

Swift Observation of Short/Hard GRB 070209

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0 Revisions

This version includes new sections for XRT and UVOT observations and analyses. The XRT and UVOT images are shown in Fig. 2 and 3, respectively. The BAT light curve (Fig. 1) is updated with finer binning (8 ms). The BAT section is updated to include a spectral lag calculation. The error size of the BAT location quoted in Introduction is corrected.

1 Introduction

BAT triggered on GRB 070209 at 03:33:41.9 UT (Trigger 259803) (Sato, *et al.*, *GCN Circ.* 6086). This was a 0.064 sec rate-trigger on a burst with $T_{90} = 0.1 \pm 0.02$ sec. Swift slewed to this burst immediately and XRT began follow-up observations at T+78 sec, and UVOT at T+83 sec. Our best position is the BAT location RA (J2000) = 03h4m51.2s, Dec (J2000) = $-47^{\circ}22'34''.2$ with an error of 2.8 arcmin (90% confidence, including boresight uncertainties).

2 BAT Observation and Analysis

Using the data set from $T - 240$ to $T + 302$ sec, the BAT ground-calculated position is RA (J2000) = 46.213° (03h4m51.2s), Dec (J2000) = -47.376° ($-47^{\circ}22'34''.2$) with an uncertainty of 2.8 arcmin, (radius, sys+stat, 90% containment). The partial coding was 85% (the bore sight angle was 26.7°).

The mask-weighted lightcurve (Fig. 1) has a single peak. T_{90} (15–350 keV) is 0.1 ± 0.02 sec (estimated error including systematics).

The time-averaged spectrum from $T + 0.0$ to $T + 0.1$ is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.55 ± 0.39 . The fluence in the 15–150 keV band is $1.1 \pm 0.3 \times 10^{-8}$ ergs cm^{-2} . The 1-sec peak photon flux measured from $T + 0.00$ sec in the 15–150 keV band is 2.4 ± 0.6 ph $\text{cm}^{-2} \text{s}^{-1}$. All the quoted errors are at the 90% confidence level.

We have performed the spectral lag analysis on this burst. The lag is -1 ± 5 ms between the 50–100 and 15–25 keV bands.

3 XRT Observation and Analysis

We have analyzed the first 12 orbits of XRT data of GRB 070209. Data in Photon Counting mode started at 03:35:10 UT, 89 s after the BAT trigger. With an exposure time of 26.9 ks we did not find X-ray sources within the BAT refined error circle (Fig. 2). We note that the following X-ray sources are detected in the 0.7–10 keV band in the proximity of the BAT error circle:

- Source #1: CR = $1.1 \pm 0.3 \times 10^{-3}$ cts/s, RA (J2000) = 03h04m57.3s, Dec (J2000) = $-47^{\circ}19'35''.6$
- Source #2: CR = $7.5 \pm 2.2 \times 10^{-4}$ cts/s, RA (J2000) = 03h05m04.9s, Dec (J2000) = $-47^{\circ}18'42''.8$
- Source #3: CR = $1.4 \pm 0.3 \times 10^{-3}$ cts/s, RA (J2000) = 03h04m39.1s, Dec (J2000) = $-47^{\circ}27'57''.3$

The estimated uncertainty of the positions of the three sources is about 5 arcsec (90% containment). Source #1 lies 3.1 arcmin from the refined BAT position, just outside the error circle. We note that this source may be fading, but due to the small number of counts we are unable to determine clearly if the source is decaying. A Swift follow-up observation will be performed in a few days to confirm whether source #1 is fading or not.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 070209 83 sec after the BAT trigger. A faint source is seen near the detection limit in some of the UVOT exposures (Fig. 3). There is no evidence that the source is fading during the first xx orbits. The White magnitude in the co-added exposure is 21.4 ± 0.3 .

