Swift Observation of Long GRB 100621A

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1 Introduction

BAT triggered (Trigger 425151) on GRB 100621A at 03:03:32 UT (Ukwatta et al., 2010a). Swift slewed immediately to the burst. This was a 59σ rate-trigger on a long burst with $T_{90} = 63.6 \pm 1.7$ sec. The XRT started acquiring data while slewing at 65 seconds after the BAT trigger, with the settled observations beginning at 03:04:48.8 UT (T+76.0s). XRT found a bright, uncatalogued X-ray source. Our best position is the enhanced XRT location at RA($J2000$) = 315.30466 deg (21h 01m 13.12s), Dec($J2000$) = -51.10624 deg (-51d 06′ 22.5″) with an uncertainty of 1.7 arcsec (90% confidence, including boresight uncertainties), reported by Evans et al. (2010). The UVOT started settled observations at $\sim T + 85$ sec. While UVOT did not detect a fading optical afterglow, UVOT did detect a source at the XRT position which may be the host galaxy.

Moreover, GRB 100621A was detected by KonusWind (Golenetskii et al., 2010). The time-integrated KonusWind spectrum of the burst is best fitted by the Band function with fit parameters: $\alpha \sim -1.7$, $\beta \sim -2.4$, and $E_p \sim 95$ keV (Golenetskii et al., 2010). INTEGRAL/SPI-ACS also detected this burst (V. Beckmann, priv. comm.).

ESO VLT equipped with X-shooter spectrograph measured the spectrum of the afterglow of GRB 100621A and determined the redshift, $z = 0.542$ (Milvang-Jensen et al., 2010). The GROND detected the NIR afterglow of the burst with various filters and also reported the detection of the host galaxy (Updike et al., 2010). SIRIUS instrument on IRSF 1.4m telescope at SAAO in South Africa, observed a re-brightening of the NIR afterglow around 90 minues after the burst (Naito et al., 2010).

2 BAT Observation and Analysis

Using the data set from $T - 240$ to $T + 962$ sec, further analysis of BAT GRB 100621A has been performed by BAT team (Ukwatta et al., 2010b). The BAT ground-calculated position is RA($J2000$) = 315.309 deg (21h 01m 14.1s), Dec($J2000$) = -51.102 deg (-51d 06′ 08.8″) $\pm$ 1.0 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 97% (the bore sight angle was 17.1 deg).

The mask-weighted light curve (Fig. 1) shows three main overlapping peaks starting at $\sim T - 8$ sec, with the main peak at $\sim T + 25$ sec, and ending at $\sim T + 220$ sec. T90 (15-350 keV) is 63.6 ± 1.7 sec (estimated error including systematics).

The time-averaged spectrum from $T - 6$ to $T + 204$ sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.90 ± 0.03. The fluence in the $15 - 150$ keV band is $2.1 \pm 0.0 \times 10^{-5}$ erg cm^{-2}. The 1-sec peak photon flux measured from $T + 24.46$ sec in the $15 - 150$ keV band is 12.8 ± 0.3 ph cm^{-2} sec. All the quoted errors are at the 90% confidence level.

The results of the batgrbproduct analysis are available at
`http://gcn.gsfc.nasa.gov/notices_s/425151/BA/`

