Swift Observation of GRB 071031

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1 Introduction

BAT triggered on GRB 071031 at 01:06:36 UT (Trigger 295670) (Stroh, *et al.*, *GCN Circ.* 7020). This was a long burst with $T_{90}(15-350\ keV) = 180 \pm 10\ sec$ (estimated error including systematics). Swift slewed immediately to the burst with XRT and UVOT beginning follow-up observations at $T + 103\ s$ and $T + 112\ s$ respectively.

Our best position is the UVOT position: RA($J2000$) = $6.4053deg$ ($00h25m37.27s$), Dec($J2000$) = $-58.05956deg$ ($-58d03'34.2$") with an uncertainty of 0.5 *arcsec*.

2 BAT Observation and Analysis

Using the data set from $T - 119$ to $T + 297$ *sec* from recent telemetry downlinks, we report further analysis of BAT GRB 071031 (Trigger 295670) (Stroh, et al., GCN Circ. 7020). The BAT ground-calculated position is RA($J2000$) = $6.399deg$ ($00h25m35.8s$), Dec($J2000$) = $-58.048deg$ ($-58d2'51$") with an uncertainty of 2.1 *arcmin*, (radius, sys+stat, 90% containment). The partial coding was 75%.

The mask-weighted light curve (Fig.1) shows multiple peaks. The first starts at $\sim T - 10$ *sec*, peaks at $\sim T + 5$ *sec*, and is essentially back to baseline by $\sim T + 40$ *sec*. The next largest peak starts at $\sim T + 100$ *sec*, peaks at $\sim T + 105$ *sec*, and returns to baseline by $\sim T + 180$ *sec*. $T_{90}(15-350\ keV) = 180 \pm 10\ sec$ (estimated error including systematics).

The time-averaged spectrum from $T - 4.5$ to $T + 192.5$ *sec* is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 2.42 ± 0.29. The fluence in the $15 - 150\ keV$ band is $(9.0 \pm 1.3) \times 10^{-7}\ erg/cm^2$. The 1-sec peak photon flux measured from $T + 2.92\ sec$ in the $15 - 150\ keV$ band is $0.5 \pm 0.1\ ph/cm2/sec$. All the quoted errors are at the 90% confidence level.

We note that the fluence ratio in a simple power-law fit between the $25 - 50\ keV$ band and the $50 - 100\ keV$ band is 1.34. This fluence ratio is larger than 1.32 which can be achieved in the Band function of $\alpha = -1.0$, $\beta = -2.5$, and $E_{peak} = 30\ keV$. Thus, preliminary analysis shows that E_{peak} of the burst is very likely around or below 30 keV. Therefore the burst can be classified as an X-ray flash.

3 XRT Observations and Analysis

We have analysed the first 4 orbits of Swift-XRT data obtained for GRB 071031 (Stroh et al. GCN Circ. 7020), totaling 658 s of Windowed Timing (WT) data and 7.8 ks of Photon Counting (PC) data.

Using 246 s of overlapping XRT Photon Counting 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($J2000$) = $6.40565deg$ ($00h25m37.36s$),Dec($J2000$) = $-58.05926deg$ ($-58d03'33.3$") with an uncertainty of 2.0 *arcsec* (radius, 90% confidence). This is 2.9 and 1.1 *arcsec* from the previous XRT and UVOT positions respectively (Stroh et al., GCN Circ 7020).

The light curve begins with a count rate $\sim 150\ cts/s$ and it is dominated by flaring. Two of the flares reach $\sim 200\ cts/s$ while in WT mode. By $T + 10\ ks$, the flux decreased down to a count rate

