

Swift Observation of GRB 070628

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1 Introduction

BAT triggered on GRB 070628 at 14:41:02 UT (Trigger 283320) (Holland, *et al.*, *GCN Circ.* 6584). This was a long burst with $T_{90} = 39.1 \pm 2.0$ s. *Swift* slewed to this burst immediately. XRT began follow-up observations at $T + 107$ s, and UVOT at $T + 1099$ s. Our best position is the UVOT location, RA(J2000) = 115.27537 deg (07^h41^m06.09^s), Dec(J2000) = -20.27928 deg ($-20^{\circ}16'45.4''$) with an error of 0.7 arcsec (radius, 90% containment, including systematic uncertainty). This burst will become Sun constrained on 30 June UT, so *Swift* will be unable to observe it.

The Burst Advocate for this burst is S. T. Holland (sholland@milkyway.gsfc.nasa.gov). Please contact the Burst Advocate by e-mail if you require additional information regarding *Swift* follow-up observations of this burst. In extremely urgent cases, after trying the Burst Advocate, you can contact the *Swift* PI by phone (see the *Swift* ToO Web site for information: <http://www.swift.psu.edu/too.html>).

2 BAT Observation and Analysis

Using the data set from $T - 240$ to $T + 67$ s further analysis of BAT GRB 070628 has been performed by the *Swift* team (Krimm, *et al.*, *GCN Circ.* 6589). The BAT ground-calculated position is RA(J2000) = 115.271 deg (07^h41^m05.1^s), Dec(J2000) = -20.281 deg ($-20^{\circ}16'50''$) ± 1.3 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 58%.

The masked-weighted light curves (Fig. 1) shows pretrigger emission starting at $T - 30$ s. The main emission peak, which is roughly symmetrical, starts at $\sim T - 5$ s and ends at $\sim T + 20$ s. T_{90} (15–350 keV) is 39.1 ± 2.0 s (estimated error including systematics). The BAT data end at $T + 67$ because *Swift* entered the SAA.

The time-averaged spectrum from $T - 31.7$ to $T + 16.2$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.91 ± 0.09 . The fluence in the 15–150 keV band is $(3.5 \pm 0.2) \times 10^{-6}$ erg cm⁻². The 1-s peak photon flux measured from $T + 4.90$ s in the 15–150 keV band is 5.1 ± 0.3 ph cm⁻² s⁻¹. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The XRT began observing the field at $T + 107$ s. Using the data from the first three orbits of XRT data of GRB 070628 the refined XRT position is RA(J2000) = 115.275833 deg (07^h41^m06.2^s), Dec(J2000) = -20.279750 deg ($-20^{\circ}16'47.1''$) ± 3.5 arcsec (90% containment). This position is within 0.5 arcmin of the BAT position (Krimm, *et al.*, *GCN Circ.* 6589) and 1.4 arcsec from the optical afterglow candidate reported by Gronwall & Holland, *GCN Circ.* 6585.

The X-ray light curve (Fig. 2) shows a fading behaviour with superimposed flaring activity. The decay slope is 1.2 ± 0.1 from $T + 20$ ks to $T + 75$ ks. 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/.

The X-ray spectrum covering the time period from $T + 1.1$ ks to $T + 14$ ks is well fit by an absorbed power law with a photon index of 2.2 ± 0.1 and a total column density of $N_H = (7.5 \pm 0.7) \times 10^{21}$ cm⁻². We note that the Galactic column density in the direction of the source is 7.35×10^{21} cm⁻² (Dickey

