Swift Observations of GRB 130515A

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1 Introduction

At T = 01:21:17 UT on 2013 May 15, the *Swift* Burst Alert Telescope (BAT) triggered and located the short GRB 130515A (trigger=555880). *Swift* immediately slewed to the burst (Malesani et al., GCN Circ. 14650).

The best *Swift* position of this burst is the UVOT-enhanced *Swift*/XRT position (`http://www.swift.ac.uk/xrt_positions/`; see also Beardmore et al., GCN Circ. 14654) with RA(J2000) = $18^{\rm h}53^{\rm m}45\overset{\rm s}{.}65$, Dec(J2000) = $-54°16'45\overset{''}{.}0$, with an uncertainty of $2\overset{''}{.}3$.

The burst was detected by several other spacecrafts, including *Fermi*/GBM (Jenke, GCN Circ. 14663), Konus/*Wind* (Golenetskii et al., GCN Circ. 14668), *Suzaku*/WAM (Iwakiri et al., GCN Circ. 14688). All detections support the short duration of the burst.

Several ground-based observatories looked for an optical/infrared counterpart to the GRB, but none was clearly identified. Three sources (S1–S3) were reported to lie inside or in close proximity to the XRT error circle (Xu et al., GCN Circ. 14653; Schmidl et al., GCN Circ. 14655; Cenko et al., GCN Circ. 14656; Nagayama & Nishiyama, GCN Circ. 14671), but none of them were found to be variable. In particular, *Gemini* observations set an upper limit to any afterglow of $R > 23.7$ mag at $t = 30$ min after the trigger (Cenko & Cucchiara, GCN Circ. 14670), and VLT spectroscopy established that source S1 inside the XRT error circle is an M-dwarf star (Levan & Tanvir, GCN Circ. 14667).

2 BAT Observations and Analysis

Using the data set from $T - 60$ s to $T + 243$ s (Barthelmy et al., GCN Circ. 14658), the BAT ground-calculated position is RA(J2000) = 83.436°, Dec(J2000) = −54.283°, which corresponds to

RA(J2000) = $18^{\rm h}53^{\rm m}44\overset{\rm s}{.}6$,
Dec(J2000) = $-54°16'57\overset{''}{.}3$,

with an uncertainty of $1\overset{'}{.}6$ (radius, sys+stat, 90% containment). The partial coding was 69%.

The mask-weighted light curve (Fig. 1) shows two overlapping peaks starting at $\sim T + 0.00$ s, peaking at $\sim T + 0.00$ s and $\sim T + 0.30$ s, and ending at $\sim T + 0.40$ s. T_{90} (15–350 keV) is 0.29 ± 0.06 s (estimated error including systematics).

The time-averaged spectrum from $T - 0.04$ s to $T + 0.33$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 0.77 ± 0.18. The fluence in the 15–150 keV band is $(1.5 \pm 0.2) \times 10^{-7}$ erg cm^{-2}. The 1-s peak photon flux measured from $T - 0.35$ s in the 15–150 keV band is 1.4 ± 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/555880/BA/`.

3 XRT Observations and Analysis

The XRT began observing the field of GRB 130515A at 01:22:32.9 UT, 75.2 s after the BAT trigger. The XRT refined position has been reported by Beardmore et al. (GCN Circ. 14654; see also `http://www.swift.ac.uk/xrt_positions/`): RA(J2000) = 283.44021°, Dec(J2000) = −54.27916°, which correspond to:

RA(J2000) = $18^{\rm h}53^{\rm m}45\overset{\rm s}{.}65$,
Dec(J2000) = $-54°16'45\overset{''}{.}0$,

with an uncertainty of $2\overset{''}{.}3$.

XRT collected 8.1 ks of data, from 82 s to 34.1 ks after the BAT trigger. The data are all in photon counting (PC) mode. The afterglow is detected only during the first orbit, and later upper limits to the count rate imply a power-law decay index $\alpha > 0.8$ (Zhang & Malesani, GCN Circ. 14661; Fig. 2).

The results of the XRT-team automatic analysis are available at `http://www.swift.ac.uk/xrt_products/00555880`.

4 UVOT Observations and Analysis

Swift/UVOT began settled observations of the field of GRB 130515A 79 s after the BAT trigger. In the UVOT exposures, no optical afterglow is detected consistent with the refined XRT position (Oates et al., GCN Circ. 14660). No optical counterpart is also detected consistent with the positions of objects S1 and S2 reported by the VLT (Xu et al., GCN Circ. 14653), GROND (Schmidl et al., GCN Circ. 14655), and *Gemini* (Cenko et al., GCN Circ. 14656). However, source S3, which is also visible in the DSS, is marginally detected with a white-band magnitude of 21.59 ± 0.39.

