

Swift Observations of GRB 100702A

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1 Introduction

At 01:03:47 UT on 2 July 2010, the Swift Burst Alert Telescope (BAT) triggered and located the short hard burst GRB 100702A (trigger=426438). Swift slewed immediately to the burst and identified an X-ray counterpart (Siegel et al., *GCN Circ.* 10916). The burst was also detected by Integral SPI/ACS (Beckman, personal communication).

The best *Swift* position for this burst is the UVOT-enhanced XRT position given in Siegel et al. (*GCN Circ.* 10916): RA, Dec (J2000) = 245.6969 (16h 22m 47.26s), -56.5316 ($-56^{\circ} 31' 53.8''$) with an uncertainty of $2.4''$. No optical or infrared afterglow was identified either in the UVOT (De Pasquale & Siegel. *GCN Circ.* 10922), ROTSE (Flewelling et al., *GCN Circ.* 10917), VLT (Malesani et al, *GCN Circ.* 10918), or Magellan (Berget et al., *GCN Circ.* 10919, *GCN Circ.* 10921).

2 BAT Observation and Analysis

At 01:03:47 UT on 2 July 2010, the Swift Burst Alert Telescope (BAT) triggered and located GRB 100702A. Using the data set from T-239 to T+963 sec for further analysis¹, the BAT ground-calculated position is RA, Dec (J2000) = 245.693 (16h 22m 46.4s), -56.549 deg ($-56^{\circ} 32' 57.4''$) with an uncertainty of 1.4 arcmin, (radius, sys+stat, 90% containment). The partial coding was 61% (Baumgartner et al., *GCN Circ.* 10926).

The mask-weighted light curve (Figure 1) shows a FRED-like pulse starting at T_{zero} to $\sim T+0.25$ sec. There is a possible weak pulse emission at T-0.25 sec. T_{90} (15-350 keV) is 0.16 ± 0.03 sec (estimated error including systematics).

The time-averaged spectrum from T+0.036 to T+0.236 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.54 ± 0.15 . The fluence in the 15-150 keV band is $1.2 \pm 0.1 \times 10^{-7}$ erg cm^{-2} . The 1-sec peak photon flux measured from T-0.36 sec in the 15-150 keV band is 2.0 ± 0.2 ph $\text{cm}^{-2} \text{sec}^{-1}$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The XRT began observing the field of GRB 100702A at 01:05:21.1 UT, 93.9 seconds after the BAT trigger. Using promptly downlinked data we found an uncatalogued fading X-ray source located at a UVOT-enhanced XRT position (Goad et al. 2007, A&A, 476, 1401; Evans et al. 2009, MNRAS, 397, 1177) of RA, Dec (J2000) = 245.6969 (16h 22m 47.26s), -56.5316 ($-56^{\circ} 31' 53.8''$) with an uncertainty of 2.4 arcseconds (radius, 90% containment), This location is 24 arcseconds from the BAT onboard

¹The results of the batgrbproduct analysis are available at http://gcn.gsfc.nasa.gov/notices_s/426438/BA/

position, within the BAT error circle. A power-law fit to a spectrum formed from promptly downlinked event data gave a column density consistent with the Galactic value of $1.12 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al. 2005).

We collected 3770 s of Swift-XRT data on the GRB, from 100 s to 9.7 ks after the BAT trigger. The data comprise 190 s in Windowed Timing (WT) mode with the remainder in Photon Counting (PC) mode. The light curve can be modeled with an initial power-law decay with an index of $\alpha=0.65$ (+0.37, -0.25), followed by a break at T+185 s to $\alpha=4.33$ (+0.53, -0.24). The afterglow was not detected after the first orbit.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of 1.92 (+0.11, -0.10). The best-fitting absorption column is $3.6 (\pm 0.4 \times 10^{21} \text{ cm}^{-2})$, in excess of the Galactic value of $2.8 \times 10^{21} \text{ cm}^{-2}$ (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is $4.45 \times 10^{-11} (6.94 \times 10^{-11}) \text{ erg cm}^{-2} \text{ count}^{-1}$.