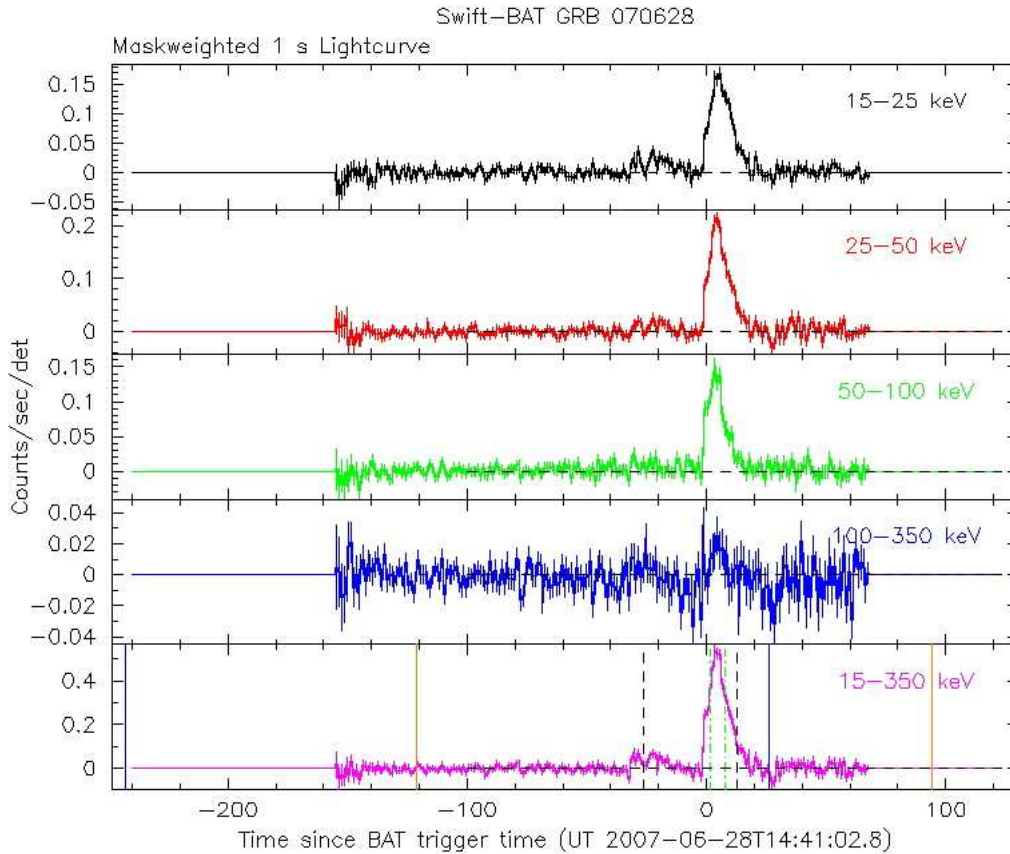


Figure 1: BAT light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are count s^{-1} illuminated-detector $^{-1}$ and T_0 is 14:41:03 UT.

& Lockman, 1990). The average observed flux over 0.3–10 keV for this spectrum is 2.5×10^{-11} erg cm^{-2} s^{-1} .

4 UVOT Observation and Analysis

The *Swift* Ultraviolet/Optical telescope (UVOT) observed the field of GRB 070628 starting 1099 s after the BAT trigger (Holland, *et al.*, *GCN Circ.* 6584). We strongly detect the afterglow in the White and *V* filters, and have a weak detection in the *B* filter. The revised UVOT position is RA(J2000) = 115.27537 deg (07^h41^m06.09^s), Dec(J2000) = -20.27928 deg ($-20^{\circ}16'45.4''$) with an error of 0.7 arcsec (radius, 90% containment, including systematic uncertainty) (Landsman, *et al.*, *GCN Circ.* 6591). This is within the refined XRT error circle. (Perri, *et al.*, *GCN Circ.* 6587).

Magnitudes and 3-sigma upper limits are reported in Table 1. The magnitudes and upper limits are not corrected for the large and uncertain extinction expected at the Galactic latitude of GRB 070628. Schlegel, *et al.* (1998) list $E_{B-V} = 0.9$ in along this line of sight.

A power-law fit to the White filter observations gives a decay index of $\sim -0.55 \pm 0.30$.

