Swift Observation of GRB 070224

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1 Introduction

BAT triggered on GRB 070224 at 20:27:58 UT (Trigger 261880) (Racusin, *et al.*, *GCN Circ.* 6137). This was a rate-trigger on a intermediate length burst with $T_{90} = 34 \pm 1$ *sec*. Swift slewed to this burst immediately and XRT began follow-up observations at $T + 143$ *sec*, and UVOT at $T + 132$ *sec*.

Our best position is the astrometrically corrected XRT location RA($J2000$) = $179.02792deg$ ($11h56m6.7s$), Dec($J2000$) = $-13.3304deg$ ($-13d19'49.6''$) with an error radius of 2.6 arcsec (90% confidence, including boresight uncertainties).

2 BAT Observation and Analysis

Using the data set from $T - 20$ to $T + 50$ *sec*, further analysis of BAT GRB 070224 has been performed by the Swift team (Tueller, *et al.*, *GCN Circ.* 6141). The BAT ground-calculated position is RA($J2000$) = $178.987deg$ ($11h55m57.0s$), Dec($J2000$) = $-13.356deg$ ($-13d21'20.1''$) with an error radius of 2.0 $arcmin$, (systematic and statistical, 90% containment). The partial coding was 100%.

The masked-weighted light curves (Fig.1) starts at trigger time T with two overlapping peaks, and returns to background at about $T + 50$ *sec*. $T_{90}(15 - 350keV)$ is 34 ± 1 (estimated error including systematics).

The time-averaged spectrum from $T - 13.8$ to $T + 24.3$ *sec* is best fitted by a simple power law model. This fit gives a photon index of 2.42 ± 0.30. For this model the total fluence in the $15 - 150$ keV band is $(3.1 \pm 0.5) \times 10^{-7} ergs/cm^2$ and the 1-sec peak flux measured from $T - 13.76$ *sec* in the $15 - 150$ keV band is 0.3 ± 0.1 $ph/cm^2/sec$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Based on an accurate mapping between the XRT and UVOT detector coordinate systems, we have used the simultaneous UVOT V-band images to astrometrically correct (relative to stellar catalogues, e.g. USNO-B1) the XRT world coordinate system, and thereby refine the XRT position. We obtain a new XRT position at RA($J2000$) = $179.02792deg$ ($11h56m6.7s$), Dec($J2000$) = $-13.3304deg$ ($-13d19'49.6''$) with an error radius of 2.6 arcsec (90% confidence, including boresight uncertainties, Racusin *et al.*, *GCN Circ.* 6151). This position is 8.1 $arcsec$ from the initial XRT position reported by Racusin *et al.*, *GCN Circ.* 6137, 3.8 $arcsec$ from the refined XRT position reported by Racusin *et al.*, *GCN Circ.* 6143, and 2.0 $arcsec$ from the optical afterglow, first reported by Thoene *et al.*, *GCN Circ.* 6142.

The $0.3 - 10$ keV light curve (Fig.2) can be modeled by a broken power-law with initial steep decline with a slope of 3.30 ± 0.31, followed by a shallow slope of 0.66 ± 0.09, beginning at $T + 580 \pm 100$ *sec* ($\chi^2/dof = 0.6, dof = 7$).

The first orbit of the X-ray lightcurve (combined WT & PC mode data) can be modeled with an absorbed power-law with photon index of 2.2 ± 0.3. The NH column density is consistent with galactic column density, $4.1 \times 10^{20} cm^{-2}$. The average observed (unabsorbed) flux over $0.3 - 10$ keV for this spectrum (spanning a time of 143-1371 seconds after the trigger) is 1.3×10^{-11} (4.0×10^{-11}) $ergs/cm^2/sec$.

