

Swift Observations of GRB 140302A

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1. Introduction

At 08:12:58 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 140302A (trigger=589685) (Pagani *et al.* GCN Circ. [15901](#)). Swift slewed immediately to the burst. At the time of the trigger, the initial BAT position was 87° from the Sun (5.9 hours West) and 101° from the 1%-illuminated Moon. **Table 1** contains the best reported positions from Swift, and the latest XRT position can be viewed at http://www.swift.ac.uk/xrt_positions.

Elliott *et al.* (GCN Circ. [15903](#)) reported the position from GROND for the optical afterglow of this GRB. **Table 2** is a summary of GCN Circulars about this GRB from observatories other than Swift.

Standard analysis products for this burst are available at http://gcn.gsfc.nasa.gov/swift_gnd_ana.html.

2. BAT Observations and Analysis

As reported by Barthelmy *et al.* (GCN Circ. [15908](#)), the BAT ground-calculated position is RA, Dec = 253.862, -12.875 deg, which is RA(J2000) = 16^h55^m26.8^s Dec(J2000) = -12°52'29.8" with an uncertainty of 1.1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 82%.

The mask-weighted light curve (**Figure 1**) shows a sharp rise starting at $\sim T-0.1$ s, peaking at $\sim T+0.2$ s, and a roughly exponential decay with several small peaks riding on top, finally returning to baseline at $\sim T+190$ s. T_{90} (15-350 keV) is 87.5 \pm 11.4 s (estimated error including systematics).

The time-averaged spectrum from T-0.09 to T+106.25 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.09 \pm 0.09. The fluence in the 15-150 keV band is (2.7 \pm 0.1) $\times 10^{-6}$ erg cm⁻². This fluence is larger than that of 69% of the long GRBs in the Second BAT GRB Catalog (Sakamoto *et al.* 2011). The 1-s peak photon flux measured from T-0.10 s in the 15-150 keV band is 1.7 \pm 0.2 ph cm⁻² s⁻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/589685/BA/](#).

3. XRT Observations and Analysis

Analysis of the initial XRT data was reported by Osborne *et al.* (GCN Circ. [15909](#)). We have analysed 10 ks of XRT data for GRB 140302A, from 78 s to 57.5 ks after the BAT trigger. The data comprise 136 s in Windowed Timing (WT) mode with the remainder in Photon Counting (PC) mode. The enhanced XRT position for this burst was given by Osborne *et al.* (GCN Circ. [15902](#)).

The light curve (**Figure 2**) can be modelled with an initial power-law decay with an index of $\alpha=1.62$ (+0.22, -0.23), followed by a break at T+183 s to an α of 4.2 (+3.3, -0.4) and a second break at T+388 s to an α of 1.48 (+0.20, -0.16).

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of 1.08 (+0.16, -0.15). The best-fitting absorption column is 3.2 (+1.0, -0.9) $\times 10^{21}$ cm^{-2} , in excess of the Galactic value of 1.5×10^{21} cm^{-2} (Kalberla *et al.* 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 6.8×10^{-11} (7.7×10^{-11}) $\text{erg cm}^{-2} \text{count}^{-1}$.

A summary of the WT-mode spectrum is thus:

Total column: 3.2 (+1.0, -0.9) $\times 10^{21}$ cm^{-2}

Galactic foreground: 1.5×10^{21} cm^{-2}

Excess significance: 3.2σ

Photon index: 1.08 (+0.16, -0.15)

The results of the XRT team automatic analysis are available at http://www.swift.ac.uk/xrt_products/00589685.

4. UVOT Observations and Analysis

The Swift/UVOT began settled observations of the field of GRB 140302A 80 s after the BAT trigger (Siegel and Pagani GCN Circ. [15912](#)). No optical afterglow consistent with the optical position (Elliott *et al.* GCN Circ. [15903](#)) is detected in the initial UVOT exposures. **Table 3** gives preliminary magnitudes using the UVOT photometric system (Breeveld *et al.* 2011, AIP Conf. Proc., 1358, 373). No correction has been made for the expected extinction in the Milky Way corresponding to a reddening of E_{B-V} of 0.52 mag. in the direction of the GRB (Schlegel *et al.* 1998).

