Swift Observations of GRB 101017A

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1 Introduction

At 10:32:47 UT on 17 October 2010, the Swift Burst Alert Telescope (BAT) triggered and located the long burst GRB 101017A (trigger=436429). Swift slewed immediately to the burst and identified an afterglow in both the X-ray and UV-optical (Siegel et al., *GCN Circ.* 11345). The burst was also detected by Integral SPI/ACS (Beckman, personal communication) and Konus-Wind (Golenetskii et al., *GCN Circ.* 11350). The optical afterglow faded rapidly and was not detected after the first orbit with UVOT (Siegel et al., *GCN Circ.* 11354). Nor was it detected by ROTSE (Pandey, *GCN Circ.* 11346), MITSuME (Kuroda et al., *GCN Circ.* 11351) or miniTAO/ANIR (Motohara et al., *GCN Circ.* 11356).

The best position for this burst is the position of the UVOT afterglow given in Siegel et al. (*GCN Circ.* 11345): RA, Dec (J2000) = 291.38565 (19h 25m 32.56s), -35.14482 (-35° $08'$ $41.4''$) with an uncertainty of $0.72''$.

2 BAT Observation and Analysis

At 10:32:47 UT on 17 October 2010, the Swift Burst Alert Telescope (BAT) triggered and located GRB 101017A. Using the data set from T-60 to T+240 sec for further analysis[1], the BAT ground-calculated position is RA, Dec (J2000) = 291.377 (19h 25m 30.5s), -35.141 deg (-35° $08'$ $25.9''$) with an uncertainty of 1.0 arcmin, (radius, sys+stat, 90% containment). The partial coding was 43% (Markwardt et al., *GCN Circ.* 11347).

The mask-weighted light curve (Figure 1) shows an overall FRED-like profile starting at T-5 sec, peaking at T+2 sec, but with multiple shorter spikes superimposed. An extended tail is detectable out to at least T+160 sec. T_{90} (15-350 keV) is 70.0±3.0 sec (estimated error including systematics).

The time-averaged spectrum from T-5.5 to T+111 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.45±0.03. The fluence in the 15-150 keV band is $1.8\pm0.1 \times 10^{-5}$ erg cm^{-2}. The 1-sec peak photon flux measured from T+2.58 sec in the 15-150 keV band is 9.4±0.4 ph cm^{-2} 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 101017A at 10:34:08.4 UT, 81.0 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) = 291.38586 (19h 25m 32.61s), -35.14514 (-35° $08'$ $42.5''$) with an

[1]The results of the batgrbproduct analysis are available at http://gcn.gsfc.nasa.gov/notices_s/436429/BA/

uncertainty of 2.6 arcseconds (radius, 90% containment), This location is 26 arcseconds from the BAT onboard position, within the BAT error circle.

We collected 29.6 ks of Swift-XRT data on the GRB, from 81 s to 100 ks after the BAT trigger. The data comprise 210 s in Windowed Timing (WT) mode with the remainder in Photon Counting (PC) mode. The light curve (Figure 2) can be modeled with a multiple broken power-law model. After an initial decay slope of $\alpha = 2.22 \pm 0.08$, the light curve steepened at $T_{break} = 260$ (+40/-20) seconds with a slope of α=3.85+1.13-0.34 and flattened again at T+527 (+52/-69) s with a decay slope of $\alpha = 1.35 \pm 0.08$.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of 1.38 ± 0.06 and an absorption column density of 20.85+2.48-2.31 $\times 10^{20}$ cm^{-2} which is in excess of the Galactic column density of 7.69×10^{20} cm^{-2} (Kalberla et al. 2005). A fit to the pc mode data shows that the spectrum steepened with a photon spectral index of 2.08 ± 0.20. The absorption column density of this fit is consistent with the result from the WT data. The counts to 0.3-10 keV flux conversion factor deduced from the WT spectrum is 6.63×10^{-11} and 7.70×10^{-11} erg cm^{-2} count^{-1} for the observed and the absorption corrected count rates. For the pc mode we found conversion factors are 5.00×10^{-11} and 7.57×10^{-11} ergs cm^{-2} counts^{-1}, respectively.