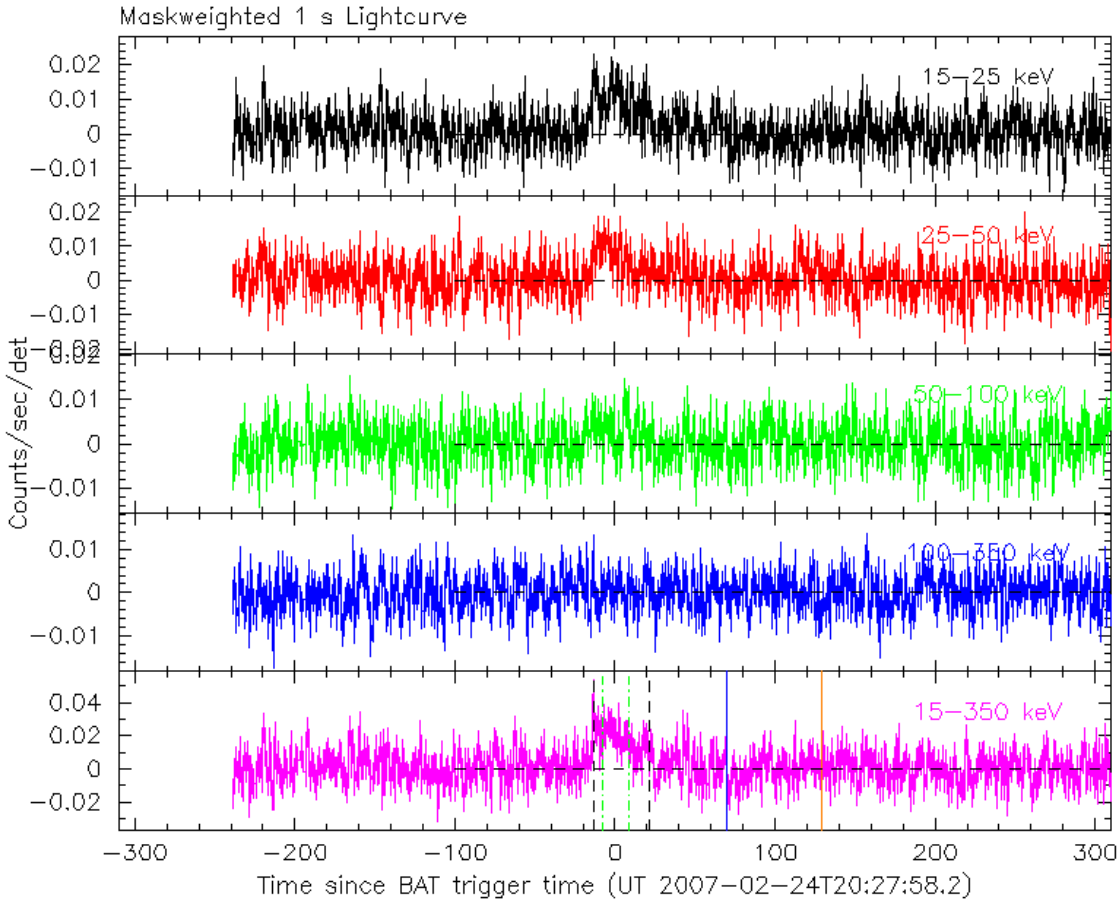

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 20:27:58 UT.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 070224 132 sec after the initial BAT trigger (Racusin *et al.*, *GCN Circ.* 6137). No new sources were detected in any of the UVOT observations within the XRT error circle. The 3-sigma upper limits for detecting a source anywhere inside the XRT error circle in the settling image, the finding chart images, and the co-added frames are summarized in Table 1.