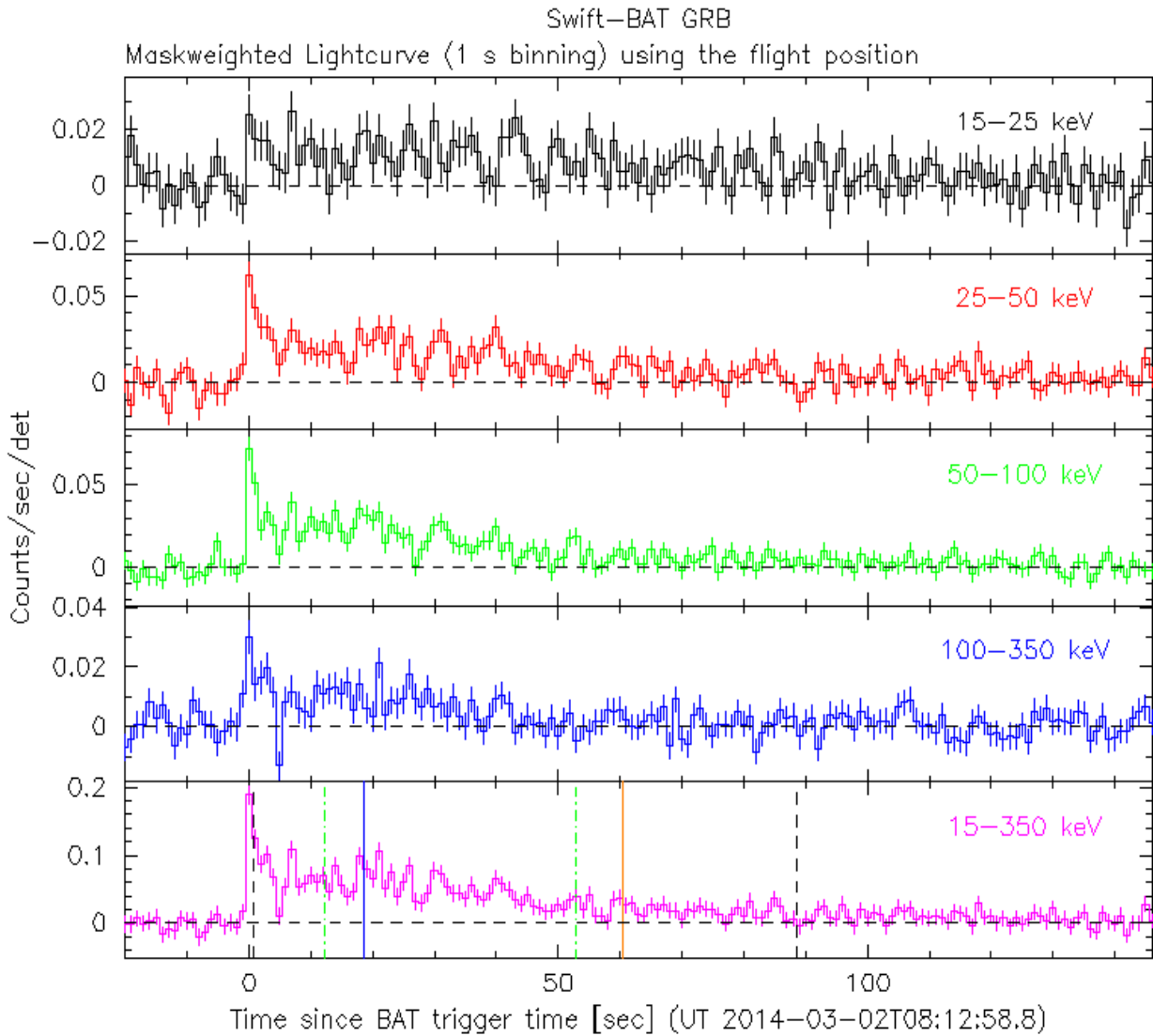


Figure 1. The BAT mask-weighted light curve in the four individual and total energy bands. The units are counts s^{-1} illuminated-detector $^{-1}$. The verticle lines correspond to following: green dotted lines are T50 interval, black dotted lines are T90 interval, blue solid line(s) is a spacecraft slew start time, and orange solid line(s) is a spacecraft slew end time.