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 101017A 88s after the BAT trigger. We identified an uncatalogued UVOT source in the u and white filters. However, this source had faded by the second orbit and was not detected again. Subsequent ground-based observations also failed to detect the optical afterglow (Pandey, *GCN Circ.* 11346, Kuroda et al., *GCN Circ.* 11351 Motohara et al., *GCN Circ.* 11356).

The magnitudes and 3-sigma upper limits for the finding chart exposures (FC) and summed images are listed in Table 1. The UVOT light curve is shown in Figure 3.

Filter	$T_{\rm Start}$	$T_{\rm stop}$	Exposure	Mag
white (fc)	88	238	147	19.85±0.22
white	88	1724	409	20.09±0.17
white	5660	7296	393	>21.03
v	630	1773	136	>18.81
v	6071	11723	1158	>19.93
b	556	1699	116	>19.66
b	5456	7091	393	>20.30
u	301	550	245	19.15±0.23
u	301	1675	343	19.22±0.20
u	5250	6886	393	>19.94
uvw1	679	1648	116	>19.22
uvw1	5046	13365	1112	>20.60
uvm2	654	1797	116	>19.08
uvm2	6276	12628	1082	>20.63
uvw2	605	1749	136	>19.52
uvw2	5866	7502	393	>20.22

Table 1: Magnitudes from UVOT observations of GRB 101017A. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight of $E(B-V) = 0.17$ mag. All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).

