

**Swift Observations of GRB 120811C**

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**1 Introduction**

At 15:34:52 UT on 2012-08-11, the Swift Burst Alert Telescope (BAT) triggered and located GRB 120811C (trigger=530689). Swift slewed immediately to the burst and found both an X-ray counterpart with the XRT and an optical afterglow with the UVOT (Barlow et al., *GCN Circ.* 13622). The burst was also detected by the Fermi GBM, with which an  $E_{peak}$  of  $54 \pm 3$  keV was measured (Jenke et al., *GCN Circ.* 13642).

The best *Swift* position ( $0.52''$  uncertainty) is the UVOT position from Kuin et al. (*GCN Circ.* 13629):

$$\begin{aligned} \text{RA (J2000)} &= 13\text{h } 18\text{m } 43.82\text{s} \\ \text{Dec (J2000)} &= +62^\circ 18' 02.8'' \end{aligned}$$

An optical afterglow was successfully detected from the ground by MASTER II (Denisenko et al. *GCN Circ.* 13623; Ivanov et al., *GCN Circ.* 13635), RTT150 (Galeev et al. *GCN Circ.* 13626, 13636), GTC (Thoene et al., *GCN Circ.* 13628), and NOT (Fynbo et al. *GCN Circ.* 13632).

A redshift of  $z = 2.671$  was reported from the GTC/OSIRIS (Thoene et al., *GCN Circ.* 13628) and NOT/ALFOSC (Fynbo et al., *GCN Circ.* 13632) spectra and is consistent with the absence of a UVOT detection in the UV bands (Kuin et al., *GCN Circ.* 13629).

**2 BAT Observation and Analysis**

At 15:34:52 UT on 2012-08-11, the Swift Burst Alert Telescope (BAT) triggered and located GRB 120811C (trigger=530689; Barlow et al., *GCN Circ.* 13622). Using the data set from T−240 s to T+962 s, the BAT ground-calculated position is RA, Dec = 199.690, +62.297 deg which is

$$\begin{aligned} \text{RA(J2000)} &= 13\text{h } 18\text{m } 45.5\text{s} \\ \text{Dec(J2000)} &= +62^\circ 17' 50.3'' \end{aligned}$$

with an uncertainty of 1.0 arcmin (radius, sys+stat, 90% containment). The partial coding was 89% (Krimm et al. *GCN Circ.* 13634).

The mask-weighted light curve shows a nearly symmetric peak starting at T−10 s, peaking at T+6 s, and ending at T+40 s.  $T_{90}$  (15-350 keV) is  $26.8 \pm 3.7$  s (estimated error including systematics).

The time-averaged spectrum from T−9.7 s to T+42.9 s is best fit by a power law with an exponential cutoff. This fit gives a photon index  $1.40 \pm 0.30$ , and  $E_{peak}$  of  $42.9 \pm 5.7$  keV ( $\chi^2=59.5$  for 56 d.o.f.). For this model the total fluence in the 15-150 keV band is  $(3.0 \pm 0.3) \times 10^{-6}$  erg  $\text{cm}^{-2}$  and the 1-s peak flux measured from T+5.27 s in the 15-150 keV band is  $4.1 \pm 0.2$  ph  $\text{cm}^{-2}$   $\text{s}^{-1}$ . A fit to a simple power law gives a photon index of  $2.04 \pm 0.06$  ( $\chi^2=74.5$  for 57 d.o.f.). All quoted errors are at the 90% confidence level.

The results of the batgrbproduct analysis are available at [http://gcn.gsfc.nasa.gov/notices\\_s/530689/BA/](http://gcn.gsfc.nasa.gov/notices_s/530689/BA/)

