

Swift Observations of GRB 120802A

*S. T. Holland (STScI), M. Stamatikos (OSU), B. P. Gompertz (U Leicester), and J. Kennea (PSU),
for the Swift Team*

1 Introduction

Swift/BAT triggered on GRB 120802A on 2012 Aug 2 at 08:00:51 UT (Trigger 529486) (Holland et al. 2012). This was a long-soft burst with a duration of $T_{90} = 50$ s (Stamatikos et al. 2012). *Swift* slewed immediately to this burst and follow-up observations started with the XRT 84.8 s after the BAT trigger. The best *Swift* position is the UVOT-enhanced XRT location, RA, Dec (J2000.0) = 44:84185, +13:76805, which corresponds to

$$\begin{aligned} \text{RA (J2000.0)} &= 02^{\text{h}}59^{\text{m}}22^{\text{s}}04 \\ \text{Dec (J2000.0)} &= +13^{\circ}46'05''0 \end{aligned}$$

with an uncertainty of $2''.8$ (radius, 90% containment, including systematics). No optical afterglow was detected by UVOT.

Gemini-North obtained an absorption redshift of $z = 3.796$ for a source inside the XRT error circle (Tanvir et al. 2012). Elenin et al. (2012) report a faint optical source on the edge of the XRT error circle that may be the optical afterglow.

2 BAT Observation and Analysis

The BAT data set from $T - 239$ to $T + 963$ s was analysed to obtain the following information. The BAT ground-calculated position is RA, Dec (J2000.0) = 44:833, +13:762, which corresponds to

$$\begin{aligned} \text{RA (J2000.0)} &= 02^{\text{h}}59^{\text{m}}20^{\text{s}}0 \\ \text{Dec (J2000.0)} &= +13^{\circ}45'43'' \end{aligned}$$

with an uncertainty of $1'.1$, (radius, systematic + statistical errors, 90% containment). The partial coding was 82% and the boresite angle was $56^{\circ}.4$.

The mask-weighted light curves (Figure 1) shows a small precursor peak from about $T - 40$ s to $T - 33$ s. This was followed by a fast rise at about $T - 2$ s which peaked at about $T + 2$ s with a second peak at about $T + 8$ s and then an exponential decay until about $T + 45$ s. T_{90} (15–350 keV) is 50 ± 31 s (estimated error including systematics).

The time-averaged spectrum from $T - 35.68$ to $T + 28.02$ s is best fit by a power-law with an exponential cutoff. The fit has a photon index of 1.21 ± 0.47 and a peak energy of $E_{\text{peak}} = 57.2 \pm 19.4$ keV. The total fluence in the 15–150 keV band is $(1.9 \pm 0.3) \times 10^{-6}$ erg cm^{-2} . The 1-s peak photon flux measured from $T + 7.94$ s in the 15–150 keV band is 3.0 ± 0.2 ph cm^{-2} s^{-1} . A fit to a single power law gives a photon index of 1.84 ± 0.10 . 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/529486/BA/.

3 XRT Observation and Analysis

The *Swift*/XRT began observing GRB 120802A at 08:02:16.3, 84.6 s after the BAT trigger. Using 539 s of Photon Counting (PC) mode data and one UVOT image the astrometrically corrected X-