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	$T_{\rm start}$ (s)	$T_{\rm stop}$ (s)	Exp. time (s)	Magnitude
white$_{\rm FC}$	79	229	147	> 21.2
u$_{\rm FC}$	291	541	246	> 20.2
white	79	6414	580	> 21.7
v	620	5388	236	> 19.8
b	546	6209	432	> 21.0
u	291	6003	659	> 20.7
w1	669	5798	413	> 20.7
m2	645	5592	236	> 20.0
w2	596	6603	415	> 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 $E_{B-V} = 0.05$ mag (Schlafly & Finkbeiner 2011, ApJ, 737 103). All photometry uses the UVOT photometric system as described by Poole et al. (2008, MNRAS, 383, 627) and Breeveld et al. (2011). Start and stop times refer to the BAT trigger time T.

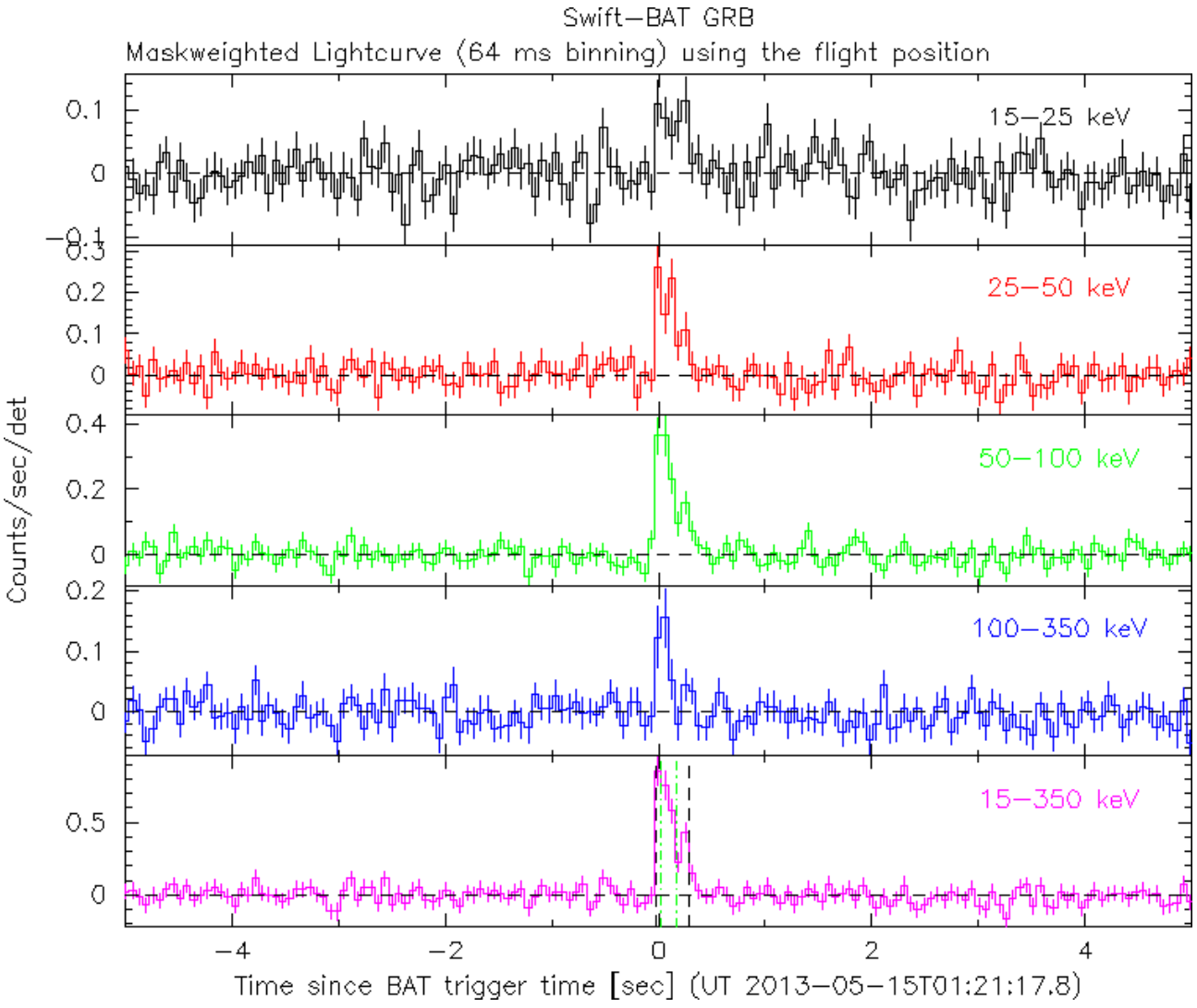

Figure 1: BAT light curves of GRB 130515A. The units of the y axes are count s^{-1} detector^{-1}, where one detector corresponds to 0.16 cm^2. In the lower panel, the vertical green and black lines mark the T_{50} and T_{90} intervals, respectively.

