Swift Observation of GRB 070621

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0 Updates

- XRT paragraph and light curve updated using the whole dataset for this burst.

1 Introduction

BAT triggered on GRB 070621 at 23:17:39.85 UT (Trigger 282808) (Sbarufatti, *et al.*, *GCN Circ.* 6560). This was a 1.024 s rate-trigger on a long burst with $T_{90} = 33$ s. Swift slewed to this burst immediately and XRT began follow-up observations at $T + 111$ s, and UVOT at $T + 120$ s. Our best position is the UVOT-enhanced XRT location RA($J2000$) = 323.79225 deg ($21^h35^m10.14^s$), Dec($J2000$) = -24.8175 deg ($-24^d49'03.1''$) with an error radius of 2.0 arcsec (90% confidence, including boresight uncertainties). No optical counterpart was detected by UVOT. Malesani *et al.*(*GCN Circ.* 6565) reported a possibly extended source near the location of GRB 070621, but its position falls outside the XRT refined error circle.

2 BAT Observation and Analysis

Using the data set from $T-240$ to $T+962$ s, further analysis of BAT GRB 070621 has been performed by the Swift team (Fenimore, *et al.*, *GCN Circ.* 6571). The BAT ground-calculated position is RA($J2000$) = 323.806 deg ($21^h35^m13.5^s$), Dec($J2000$) = -24.809 deg ($-24^d48'32''$) $\pm$ 1.0 $arcmin$, (radius, systematic and statistical, 90% containment). The partial coding was 31%.

The mask-weighted light curves (Fig.1) show several overlapping peaks starting at $\sim T-20$ and ending at $\sim T+40$ s. There is a low-significance bump ($\sim$ 3σ) from $T+70s$ to $T+105$ s. $T_{90}(15-350keV)$ is 33.3 ± 1.0 s (estimated error including systematics).

The time-averaged spectrum from $T-5.2$ to $T+36.4$ s is best fitted by a simple power law model. This fit gives a photon index of 1.57 ± 0.06. For this model the total fluence in the $15-150$ keV band is $(4.3 \pm 0.1) \times 10^{-6}$ $ergs\ cm^{-2}$ and the 1-s peak flux measured from $T+21.56$ s in the $15-150$ keV band is 2.3 ± 0.3 $ph\ cm^{-2}s^{-1}$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using 746 s of overlapping data in XRT Photon Counting mode and UVOT V-band we obtained a refined position of RA($J2000$) = 323.79225 deg ($21^h35^m10.14^s$), Dec($J2000$) = -24.8175 deg ($-24^d49'03.1''$)$\pm$ 2.0 $arcsec$ (90% confidence radius, including boresight uncertainties). This position is within 4.8 $arcsec$ of the initial XRT position.

XRT observed the afterglow for 105 ks, distributed between $T+111s$ and $T+900ks$. The $0.3-10$ keV light curve (Fig.2) shows an initial steep decline with a slope of 3.8 ± 0.1, followed by a shallow slope of 0.91 ± 0.04, beginning at $T+380 \pm 10$ s. Around $T+80ks$, there is a second break, after which the light curve decays with index 1.4 ± 0.2. The source was last detected at flux $2.2 \times 10^{-14} ergs\ cm^{-2}s^{-1}$.

The first two segments of the X-ray lightcurve up to $T + 5ks$ (150 s in Window Timing mode, 1.3 ks in Photon Counting mode) can be modeled with a single absorbed power-law with photon index of 2.5 ± 0.3. The $N_{\rm H}$ column density is $(4.4 \pm 0.9) \times 10^{21}\ cm^{-2}$, significantly in excess with respect to the galactic value in the direction of the burst, $3.5 \times 10^{20}\ cm^{-2}$. The average observed (unabsorbed) flux over $0.3 - 10\ keV$ for this spectrum is $8.4. \times 10^{-10}$ (2.2×10^{-9}) $ergs\ cm^{-2}s^{-1}$ for the WT part and 1.4×10^{-11} (3.6×10^{-11}) $ergs\ cm^{-2}s^{-1}$ for the PC part.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 070621 at 23:19:39.85 UT, 120 s after the initial BAT trigger (Holland *et al.*, *GCN Circ.* 6573). No new source was detected within the XRT error circle in the white and V finding exposures, or in the co-added images in any filter down to 3-sigma magnitude. Upper limits are summarized in Table 1. These upper limits are not corrected for the Galactic extinction corresponding to a reddening of $E_{B-V} = 0.05\ mag$.

Filter	Start	Stop	Exposure	3-Sigma UL
V	226	1360	806	20.2
B	702	714	10	18.6
U	680	4799	88	19.7
UVW1	656	4744	236	20.3
UVM2	631	802	38	18.8
UVW2	733	752	19	18.1
White	120	954	204	21.3

Table 1: Magnitude limits from UVOT observations.