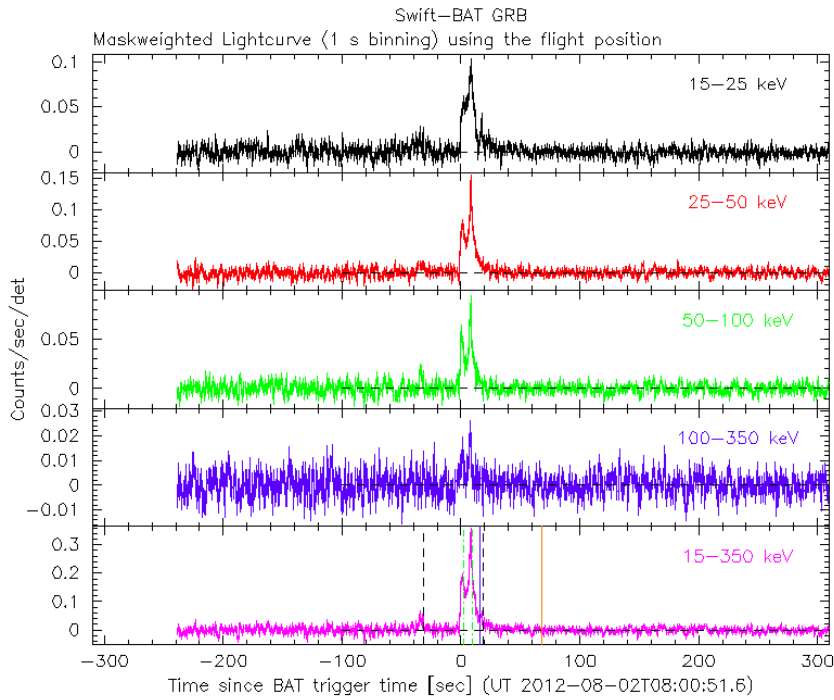


Figure 1: BAT light curves. The mask-weighted 1 s light curves in the four individual plus total energy bands. The units are $\text{count s}^{-1} \text{ illuminated-detector}^{-1}$ and T_0 is 08:00:51.6 UT.

ray position (using the XRT–UVOT alignment and matching UVOT field sources to the USNO-B1.0 catalogue) is RA, Dec (J2000.0) = $44^{\circ}84'18.5$, $+13^{\circ}76'80.5$ (Evans et al. 2012), which corresponds to

$$\begin{aligned} \text{RA (J2000.0)} &= 02^{\text{h}}59^{\text{m}}22.^{\text{s}}04 \\ \text{Dec (J2000.0)} &= +13^{\circ}46'05''.0 \end{aligned}$$

with an uncertainty of $2''.8$ (radius, 90% containment).

The X-ray light curve (Figure 2) can be modelled with an initial power-law decay with an index of $\alpha_1 = 2.7 \pm 0.4$, a break at $t_b = 270$ s, and a second, shallower decay with $\alpha_2 = 0.35 \pm 0.05$.

A spectrum formed from the PC mode data can be fit with an absorbed power-law with a photon spectral index of $2.10^{+0.21}_{-0.20}$. The best-fitting absorption column is $(1.5 \pm +0.5) \times 10^{21} \text{ cm}^{-2}$ in excess of the Galactic value of $9.6 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al. 2005). The counts-to-observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 3.6×10^{-11} (5.1×10^{-11}) $\text{erg cm}^{-2} \text{ count}^{-1}$. The results of the XRT team’s automated analysis are available at http://www.swift.ac.uk/xrt_products/0052.

4 UVOT Observation and Analysis

The *Swift*/UVOT observed of the field of GRB 120802A starting at 70 s after the BAT trigger with settled observations starting at 87 s. No optical afterglow consistent with the UVOT-enhanced (Goad et al. 2008) XRT position (Holland et al. 2012) is detected in any of the UVOT exposures. Preliminary $3\text{-}\sigma$ upper limits using the UVOT photometric system (Breeveld et al. 2011) for the finding chart (FC)

