

Swift Observations of GRB 120816A

K.L. Page (U. Leicester), D.M. Palmer (LANL), S. Immler (CRESS/CSG/UMD), S.D. Barthelmy (GSFC), D.N. Burrows (PSU), M.H. Siegel (PSU) & N. Gehrels (GSFC) for the Swift Team

1 Introduction

BAT triggered on GRB 120816A at 19:18:34 UT (trigger number 531223; Page et al. GCN Circ. 13654) and slewed immediately, finding an X-ray afterglow in the promptly-downlinked data. The best *Swift* position (Osborne et al., GCN Circ. 13660) is that determined from the UVOT observation: RA, Dec(J2000) = $18^h 48^m 34.5^s$, $-06^{\circ} 56' 16.4''$, with an estimated uncertainty of 0.6 arcsec (radius, 90% confidence).

The OPTIMA-Burst photo/polarimeter detected a fading optical source (Rau & Kanbach, GCN Circ. 13657) consistent with the XRT position. ROTSE (Zheng, Rujopakarn & Guver, GCN Circ. 13655), TAROT (Klotz et al., GCN Circ. 13656), BOOTES-2 (Jelinek et al., GCN Circ. 13658), the Bassano Bresciano Observatory (U.Quadri et al., GCN Circ. 13665) and the Kuban State University Astrophysical Observatory (Ivanov et al., GCN Circ. 13668) all observed the field, but did not detect this source.

2 BAT Observation and Analysis

Using the data set from T−60 to T+192 s, analysis of the BAT data of GRB 120816A was performed. The BAT ground-calculated position is RA, Dec = 282.133, -6.981 deg, which is equivalent to:

$$\begin{aligned} \text{RA(J2000)} &= 18^h 48^m 32.0^s \\ \text{Dec(J2000)} &= -06^{\circ} 58' 51.6'' \end{aligned}$$

with an uncertainty of 2.5 arcmin, (radius, systematic + statistical, 90% containment). The partial coding was 9%.

The mask-weighted light curve (Fig. 1) shows a single peak starting at $\sim T+0$ s, peaking at $\sim T+1$ s, and ending at $\sim T+8$ s. T_{90} (15–350 keV) is 7.6 ± 3.1 s (estimated error including systematics).

The time-averaged spectrum from T−1.97 to T+6.66 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is $\Gamma = 2.54 \pm 0.40$. The fluence in the 15–150 keV band is $4.3 \pm 1.0 \times 10^{-7}$ erg cm^{−2}. The 1-s peak photon flux measured from T+0.82 s in the 15–150 keV band is 2.1 ± 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/531223/BA/.

3 XRT Observations and Analysis

The XRT began observing the burst 136 s after the trigger (Page, GCN Circ. 13663). Using 3040 s of XRT Photon Counting mode data and 6 UVOT images, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 82.14298, -6.93791 deg which is equivalent to:

$$\begin{aligned} \text{RA(J2000)} &: 18^h 48^m 34.33^s \\ \text{Dec(J2000)} &: -06^{\circ} 56' 16.3'' \end{aligned}$$

with an uncertainty of 1.6 arcsec (radius, 90% confidence).

The light curve (Fig. 2) can be modelled with a simple power-law with a decay index of $\alpha = 0.94_{-0.07}^{+0.08}$.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index, $\Gamma = 2.10_{-0.25}^{+0.26}$. The best-fitting absorption column is $(6.4_{-1.4}^{+1.5}) \times 10^{21} \text{ cm}^{-2}$, in excess of the Galactic value of $3.7 \times 10^{21} \text{ cm}^{-2}$ (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 4.8×10^{-11} (9.5×10^{-11}) $\text{erg cm}^{-2} \text{ count}^{-1}$.

The results of the XRT-team automatic analysis are available at http://www.swift.ac.uk/xrt_products/00531223.

4 UVOT Observation and Analysis

The UVOT observed the field of GRB 120816A starting 117 s after the BAT trigger (Immler & Page, GCN Circ. 13678). We detect an uncatalogued source inside the enhanced XRT error circle (Osborne et al., GCN Circ. 13660) with preliminary coordinates RA, Dec = 282.14359, -6.93788 deg which is equivalent to:

$$\text{RA (J2000)} = 18^h 48^m 34.5^s$$

$$\text{Dec (J2000)} = -06^\circ 56' 16.4''$$

with an estimated uncertainty of 0.6 arcsec (radius, systematic + statistical, 90% confidence). The UVOT detection is consistent with the optical afterglow reported by Rau & Kanbach (GCN Circ. 13657). Source magnitudes and 3-sigma upper limits at this location are given in Table 1; photometry is on the UVOT photometric system described in Breeveld et al. (2011, AIP Conf. Proc. 1358, 373). The quoted magnitudes and upper limits have not been corrected for the Galactic extinction along the line of sight to this burst of $E(B-V) = 0.703 \text{ mag}$.