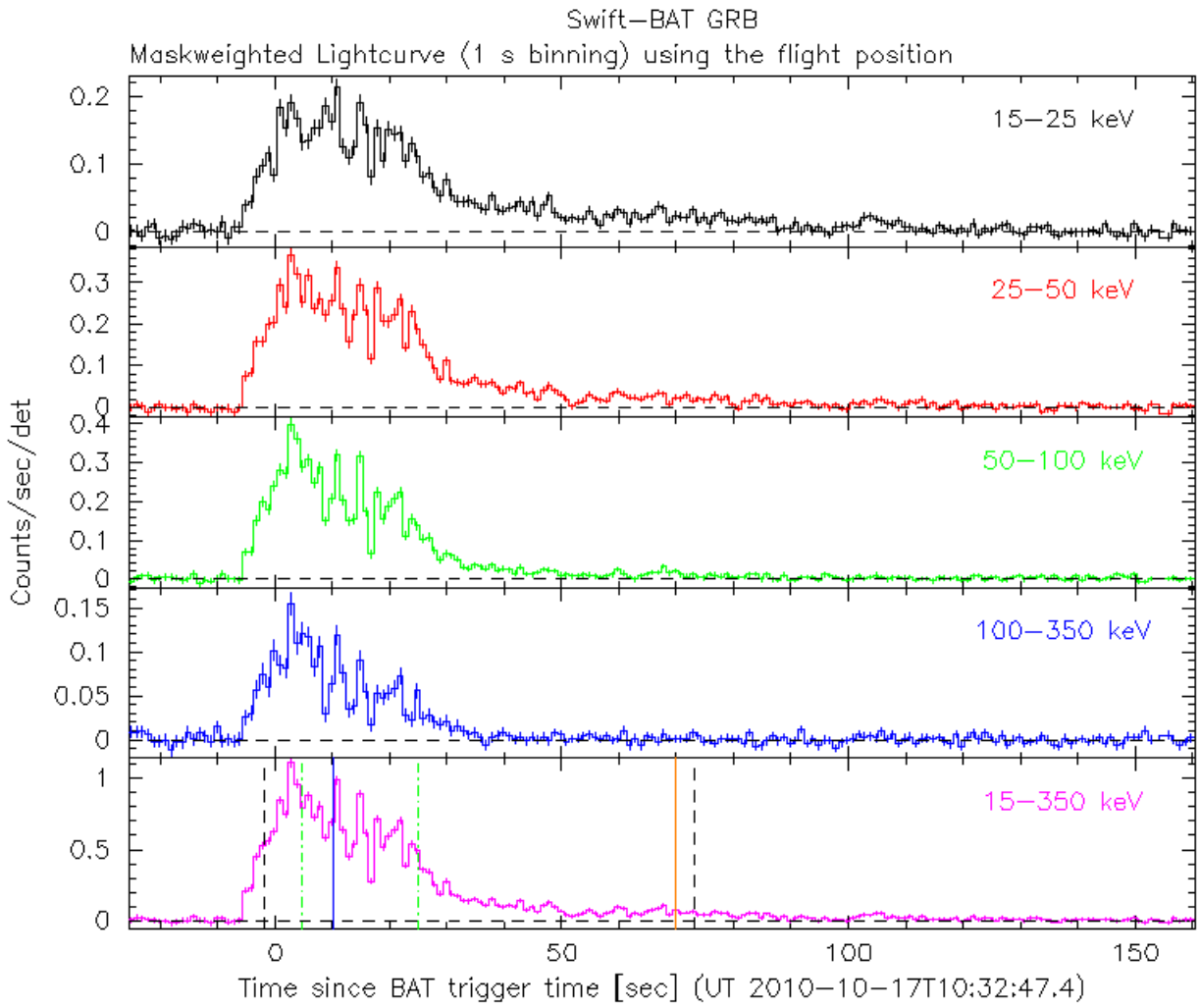

Figure 1: BAT Light curve of GRB 101017A.

