Swift Observations of GRB 130625A

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1 Introduction

At 07:00:39 UT on 2013-06-25, the Swift Burst Alert Telescope (BAT) triggered and located GRB 130625A (trigger=558982). Swift slewed immediately to the burst and found an uncatalogued X-ray source (Grupe et al., *GCN Circ.* 14923).

The best *Swift* position of this burst is the Swift XRT position given in Goad et al. (*GCN Circ.* 14924) with RA-2000 = 22h 53m 06.69s, and Dec-2000 = $+82° 10' 27.8''$ with an uncertainty of $2.2''$.

There are only two ground-based optical follow-up observations reported on this burst: 1) the Mt. Nanshan, Xinjiang Observatory in China (Xu et al., *GCN Circ.* 14927) and 2) the Master II robotic telescope (Yurkov et al., *GCN Circ.* 14929). None of these reported a detection of an optical afterglow.

2 BAT Observation and Analysis

At 07:00:39 UT on 2013-06-25, the Swift Burst Alert Telescope (BAT) triggered and located GRB 130625A (trigger=588982, Grupe et al., *GCN Circ.* 14923). Using the data set from T-60 to T+243 s, the BAT ground-calculated position is RA, Dec = 343.336, +82.171 deg which is

RA(J2000) = 22h 53m 20.6s

Dec(J2000) = $+82° 10' 17.1''$

with an uncertainty of 1.3 arcmin, (radius, sys+stat, 90% containment). The partial coding was 75% (Palmer et al. *GCN Circ.* 14925).

The mask-weighted light curve (Figure 1) shows two overlapping peaks starting at T-25 s, peaking at T+3s and ending at T+60s. The T_{90} (15-350 keV) is 38.1±4.9 s (estimated error including systematics).

The time-averaged spectrum from T-28.17 to T+18.50 s is best fit by a single power law. This fit gives a photon index of 1.37±0.09 ($\chi^2 = 47.4$ for 57 d.o.f.). For this model the total fluence in the 15-150 keV band is $1.8 \pm 0.1 \times 10^{-6}$ erg cm^{-2}. The 1s peak flux measured from T+2.54 s in the 15-150 keV band is 1.2 ±0.2 photons 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/588982/BA/.

3 XRT Observations and Analysis

The XRT began observing the field of GRB 130625A at 07:02:16.7 UT on 2013-06-25, 97.2 seconds after the BAT trigger. Using 1226 s of XRT Photon Counting mode data and 1 UVOT image for GRB 130625A, Goad et al. (*GCN Circ.* 14924) found an astrometrically corrected X-ray position (using

the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 343.27789, +82.17438 which is equivalent to:

RA (J2000): 22h 53m 06.69s

Dec (J2000): $+82° 10' 27.8''$

with an uncertainty of $2.2''$ (radius, 90% confidence). The latest position can be viewed at 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 $\Gamma = 2.88^{+1.09}_{-0.80}$. The best-fitting absorption column is $4.17^{+2.92}_{-2.24} \times 10^{21}$ cm^{-2}, in excess of the Galactic value of 1.1×10^{21} cm^{-2} (Kalberla et al. 2005). Following the relation given in Grupe et al. (2007, AJ, 133, 2216) the excess column density $\Delta N_{\mathrm{H}} = 3.07 \times 10^{21}$ cm^{-2} suggests that the redshift of this burst is z<2.5. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 2.6×10^{-11} (9.3×10^{-11}) erg cm^{-2} count^{-1}. The analysis if the afterglow data in pc mode are consistent with these parameters.

The light curve of the X-ray afterglow follows the typical canonical behavior. The $0.3 - 10$ keV light curve given below (Fig.2) can be modeled by a broken power-law model described by the following parameters:

$\alpha_1 = 6.4^{+1.2}_{-4.3}$

$T_{\mathrm{break},1} = 180^{+250}_{-25}$ s

$\alpha_2 = 0.1 \pm 0.5$

$T_{\mathrm{break},2} = 4.1^{+1.9}_{-3.3}$ ks

$\alpha_3 = 2.8^{+2.0}_{-1.8}$

The results of the XRT-team automatic analysis are available at

http://www.swift.ac.uk/xrt_products/00588982.

4   UVOT analysis

The Swift/UVOT began observations of the field of GRB 130131A 102 s after the BAT trigger (Grupe et al., *GCN Circ.* 14923) with the finding chart in the white filter. Linevsky et al. (*GCN Circ.* 14928) reported that no optical/UV counterpart consistent with enhanced XRT position (Goad et al, *GCN Circ.* 14924) was found.

The 3σ upper limits for the summed images are listed in Table 1.

