

Swift Observations of GRB 120118B

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1 Introduction

BAT triggered on GRB 120118B at 17:00:21.1 UT on the 18th of January 2012 (Trigger 512003) (Littlejohns, *et al.*, *GCN Circ.* 12852). This was a long burst with $T_{90}(15 - 350 \text{ keV}) = 23.3 \pm 4.0 \text{ s}$. Swift slewed to this GRB immediately with both XRT and UVOT beginning follow-up observations at T+112.1 s and T+116 s respectively.

The best position is that derived from using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue to correct the X-ray location astrometrically (with an error of 1.8 arcsec at 90% confidence):

$$\begin{aligned} \text{RA}(J2000) &= 124.87106^\circ (08^h 19^m 29.05^s) \\ \text{Dec}(J2000) &= -7.18474^\circ (-07^\circ 11' 05.1'') \end{aligned}$$

Stacking images from the white filter there was a 3.9σ possible detection of the source using the UVOT instrument, giving a position with an error radius of 1.1 arcseconds at 90% confidence.

$$\begin{aligned} \text{RA}(J2000) &= 124.8719^\circ (08^h 19^m 29.2^s) \\ \text{Dec}(J2000) &= -7.1851^\circ (-07^\circ 11' 06'') \end{aligned}$$

This position is, however, inconsistent with both the enhanced XRT position and the low significance object seen by the TNG telescope in the obtained H-band observations (D'Avanzo, *et al.*, *GCN Circ.* 12870).

Observations of the field of view were also performed by MASTER II (Gres, *et al.*, *GCN Circ.* 12853), Faulkes Telescope South (Melandri, *et al.*, *GCN Circ.* 12856), NOT (Vreeswijk, *et al.*, *GCN Circ.* 12858), Lulin (Hsiao, *et al.*, *GCN Circ.* 12868), TNG (D'Avanzo, *et al.*, *GCN Circ.* 12870) and RTT150 (Bikmaev, *et al.*, *GCN Circ.* 12879), however only upper limits were detected with these instruments.

2 BAT Observation and Analysis

Using the data set from T-61 to T+242 s, further analysis was performed by the *Swift* BAT team (Sakamoto, *et al.*, *GCN Circ.* 12873). The BAT ground-calculated position is shown below, with a radius of 1.3 arcmin (90% containment including systematic and statistical errors). The partial coding fraction was 40%.

$$\begin{aligned} \text{RA}(J2000) &= 124.862^\circ (08^h 19^m 26.9^s) \\ \text{Dec}(J2000) &= -7.178^\circ (-07^\circ 10' 39.5'') \end{aligned}$$

The masked-weighted light curves (Fig.1) from T-310 to T+310 s shows a single smooth fast rise exponential (FRED) peak, starting at approximately T-5 s and ending at T+25 s. $T_{90}(15 - 350 \text{ keV})$ for this burst is $23.26 \pm 4.02 \text{ s}$ (estimated error including systematics).

The time-averaged spectrum from T-1.92 to T+30.51 s is best fitted by a simple power law model. The power law index of the time-averaged spectrum is 2.08 ± 0.11 . The fluence in the 15-150 keV band is $1.8 \pm 0.1 \times 10^{-6} \text{ erg.cm}^{-2}$. The one second peak photon flux measured from T+6.69 s in the 15-150 keV band is $2.2 \pm 0.3 \text{ ph.cm}^{-2}.s^{-1}$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using data from both the XRT and UVOT instruments for GRB 120118B (1.4 ks in Photon Counting mode and 2 UVOT images), the refined XRT position is (at 90% confidence with an error of 1.8 arcsec):

$$\begin{aligned} \text{RA}(J2000) &= 124.871066^\circ (08^h 19^m 29.05^s) \\ \text{Dec}(J2000) &= -7.18474^\circ (-07^\circ 11' 05.1'') \end{aligned}$$

