

# Swift Observations of GRB 120324A

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## 1. Introduction

Zhang *et al.* (GCN Circ. 13090) reported the initial Swift results. At 05:59:11 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 120324A (trigger=518507). Swift slewed immediately to the burst. **Table 1** contains the best reported positions from Swift. The latest XRT position can be viewed at [http://www.swift.ac.uk/xrt\\_positions](http://www.swift.ac.uk/xrt_positions).

**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](http://gcn.gsfc.nasa.gov/swift_gnd_ana.html).

## 2. BAT Observations and Analysis

Analysis of the BAT data was reported by Cummings *et al.* (GCN Circ. 13096). The BAT ground-calculated position is RA, Dec = 291.081, 24.140 deg, which is RA(J2000) = 19h 24m 19.5s Dec(J2000) = +24d 08' 23.6" 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 many overlapping peaks starting at  $\sim T-190$  s with a weak precursor peak, the main peak at  $\sim T+33$  s, and ending at  $\sim T+180$  s (and possible as long as  $\sim T+330$  s at the 2-sigma level).  $T_{90}(15-350 \text{ keV})$  is  $118 \pm 10$  s (estimated error including systematics).

The time-averaged spectrum from  $T-150.5$  to  $T+142.5$  s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is  $1.34 \pm 0.04$ . The fluence in the 15-150 keV band is  $1.01 \pm 0.03 \times 10^{-5} \text{ erg cm}^{-2}$ . The 1-s peak photon flux measured from  $T+33.68$  s in the 15-150 keV band is  $5.9 \pm 0.2 \text{ ph cm}^{-2} \text{ s}^{-1}$ . 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/518507/BA/](http://gcn.gsfc.nasa.gov/notices_s/518507/BA/).

## 3. XRT Observations and Analysis

Analysis of the XRT data was reported by Sbarufatti *et al.* (GCN Circ. 13101). We have analysed 8.3 ks of XRT data for GRB 120324A (Zhang et al. GCN Circ. 13090), from 81 s to 29.5 ks after the BAT trigger.

The late-time light curve (**Figure 2**) (from  $T_0+4.7$  ks) can be modelled with a power-law decay with a decay index of  $\alpha=1.04 \pm 0.07$ .

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of  $2.12 \pm 0.10$ . The best-fitting absorption column is  $1.10 (+0.09, -0.08) \times 10^{22} \text{ cm}^{-2}$ , in excess of the Galactic value of  $4.5 \times 10^{21} \text{ cm}^{-2}$  (Kalberla et al. 2005). The PC mode spectrum has a photon index of  $2.07 \pm 0.14$  and a best-fitting absorption column of  $1.18 (+0.13, -0.12) \times 10^{22} \text{ cm}^{-2}$ . The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is  $5.7 \times 10^{-11} (1.3 \times 10^{-10}) \text{ erg cm}^{-2} \text{ count}^{-1}$ .

The results of the XRT team automatic analysis are available at [http://www.swift.ac.uk/xrt\\_products/00518507](http://www.swift.ac.uk/xrt_products/00518507).

## 4. UVOT Observations and Analysis

Analysis of the UVOT data was reported by Oates and Zhang (GCN Circ. 13095). The Swift/UVOT began settled observations of the field of GRB 120324A 84 s after the BAT trigger. No optical afterglow, consistent with the XRT position (Evans et al., GCN Circ. 13093) or the uncatalogued object reported by the Liverpool Telescope (Guidorzi et al., GCN Circ. 13092), 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 1.12 mag. in the direction of the GRB (Schlegel *et al.* 1998).

