

Swift Observation of GRB 101225A

J. L. Racusin (NASA/GSFC), J. Cummings (NASA/GSFC/UMBC), S. Holland (NASA/CRESST/USRA/GSFC), H. Krimm (NASA/GSFC/USRA), S. R. Oates (UCL-MSSL), K. Page (U. Leicester), M. Siegel (PSU), for the Swift Team

1 Introduction

BAT triggered on GRB 101225A at 18:37:45 UT (Trigger 441015) (Racusin, *et al.*, *GCN Circ.* 11493). This was a 1088 sec image-trigger on an extremely long burst with $T_{90} > 1650$ sec. Swift slewed to this burst at the end of the image trigger and XRT began follow-up observations at $T + 1383$ sec, and UVOT at $T + 1387$ sec. Our best position is the Enhanced XRT location $RA(J2000) = 0.19782deg$ (00h00m47.48s), $Dec(J2000) = +44.60027deg$ (+44d36'01.0") with an error of 1.4 arcsec (radius, 90% confidence, Evans, *et al.*, *GCN Circ.* 11497).

2 BAT Observation and Analysis

Using the data set from $T - 80$ to $T + 1758$ sec, further analysis of BAT GRB 101225A has been performed by Swift team (Palmer, *et al.*, *GCN Circ.* 11500, Cummings, *et al.*, *GCN Circ.* 11504). The BAT ground-calculated position is $RA(J2000) = 0.204deg$ (00h00m48.9s), $Dec(J2000) = +44.574deg$ (+44d34'26.0") with an error of 3.6 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 85%.

The masked-weighted light curve (Fig.1) shows that the GRB entered the BAT field of view at $\sim T - 80$ sec during a pre-planned slew. The light curve was largely flat until it exited the field of view at $T + 1091$ sec. After re-entering the field of view at $T + 1372$ sec, the most intense emission in the 14 – 50 keV range was observed until exiting the field of view at $T + 1758$ sec. No emission was observed in the subsequent orbits. $T_{90}(15 - 350keV)$ is > 1650 sec.

The time-averaged spectra from $T + 0$ to $T + 963$ sec and from $T + 1372$ to $T + 1672$ sec are best fitted by simple power law models. These fits give photon indices of 1.91 ± 0.35 and 1.87 ± 0.21 , respectively. For these models the total fluences in each time period in the 15 – 150 keV band are $(1.7 \pm 0.4) \times 10^{-6}$ and $(9.0 \pm 0.2) \times 10^{-7} ergs/cm^2$. Since the event was in progress both when the source entered the BAT field of view and when it left the field of view due to Swift orbit-constrained slews, it is not possible to determine the total burst fluence or constrain T_{90} . All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using 12 ksec of XRT Photon Counting mode data and 28 UVOT images for GRB 101225A, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): $RA(J2000) = 0.19782deg$ (00h00m47.48s), $Dec(J2000) = +44.60027 deg$ (+44d36'01.0") with an error of 1.4 arcsec (radius, 90% confidence). This position is within 6.1 arcsec of the initial XRT position, and 1.4 arcsec from the optical afterglow candidate, reported by Xu *et al.*, *GCN Circ.* 11495.

The 0.3 – 10 keV light curve (Fig.2) shows an initial shallow decline with a slope of 1.11 ± 0.01 , following by a steep slope of $5.95^{+0.20}_{-0.19}$, beginning at $T + 21.7 \pm 0.3$ ksec.

The WT and PC spectra can be modeled with an absorbed power-law with spectral indices of 1.65 ± 0.03 and 1.94 ± 0.05 , respectively. The NH column density is in excess of the Galactic column density ($7.9 \times 10^{20} cm^{-2}$) with fit values of $1.45 \pm 0.17 \times 10^{21} cm^{-2}$ and $1.19 \pm 0.23 \times 10^{21} cm^{-2}$. The average