The 0.3-10 keV light curve (Fig.2) can be modelled with a series of power law decays, with two breaks. The initial decline has a slope of $3.84_{-0.46}^{+0.54}$, followed by a slight brightening of flux with a slope of $-0.30_{-0.27}^{+0.25}$ beginning at T+319.6 $_{-38.6}^{+46.6}$ s. At T+2774 $_{-559}^{+964}$ s there is a second break, after which the light curve decays once more, to a slope of $1.05_{-0.10}^{+0.11}$.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of $2.15_{-0.53}^{+0.63}$. The best-fitting absorption column is $1.0_{-1.0}^{+1.8} \times 10^{21} \text{ cm}^{-2}$ in excess of the Galactic value of $6.9 \times 10^{20} \text{ cm}^{-2}$ (Kalberla, *et al.*, 2005). The PC mode spectrum has a photon index of $2.23_{-0.18}^{+0.19}$ and a best-fitting absorption column of $2.1_{-0.57}^{+0.61} \times 10^{21} \text{ cm}^{-2}$. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is $4.7 \times 10^{-11} (6.5 \times 10^{-11}) \text{ ergs.cm}^{-2}.ct^{-1}$.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 120118B 116 seconds after the BAT trigger (Littlejohns et al., GCN Circ. 12852). There is a possible detection (3.9 sigma) in summed broadband white images obtained during the first 18 ks after the BAT trigger. D'Avanzo and Palazzi (GCN Circ. 12870) also note a low-significance source in their H-band image obtained approximately 36 ks after the trigger. The UVOT position is poorly constrained due to image artifacts related to a nearby star; the best UVOT position is

$$\begin{aligned} \text{RA}(J2000) &= 124.8719^\circ (08^h 19^m 29.2^s) \\ \text{Dec}(J2000) &= -7.1851^\circ (-07^\circ 11' 06'') \end{aligned}$$

with an estimated uncertainty of 1.1 arcsec (radius, 90% confidence). This position is 3.3 arcseconds from the enhanced XRT position (Osborne et al., GCN Circ. 12857).

In a followup Swift observation performed nine days after the BAT trigger, no reliable detection was obtained in a 3 ks exposure in the white filter.

Table 1 provides photometry and 2-sigma upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc. 1358, 373) with a 4-arcsec aperture centered on the XRT position and a 25 arcsecond annular background region. The background region includes a linear "stripe" of enhanced counts, an artifact due to a nearby star, which crossed the position of the XRT counterpart in a number of the early epoch images. The magnitudes in the table are not corrected for Galactic extinction due to the reddening of $E(B-V) = 0.15$ in the direction of the burst (Schlegel et al. 1998).

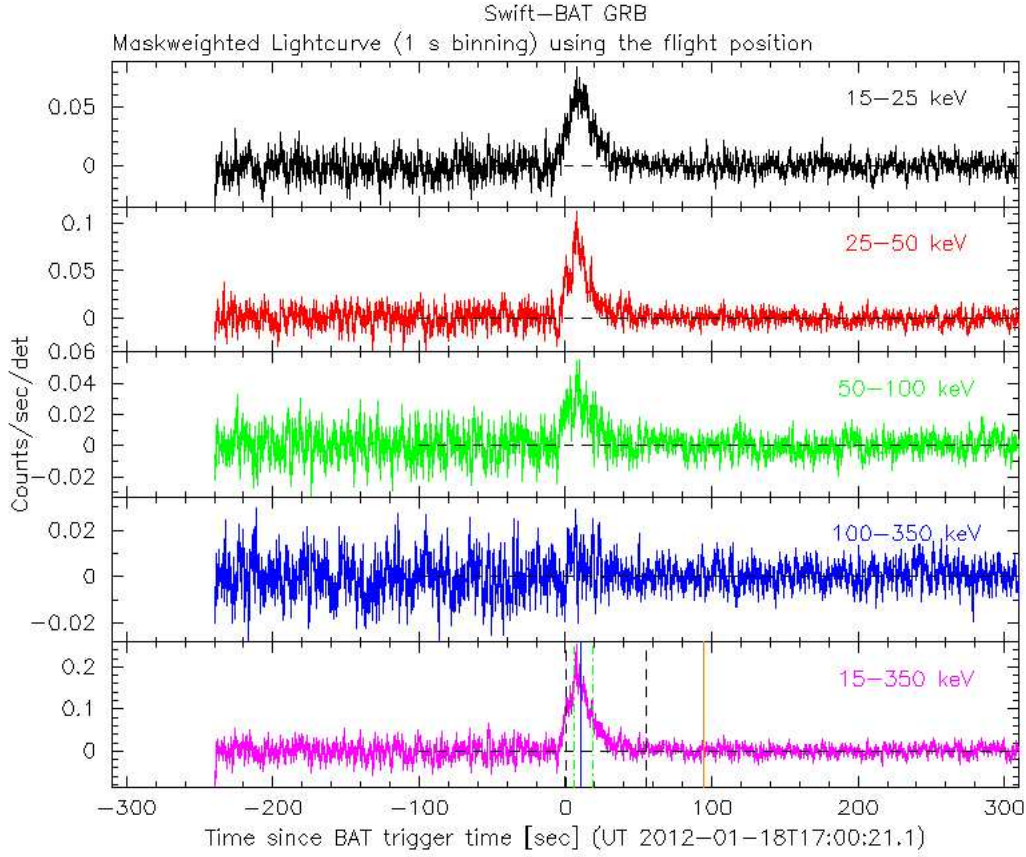


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector (note illum-det = 0.16 cm^2) and T_0 is 17:00:21.1 UT.

