Swift Observations of GRB 130420B

S.R. Oates (UCL-MSSL), C. B. Markwardt (GSFC), K.L. Page (U. Leicester), M. De Pasquale (MSSL-UCL), S. D. Barthelmy (NASA/GSFC), D. N. Burrows (PSU), M. H. Siegel (PSU) and N. Gehrels (NASA/GSFC) for the Swift team

1. Introduction

At 12:56:31 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 130420B (trigger=553996) (Oates *et al*. GCN Circ. 14411). Swift slewed immediately to the burst. Initially only ~10s were obtained by XRT and UVOT before Swift slewed away from the field, but observations resumed around 4ks. At the time of the trigger, the initial BAT position was 111° from the Sun (10.3 hours East) and 55° from the 69%-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.

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 Markwardt *et al*. (GCN Circ. 14420), the BAT ground-calculated position is RA, Dec = 183.095, 54.376 deg which is RA(J2000) = 12h 12m 22.7s Dec(J2000) = +54d 22' 33.2" with an uncertainty of 1.1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 100%.

The mask-weighted light curve shows a single gradual peak beginning at about T-5 seconds and detectable to T+12 seconds. T_{90} (15-350 keV) is 10.2 ± 5.4 s (estimated error including systematics).

The time-averaged spectrum from T-1.0 to T+16.0 s is best fit by a power law with an exponential cutoff. This fit gives a photon index 0.28 ± 0.52, and E_{peak} of 71.3 ± 14.0 keV (χ^2 42.36 for 56 d.o.f.). For this model the total fluence in the 15-150 keV band is 6.0 ± 0.5 x 10^{-07} erg cm^{-2} and the 1-s peak flux measured from T+0.91 s in the 15-150 keV band is 1.4 ± 0.1 ph cm^{-2} s^{-1}. A fit to a simple power law gives a photon index of 1.45 ± 0.10 (χ^2 61.94 for 57 d.o.f.). 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/553996/BA/.

3. XRT Observations and Analysis

Analysis of the initial XRT data was reported by Page and Oates (GCN Circ. 14430). We have analysed 10 ks of XRT data for GRB 130420B, from 39 s to 92.5 ks after the BAT

trigger. The data comprise 10 s in Windowed Timing (WT) mode (the first 10 s were taken while Swift was slewing) with the remainder in Photon Counting (PC) mode.

The light curve (**Figure 2**) can be modelled with a power-law decay with a decay index of α=1.09 (+0.09, -0.14).

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of 2.0 ± 0.4. The best-fitting absorption column is 5.0 (+10, -5) x 10^{20} cm^{-2}, consistent with the Galactic value of 1.4 x 10^{20} cm^{-2} (Kalberla *et al*. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 1.03 (+0.25, -0.20) x 10^{-12} (1.23 (+0.24, -0.21) x 10^{-12}) erg cm^{-2} $count^{-1}$.

A summary of the PC-mode spectrum is thus:

Total column: 5 (+10, -5) x 10^{20} cm^{-2}

Galactic foreground: 1.4 x 10^{20} cm^{-2}

Photon index: 2.0 ± 0.4

The results of the XRT team automatic analysis are available at http://www.swift.ac.uk/xrt_products/00553996.

4. UVOT Observations and Analysis

The Swift/UVOT began settled observations of the field of GRB 130420B 57 s after the BAT trigger (De Pasquale and Oates GCN Circ. 14425). No optical afterglow consistent with the XRT position (Page *et al*., GCN circ 14421) is detected in the initial and summed 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 0.02 mag. in the direction of the GRB (Schlegel *et al*. 1998).

