Swift Observation of GRB 130327A

T. N. Ukwatta (MSU), H. A. Krimm (GSFC/USRA), A. Maselli (INAF-IASFPA), C. Pagani (U. Leicester), C. A. Swenson (PSU), S. D. Barthelmy (GSFC), D. N. Burrows (PSU), M. H. Siegel (PSU), and N. Gehrels (GSFC) for the Swift Team

1 Introduction

BAT triggered (Trigger 552063) on GRB 130327A at 01:47:34 UT (Ukwatta et al., 2013). Swift slewed immediately to the burst. This was a $8.6\,\sigma$ rate-trigger on a burst with $T_{90} = 9.0 \pm 2.8$ sec. The XRT began observing the field at 01:48:57.0 UT, 83.0 seconds after the BAT trigger and found a uncatalogued X-ray source. The UVOT started settled observations 104 seconds after the trigger and no optical afterglow was detected. Our best position is the enhanced XRT position at RA($J2000$) = 92.03858 deg (06h 08m 9.26s), Dec($J2000$) = +55.71475 deg (+55d 42′ 53.1″) with an uncertainty of 1.9 arcsec (90% confidence).

Subsequent ground based optical and NIR observations have identified a faint fading optical/NIR afterglow within the XRT error circle located at RA($J2000$) = 92.03875, Dec(J2000) = +55.71504 with an uncertainty of 0.5 arcsec (Morgan , 2013; Butler et al., 2013; Cucchiara & Cenko , 2013; Cucchiara et al., 2013).

2 BAT Observation and Analysis

Using the data set from $T - 239$ to $T + 963$ sec, further analysis of BAT GRB 130327A has been performed by BAT team (Barthelmy et al., 2013). The BAT ground-calculated position is RA($J2000$) = 91.984 deg (06h 07m 56.2s), Dec($J2000$) = 55.732 deg (+55d 43′ 56.2″) ± 2.2 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 61% (the bore sight angle was 36.3 deg).

BAT light curve (Fig. 1) shows a single peak starting at $\sim T - 5$ sec, peaking at $\sim T + 1$ sec, and ending at $\sim T + 8$ sec. T90 (15-350 keV) is 9.0 ± 2.8 sec (estimated error including systematics).

The time-averaged spectrum from $T - 4.38$ to $T + 5.62$ sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 2.26 ± 0.36. The fluence in the $15 - 150$ keV band is $2.3 \pm 0.5 \times 10^{-7}$ erg cm^{-2}. The 1-sec peak photon flux measured from $T + 0.62$ sec in the $15 - 150$ keV band is 0.9 ± 0.2 ph cm^{-2}sec^{-1}. 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/552063/BA/`

