Swift Observations of the GRB 070531

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for the Swift Team:

1. INTRODUCTION

At 02:10:17 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 070531 (trigger=280958). Swift slewed immediately to the burst. Our best position is from the Swift XRT, which is:
RA(J2000) = 00 26 58.50
Dec(J2000) = +74 18 46.7
with an uncertainty of 2.1 arcsec (90% confidence). The gamma-ray light curve shows a single FRED-like peak with a duration of about 20 sec, and a rapidly fading X-ray counterpart was detected. Swift observations of GRB 070531 are complete.

2) BAT OBSERVATION AND ANALYSIS

The following analysis uses the data set from T-240 to T+963 (Sato et al. GCN #6479). The BAT ground-calculated position is RA, Dec = 6.722, 74.316 deg which is
RA(J2000) = 00h 26m 53.3s
Dec(J2000) = 74d 18' 58"
with an uncertainty of 1.7 arcmin, (radius, sys+stat, 90% containment). The partial coding was 44%, and the burst was 44.1 deg off-axis.

The mask-weighted light curve shows a singe FRED peak starting at T+0, with a long weak tail out to at least T+150 sec (Figure 1). There is a 20-sec gap in the data; the weak emission is back to background by T+170 sec. T90 (15-350 keV) is 44 ± 2 sec (estimated error including systematics).

The time-averaged spectrum from T-2.4 to T+44.6 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.41 ± 0.20. The fluence in the 15-150 keV band is 1.1 ± 0.1 x 10^{-6} erg cm^{-2}. The 1-sec peak photon flux measured from T+1.08 sec in the 15-150 keV band is 1.0 ± 0.2 ph cm^{-2} s^{-1}. All the quoted errors are at the 90% confidence level.

3. XRT OBSERVATION AND ANALYSIS

Using 399 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) of RA, Dec = 6.74368, +74.31296 which is equivalent to:
RA(J2000) = 00 26 58.50
Dec(J2000) = +74 18 46.7
with an uncertainty of 2.1 arcsec (90% confidence). This is 3.7 arcsec from the XRT position given in GCN Circ. 6477 (Page & Markwardt), likely due to the afterglow being positioned over the bad columns.

Because of the Sun-angle of this burst, and its relative faintness, only 1 full and 1 partial orbit of data was collected. A light curve is shown in Figure 2. A clear break in this brief light-curve is seen near time T+466±62 s, with power law indices 0.7 ± 0.2 and 2.7 +0.9/-0.7 before and after the break, respectively. XRT observations from the second orbit of data produced only an upper limit (see Figure 2).

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/. For count rate light curves, the approximate flux conversion is 1 count/sec = 1.07 x 10^{-10} erg/cm^2/sec (absorbed) = 1.07 x 10^{-10} erg/cm^2/sec (unabsorbed) in the 0.3-10 keV band.

The X-ray spectrum of the entire first orbit of data can be fitted with a power-law of Gamma = 1.00 ± 0.13, together with an absorption column consistent with the Galactic value (NH = 1.97 x 10^{21} cm^{-2}). There is no evidence for spectral evolution across the break seen in the light-curve. Between 138 and 1070 seconds after the burst, the observed (unabsorbed) 0.3-10 keV flux is 4.47 x 10^{-11} (4.85 x 10^{-11}) erg cm^{-2} s^{-1}.

4. UVOT OBSERVATION AND ANALYSIS

The Swift Ultraviolet/Optical telescope (UVOT) began its White filter finding chart exposure 135 seconds after the trigger (de Pasquale et al. GCN #6481). No optical transient is found inside the XRT refined error circle described in Section 3 above, neither in the initial V and White filter exposures, nor the summed exposures.

In Table 1, we report the 3 sigma upper limits for any optical transient. No correction has been made for the Galactic reddening toward the burst, E(B-V)=0.38.