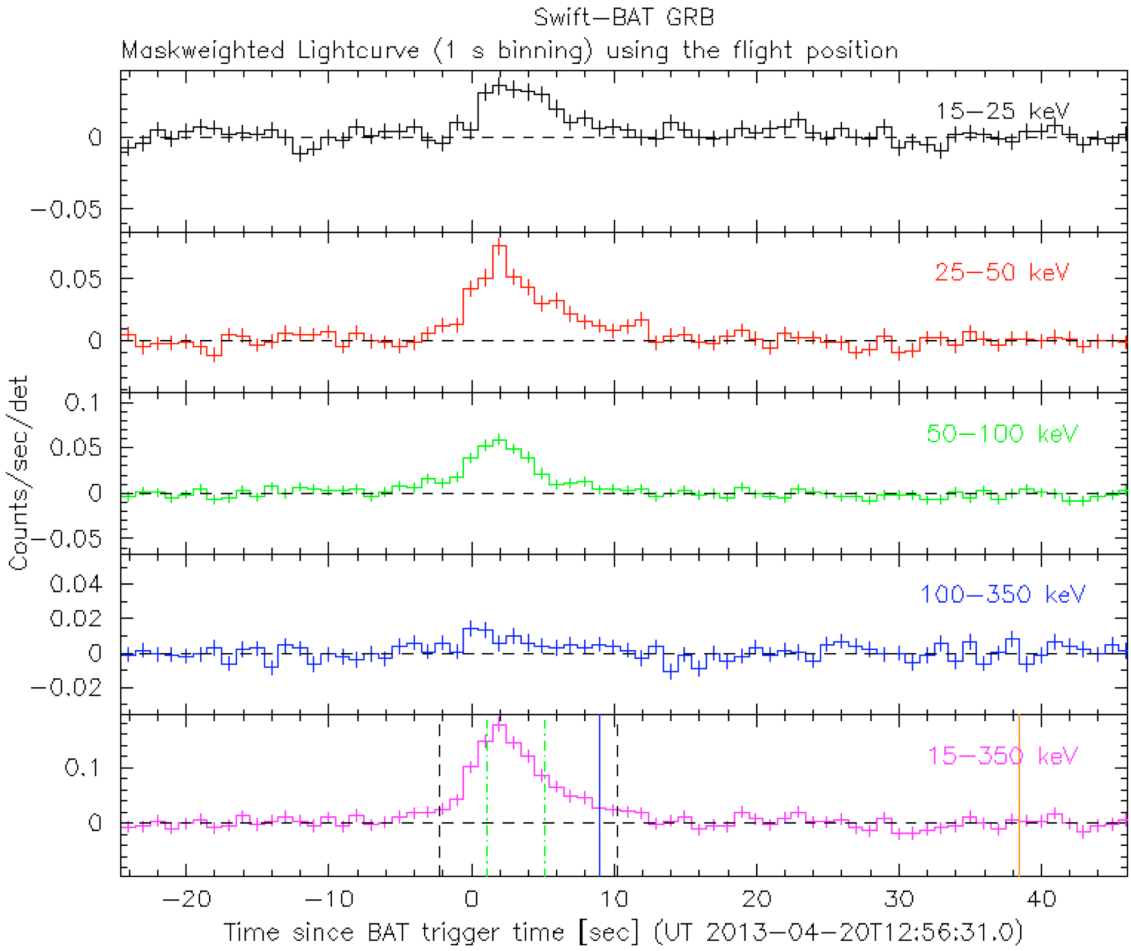

Figure 1. The BAT mask-weighted light curve in the four individual and total energy bands. The units are counts s^{-1} illuminated-detector^{-1}.