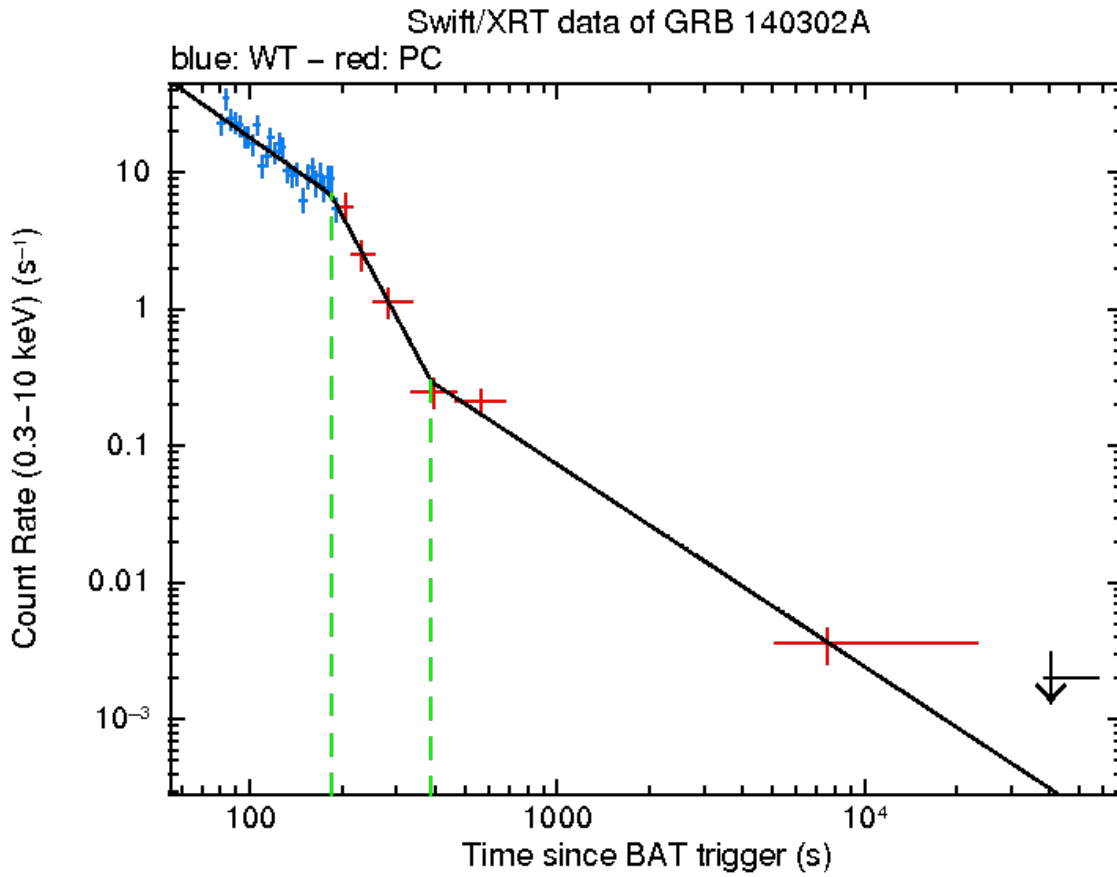


Figure 2. The XRT light curve.

RA (J2000)	Dec (J2000)	Error	Note	Reference
16 ^h 55 ^m 26.09 ^s	-12°52'41.6"	2.3"	XRT-final	UKSSDC
16 ^h 55 ^m 26.09 ^s	-12°52'41.6"	2.3"	XRT-enhanced	Osborne <i>et al.</i> GCN Circ. 15907
16 ^h 55 ^m 26.8 ^s	-12°52'29.8"	1.1'	BAT-refined	Barthelmy <i>et al.</i> GCN Circ. 15908

Table 1. Positions from the Swift instruments.

Band	Authors	GCN Circ.	Subject	Observatory	Notes
Optical	Elliott <i>et al.</i>	15903	GROND afterglow candidate	GROND	detection
Optical	Kuroda <i>et al.</i>	15911	MITSuME Okayama upper limits	MITSuME Okayama	upper limits
Gamma-ray	Fitzpatrick	15910	Fermi GBM detection	Fermi GBM	$E_{\text{peak}}=462\pm 53$ keV Fluence= $1\pm 0.05\times 10^{-5}$ erg cm^{-2} (75 th percentile for long GRBs)

Table 2. Summary of GCN Circulars from other observatories sorted by band and then circular number.

Filter	T _{start} (s)	T _{stop} (s)	Exp(s)	Mag
white (fc)	80	230	147	>20.5
white	80	593	167	>20.6
white	10575	11481	590	>21.1
v	624	643	19	>18.3
v	16940	17847	590	>19.4
b	549	569	19	>19.3
b	9662	10569	590	>20.5
u (fc)	293	543	246	>19.7
uvw1	672	692	19	>19.0
uvm2	17853	17993	137	>18.9
uvw2	11487	12232	732	>20.2

Table 3. UVOT observations reported by Siegel and Pagani (GCN Circ. [15912](#)). The start and stop times of the exposures are given in seconds since the BAT trigger. The preliminary 3- σ upper limits are given. No correction has been made for extinction in the Milky Way.