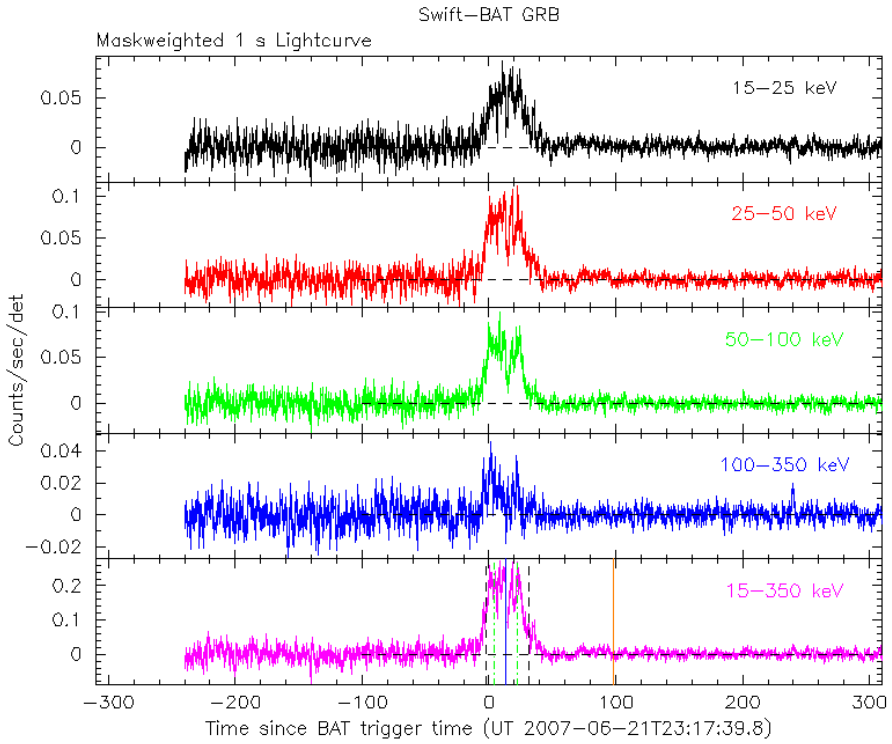

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/s/illuminated-detector and T_0 is 23:17:39.85 UT.

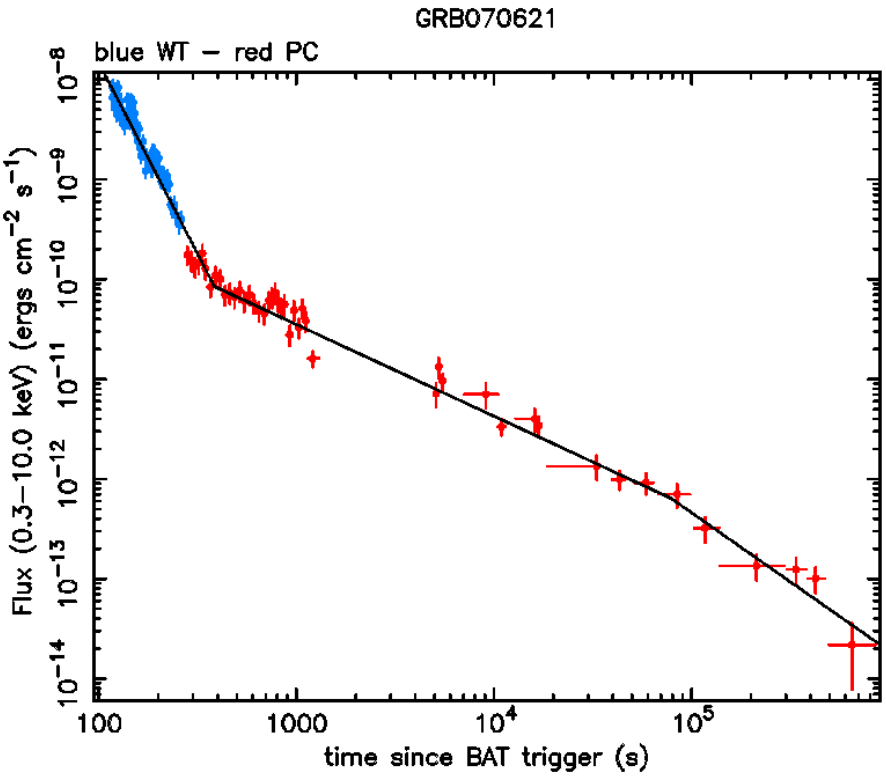

Figure 2: XRT Lightcurve. Flux ($ergs\ cm^{-2}s^{-1}$) in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is 1 count/s = $\sim 8.6\times10^{-11}\ ergs\ cm^{-2}s^{-1}$.