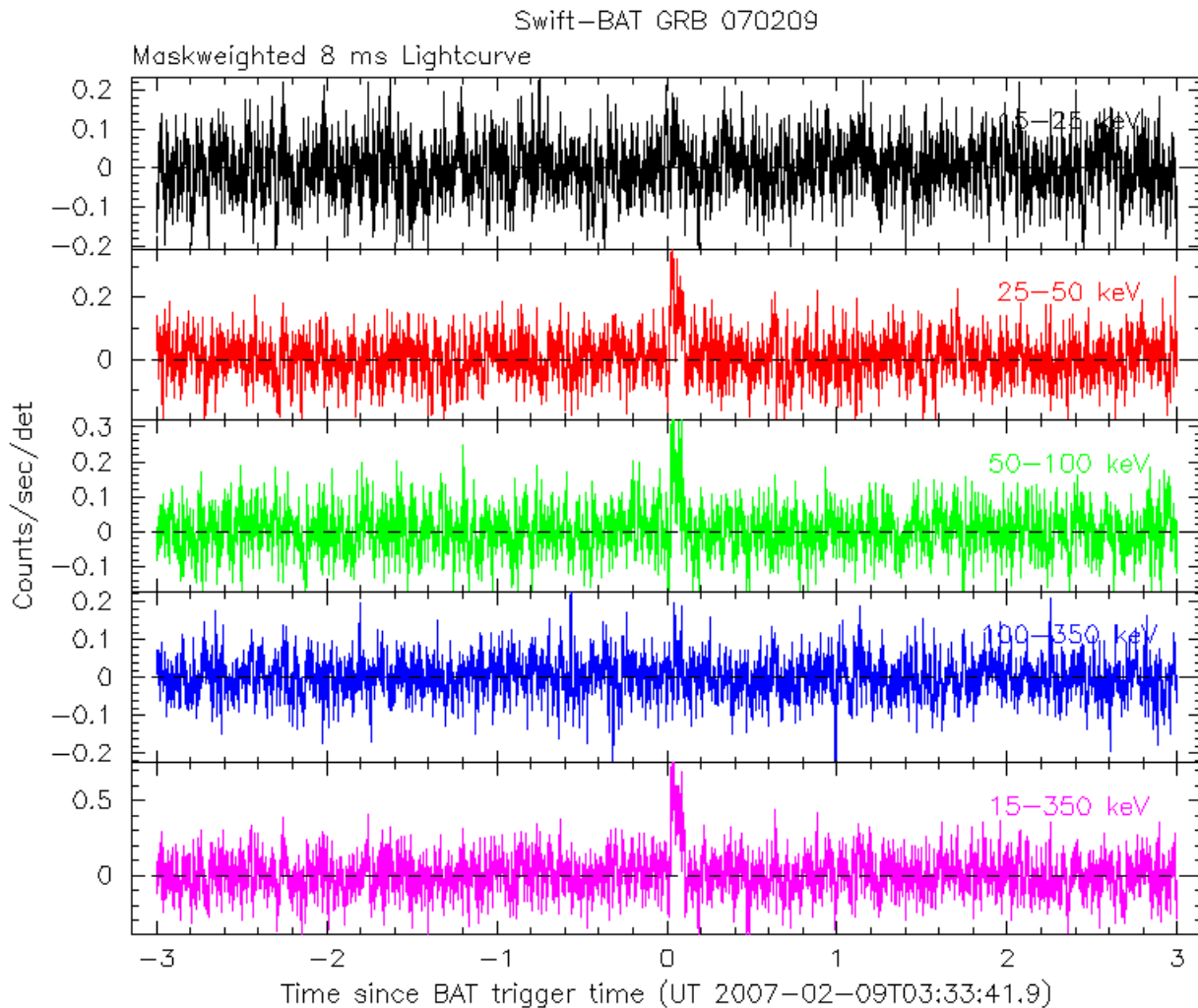


Figure 1: BAT light curve for GRB 070208. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 03:33:41.9 UT.

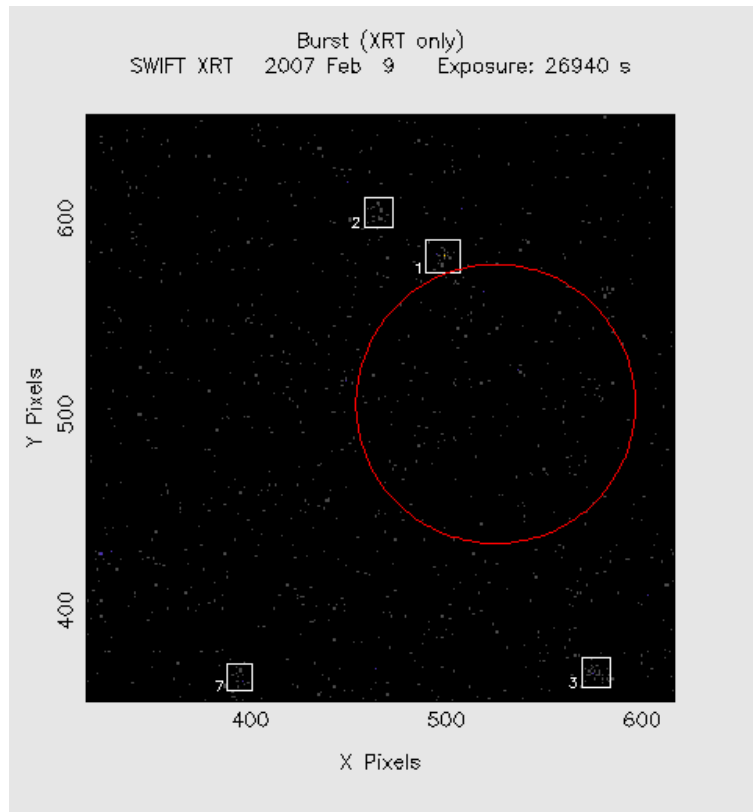


Figure 2: The XRT image in 0.7–10 keV band. Three X-ray sources are detected in the proximity of the BAT refined error circle (red circle).

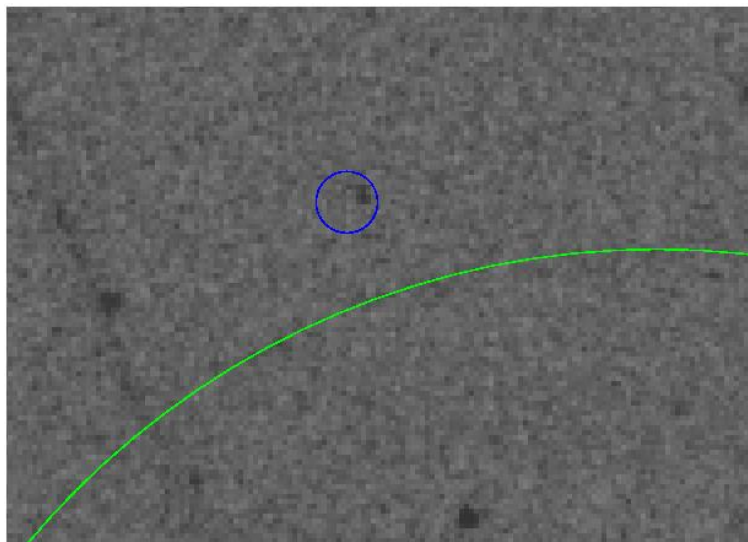


Figure 3: The UVOT co-added White image. The green circle is the refined BAT error circle. A faint source is seen within the XRT error circle for the source #1 (blue circle).