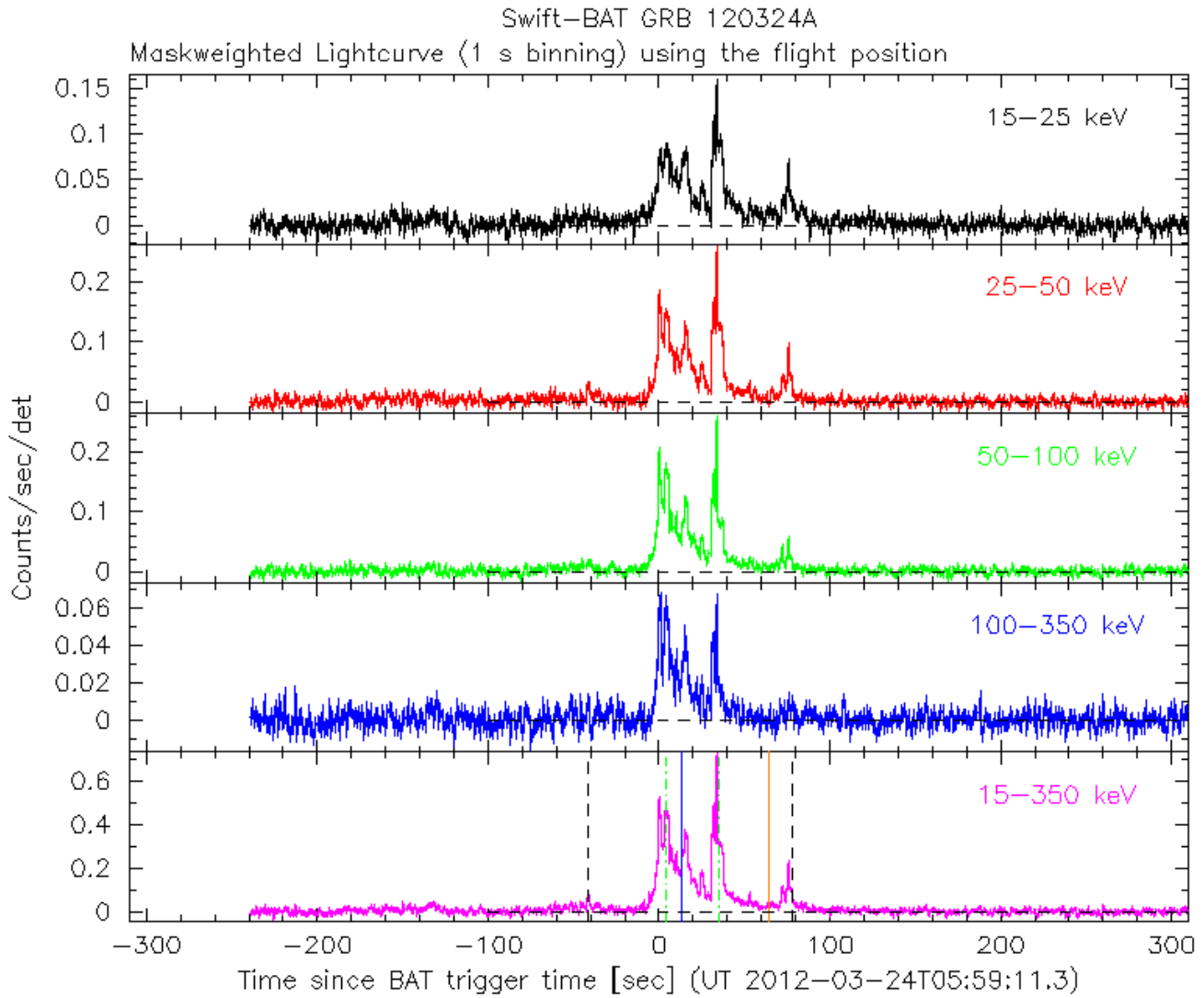


Figure 1. The BAT mask-weighted light curve in the four individual and total energy bands. The units are counts  $s^{-1}$  illuminated-detector $^{-1}$ .