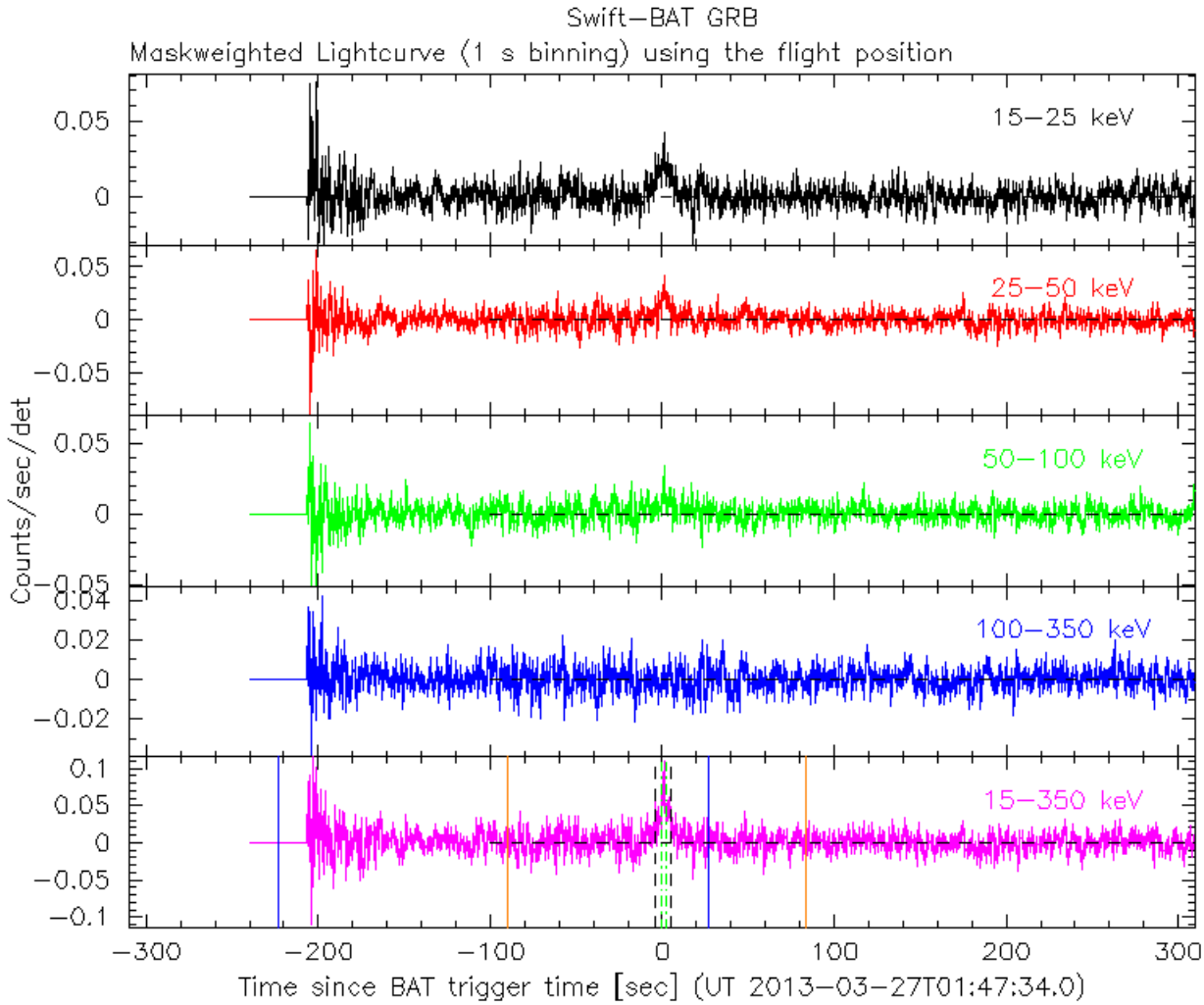

Figure 1: The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 01:47:34 UT.

3 XRT Observations and Analysis

Analysis of the initial XRT data was reported by Pagani et al. (2013). We have analysed 37.3 ks of XRT data for GRB 130327A, from 83 s to 310 ks after the BAT trigger. The data comprise 902 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 enhanced XRT position (Osborne et al., 2013) for this burst is: RA, Dec = 92.03858, +55.71475 which is equivalent to:

RA (J2000): 06h 08m 9.26s
Dec (J2000): +55d 42' 53.1"

with an uncertainty of 1.9 arcsec (radius, 90% confidence).

