

# *Swift* Observations of GRB 130211A

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## 1. Introduction

At 03:36:32 UT, the *Swift* Burst Alert Telescope (BAT) triggered and located GRB 130211A (trigger=548276) (Oates *et al.* GCN Circ. 14195). *Swift* slewed immediately to the burst. **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](http://www.swift.ac.uk/xrt_positions).

Knust *et al.* (GCN Circ. 14196) 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](http://gcn.gsfc.nasa.gov/swift_gnd_ana.html).

## 2. BAT Observations and Analysis

As reported by Ukwatta *et al.* (GCN Circ. 14197), the BAT ground-calculated position is RA, Dec = 147.524, -42.330 deg which is RA(J2000) = 09h 50m 05.7s Dec(J2000) = -42d 19' 47.1" with an uncertainty of 2.1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 40%.

The mask-weighted light curve (**Figure 1**) shows multiple, weak, overlapping peaks starting at  $\sim T-10$  s, peaking at  $\sim T-2$  s, and ending at  $\sim T+30$  s.  $T_{90}(15-350 \text{ keV})$  is  $25.1 \pm 6.3$  s (estimated error including systematics).

The time-averaged spectrum from T-1.56 to T+32.00 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is  $1.81 \pm 0.24$ . The fluence in the 15-150 keV band is  $6.4 \pm 1.0 \times 10^{-7} \text{ erg cm}^{-2}$ . The 1-s peak photon flux measured from T-1.58 s in the 15-150 keV band is  $0.7 \pm 0.2 \text{ ph cm}^{-2} \text{ s}^{-1}$ . 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/548276/BA/](http://gcn.gsfc.nasa.gov/notices_s/548276/BA/).

## 3. XRT Observations and Analysis

Analysis of the initial XRT data was reported by Burrows *et al.* (GCN Circ. 14198). We have analysed 20.1 ks of XRT data for GRB 130211A, from 104 s to 74.4 ks after the BAT trigger. The first 8 s were taken while *Swift* was slewing, the rest of the data comprise of 201 s in Windowed Timing (WT) mode with the remainder in Photon Counting (PC) mode.

The late-time light curve (**Figure 2**) (from T0+1.1 ks) can be modeled with a power-law decay with a decay index of  $\alpha=0.57$  (+0.16, -0.15).

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of  $3.53$  (+0.14, -0.13). The best-fitting absorption column is  $3.71$  (+0.39, -0.37)  $\times 10^{21} \text{ cm}^{-2}$ , in excess of the Galactic value of  $2.2 \times 10^{21} \text{ cm}^{-2}$  (Kalberla *et al.* 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is  $2.5 \times 10^{-11}$  ( $2.3 \times 10^{-10}$ )  $\text{erg cm}^{-2} \text{ count}^{-1}$ .

A summary of the WT-mode spectrum is thus:

Total column:  $3.53 (+0.39, -0.37) \times 10^{21} \text{ cm}^{-2}$

Galactic foreground:  $2.2 \times 10^{21} \text{ cm}^{-2}$

Photon index:  $3.53 (+0.14, -0.13)$

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of  $2.20 (+0.47, -0.21)$ . The best-fitting absorption column is  $0.0 (+1.2, -0.0) \times 10^{21} \text{ cm}^{-2}$ , consistent with no excess above the Galactic value of  $2.2 \times 10^{21} \text{ cm}^{-2}$  (Kalberla *et al.* 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is  $3.5 \times 10^{-11}$  ( $5.8 \times 10^{-11}$ )  $\text{erg cm}^{-2} \text{ count}^{-1}$ .

A summary of the PC-mode spectrum is thus:

Total column:  $0.0 (+1.2, -0.0) \times 10^{21} \text{ cm}^{-2}$

Galactic foreground:  $2.2 \times 10^{21} \text{ cm}^{-2}$

Photon index:  $2.20 (+0.47, -0.21)$

The results of the XRT team automatic analysis are available at [http://www.swift.ac.uk/xrt\\_products/00548276](http://www.swift.ac.uk/xrt_products/00548276).

## 4. UVOT Observations and Analysis

The *Swift*/UVOT began settled observations of the field of GRB 130211A 125 s after the BAT trigger (Oates GCN Circ. 14199). No optical afterglow consistent with the optical position (Knust *et al.* GCN Circ. 14196) 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 0.53 mag. in the direction of the GRB (Schlegel *et al.* 1998).

