

Swift Observations of GRB 071118

J. R. Cummings (UMBC/NASA GSFC), A. Moretti (INAF-UAB), M. De Pasquale, MSSL/UCL

1. INTRODUCTION

At 08:57:17 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 071118 (trigger=296856). Swift slewed immediately to the burst. The XRT found a fading source in the BAT error circle. The UVOT found a faint source in the XRT error circle, not seen in later exposures. The best position is the UVOT position

$$\text{RA} = 19\ 58\ 51.8$$

$$\text{Dec} = +70\ 07\ 29.2$$

with an uncertainty of 0.6 arcsec (radius, 90% confidence).

2) BAT OBSERVATION AND ANALYSIS

Using the data set from T-239 to T+303 s, the BAT ground-calculated position is RA, Dec = 299.839, 70.130 deg, which is

$$\text{RA (J2000)} = 19\text{h } 59\text{m } 21.4\text{s}$$

$$\text{Dec (J2000)} = +70\text{d } 07'\ 47''$$

with an uncertainty of 2.7 arcmin, (radius, sys+stat, 90% containment). The partial coding was 100%. The mask-weighted light curve shows a broad single peak starting at $\sim T-25$ s, peaking at $\sim T+55$ sec, and ending at $\sim T+110$ s. T90 (15-350 keV) is 71 ± 20 s (estimated error including systematics).

The time-averaged spectrum from T+4.5 to T+81.2 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.63 ± 0.29 . The fluence in the 15-150 keV band is $5.0 \pm 1.0 \times 10^{-7}$ erg/cm². The 1-s econd peak photon flux measured from T+80.26 s in the 15-150 keV band is 0.3 ± 0.1 ph/cm²/s. All the quoted errors are at the 90% confidence level.

3. XRT OBSERVATION AND ANALYSIS

Data from the first 4 orbits of Swift-XRT included 122 s in Windowed Timing (WT) mode, starting 128 s after the BAT trigger and 8.8 ks in Photon Counting (PC) mode. Using 1298 sec of overlapping XRT PC mode and UVOT V-band data, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 299.71558, 70.12449 which is equivalent to:

$$\text{RA (J2000)} = 19\ 58\ 51.74$$

$$\text{Dec (J2000)} = +70\ 07\ 28.2$$

with an uncertainty of 1.6 arcsec (radius, 90% confidence). This location is 2.7 arcsec from the XRT position measured using prompt downlinked data (Cummings et al., GCN Circ. 7106) and 152 arcsec from the BAT refined position (Markwardt et al. GCN Circ. 7109).

The light-curve in the first orbit (up to 2 ks from the trigger) shows a steep decay accompanied by flaring activity. From the second orbit on, the afterglow shows a more regular decay with a shallow phase ($\alpha_1 = 0.6 \pm 0.2$) until T+11 ks and a steeper decay after ($\alpha_1 = 1.6 \pm 0.2$).

The spectrum formed from all the WT data can be modelled with a power-law of photon index $\Gamma = 1.64 \pm 0.13$, with an absorbing column of $\text{NH} = (2.7 \pm 0.6) \times 10^{21}$ cm⁻² (in excess with respect to the Galactic value of 9.7×10^{20} cm⁻²). The spectrum formed from the PC data can be modelled with a power-law of photon index $\Gamma = 1.62 \pm 0.06$, with an absorbing column of $\text{NH} = (2.6 \pm 0.4) \times 10^{21}$ cm⁻², which is consistent with the previous one.

4. UVOT OBSERVATION AND ANALYSIS

The Swift/UVOT began observing the field of GRB 071118 (Cummings et al, GCN 7106) 132 sec after the BAT trigger.

In the v band finding chart, an uncatalogued source is detected inside the refined XRT error circle (Moretti et al 7111) with ~ 6 sigma significance. This source looks extended; however it is not found at late times, which indicates that it is the optical afterglow of GRB 071118. Its detection suggests that this GRB took place at redshift $z < \sim 5$. The coordinates of this source are

$$\begin{aligned} \text{RA} &= 19\ 58\ 51.8 \\ \text{Dec} &= +70\ 07\ 29.2 \end{aligned}$$

with an error of 0.6 arcsec. No new source is detected within the XRT error circle in the b, u or uv filters, either in the single or co-added exposures.

In Table 1, we indicate the magnitude of the optical afterglow and the 3-sigma upper limits. We do caution that the photometry may be affected by the halo of a near bright star and the crowded field.

Table 1: UVOT Observations.

Filter	Time (s)	Mag
White	134-233	>20.6
White	734-743	>19.4
White	874-973	20.4 +/- 0.2
White	1484-1983	>20.6
White	5765-7391	>21.4
v	240-639	19.1 +/- 0.2
v	774-793	> 18.1
v	981-1380	19.1 +/- 0.2
v	1524-2033	>19.1
v	6166-7801	>19.2
v	17862-18789	>20.4

Optical photometry from the 50 cm MITSuME telescope was reported by M. Yoshida et al. (GCN circ. 7119):

mid-UT	exp-T	g'	Rc	Ic
9:03:22	5min	>16.9	18.5 ± 0.5	>17.8
10:12:12	25min	>19.1	19.1 ± 0.3	18.5 ± 0.3
11:16:35	45min	>20.0	20.2 ± 0.3	19.7 ± 0.3
12:33:20	57min	>20.3	20.7 ± 0.4	>20.2

An upper limit of 22.5 magnitude at ~ 16.5 hours after the burst was reported by S. B. Cenko et al. (GCN circ. 7120) using the Palomar 60-inch telescope.