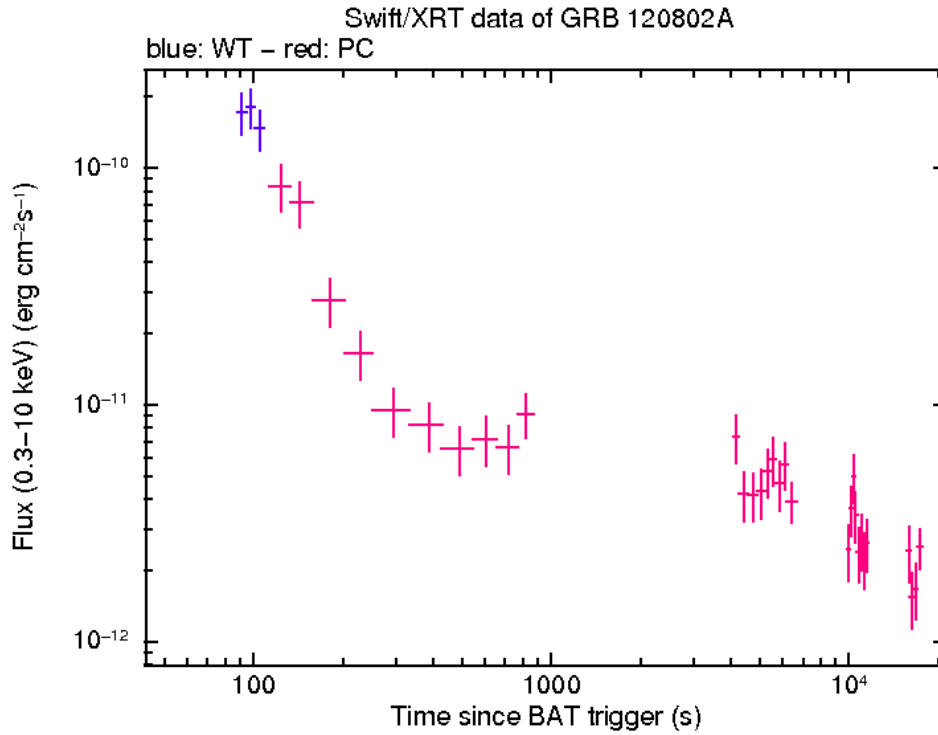


Figure 2: XRT flux light curves in $\text{erg cm}^{-2} \text{s}^{-1}$ in the 0.3–10 keV band: Window Timing mode (blue), and Photon Counting mode (red). The conversion factor to observed (unabsorbed) flux is 3.6×10^{-11} (5.1×10^{-11}) $\text{erg cm}^{-2} \text{count}^{-1}$.

and coadded exposures are given in Table 1. These upper limits are not corrected for the Galactic extinction due to the reddening of $E_{B-V} = 0.14$ mag in the direction of the burst (Schlafly et al. 2011).

References

- Breeveld et al., 2011, AIP Conf. Proc. 1358, 373
 Elenin, L., et al., 2012, GCN Circ. 13609
 Evans, P. A., et al., 2012, GCN Circ. 13558
 Goad, M. R., et al., 2008, A&A, 492, 873
 Holland, S. T., et al., 2012, GCN Circ. 13555
 Kalberla, P. M. W., et al., 2005, A&A, 440, 775
 Schlafly, E. F., et al., 2011, ApJS, 737, 103
 Stamatikos, M., et al., 2012, GCN Circ. 13559
 Tanvir, N. R., et al., 2012, GCN Circ. 13562

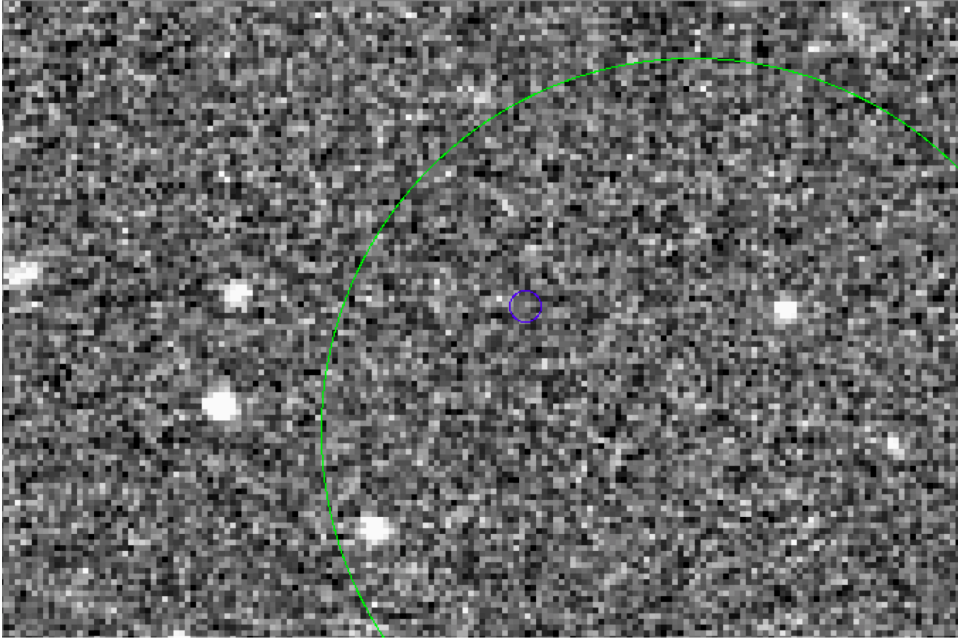


Figure 3: UVOT white finding chart for GRB 120802A. The green circle indicates the refined BAT error circle and the blue circle indicates the UVOT-enhanced XRT error circle. North is up and east is to the left.

Filter	T_{start}	T_{stop}	Exp(s)	Mag
white (FC)	87	237	147	> 20.8
<i>u</i> (FC)	300	550	246	> 19.9
<i>v</i>	630	16 594	1317	> 20.5
<i>b</i>	555	6625	332	> 20.4
<i>u</i>	300	6548	658	> 20.5
uvw1	678	17 567	492	> 20.4
uvm2	4504	17 499	1279	> 21.2
uvw2	4095	11 737	1279	> 21.4
white	87	10 731	1268	> 22.1

Table 1: UVOT $3\text{-}\sigma$ upper limits for GRB 120802A. T_{start} and T_{stop} are the times, in seconds since the BAT trigger, of the start and stop of the observations. Exp is the total exposure time.