Filter	Start (s since trigger)	Stop (s since trigger)	Exposure (s)	Mag.	Error
white	134	284	147	18.5	0.2
white	573	6306	598	19.9	0.2
v	117	6716	500	>19.0	
b	548	11345	1174	>19.6	
u	293	7286	672	>21.1	
uvw1	672	7126	490	>21.1	
uvm2	647	6921	490	>19.5	
uvw2	599	6511	490	>19.8	

Table 1: Magnitude limits from UVOT observations

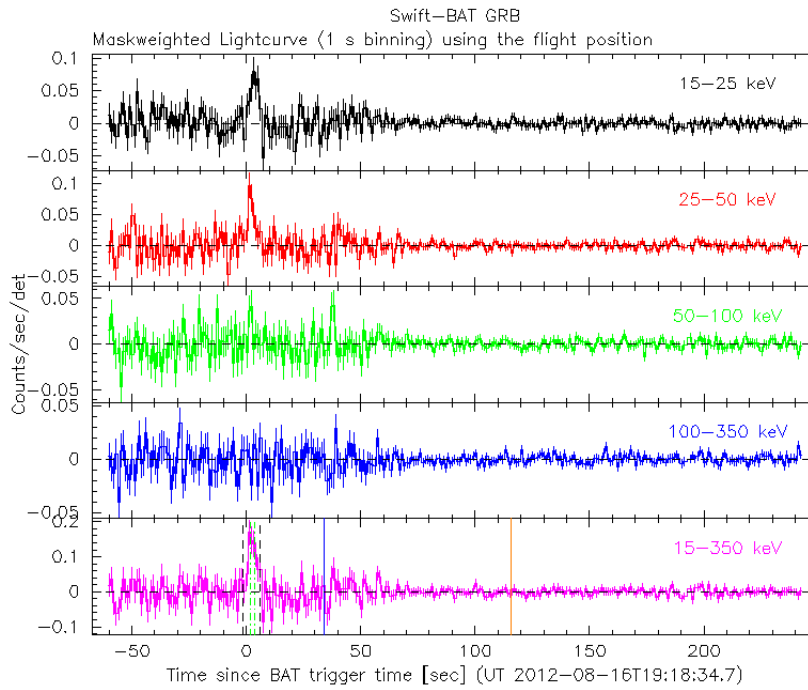


Figure 1: BAT light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector (note illum-det = 0.16 cm^2) and T_0 is 19:18:34 UT.

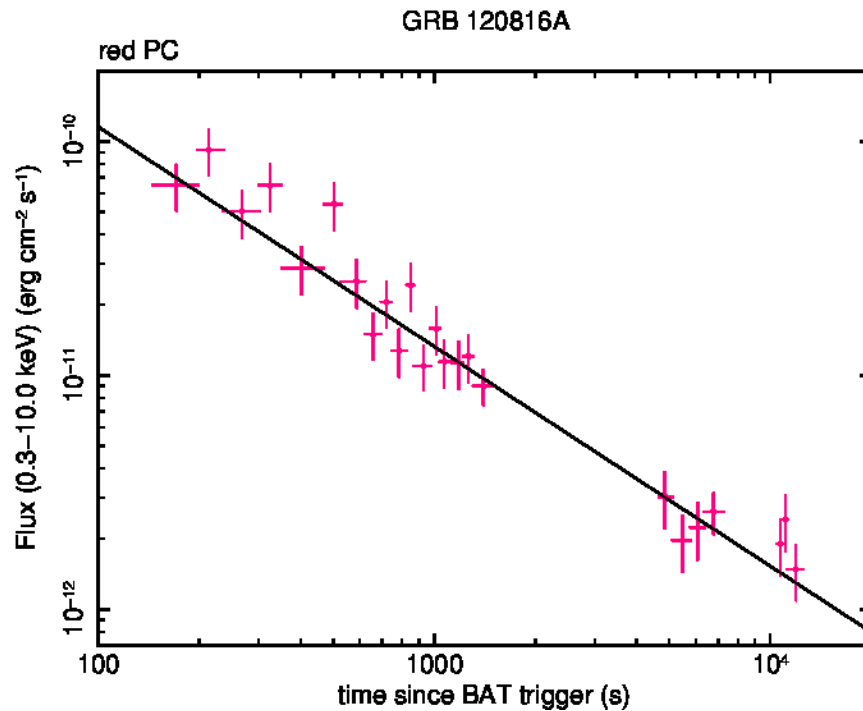


Figure 2: XRT light curve. Flux light curve in the 0.3-10 keV band; all the data were collected in Photon Counting mode. The approximate conversion is $1 \text{ count s}^{-1} = \sim 4.8 \times 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1}$.