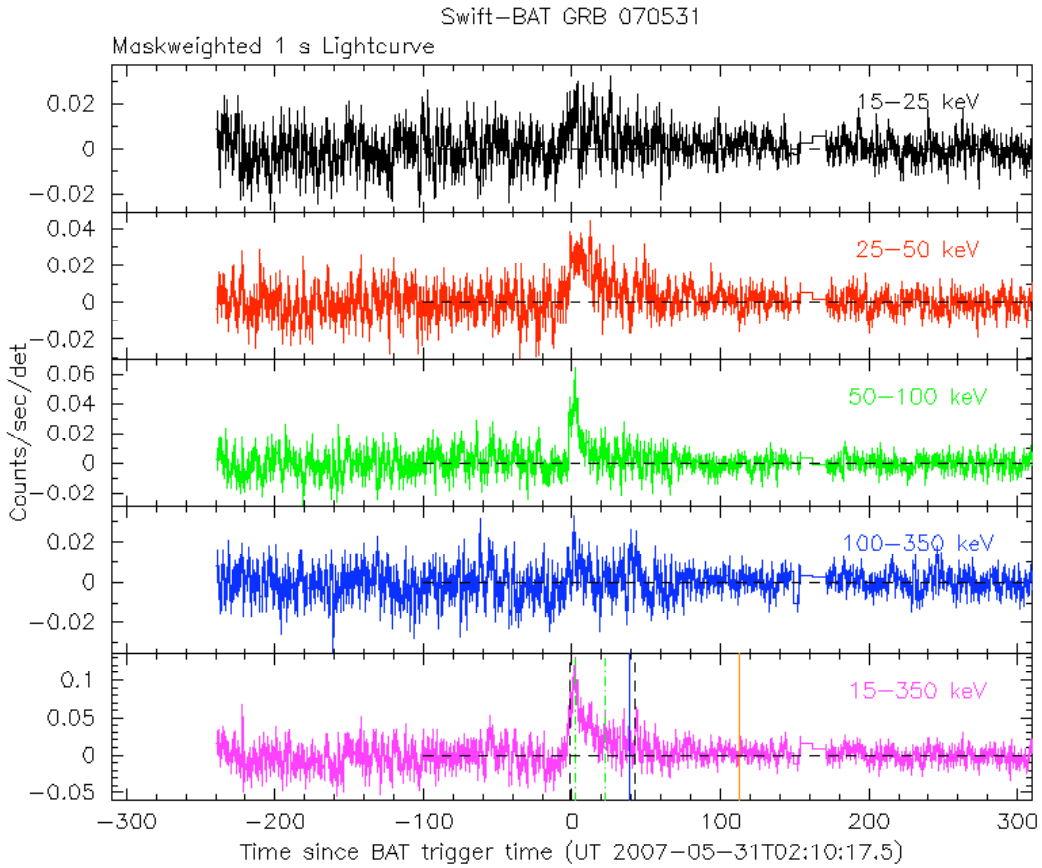

Fig.1: BAT lightcurve with 1 sec time bins. The lightcurve has 4 individual energy bands (15-25 keV, 25-50, 50-100, 100-150, starting from top), plus the total band (bottom). The vertical dashed lines indicate the T50 (green) and T90 (black) intervals. The blue and red lines indicate the spacecraft slew start and stop times, respectively.

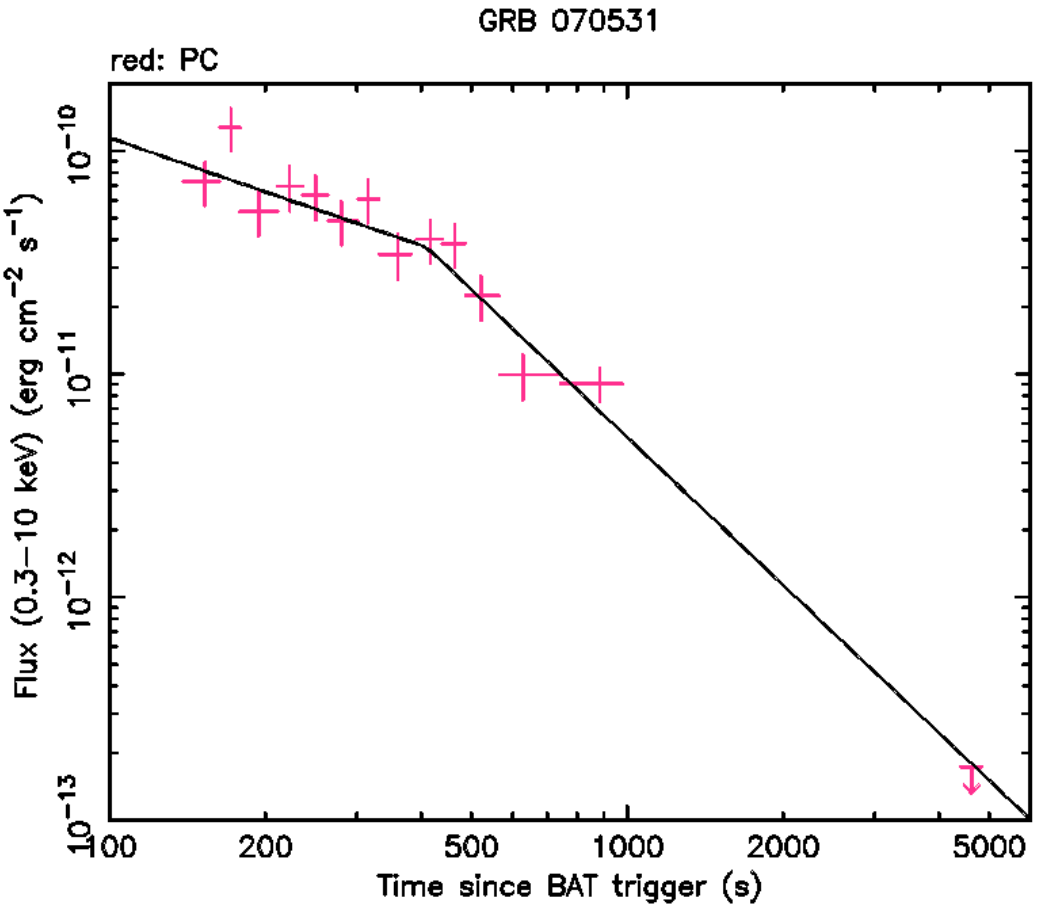

Fig. 2: Swift XRT lightcurve in flux units. All data were taken in Photon Counting (PC) mode. The best-fit broken power law model is shown as a black line.

Table 1: UVOT Upper Limits.

Filter	Time (s)	Expo(s)	Mag (3-σ UL)
WHITE	132-321	98	19.5
WHITE	132-966	207	19.9
V	238-637	393	19.2
V	238-1111	524	19.3
B	716-726	10	18.2
U	692-4845	76	18.9
UVW1	668-4803	236	19.2
UVM2	643-4598	236	19.5
UVW2	745-764	20	17.8

(Times are given in seconds after the BAT trigger.)