Swift Observations of GRB 130508A

S. T. Holland (STScI), A. Amaral-Rogers, P. A. Evans (U. Leicester), and T. Sakamoto (AGU), for the Swift *Team*

1 Introduction

Swift/BAT triggered on GRB 130508A on 2012 May 8 at 17:08:53 UT (Trigger 555413) (Holland et al. 2013). This was a long–soft burst with a duration of T_{90} = 42 s (Sakamoto et al. 2013). *Swift* slewed immediately to this burst and follow-up observations started with the XRT 130.5 s after the BAT trigger. The best *Swift* position is the UVOT-enhanced XRT location, RA, Dec (J2000.0) = 305.°3218, +34.°9583, which corresponds to

$$\begin{aligned} \text{RA (J2000.0)} &= 20^{\rm h}21^{\rm m}17.^{\rm s}22 \\ \text{Dec (J2000.0)} &= +34^\circ57'29.''9 \end{aligned}$$

with an uncertainty of 2.″5 (radius, 90% containment, including systematics). UVOT did not detect an optical or ultraviolet afterglow.

2 BAT Observation and Analysis

The BAT data set from $T - 60$ to $T + 243$ s was analysed to obtain the following information. The BAT ground-calculated position is RA, Dec (J2000.0) = 305.°351, +34.°966, which corresponds to

$$\begin{aligned} \text{RA (J2000.0)} &= 20^{\rm h}21^{\rm m}24.^{\rm s}2 \\ \text{Dec (J2000.0)} &= +34^\circ57'58'' \end{aligned}$$

with an uncertainty of 2.′2, (radius, systematic + statistical errors, 90% containment). The partial coding was 60%.

The mask-weighted light curves (Figure 1) shows a single peak from about $T + 9$ s to $T + 55$ s. T_{90} (15–350 keV) is 42 ± 11 s (estimated error including systematics).

The time-averaged spectrum from $T + 9.62$ to $T + 56.75$ s is best fit by a power law with a photon index of 1.80 ± 0.23. The total fluence in the 15–150 keV band is $(6.6 \pm 1.0) \times 10^{-7}$ erg cm^{-2}. The 1-s peak photon flux measured from $T + 11.07$ s in the 15–150 keV band is 0.7 ± 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/555413/BA/`.

3 XRT Observation and Analysis

The *Swift*/XRT began observing GRB 130508A at 17:11:03.9, 130.5 s after the BAT trigger. The astrometrically corrected X-ray position (using the XRT–UVOT alignment and matching UVOT field sources to the USNO-B1.0 catalogue) is RA, Dec (J2000.0) = 305.°3218, +34.°9583 (Evans et al. 2013), which corresponds to

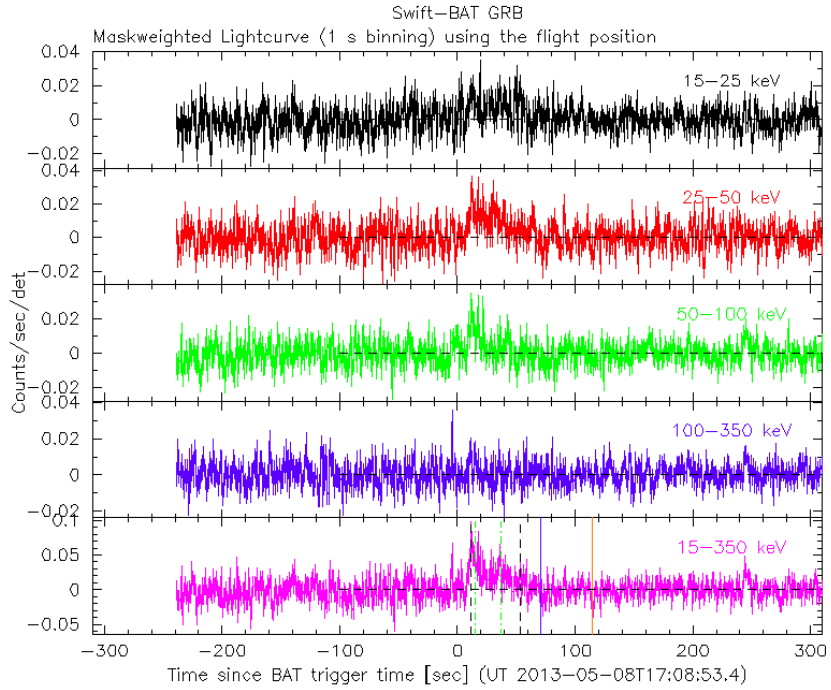

Figure 1: BAT light curves. The mask-weighted 1 s light curves in the four individual plus total energy bands. The units are count s^{-1} illuminated-detector^{-1} and T_0 is 17:08:53.4 UT.

$$\begin{aligned} \text{RA (J2000.0)} &= 20^{\rm h}21^{\rm m}17\overset{\rm s}{.}22 \\ \text{Dec (J2000.0)} &= +34^\circ57'29\overset{''}{.}9 \end{aligned}$$

with an uncertainty of $2\overset{''}{.}5$ (radius, 90% containment).

The X-ray light curve (Figure 2) can be modelled with a power-law decay with an index of $\alpha = 2.0^{+0.4}_{-0.3}$.

A spectrum formed from the PC mode data can be fit with an absorbed power-law with a photon spectral index of $1.0^{+0.6}_{-0.5}$. The best-fitting absorption column is $1.6^{+1.0}_{-0.8} \times 10^{22}$ cm^{-2} in excess of the Galactic value of 7.7×10^{21} cm^{-2} (Kalberla et al. 2005). The counts-to-observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 1.0×10^{-10} (1.3×10^{-10}) erg cm^{-2} count^{-1}. The results of the XRT team's automated analysis are available at `http://www.swift.ac.uk/xrt_products/00555413`.

