Swift Observations of GRB 130831B

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1 Introduction

At $T = 13{:}48{:}19$ UT on 2013 August 31, the *Swift* Burst Alert Telescope (BAT) triggered and located the short GRB 130831B (trigger=568855). *Swift* immediately slewed to the burst (Malesani et al., GCN Circ. 15141).

The best *Swift* position of this burst is the UVOT-enhanced *Swift*/XRT position (`http://www.swift.ac.uk/xrt_positions/00568855/`; see also Goad et al., GCN Circ. 15149) with RA(J2000) = $12^{\mathrm{h}}49^{\mathrm{m}}40\overset{\mathrm{s}}{.}89$, Dec(J2000) = $-29°10'59\overset{''}{.}9$, with an uncertainty of $1\overset{''}{.}4$.

The burst location was close to the Sun ($49\overset{\circ}{.}1$ away), hence very limited ground-based follow-up was carried out. The GROND team reported upper limits to the optical and NIR brightness (Sudilovsky et al., GCN Circ. 15158). There was no report of gamma-ray detection by other spacecraft.

2 BAT Observations and Analysis

Using the data set from $T - 240$ s to $T + 902$ s (Baumgartner et al., GCN Circ. 15163), the BAT ground-calculated position is RA(J2000) = $192.454°$, Dec(J2000) = $-29.187°$, which corresponds to

RA(J2000) = $12^{\mathrm{h}}49^{\mathrm{m}}48\overset{\mathrm{s}}{.}9$,
Dec(J2000) = $-29°11'13\overset{''}{.}5$,

with an uncertainty of $2\overset{'}{.}1$ (radius, sys+stat, 90% containment). The partial coding was 14%.

The mask-weighted light curve (Fig. 1) shows a multi-peak episode starting at $\sim T - 12$ s, with the most intense peak at $\sim T + 1$ s, and ending at $\sim T + 30$ s. T_{90} (15–350 keV) is 37.8 ± 10.4 s (estimated error including systematics).

The time-averaged spectrum from $T - 13.9$ s to $T + 30.6$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.88 ± 0.21. The fluence in the 15–150 keV band is $(1.4 \pm 0.2) \times 10^{-6}$ erg cm^{-2}. The 1-s peak photon flux measured from $T - 0.05$ s in the 15–150 keV band is 2.4 ± 0.5 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/568855/BA/`.

3 XRT Observations and Analysis

The XRT began observing the field of GRB 130831B 112 s after the BAT trigger (Stroh et al., GCN Circ. 15154). The XRT refined position (`http://www.swift.ac.uk/xrt_positions/00568855/`; see also Goad et al., GCN Circ. 15149) is RA(J2000) = 192.42038°, Dec(J2000) = −29.18330°, which corresponds to:

RA(J2000) = $12^{\mathrm{h}}49^{\mathrm{m}}40\overset{\mathrm{s}}{.}89$,
Dec(J2000) = $-29°10'59\overset{''}{.}9$,

with an uncertainty of $1\overset{''}{.}4$.

XRT collected 6.8 ks of data, from 112 s to 35.4 ks after the BAT trigger. The data comprise 8 s in windowed timing (WT) mode (taken while *Swift* was slewing), with the remainder in photon counting (PC) mode. The light curve (Fig. 2) shows some initial flaring activity up to ~ 1000 s after the trigger, and the late-time light curve (from $T + 5.1$ ks and onwards) can be modelled with a power-law decay with a decay index of $\alpha = 1.24^{+0.12}_{-0.11}$.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of $2.07^{+0.16}_{-0.15}$. The best-fitting absorption column is $(1.6 \pm 0.4) \times 10^{21}$ cm^{-2}, in excess of the Galactic value of 6.2×10^{20} cm^{-2} (Kalberla et al. 2005, A&A, 440, 775). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 3.7×10^{-11} (5.3×10^{-11}) erg cm^{-2} count^{-1}.

The results of the XRT-team automatic analysis are available at `http://www.swift.ac.uk/xrt_products/00568855`.

4 UVOT Observations and Analysis

Swift/UVOT began settled observations of the field of GRB 130831B 130 s after the BAT trigger (Marshall & Malesani, GCN Circ. 15160). In the UVOT exposures, no optical afterglow is detected consistent with the refined XRT position (Goad et al., GCN Circ. 15149).