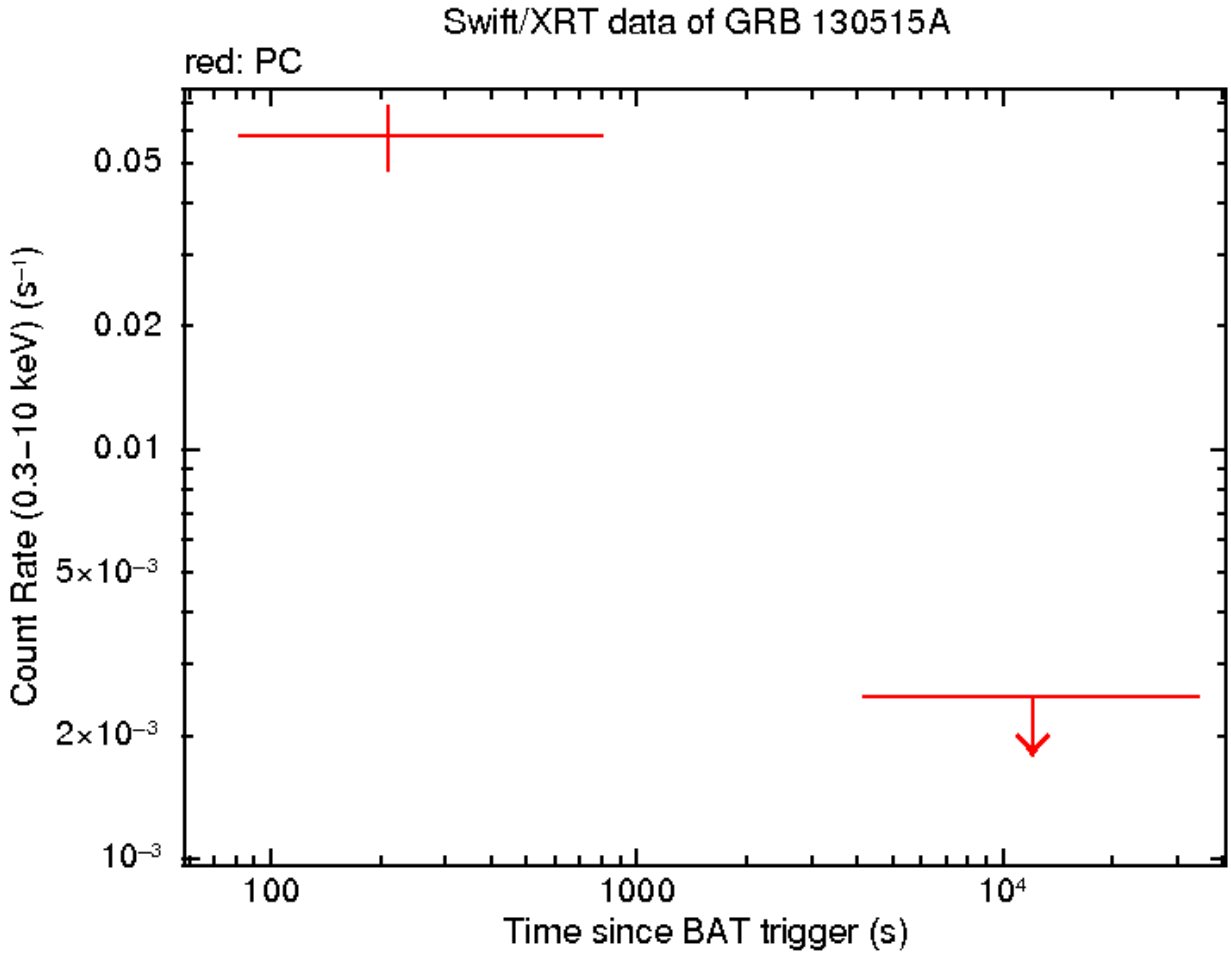

Figure 2: *Swift*/XRT count rate light curve of GRB 130515A in the 0.3–10 keV band. The upper limit is at the 3σ confidence level.