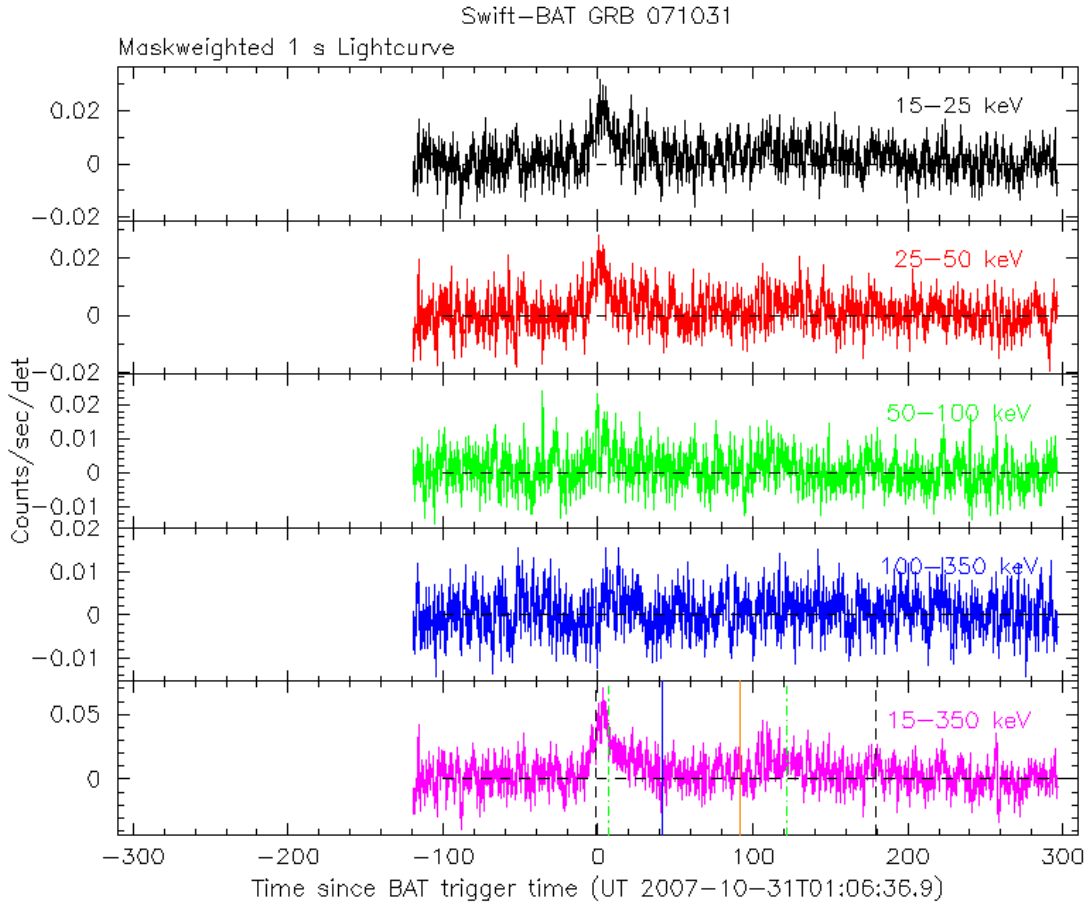

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 01:06:36 UT.

$\sim 0.01\ cts/s$. Due to the amount of flaring in this X-ray light curve, we are unable to determine the slope of the underlying power laws and thus are presently unable to predict the count rate at $T + 24\ hours$.

The WT data (109-750 seconds) can be modeled as an absorbed power-law, with photon index of 1.89 ± 0.02 and a total absorbing column of $N_H = (7.0 \pm 0.4) \times 10^20 cm^{-2}$ which is greater than the Galactic value of $1.22 \times 10^20 cm^{-2}$. The $0.3 - 10\ keV$ absorbed (unabsorbed) flux during this time is 1.2×10^{-9} (1.4×10^{-9}) $ergs/cm^2/sec$.

4 UVOT Observation and Analysis

The Swift/UVOT observed the burst GRB 071031 (Stroh et al. GCN Circ. 7020) starting with the finding chart exposure in white, 114 s after the BAT trigger. The afterglow is detected at the UVOT position given in Stroh et al. (GCN Circ. 7020) in white, v and b until at least 7000s after the trigger. It is barely detected in u and not at all in the UV filters; this is consistent with the redshift of $z = 2.692$ found by Ledoux et al. (GCN Circ. 7023). The brightness apparently increases for the first few hundred seconds and then fades with an estimated temporal slope in the v filter of $\alpha = 0.56$.