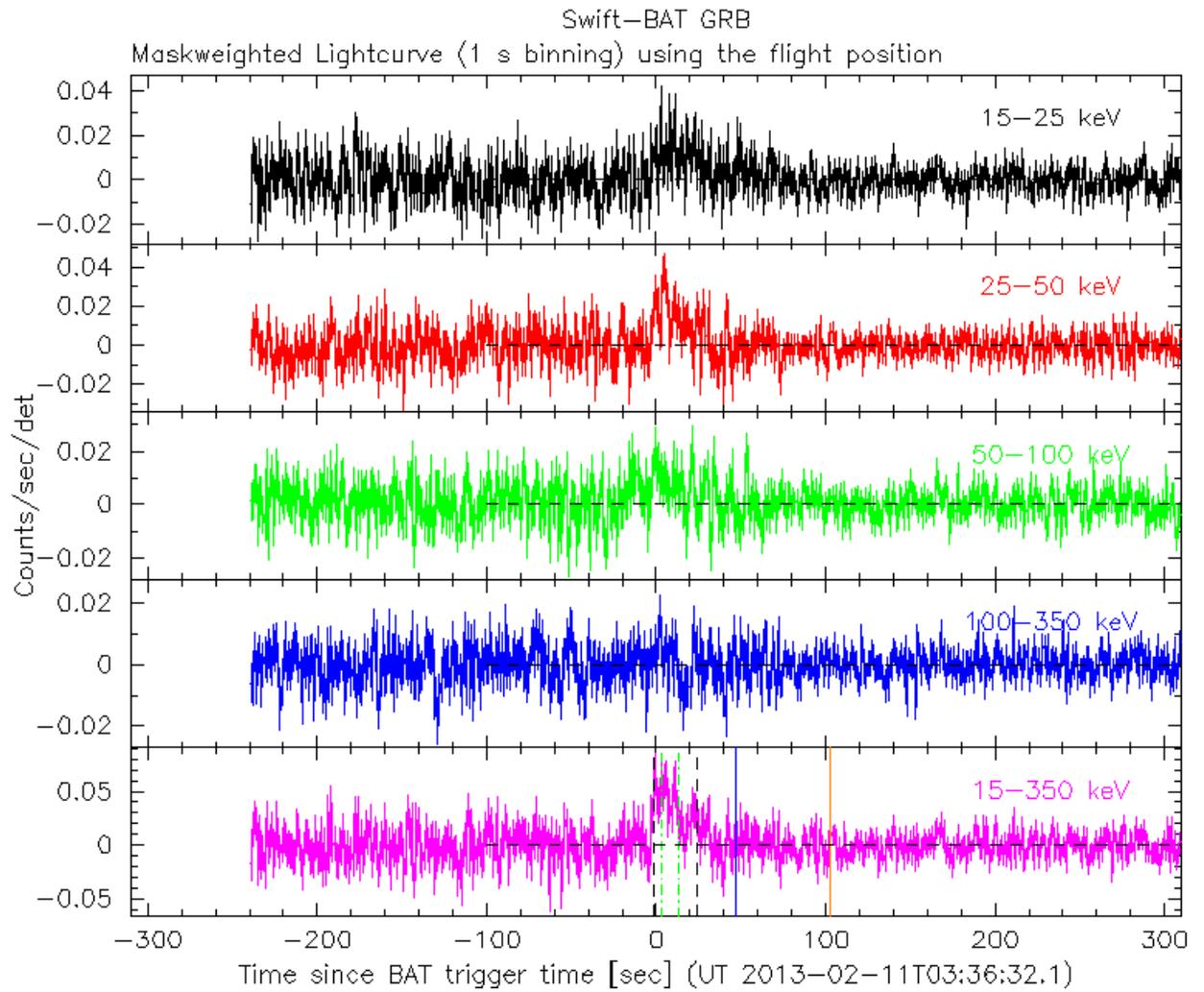


Figure 1. The BAT mask-weighted light curve in the four individual and total energy bands. The units are counts  $s^{-1}$  illuminated-detector $^{-1}$ .