Filter	T_{Start} (seconds)	T_{Stop} (seconds)	Exposure Time (seconds)	Magnitude
white (finding)	116	265	147	>21.5
white	116	18655	2359	22.2 ± 0.3
white	744969	775472	3247	>23.3
v	657	30359	1194	>21.1
b	583	12212	1179	>22.0
u	328	7350	947	>21.6
uvw1	707	7161	471	>21.1
uvm2	1064	35893	1150	>21.6
uvw2	633	24679	1407	>22.0

Table 1: Magnitude and upper limits from UVOT observations

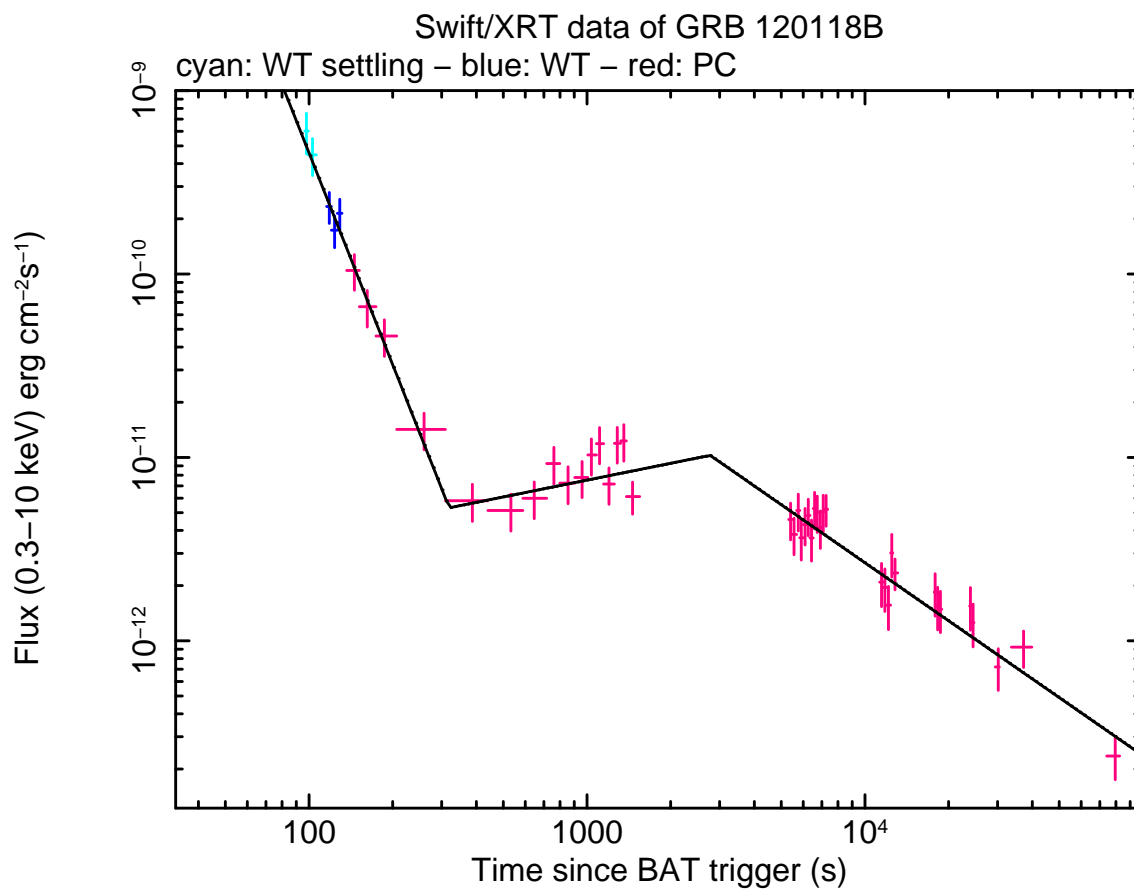


Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing Settling mode (cyan), Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is 1 count $\approx 3.6 \times 10^{-11} \text{ ergs.cm}^{-2}$.