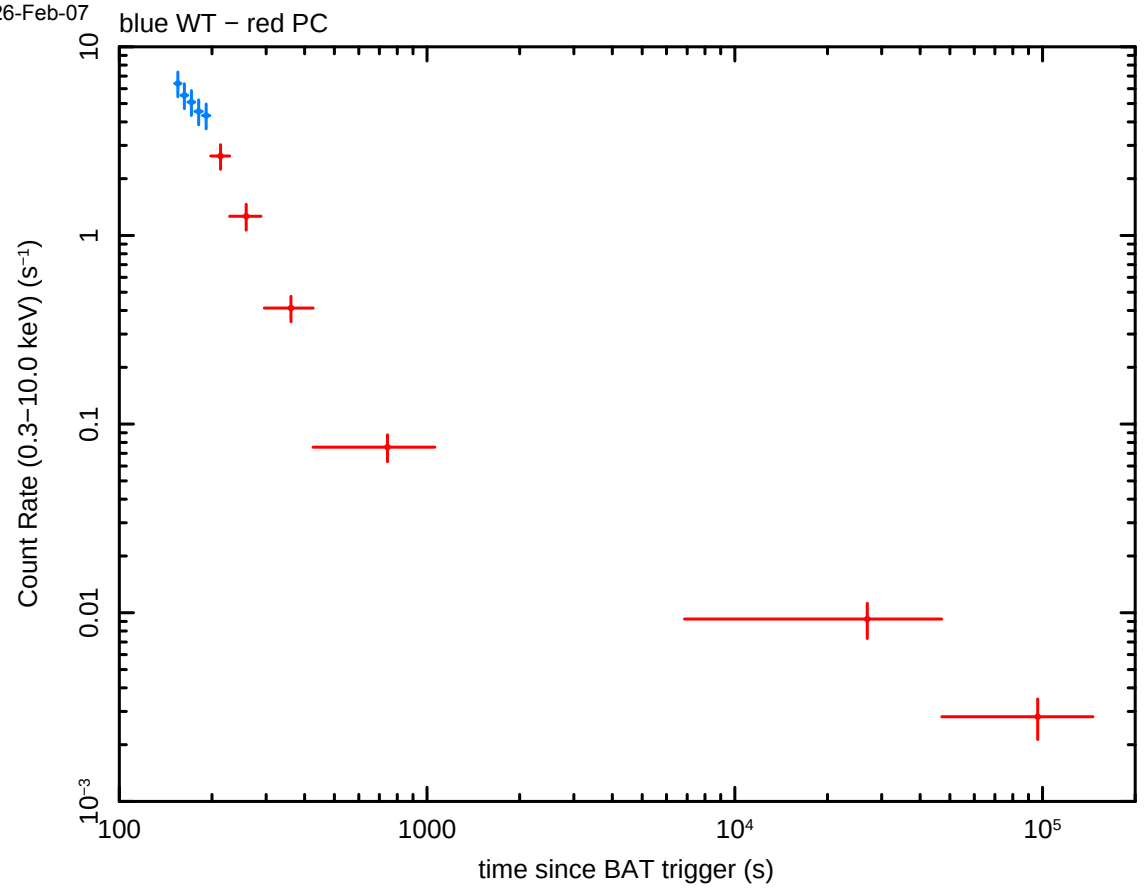

Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing mode (red), Photon Counting mode (blue). The approximate conversion is 1 count/sec = $\sim 4.0 \times 10^{-11}$ $ergs/cm^2/sec$.

Filter	Start	Stop	Exposure	3-Sigma UL
V (Settling)	132	144	12	17.1
White (Finding)	156	254	96	20.6
V (Finding)	259	659	393	20.2
V	259	1367	1593	21.0
B	737	747	10	18.5
U	713	733	19	18.5
UVW1	689	5512	132	19.8
UVM2	665	833	39	18.3
UVW2	766	785	19	18.2
White	154	962	304	21.3
V	35,712	126,303	1553	20.9
B	7159	128,636	1987	22.1
U	6954	93,932	1952	21.7
UVW1	6750	145,987	4321	22.1
UVM2	12,574	143,883	4621	22.5
UVW2	29,833	122,852	4358	22.5

Table 1: Magnitude limits from UVOT observations. The values quoted above are not corrected for the expected Galactic extinction corresponding to a reddening of $E_{B-V} = 0.06$ mag towards the direction of the burst (Schlegel et al. 1998).