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 100702A 101s after the BAT trigger. The enhanced XRT error circle appears crowded with sources which blend together. There is no indication of change of optical flux between the first exposures and later ones for any sources in or near the XRT error circle. The preliminary magnitudes and 3-sigma upper limits for the finding chart exposures (FC) and summed images for the emission in the XRT enhanced error circle are listed in Table 1. ROTSE (Flewelling et al., *GCN Circ.* 10917), VLT (Malesani et al, *GCN Circ.* 10918) and Magellan (Berget et al., *GCN Circ.* 10919, *GCN Circ.* 10921) found similar results, with multiple sources in the field, none of which showed any fading.

| Filter | T_{Start} | T_{stop} | Exposure | Mag |
|------------|--------------------|-------------------|----------|------------|
| white (FC) | 101 | 251 | 147 | 17.99±0.07 |
| white | 594 | 10684 | 1295 | 17.84±0.05 |
| u (FC) | 314 | 564 | 246 | 18.85±0.17 |
| u | 5020 | 5151 | 131 | 18.96±0.26 |
| v | 4405 | 17014 | 735 | 16.72±0.04 |
| b | 570 | 6306 | 216 | 17.79±0.08 |
| uvw1 | 4815 | 5015 | 196 | >19.60 |
| uvm2 | 4610 | 4810 | 197 | >19.40 |
| uvw2 | 4200 | 16457 | 1432 | >20.85 |

Table 1: Magnitudes from UVOT observations of GRB 100702A. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight of $E(B - V) = 0.41$ mag. All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).