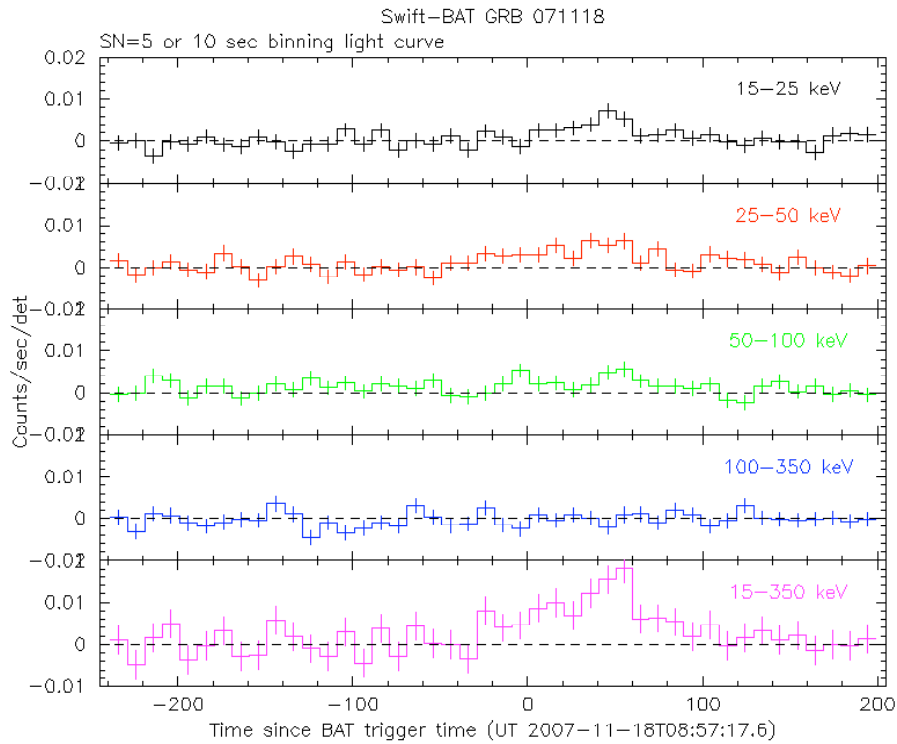


Fig.1: BAT Lightcurve. The light curve in the 4 individual plus total energy bands, with 10-second binning.

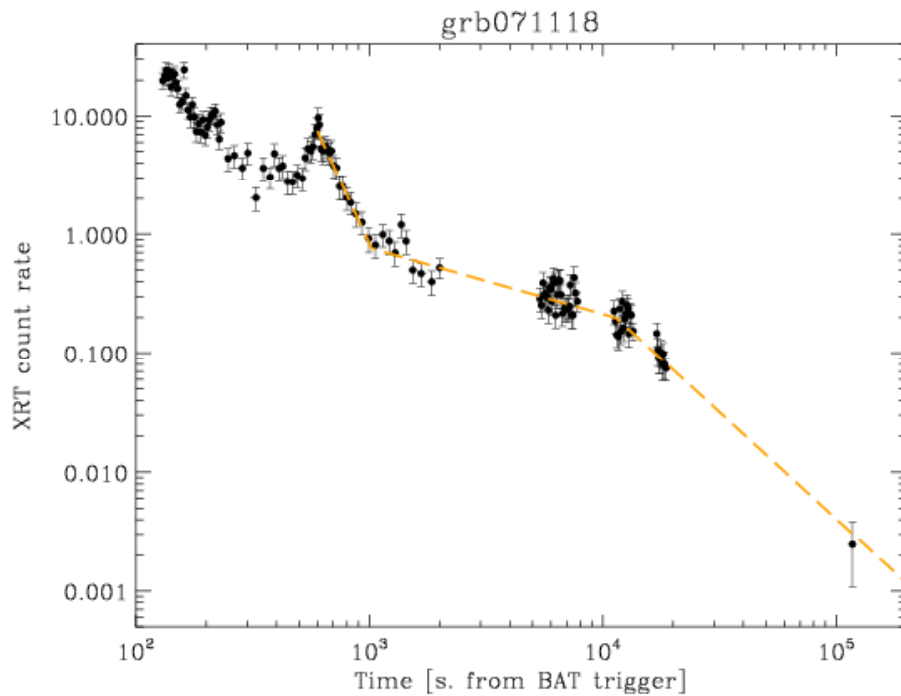


Fig. 2: XRT Lightcurve. $\alpha_1 = -4.2 \pm 0.3$, $t_{b1} = (1.0 \pm 0.2) \times 10^3$, $\alpha_2 = -0.6 \pm 0.1$, $t_{b2} = (1.1 \pm 0.3) \times 10^4$, $\alpha_3 = -1.8 \pm 0.2$. The XRT counts-to-flux conversion is $6.4E-11$ (absorbed) or $8.2 E-11$ (unabsorbed) $\text{erg cm}^{-2} \text{ct}^{-1}$.