Swift Observations of GRB 110625A

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1 Introduction

BAT triggered on GRB 110625A at 21:08:28 UT (trigger number 456073; Page et al., GCN Circ. 12088), slewing immediately. An afterglow was detected by the XRT, with the best *Swift* position being that derived from the promptly downlinked event data, using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue: RA, Dec (J2000) = $19^h\ 06^m\ 55.85^s$, $+06^o$ 45' 19.2", with an estimated uncertainty of 2.1 arcsec (radius, 90% confidence).

GRB 110625A was also detected by *INTEGRAL*/SPI-ACS (Beckmann, priv. comm.), *Konus*-Wind (Golenetskii et al., GCN Circ. 12093), *Suzaku*-WAM (Mizuno et al., GCN Circ. 12102) and both *Fermi* GBM and LAT (Tam & Kong, GCN Circ. 12097; Gruber et al., GCN Circ. 12100). No optical afterglow was detected by *ROTSE* (Zheng & Rujopakarn, GCN Circ. 12089) or the Konkoly Observatory (Kelemen, GCN Circ. 12094). However, Im et al. (GCN Circ. 12095) reported a NIR object detected by UKIRT within the XRT error circle given by Page et al. (GCN Circ. 12092), confirmed by I-band images at the Calar Alto Observatory (Gorosabel et al., GCN Circ. 12098). *GROND* observations (Filgas et al., GCN Circ. 12096) suggested this source was not varying and likely too blue to be the afterglow given the large foreground extinction in this direction.

2 BAT Observation and Analysis

Using the data set from T−240 to T+602 s, the BAT ground-calculated position is RA, Dec = 286.751, 6.755 deg, which is equivalent to

RA(J2000) = $19^h\ 07^m\ 00.3^s$
Dec(J2000) = $+06^d$ 45' 17.8"

with an uncertainty of 1.3 arcmin (radius, sys+stat, 90% containment). The partial coding was 5%.

The mask-weighted light curve (Figure 1) shows a series of peaks starting at T−12 s, with major peaks at ∼T−5, ∼T+2, ∼T+13 and ∼T+18 s, followed by a long tail ending at ∼T+350 s. T_{90} (15–350 keV) is 44.5 ± 10.1 s (estimated error including systematics).

The time-averaged spectrum from T−6.2 to T+140.3 s is best fit by a simple power-law model. The power law index of this time-averaged spectrum is 1.44 ± 0.04. The fluence in the 15–150 keV band is $(2.8 \pm 0.1) \times 10^{-5}$ erg cm^{-2}. The 1-s peak photon flux measured from T+13.74 s in the 15–150 keV band is 49.5 ± 2.4 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/456073/BA/

3 XRT Observations and Analysis

The XRT began observing the burst 140.3 s after the trigger (Page et al., GCN Circ. 12088). Using the promptly downlinked event data, we find an astrometrically-corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) of RA, Dec = 286.7327, 6.7553 which is equivalent to:

RA (J2000): $19^h\ 06^m\ 55.85^s$
Dec(J2000): $+06^o$ 45' 19.2"

with an uncertainty of 2.1 arcsec (radius, 90% confidence).

The light curve can be modelled with an initial power-law decay with an index of $\alpha_1 = 1.14 \pm 0.04$, followed by a break at T+17^{+11}_{-10} ks to a slope of $\alpha_2 = 2.3^{+1.6}_{-0.4}$.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index, Γ of 2.5 ± 0.4. The best-fitting absorption column is $6.3^{+1.1}_{-1.0} \times 10^{22}$ cm^{-2}, in excess of the Galactic value of 1.4×10^{22} cm^{-2} (Kalberla et al. 2005). The PC mode spectrum has a photon index of 1.8 ± 0.4 and a best-fitting absorption column of $5.9^{+1.3}_{-1.1} \times 10^{22}$ cm^{-2}. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 1.1×10^{-10} (3.2×10^{-10}) erg cm^{-2} count^{-1}.

The results of the XRT-team automatic analysis are available at
http://www.swift.ac.uk/xrt_products/00456073.