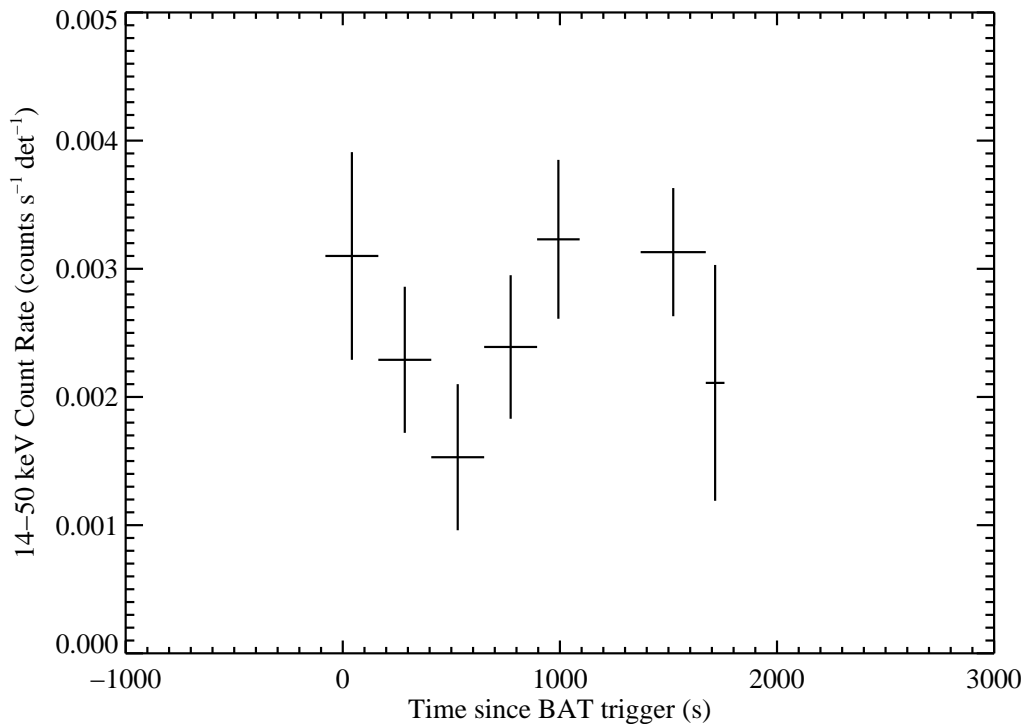


Figure 1: BAT Light curve. The mask-weighted light curve in the 14-50 keV energy band. The units are counts/sec/illuminated-detector and T_0 is 18:37:45 UT.

observed (unabsorbed) flux over $0.3 - 10$ keV for this spectrum (spanning a time of $1.4 - 7.3$ ksec and $7.3 - 190$ ksec after the trigger) is 2.07×10^{-9} (2.5×10^{-9}) $ergs/cm^2/sec$ and 1.91×10^{-11} (2.5×10^{-11}) $ergs/cm^2/sec$, respectively.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 101225A at 19:00:52.5 UT, 1387 sec after the initial BAT trigger (Siegel *et al.*, *GCN Circ.* 11499). The afterglow was detected in the b, u, w1, w2, and m2 filters. The best sampled light curve is in the w2 band. The preliminary light curve using the UVOT photometric system (Poole *et al.* 2008, *MNRAS*, 383, 627) is shown in Figure 3. These measurements are not corrected for Galactic extinction $E(B - V) = 0.10$ in the direction of the burst (Schlegel, D. J., *et al.* 1998, *ApJ*, 500, 525).