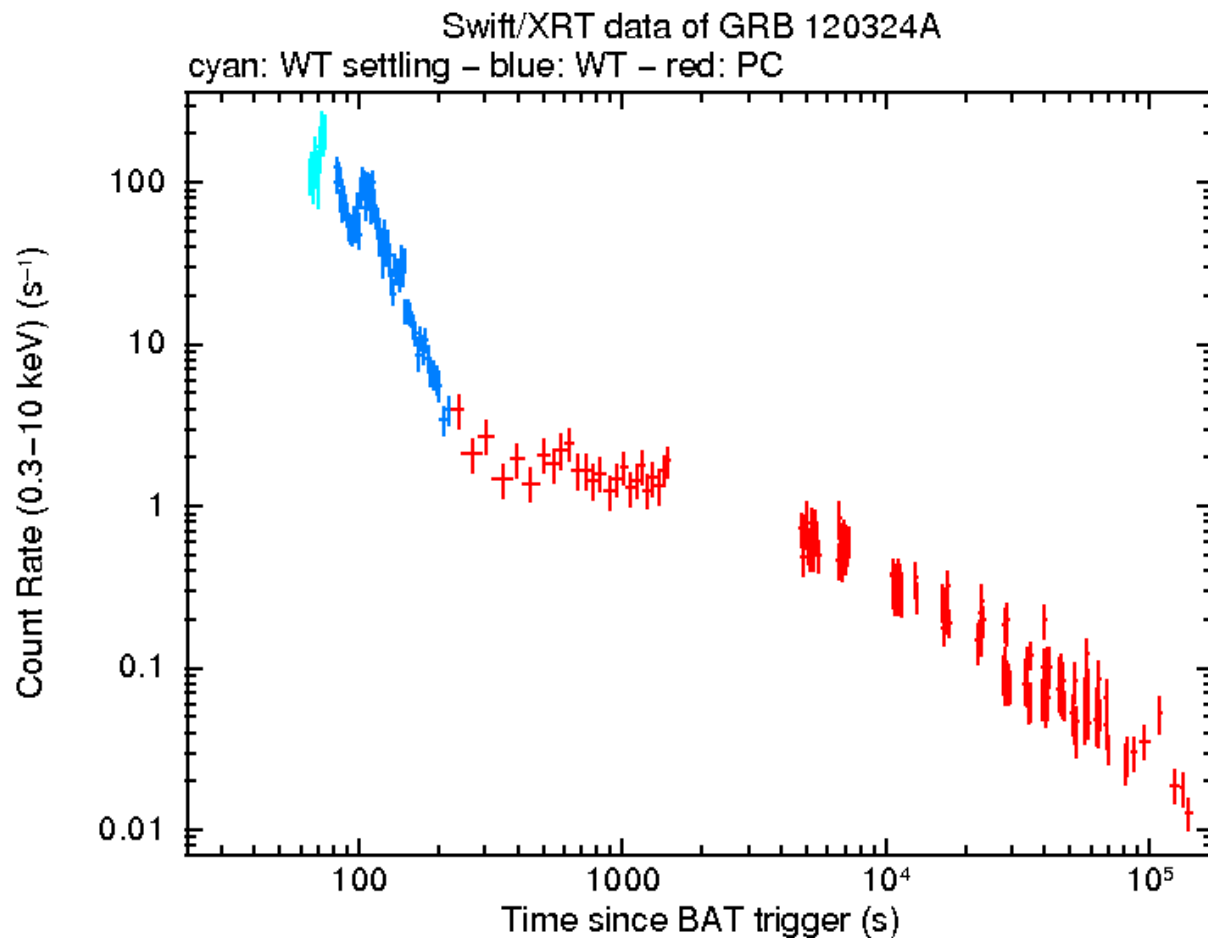


Figure 2. The XRT light curve.

RA	Dec	Error	Note	Reference
19 <sup>h</sup> 24 <sup>m</sup> 18.90 <sup>s</sup>	+24°07' 46.5"	1.7"	XRT-enhanced	Evans <i>et al.</i> GCN Circ. 13093
19 <sup>h</sup> 24 <sup>m</sup> 19.5 <sup>s</sup>	+24°08' 23.6"	1.1'	BAT-refined	Cummings <i>et al.</i> GCN Circ. 13096

Table 1. Positions from the Swift instruments.

Band	Authors	GCN Circ.	Observatory	Notes
Optical	Guidorzi and Melandri	13092	Liverpool Telescope	detection
Optical	Klotz <i>et al.</i>	13094	TAROT	
Optical	Im <i>et al.</i>	13097	CQUEAN	
Optical	Sudilovsky <i>et al.</i>	13098	GROND	
Optical	Rumyantsev <i>et al.</i>	13179	CrAO	upper limits
Gamma-ray	Golenetskii <i>et al.</i>	13100	Konus-Wind	

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

<b>Filter</b>	<b>T<sub>start</sub>(s)</b>	<b>T<sub>stop</sub>(s)</b>	<b>Exp(s)</b>	<b>Mag</b>
white <sub>FC</sub>	84	234	147	>21.2
u <sub>FC</sub>	297	547	246	>20.2
white	84	4917	569	>22.1
v	627	5329	294	>19.9
b	553	1510	89	>19.6
u	297	1493	324	>20.2
w1	676	5615	171	>19.9
m2	652	5534	216	>20.0
w2	603	5124	274	>20.8

Table 3. UVOT Observations. The start and stop times of the exposures are given in seconds since the BAT trigger. The preliminary 3- $\sigma$  upper limits are given. No correction has been made for extinction in the Milky Way.

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