4 UVOT Observation and Analysis

The *Swift*/UVOT observed of the field of GRB 130508A starting 117 s after the BAT trigger with settled observations starting at 136 s. There is no evidence for an optical afterglow consistent with the UVOT-enhanced (Goad et al. 2008) XRT position (Holland et al. 2013) in any of the UVOT exposures. Preliminary 3-σ upper limits using the UVOT photometric system (Breeveld et al. 2011) for the finding chart (FC) and coadded exposures are given in Table 1. These upper limits are not corrected for the Galactic extinction due to the reddening of $E_{B-V} = 2.54$ mag in the direction of the burst (Schlafly et al. 2011).

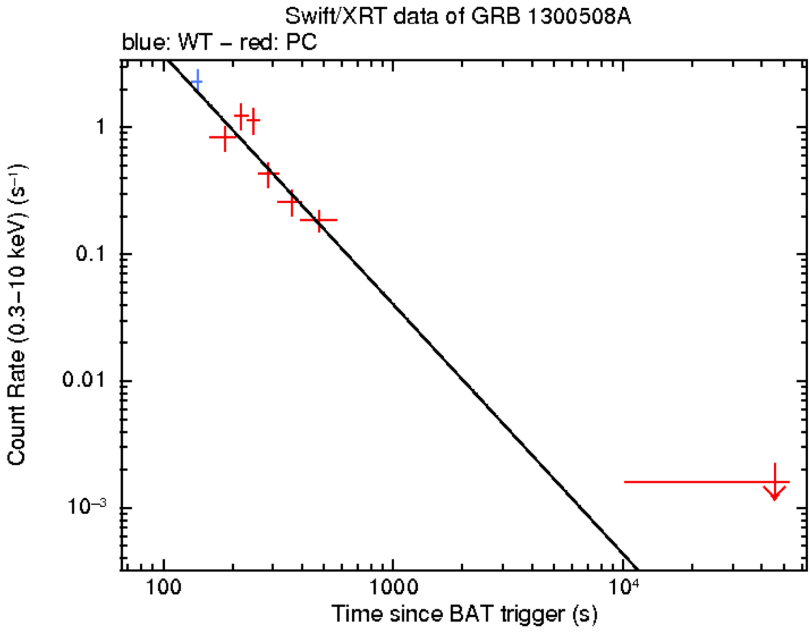

Figure 2: XRT flux light curves in erg cm^{-2} s^{-1} in the 0.3–10 keV band: Window Timing mode (blue), and Photon Counting mode (red). The conversion factor to observed (unabsorbed) flux is 1.0×10^{-10} (1.3×10^{-10}) erg cm^{-2} count^{-1}.

References

Breeveld et al., 2011, AIP Conf. Proc. 1358, 373

Evans, P. A., et al., 2013, GCN Circ. 14614

Goad, M. R., et al., 2008, A&A, 492, 873

Holland, S. T., et al., 2013, GCN Circ. 14607

Kalberla, P. M. W., et al., 2005, A&A, 440, 775

Sakamoto, T., et al., 2013, GCN Circ. 14613

Schlafly, E. F., et al., 2011, ApJS, 737, 103

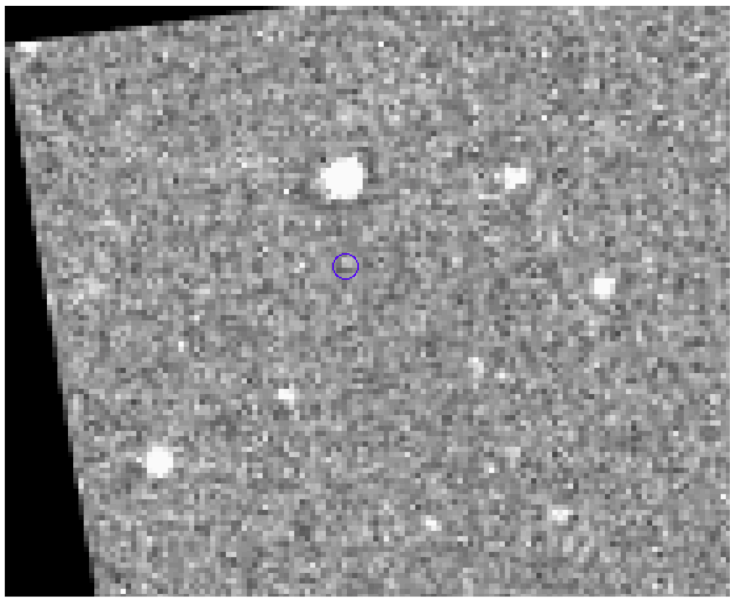

Figure 3: UVOT white finding chart for GRB 130508A. The blue circle indicates the UVOT-enhanced XRT error circle. North is up and east is to the left.

Filter	$T_{\rm start}$	$T_{\rm stop}$	Exp (s)	Mag
white (FC)	136	285	147	> 20.8
u (FC)	296	545	246	> 19.8
v	4416	5642	393	> 20.0
b	551	6336	288	> 20.5
u	296	6257	639	> 20.5
uvw1	4417	6052	393	> 20.3
uvm2	4212	5847	393	> 20.3
uvw2	3801	5437	393	> 20.5
white	136	5231	344	> 21.5

Table 1: UVOT 3-σ upper limits for GRB 130508A. $T_{\rm start}$ and $T_{\rm stop}$ are the times, in seconds since the BAT trigger, of the start and stop of the observations. Exp is the total exposure time.