Preliminary 3-sigma upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc., 1358, 373) for the first finding chart (FC) exposure and subsequent exposures at the refined XRT position are reported in the following table.

Filter	T_{start} (s)	T_{stop} (s)	Exp. time (s)	Magnitude
white (FC)	130	279	147	>20.3
u (FC)	288	537	246	>19.6
white	130	6384	439	>20.9
v	618	5490	274	>19.7
b	543	6312	274	>20.5
u	288	6106	501	>20.3
w1	667	5901	274	>20.2
m2	642	5695	255	>20.9
w2	593	5285	274	>20.7

Upper limits are at 3σ confidence level. The quoted values have not been corrected for the expected Galactic extinction along the line of sight of $E_{B-V} = 0.08$ mag (Schlafly & Finkbeiner 2011, ApJ, 737, 103). Start and stop times refer to the BAT trigger time T.
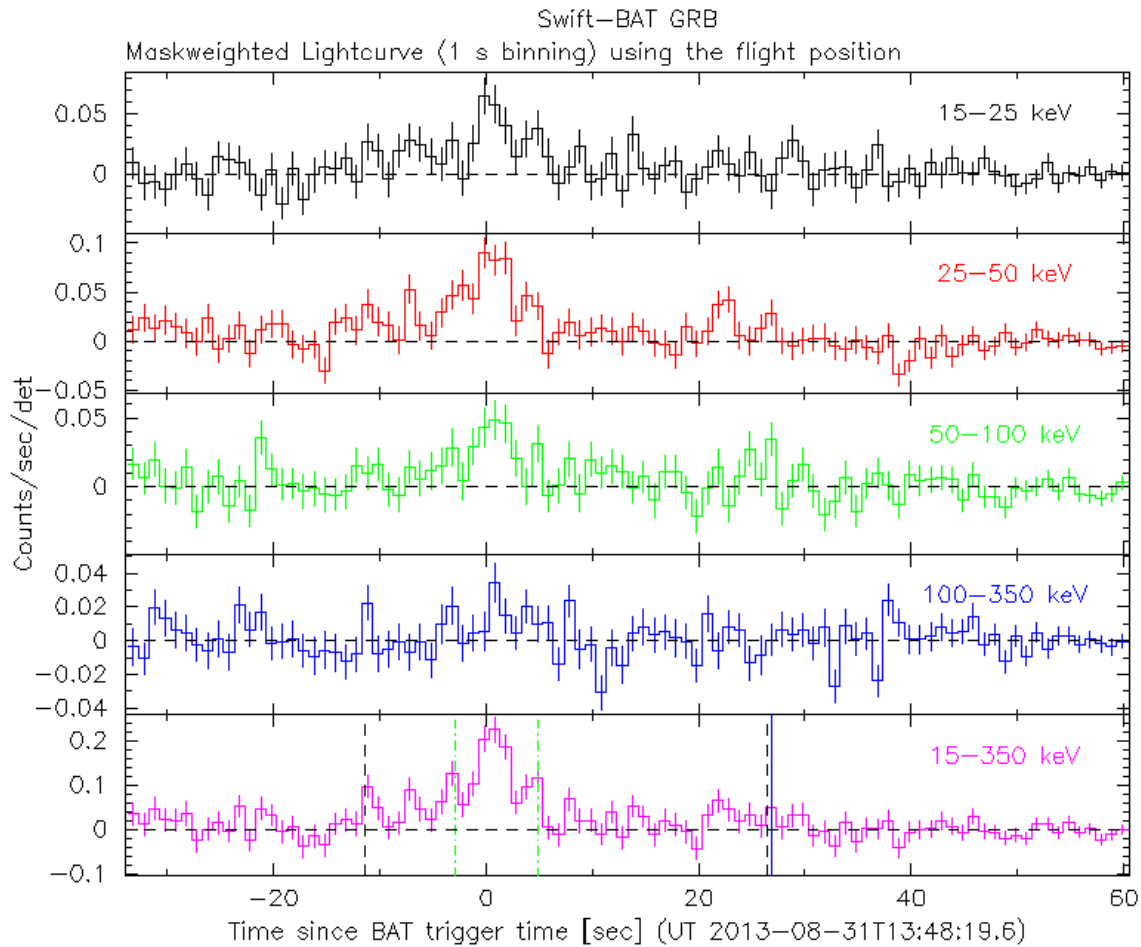