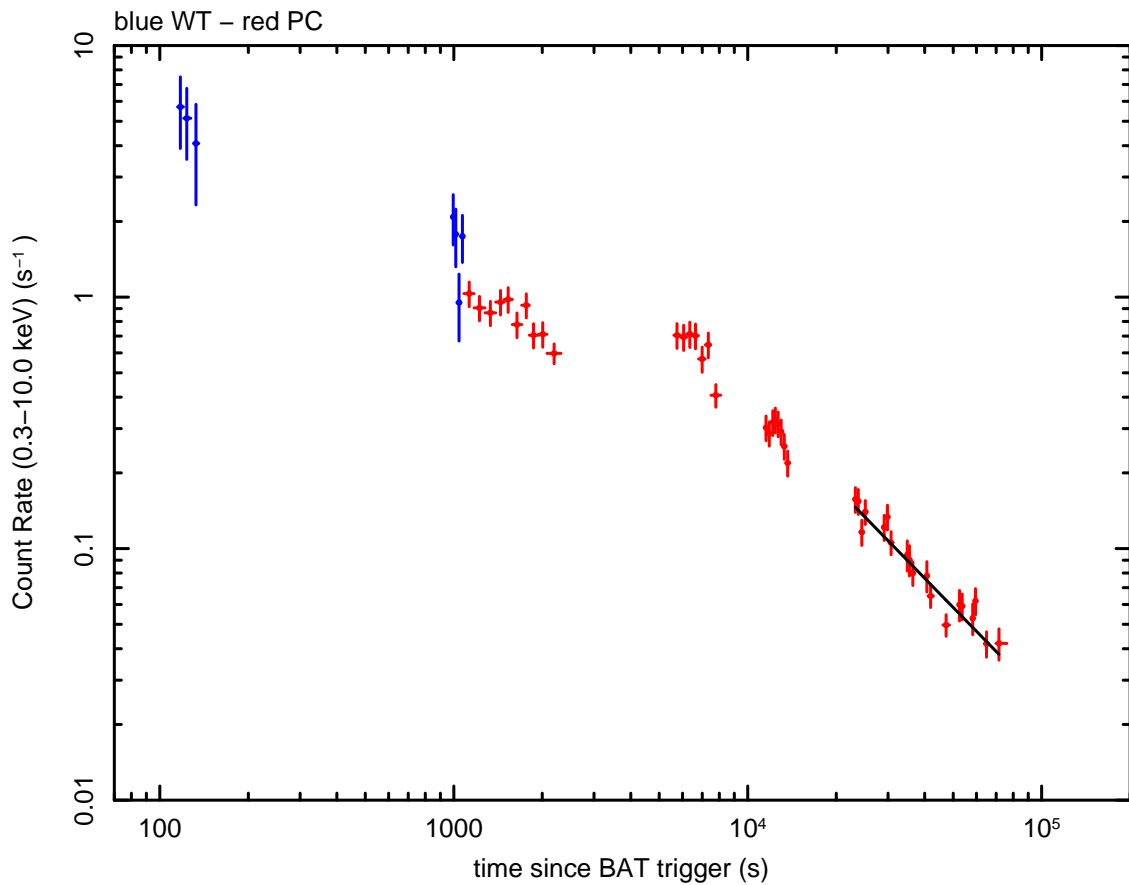


Figure 2: XRT flux lightcurve in count s^{-1} in the 0.3–10 keV band: Window Timing mode (blue) and Photon Counting mode (red). The conversion factor to observed 0.3–10 keV flux for this burst is 1 count $s^{-1} = 5.3 \times 10^{-11}$ erg cm^{-2} s^{-1} .

References

- 1) Dickey, J. M., & Lockman, F. J., 1990, ARAA, 28, 215
- 2) Schlegel, D. J., Finkbeiner, D. P., & Davis, M., 1998, ApJ, 500, 525

Filter	Start	Stop	Exposure (s)	Mag	Err
WHITE	1099	1199	98	19.65	0.11
	1202	1302	98	19.62	0.11
	6628	6827	197	20.59	0.15
	11 691	11 990	295	> 21.2	(3 sigma)
<i>V</i>	1309	1708	393	18.88	0.11
	1850	5804	256	19.55	0.25
	13 207	13 506	295	> 19.6	(3 sigma)
<i>B</i>	1786	6622	78	20.7	0.3
	7856	8055	197	> 20.4	(3 sigma)
<i>U</i>	6217	6417	197	> 20.0	(3 sigma)
UVW1	6014	6213	197	> 19.8	(3 sigma)
UVM2	5809	6008	197	> 19.6	(3 sigma)
UVW2	6833	7032	197	> 19.9	(3 sigma)

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