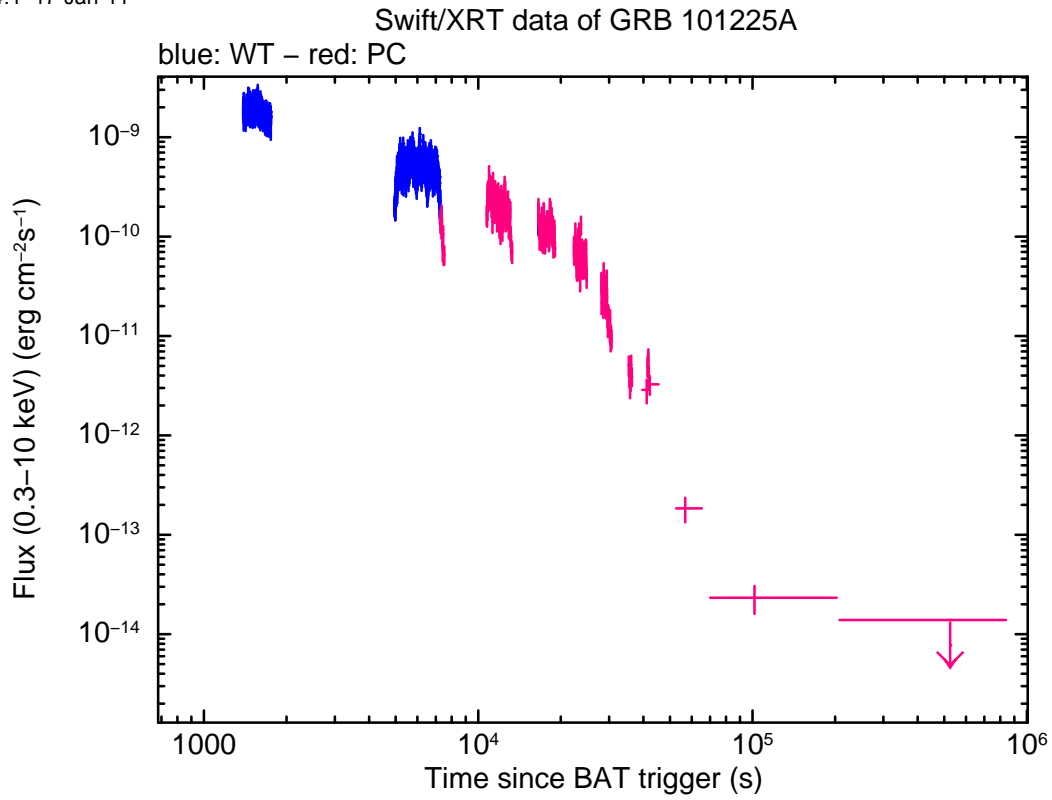


Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is 1 count/sec = $\sim 4.1 \times 10^{-11}$ *ergs/cm²/sec*.

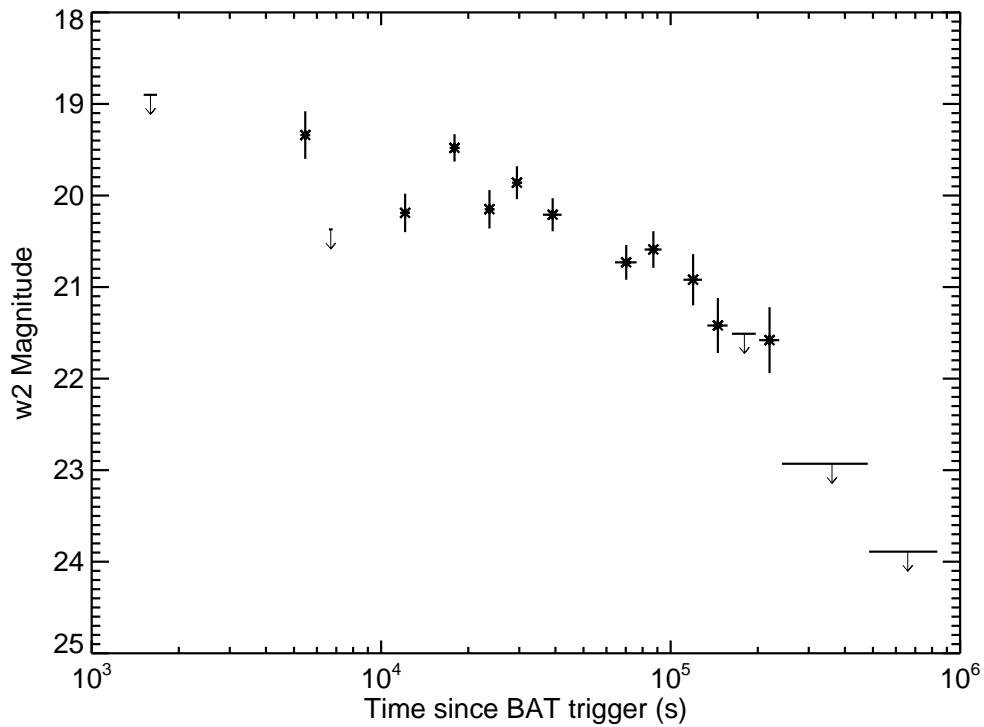


Figure 3: UVOT uvw2 filter light curve. Upper limits are 3σ confidence.