Figure 1: BAT light curves of GRB 130831B. The units of the y axes are count s^{-1} detector^{-1}, where one detector corresponds to 0.16 cm^2. In the lower panel, the vertical green and black lines mark the T_{50} and T_{90} intervals, respectively, while the solid blue line indicates the slew time.
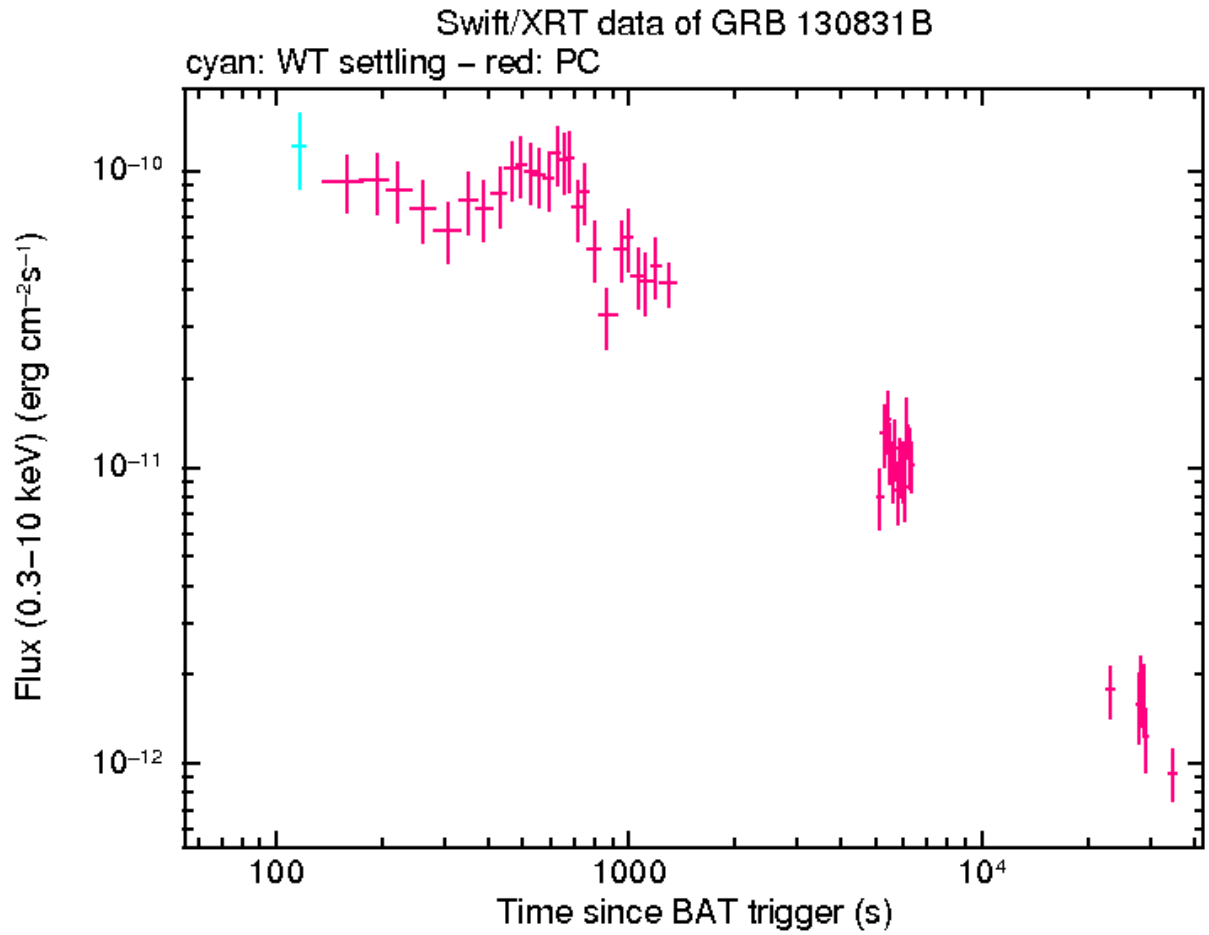
Figure 2: *Swift*/XRT flux light curve of GRB 130831B in the 0.3–10 keV band. The cyan and red points indicate WT (settling) and PC mode data, respectively.