69.0$ to $T + 62.7$ s is best fit by a power law with an exponential cutoff. This fit gives a photon index 1.08 ± 0.45 , and Epeak of 45.1 ± 4.7 keV ($\chi^2/\text{dof} = 34.6/56$). For this model the total fluence in the 15–150 keV band is $(2.3 \pm 0.2) \times 10^{-6}$ erg cm⁻² and the 1-sec peak flux measured from $T + 17.60$ s in the 15–150 keV band is 1.3 ± 0.2 ph cm⁻² s⁻¹. A fit to a simple power law gives a photon index of 1.98 ± 0.09 ($\chi^2/\text{dof} = 48.9/57$). All the quoted errors are at the 90% confidence level (Tueller *et al.*, *GCN Circ.* 8574).

The results of the batgrbproduct analysis are available at http://gcn.gsfc.nasa.gov/notices_s/335895/BA/.

3 XRT Observations and Analysis

The XRT began observing GRB 081128 in Windowed Timing mode, 197.5 s after the BAT trigger. Using 2 ks of overlapping XRT and UVOT data, the UVOT-enhanced XRT position was found to be RA(J2000)= 20.8041 deg (01^h23^m12.98^s), Dec(J2000)= +38.1271 deg (+38^d07'37.5"), with an uncertainty of 1.8 arcsec (radius, 90% confidence), (Evans *et al.*, *GCN Circ.* 8573).

The light curve (Fig. 2), totalling 129 ks exposure and spanning from 197.5 to 8.8×10^5 s, can be modelled with a double broken power law with the following best-fitting parameters: $\alpha_{x1} = 4.33_{-0.02}^{+0.01}$,

$t_{b1} = 600$ s, $\alpha_{x2} = 0.84_{-0.08}^{+0.09}$, $t_{b2} = 32.6$ ks, $\alpha_{x3} = 1.31_{-0.25}^{+0.33}$ ($\chi^2/\text{dof} = 54.9/49$).

The WT mode spectrum spanning from 197.5 to 301 s can be poorly modelled with an absorbed simple power-law, with a photon index of 3.7 ± 0.4 and a column density of $2.7 \pm 0.1 \times 10^{21}$ cm $^{-2}$ (P-value= 5×10^{-5}). The fit is statistically improved adding a black body component of temperature $T = 0.15 \pm 0.03$ keV. In this case we obtain a photon index of 1.8 ± 0.6 and a column density of $1.2 \pm 0.1 \times 10^{21}$ cm $^{-2}$ (P-value=0.4). This result makes GRB 081128 similar to the sample considered by Moretti et al., 2008 A&A 478, 409.

The PC spectrum extracted in the time interval 0.3–35 ks can be modelled with an absorbed power-law, with a photon index of 1.7 ± 0.2 and a column density of $0.5 \pm 0.4 \times 10^{21}$ cm $^{-2}$ compatible with the Galactic value in this direction (0.6×10^{21} cm $^{-2}$) The observed (unabsorbed) 0.3–10 keV flux over this time interval is 3.0×10^{-12} (3.3×10^{-12}) erg cm $^{-2}$ s $^{-1}$. Uncertainties are given at 90% confidence (Margutti *et al.*, *GCN Circ.* 8578).

Detailed light curves in both count rate and flux units are available in both graphical and ASCII formats at http://www.swift.ac.uk/xrt_curves/.

4 UVOT Observations and Analysis

The UVOT observed the field of GRB 081128 starting 206 s after the BAT trigger. We do not detect any source inside the UVOT-enhanced XRT error circle (Evans *et al.*, *GCN Circ.* 8573) down to the 3σ upper limits reported in Table 1.

Filter	T_{mid} (s)	Exposure (s)	Mag
white	257	150	> 20.9
white	583	308	> 21.3
v	3003	247	> 19.4
b	644	58	> 19.6
u	619	58	> 19.3
uvw1	595	58	> 19.0
uvm2	570	58	> 18.6
uvw2	2470	236	> 19.9
white	22263	625	> 21.4
v	51434	3535	> 21.0

Table 1: Magnitudes from UVOT observations.

The quoted upper limits are not corrected for the Galactic extinction corresponding to a reddening of $E_{B-V} = 0.05$ mag (Schlegel *et al.*, 1998). The photometry is on the UVOT flight system described in Poole *et al.* (2008, MNRAS, 383, 627).