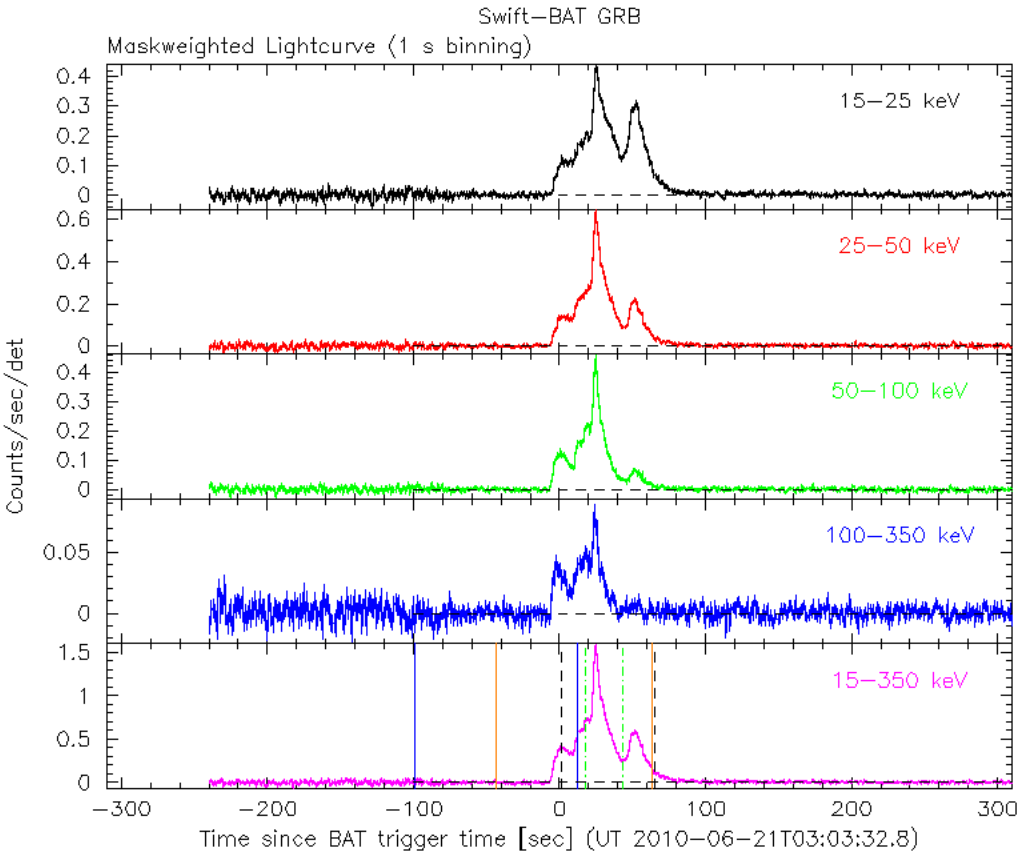

Figure 1: The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 03:03:32 UT.

3 XRT Observations and Analysis

XRT data were collected from $T+65$ s to $T+1880$ ks. The data comprise 322 s in Windowed Timing (WT) mode (the first 9 s were taken while Swift was slewing) with the remainder in Photon Counting (PC) mode. The best position of the X-ray afterglow is the enhanced XRT position (Evans et al., 2010)

RA(J2000) = 21h 01m 13.12s
Dec(J2000)= -51d 06' 22.5"

with an uncertainty of 1.7 arcsec (radius, 90% confidence).

Starting from 80 seconds after the burst the X-ray light curve (0.3−10 keV; Fig. 2) can be modelled with 4 power-law decays with best fit decay indexes and temporal breaks: $\alpha_1 = 3.87^{+0.02}_{-0.03}$, $t_{\rm break1} = 439^{+10}_{-10}$ s, $\alpha_2 = 0.51^{+0.02}_{-0.03}$, $t_{\rm break2} = 6.2^{+1.2}_{-0.5}$ ks, $\alpha_3 = 1.0^{+0.1}_{-0.1}$, $t_{\rm break3} = 122^{+0.13}_{-0.21}$ ks and a final slope with $\alpha_4 = 1.73^{+0.08}_{-0.08}$.