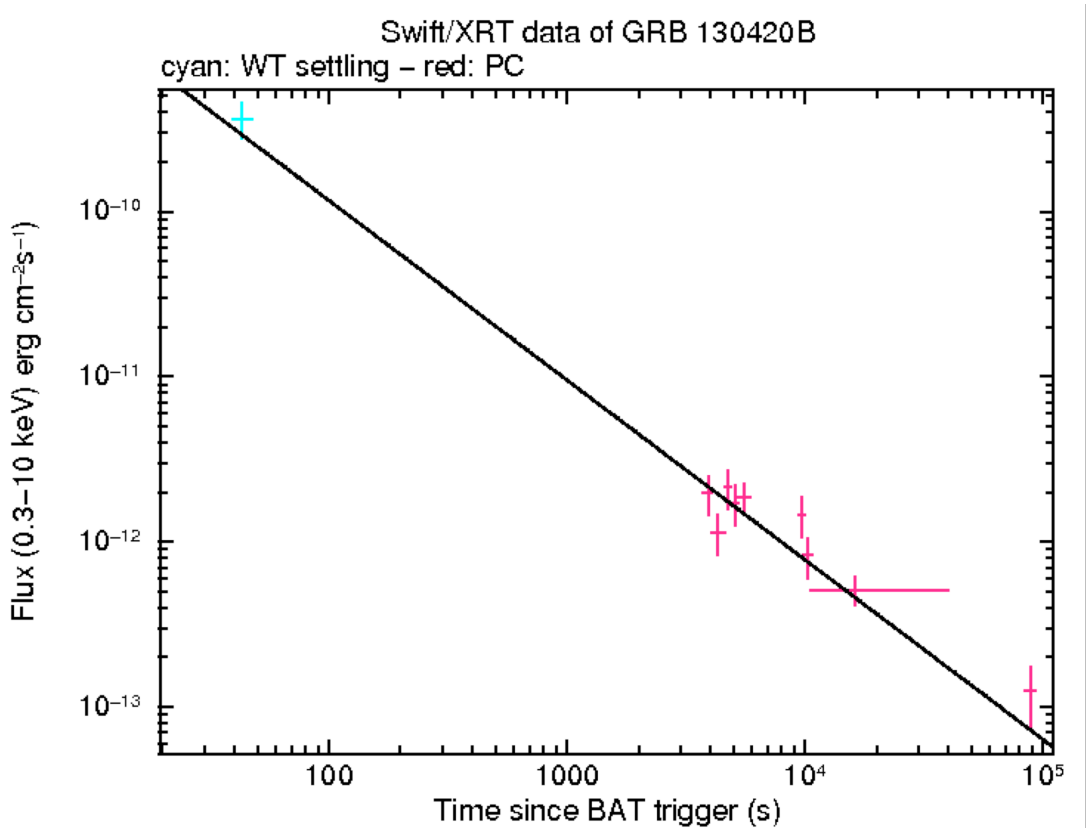

Figure 2. The XRT light curve.

RA	Dec	Error	Note	Reference
12h12m30.73s	+54o23' 25.9"	2.0"	XRT-enhanced	Page *et al*. GCN Circ. 14421
12h12m22.7s	+54o22' 33.2"	1.1'	BAT-refined	Markwardt *et al*. GCN Circ. 14420

Table 1. Positions from the Swift instruments.

Band	Authors	GCN Circ.	Subject	Observatory	Notes
Optical	Yurkov *et al*.	14412	MASTER-Net optical observations	MASTER	upper limits
Optical	Melandri *et al*.	14414	Faulkes Telescope North observations	FTN	upper limits
Optical	Zhao *et al*.	14423	GMG optical upper limit	Gao-Mei-Gu	upper limits
Optical	Xu *et al*.	14426	Weihai optical upper limit	Weihai	upper limits
Optical	Butler *et al*.	14432	RATIR Optical and NIR Observations	RATIR	upper limits
Radio	Zauderer and Berger	14444	CARMA and VLA radio observations	CARMA	upper limits
Gamma-ray	Rau	14435	Fermi GBM observation	Fermi GBM	detection

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	57	5841	460	>21.7
v	4707	4907	197	>19.6
b	4091	5727	393	>20.9
u	3886	5521	393	>20.6
w1	5117	5317	197	>20.1
m2	4912	5111	197	>19.8
w2	4502	4702	197	>20.1

Table 3. UVOT observations reported by De Pasquale and Oates (GCN Circ. 14425). 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.

June 05, 2013