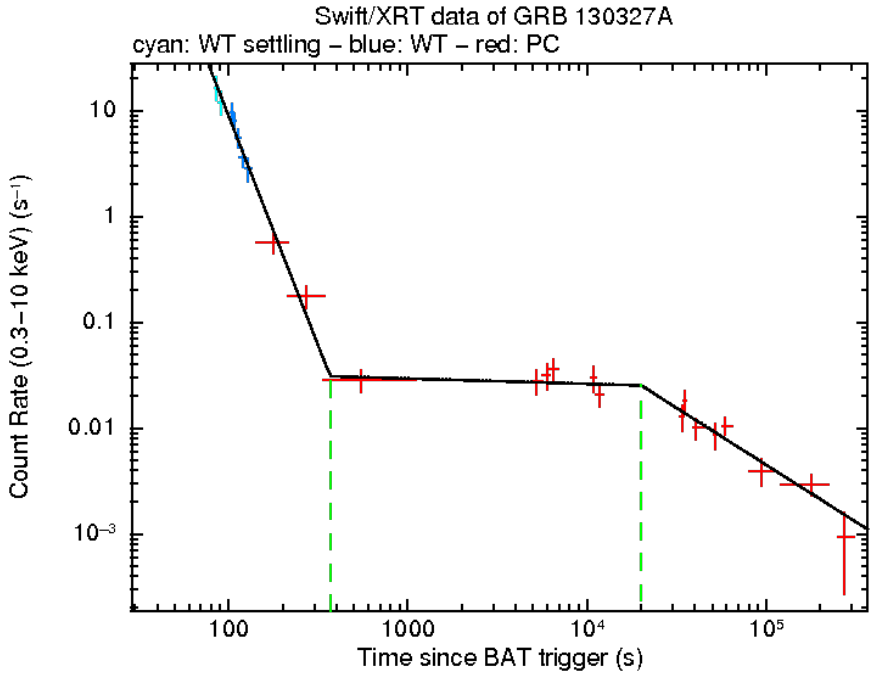

Figure 2: XRT Lightcurve. Count rate in the $0.3-10$ keV band is plotted with Window Timing (WT) mode data in blue, WT Settling data in light blue and Photon Counting (PC) mode data in red. The approximate conversion is 1 count/sec = $\sim 3.2 \times 10^{-11}$ ergs/cm^2/sec.

The X-ray light curve (Fig. 2) can be modelled with a broken power law decay with following parameters: $\alpha_1 = 4.3^{+0.5}_{-0.4}$, $T_{\rm break1} = 369^{+62}_{-48}$ sec, $\alpha_2 = 0.05^{+0.13}_{-0.15}$, $T_{\rm break2} = 2.0^{+0.9}_{-0.7} \times 10^4$ sec, and $\alpha_3 = 1.08^{+0.26}_{-0.22}$.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of $2.28^{+0.29}_{-0.13}$. The best-fitting absorption column is consistent with the Galactic value of 1.3×10^{21}cm^{-2} (Kalberla et al., 2005). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is $3.2 \times 10^{-11} (4.1 \times 10^{-11})$ erg cm^{-2}count^{-1}.

A summary of the PC-mode spectrum is thus:
Total column: $0^{+3.7}_{-0} \times 10^{20}\mathrm{cm}^{-2}$
Galactic foreground: $1.3 \times 10^{21}\mathrm{cm}^{-2}$
Excess significance: <1.6 sigma
Photon index: $2.28^{+0.29}_{-0.13}$

The results of the XRT-team automatic analysis are available at
`http://www.swift.ac.uk/xrt_products/00552063`.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 130327A 104 s after the BAT trigger (Swenson et al., 2013). No optical afterglow consistent with the XRT position (Osborne et al., 2013) is detected in the initial UVOT exposures. Preliminary 3-sigma upper limits using the UVOT photometric system (Breeveld et al., 2011) for the first finding chart (FC) exposure and subsequent exposures are:

Filter	Tstart (s)	Tstop (s)	Exposure (s)	Magnitude
white_FC	104	254	147	>21.2
u_FC	317	567	246	>20.0
white	104	6491	727	>21.8
v	646	6877	428	>19.8
b	572	6286	432	>20.7
u	317	6081	659	>20.4
w1	695	12014	1111	>21.6
m2	671	11107	1141	>21.0
w2	622	6696	452	>21.9

Table 1: Magnitudes and limits from UVOT observations

The magnitudes in the table are not corrected for the Galactic extinction due to the reddening of E(B-V) = 0.13 in the direction of the burst (Schlegel et al., 1998).

References

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