4 UVOT Observation and Analysis

The UVOT began observing the burst 127 s after the trigger, with settled observations starting at 205 s (Page et al., GCN Circ. 12088). No new source was detected within the XRT error circle in any of the UVOT filters and the upper limits are summarized in Table 1. There is no evidence for a source at the location of the infrared object detected by UKIRT (Im et al., GCN Circ. 12095) and GROND (Filgas et al., GCN Circ. 12096).

These limits are not corrected for the large, but uncertain, Galactic extinction of E(B-V) = 10.52 in the direction of the burst (Schlegel et al. 1998). The photometry is on the UVOT photometric system described in Poole et al. (2008).

Filter	Start (s since trigger)	Stop (s since trigger)	Exposure	3-Sigma UL
u (finding)	205	455	246	>20.7
u (finding)	858	1008	147	>20.4
v	511	1233	97	>19.5
b	460	1332	117	>20.6
u	205	248 845	9022	>22.9
uvw1	560	133 655	3505	>22.2
uvm2	535	102 818	7866	>22.7
uvw2	486	1339	98	>19.8

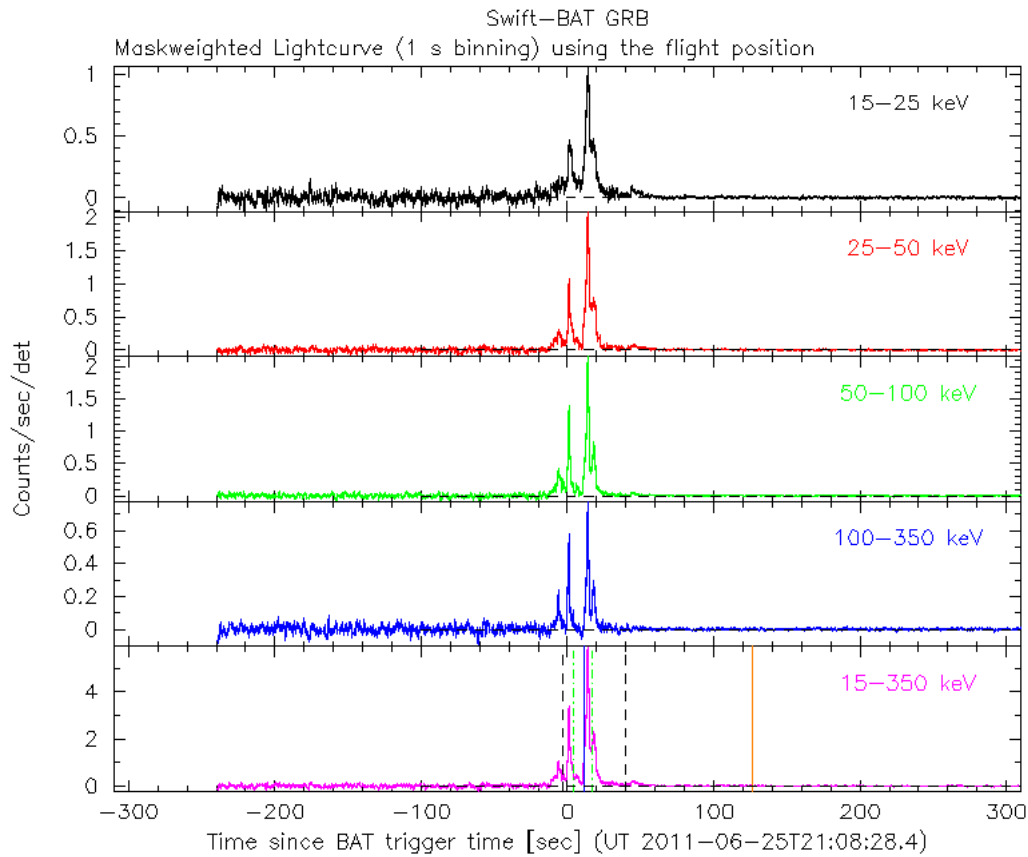Table 1: Magnitude limits from UVOT observations