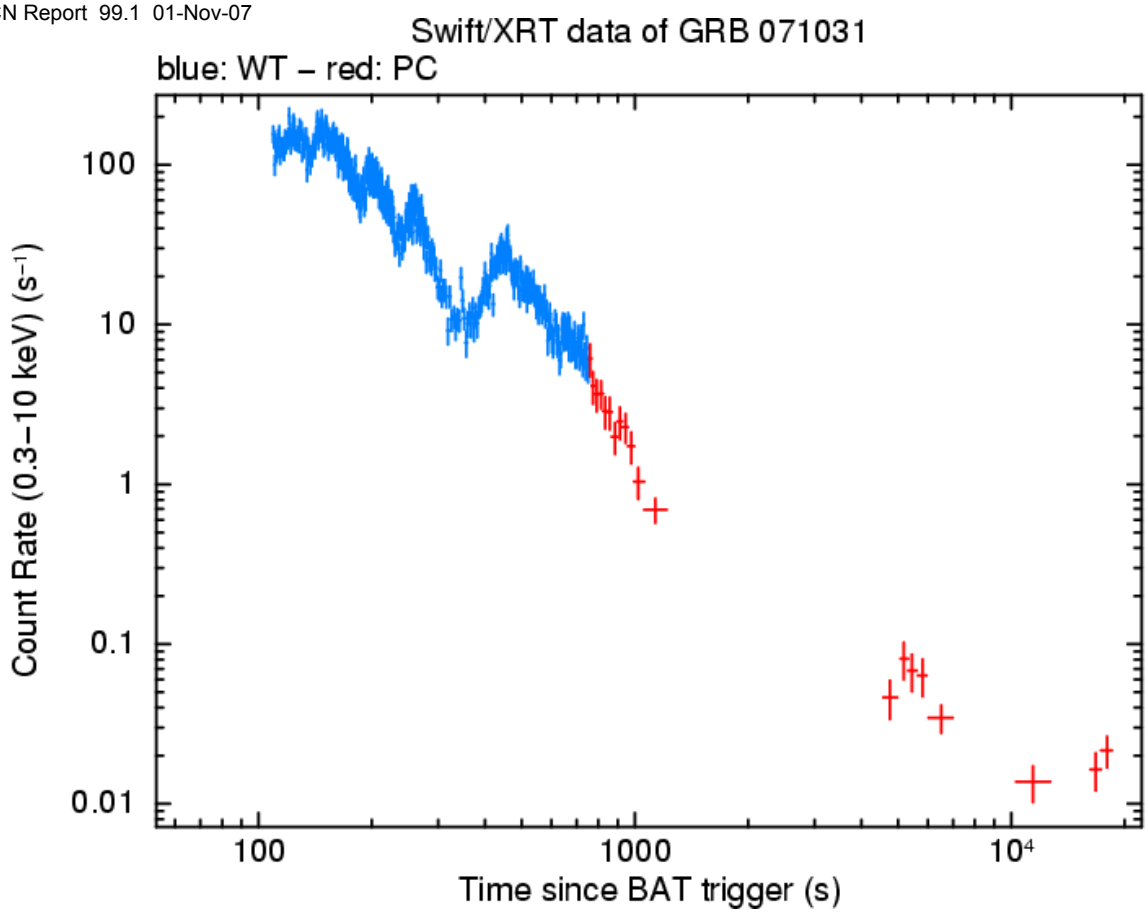

Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is $1 count/sec = 6.8 \times 10^{-14}\ ergs/cm^2/sec$.

The initial UVOT magnitudes and upper limits from single exposures or co-added exposures are summarized in Table 1.

The values in the table are not corrected for the expected Galactic extinction corresponding to a reddening of $E_{B-V} = 0.012\ mag$ in the direction of the burst (Schlegel et al. 1998).

Filter	Tstart(s)	Tstop(s)	Exp(s)	Mag
white	114	213	99.8	19.88 ± 0.14
white	715	724	9.8	19.3 ± 0.3
white	867	966	99.8	19.41 ± 0.1
white	6778	6977	199.8	20.67 ± 0.18
v	220	619	399.8	19.08 ± 0.15
v	973	1219	246.2	18.5 ± 0.13
v	11517	11816	299.8	19.93 ± 0.32
b	700	709	9.8	>18.8 (3 sigma UL)
b	6573	6772	199.8	20.25 ± 0.23
u	675	847	38.9	19.38 ± 0.38
u	4933	6567	393.3	>20.8 (3 sigma UL)
uvw1	651	16990	1317.7	>21.4 (3 sigma UL)
uvm2	626	12782	1089.4	>21.2 (3 sigma UL)
uvw2	730	11206	1118.4	>21.5 (3 sigma UL)

Table 1: Magnitudes and 3 sigma upper limits from UVOT observations