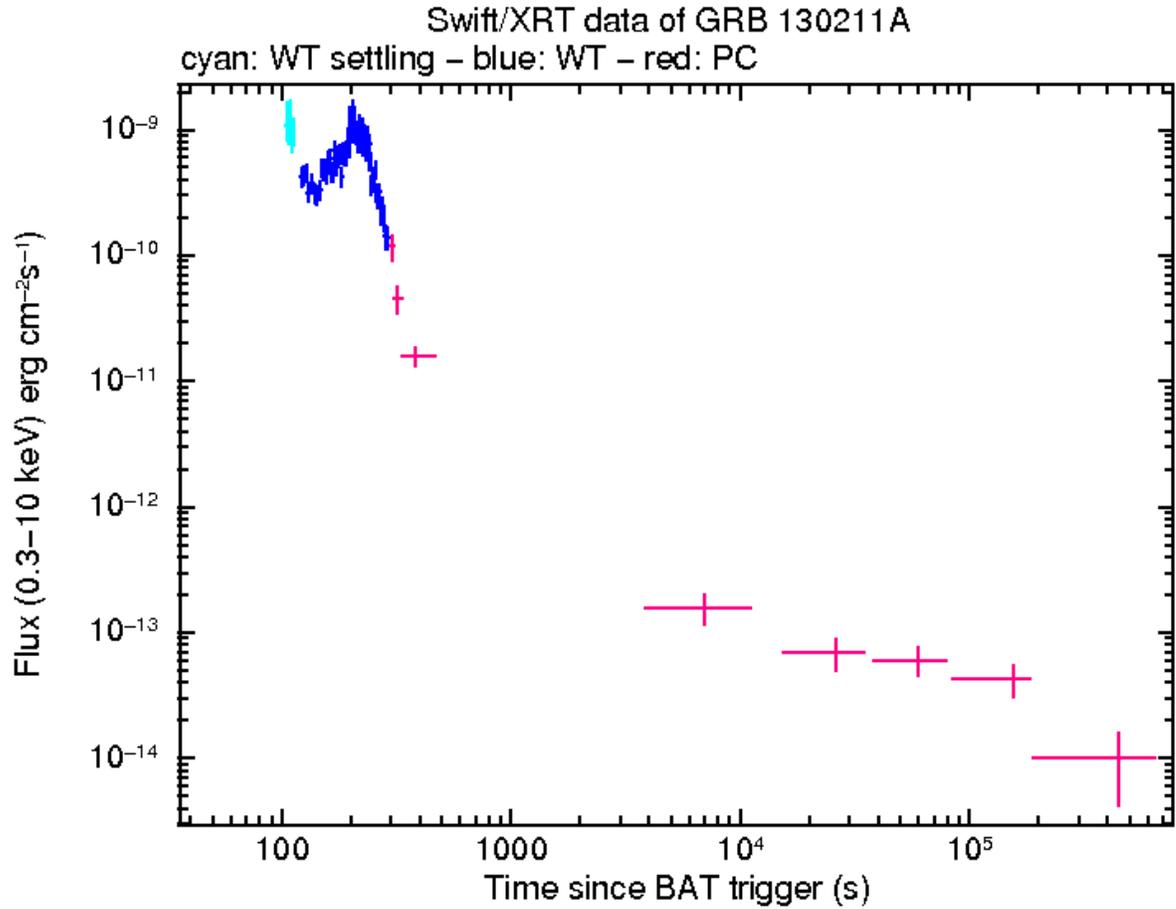


Figure 2. XRT flux light curve of GRB 130211A in the 0.3-10 keV band. The approximate conversion is  $1 \text{ count s}^{-1} = 2.5 \times 10^{-11} \text{ erg cm}^{-2}$  (observed flux).

RA	Dec	Error	Note	Reference
09 <sup>h</sup> 50 <sup>m</sup> 08.68 <sup>s</sup>	-42°20' 32.5"	3.6"	XRT-refined	Burrows <i>et al.</i> GCN Circ. 14198
09 <sup>h</sup> 50 <sup>m</sup> 05.7 <sup>s</sup>	-42°19' 47.1"	2.1'	BAT-refined	Ukwatta <i>et al.</i> GCN Circ. 14197

Table 1. Positions from the *Swift* instruments.

Band	Authors	GCN Circ.	Subject	Observatory	Notes
Optical	Knust <i>et al.</i>	14196	GROND detection of the afterglow	GROND	detection

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

Filter	T <sub>start</sub> (s)	T <sub>stop</sub> (s)	Exp(s)	Mag
white <sub>FC</sub>	125	275	147	>21.8
white	125	17061	1076	>22.9
v	4470	22933	1646	>21.7
b	3854	16303	1278	>22.4
u	284	29091	650	>21.3
w1	4880	28760	1082	>21.8
m2	4674	27853	1175	>21.6
w2	4265	22020	1968	>22.2

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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