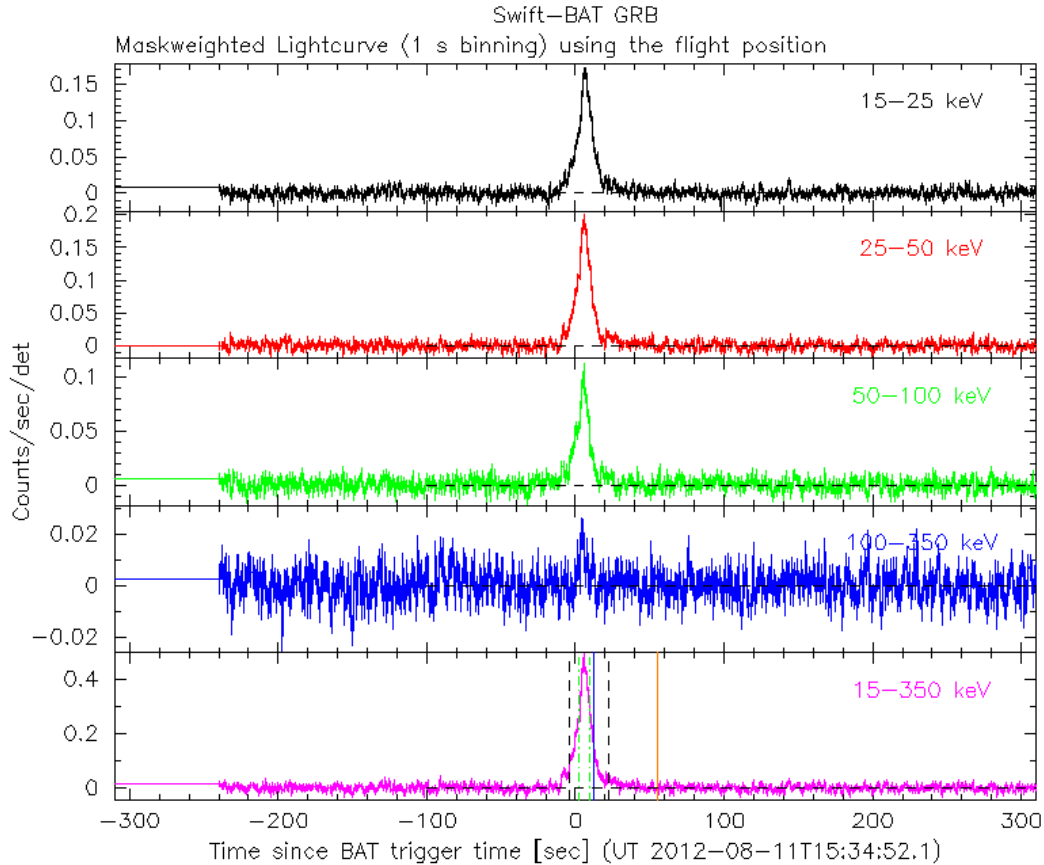


Figure 1: The mask-weighted BAT light curve of GRB 120811C in the 4 individual plus total energy bands.

### 3 XRT Observations and Analysis

The XRT began observing the field of GRB 120811C at 15:36:00.8 UT, 68.7 seconds after the BAT trigger. Using 1291 s of XRT Photon Counting mode data and 2 UVOT images for GRB 120811C, Evans et al. (*GCN Circ.* 13625) found an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) of RA, Dec = 199.68285, +62.30068 which is equivalent to:

$$\begin{aligned} \text{RA (J2000): } & 13\text{h } 18\text{m } 43.88\text{s} \\ \text{Dec (J2000): } & +62^\circ 18' 02.4'' \end{aligned}$$

with an uncertainty of 1.7 arcsec (radius, 90% confidence).

The latest position can be viewed at [http://www.swift.ac.uk/xrt\\_positions](http://www.swift.ac.uk/xrt_positions). Position enhancement is described by Goad et al. (2007, A&A, 476, 1401) and Evans et al. (2009, MNRAS, 397, 1177).

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of  $\Gamma = 2.74^{+0.14}_{-0.13}$ . The best-fitting absorption column is  $1.08^{+0.22}_{-0.20} \times 10^{21} \text{ cm}^{-2}$ , in excess of the Galactic value of  $2.1 \times 10^{20} \text{ cm}^{-2}$  (Kalberla et al. 2005). The PC mode spectrum has a photon index of  $\Gamma = 2.00 \pm 0.15$  and a best-fitting absorption column density of  $N_{\text{H}} = 8.8^{+3.4}_{-3.1} \times 10^{20} \text{ cm}^{-2}$ . The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is  $3.6 \times 10^{-11}$  ( $4.5 \times 10^{-11}$ )  $\text{erg cm}^{-2} \text{ count}^{-1}$ .

The 0.3 – 10 keV light curve given below (Fig.2) can be modeled with a series of power-law decays. The light curve displays an initial decay slope of  $\alpha = 3.12^{+0.13}_{-0.14}$  with a break at T+224 s followed by a flattening of the decay slope to  $\alpha$  of  $0.44^{+0.12}_{-0.27}$ . The light curve breaks again at T+1468 s and continues with a normal decay slope of  $\alpha = 1.06^{+0.19}_{-0.09}$ .