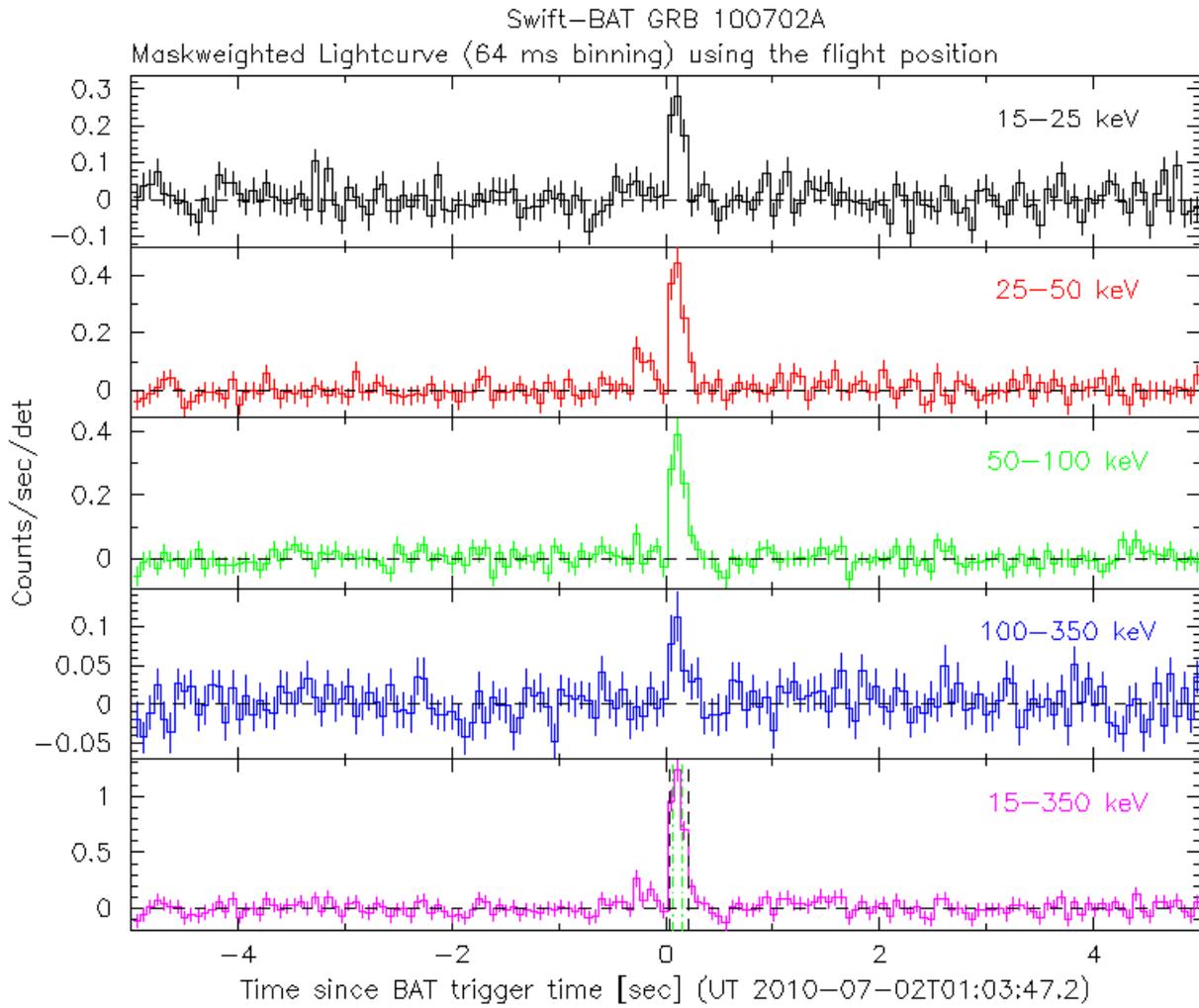


Figure 1: BAT Light curve of GRB 100702A.

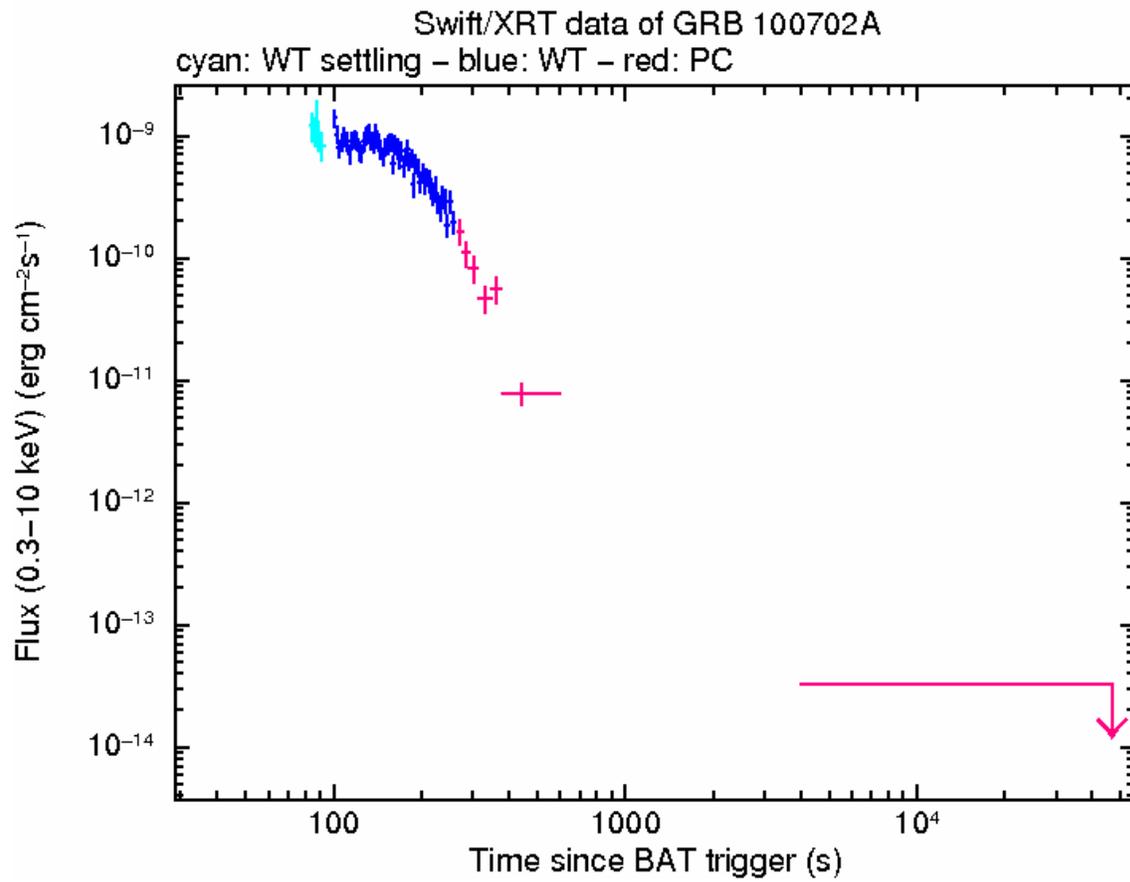


Figure 2: XRT flux light curve of GRB 100702A in the 0.3-10 keV band. The approximate conversion is $1 \text{ count s}^{-1} = \sim 3.8 \times 10^{-11} \text{ ergs s}^{-1} \text{ cm}^{-2}$.