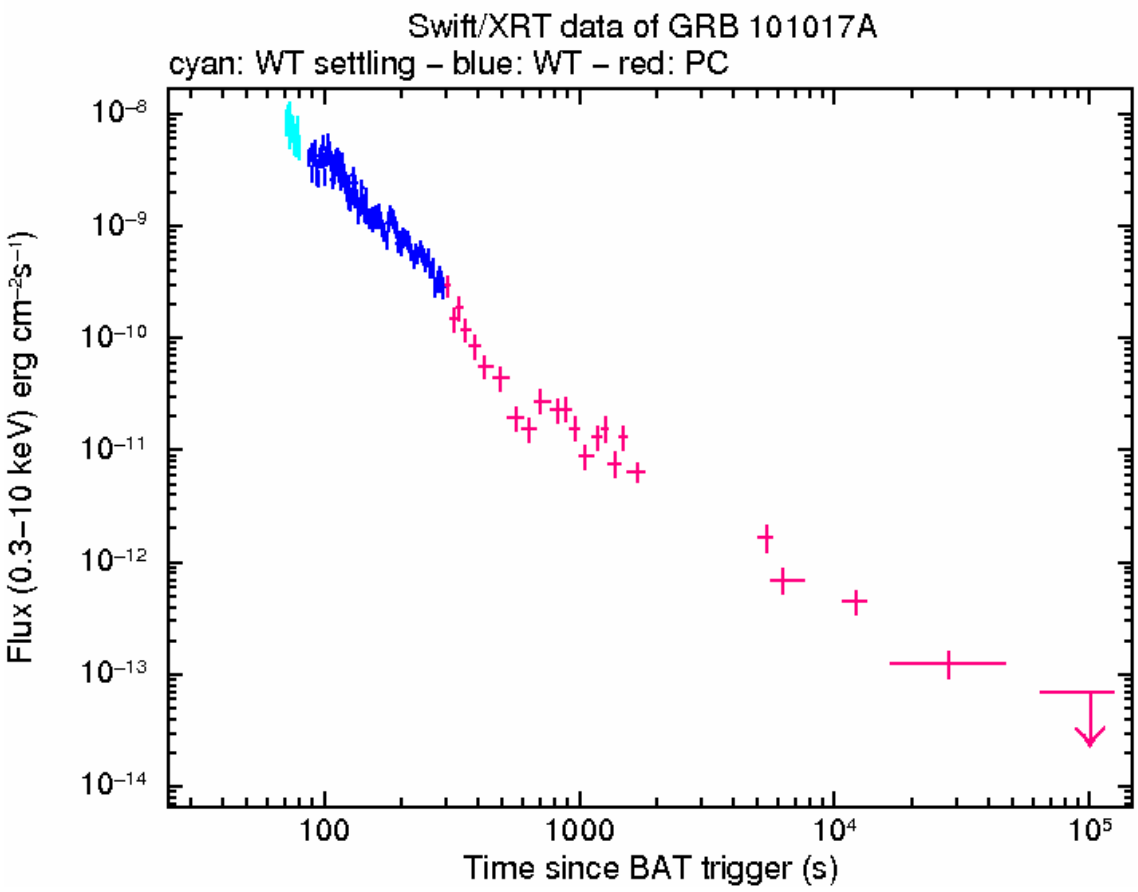

Figure 2: XRT flux light curve of GRB 101017A in the 0.3-10 keV band. The approximate conversion is 1 count $s^{-1} = \sim 4.1 \times 10^{-11}$ergs s^{-1} cm^{-2}.

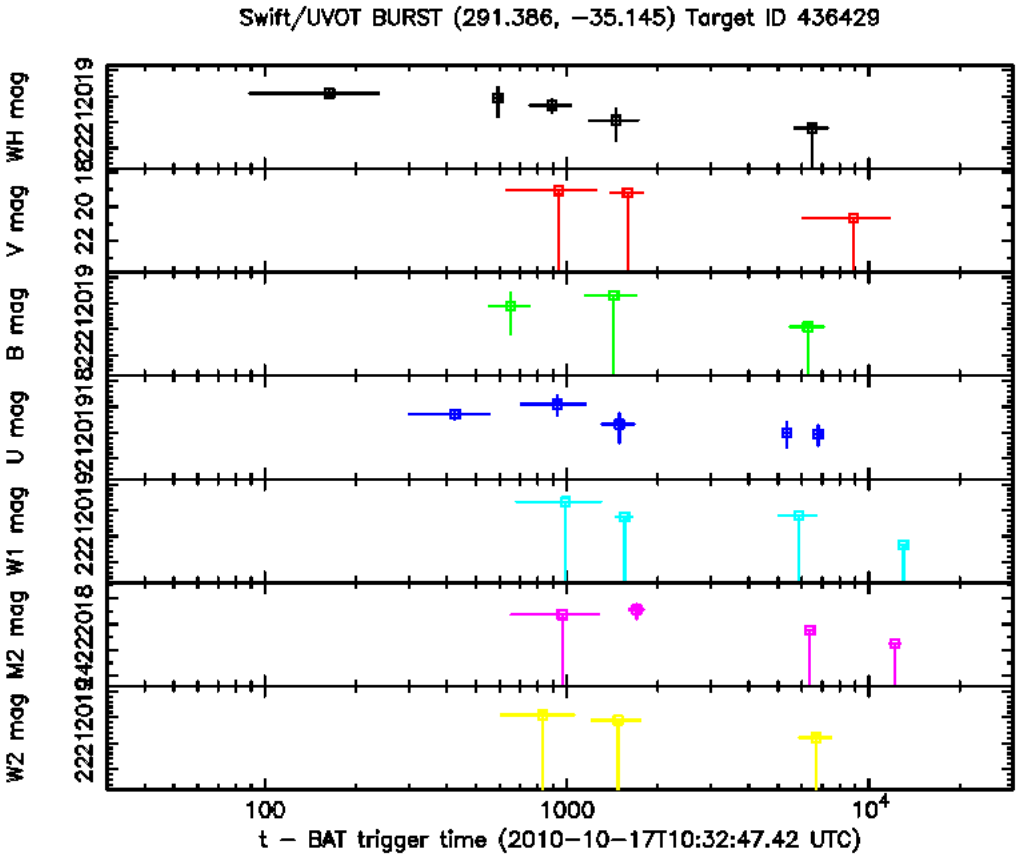

Figure 3: UVOT light curve of GRB 101017A in all seven UVOT filters.