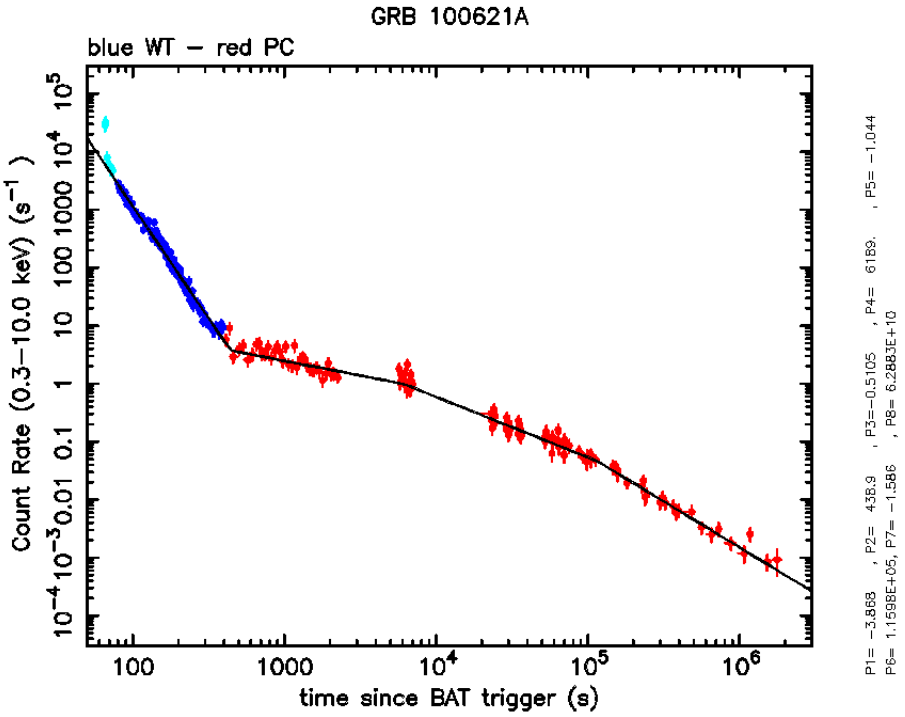

Figure 2: XRT Lightcurve. Count rate in the $0.3-10$ keV band is plotted with Window Timing (WT) mode data in blue and Photon Counting (PC) mode data in red. Note that the data obtained while the spacecraft was settling (cyan points) are preliminary and should be treated with caution. The data here were extremely piled up and necessitated use of the PSF wings beyond the radius to which they are calibrated. Improved calibration to these large radii is in progress. The XRT light curve can be modelled with 4 power-law decays (see text). The approximate conversion is 1 count/sec $= \sim 4.4 \times 10^{-11}$ ergs/cm^2/sec.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of $2.72^{+0.07}_{-0.06}$. The best-fitting absorption column is $5.79^{+0.27}_{-0.26} \times 10^{21}\,{\rm cm}^{-2}$, in excess of the Galactic value of $2.9 \times 10^{20}\,{\rm cm}^{-2}$ (Kalberla et al., 2005). The PC mode data energy spectrum has a photon index of $2.41^{+0.10}_{-0.10}$ and a best-fitting absorption column of $6.8^{+0.5}_{-0.5} \times 10^{21}\,{\rm cm}^{-2}$. The counts to observed (unabsorbed) $0.3-10$ keV flux conversion factor deduced from this spectrum is

$4.4 \times 10^{-11} (1.2 \times 10^{-10})$ erg cm^{-2}count^{-1}.

The results of the XRT-team automatic analysis are available at
`http://www.swift.ac.uk/xrt_products/00425151`

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 100621A, 85 seconds after the BAT trigger (Oates et al., 2010). We detect a source at the enhanced Swift XRT position and at the location of the GROND source (Updike et al., 2010). This source is also observed in the DSS and observed to be constant during the first 7000 s and is thus likely to be the host galaxy, which is also suggested by Updike et al. (2010).

The magnitudes and 3-sigma upper limits for the finding chart exposures (FC) and summed images for this possible host galaxy are:

Filter	Tstart (s)	Tstop (s)	Exposure (s)	Magnitude
white (FC)	85	234	147	20.87 ± 0.35
white	576	7093	519	20.46 ± 0.15
u (FC)	297	546	246	> 20.18
u	700	6683	360	> 20.14
v	626	6067	391	19.49 ± 0.31
b	552	6888	372	20.27 ± 0.28
uvw1	1107	6478	352	19.64 ± 0.25
uvm2	6073	6273	197	> 19.66
uvw2	5663	5863	197	19.60 ± 0.28

Table 1: Magnitudes and limits from UVOT observations

The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight of $E(B-V) = 0.03$ mag. All photometry is on the UVOT photometric system described in Poole et al. (2008).

References

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