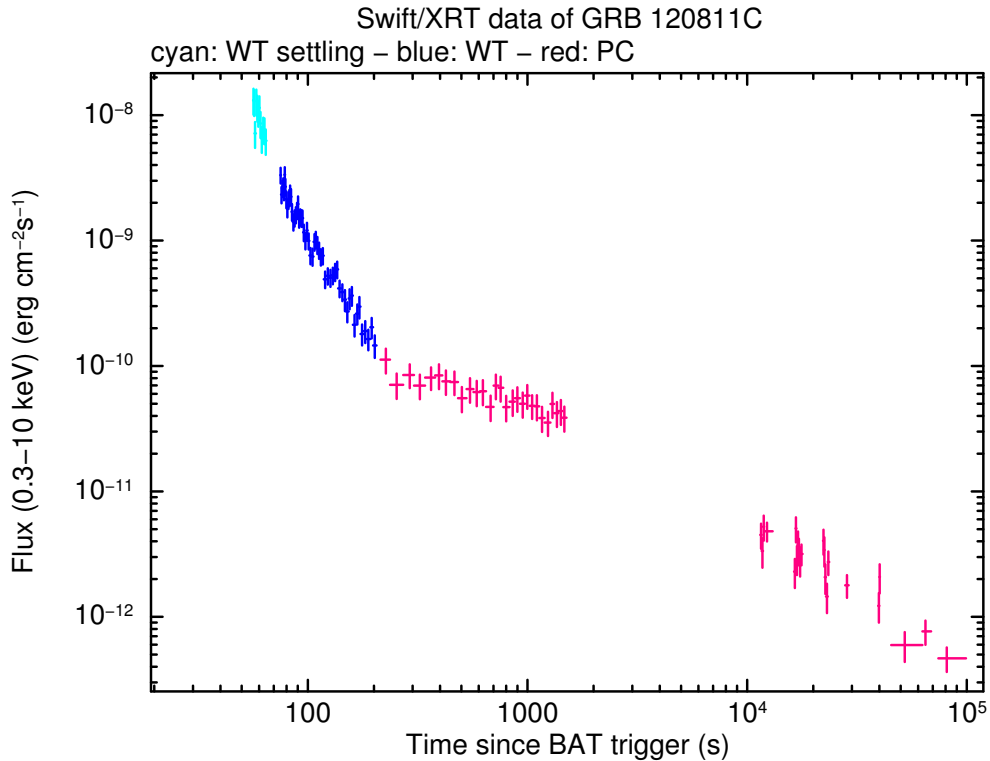


Figure 2: XRT flux light curve of GRB 120811C in the 0.3-10 keV band. The approximate conversion is  $1 \text{ count s}^{-1} = \sim 3.6 \times 10^{-11} \text{ ergs s}^{-1} \text{ cm}^{-2}$ .

The XRT-team analysis results are available at [http://www.swift.ac.uk/xrt\\_products/00530689](http://www.swift.ac.uk/xrt_products/00530689).

## 4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 120811C 76 s after the BAT trigger (Barlow et al., *GCN Circ.* 13622) with the white-filter finding chart. A source consistent with the XRT position (Evans et al., *GCN Circ.* 13625) was detected in the initial UVOT exposures at the position:

$$\begin{aligned} \text{RA (J2000)} &= 13:18:43.82 = 199.68258 \text{ (deg.)} \\ \text{Dec (J2000)} &= +62:18:02.8 = 62.30077 \text{ (deg.)} \end{aligned}$$

with an estimated uncertainty of 0.52 arcsec. (radius, 90% confidence).

Detections and  $3\text{-}\sigma$  upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc. 1358, 373) for the exposures are:

Filter	$T_{\text{Start}}$ [s]	$T_{\text{stop}}$ [s]	Exposure [s]	Mag
white	76	226	147	18.59 +/- 0.05
v	620	1243	78	18.49 +/- 0.19
b	544	739	39	18.95 +/- 0.19
u	288	538	246	18.61 +/- 0.09
w1	670	1464	97	>20.0
m2	819	1439	78	>20.5
w2	595	1219	78	>19.7

Table 1:  $3\sigma$  upper limits from UVOT observations of GRB 120811C. The quoted values have not been corrected for the expected Galactic extinction along the line of sight of  $E_{B-V} = 0.03$  mag. All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627) and Breeveld et al. (2011, AIP Conf. Proc., Vol. 1358, 373)

The absence of a detection in the UV bands is consistent with the reported redshift from Thoene et al., (*GCN Circ.* 13628).