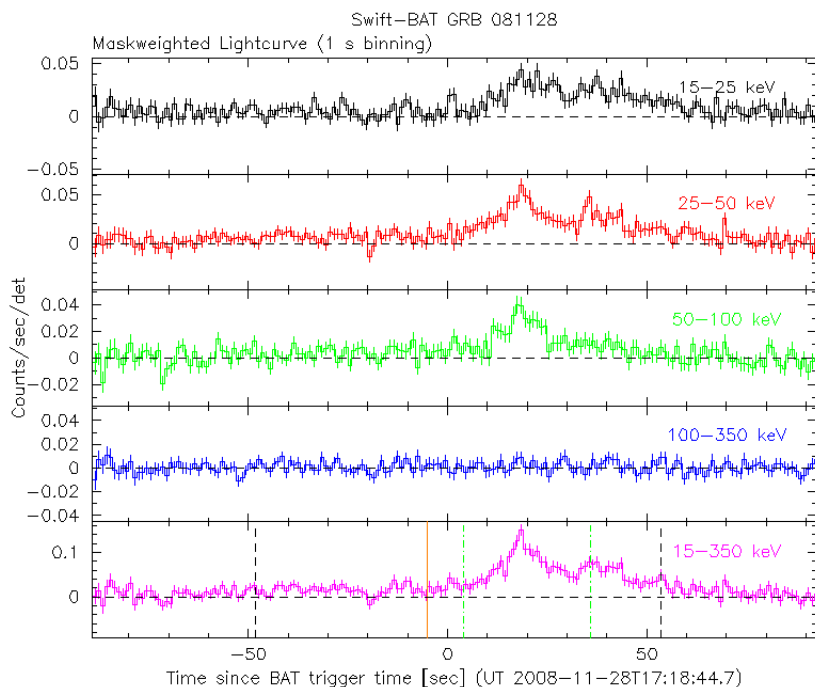


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/s/illuminated-detector (note illum-det = 0.16 cm^2) and T_0 is 17:18:44 UT.

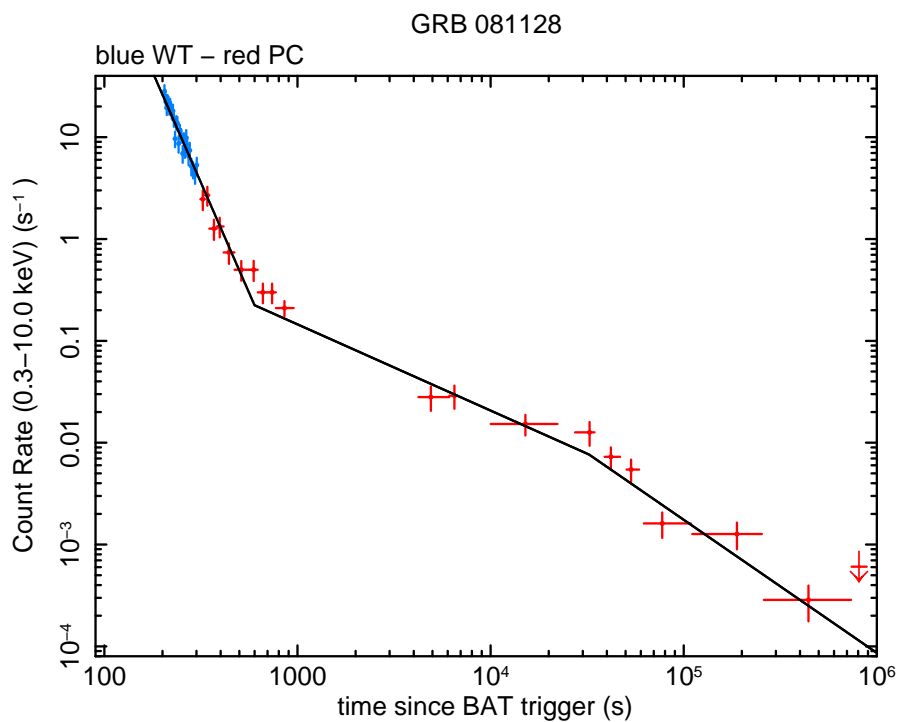


Figure 2: XRT Lightcurve. Flux in the 0.3-10 keV band: Windowed Timing (blue) and Photon Counting (red) modes. The approximate conversion is $1 \text{ count/s} \sim 4.4 \times 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1}$.