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts s^{-1} (illuminated-detector)$^{-1}$ (note illum-det $= 0.16$ cm^2) and T_0 is 21:08:28.4 UT.
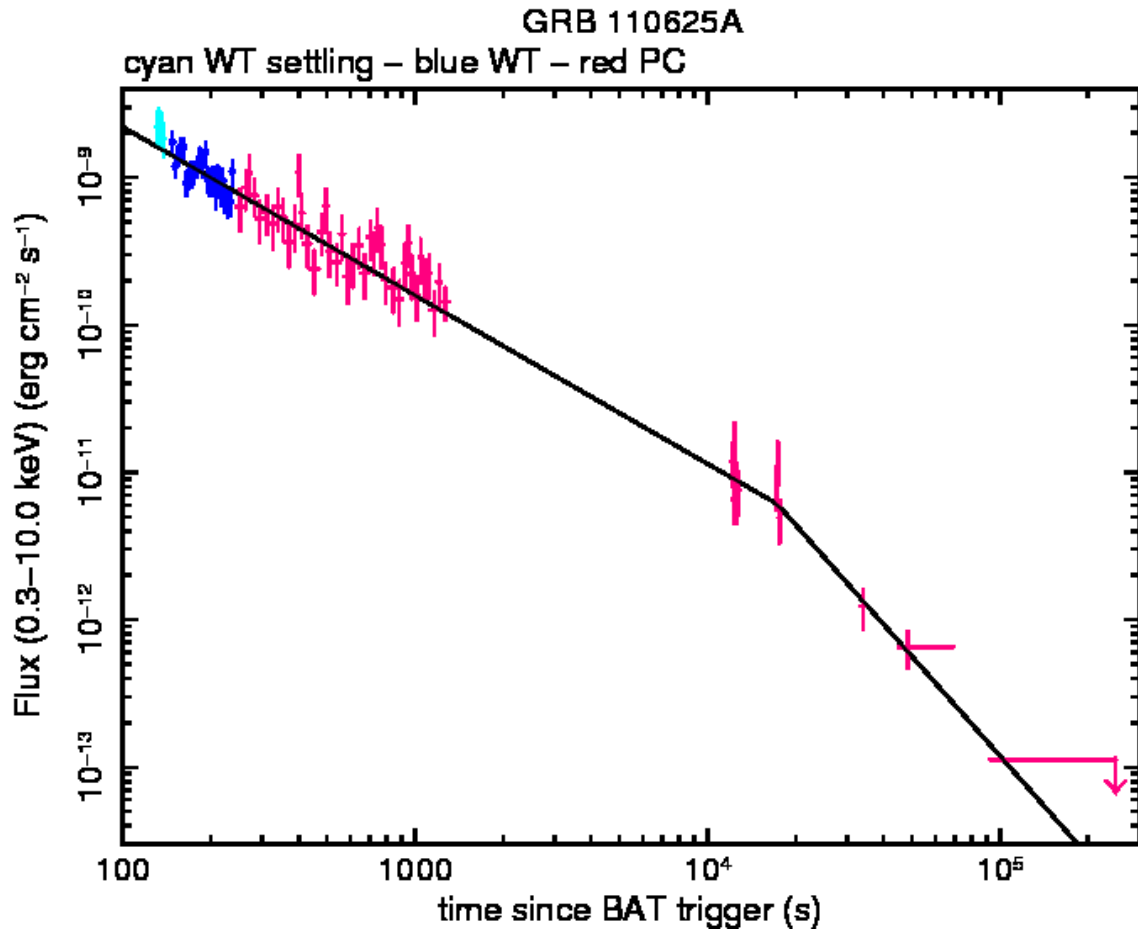
Figure 2: XRT Lightcurve. Count rate light-curve in the 0.3-10 keV band: Window Timing mode (cyan: settling; blue: pointing) and Photon Counting mode (red). The approximate conversion is 1 count $s^{-1} = 1.1 \times 10^{-10}$ erg^{-2} s^{-1}.