Filter	T_{Start}	T_{stop}	Exposure	Mag
white_FC	102	252	147	>20.96
u_FC	595	1890	283	>21.34
white	644	1940	155	>19.34
v	570	1866	136	>20.21
b	315	565	245	>20.26
u	315	2003	617	>20.81
w1	694	1989	136	>19.60
m2	844	6816	332	>20.04
w2	620	1916	155	>19.79

Table 1: 3σ upper limits from UVOT observations of GRB 130625A. The quoted values have not been corrected for the expected Galactic extinction along the line of sight of $E_{\text{B}-\text{V}} = 0.22$ mag (Schlegel et al., 1998). All photometry uses the UVOT photometric system as described in Poole et al. (2008, MNRAS, 383, 627) and Breeveld et al. (2011, AIP Conf. Proc., Vol. 1358, 373)
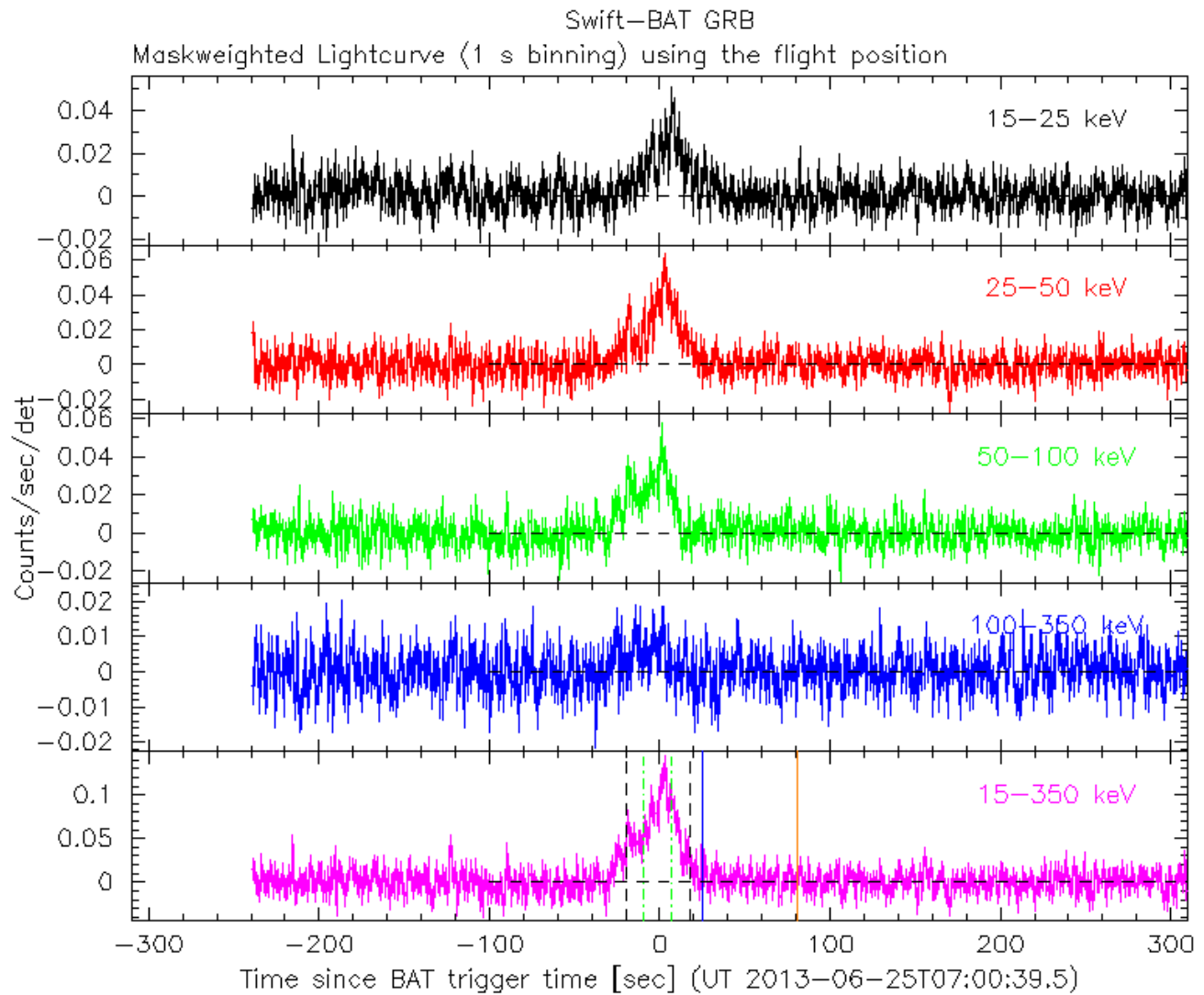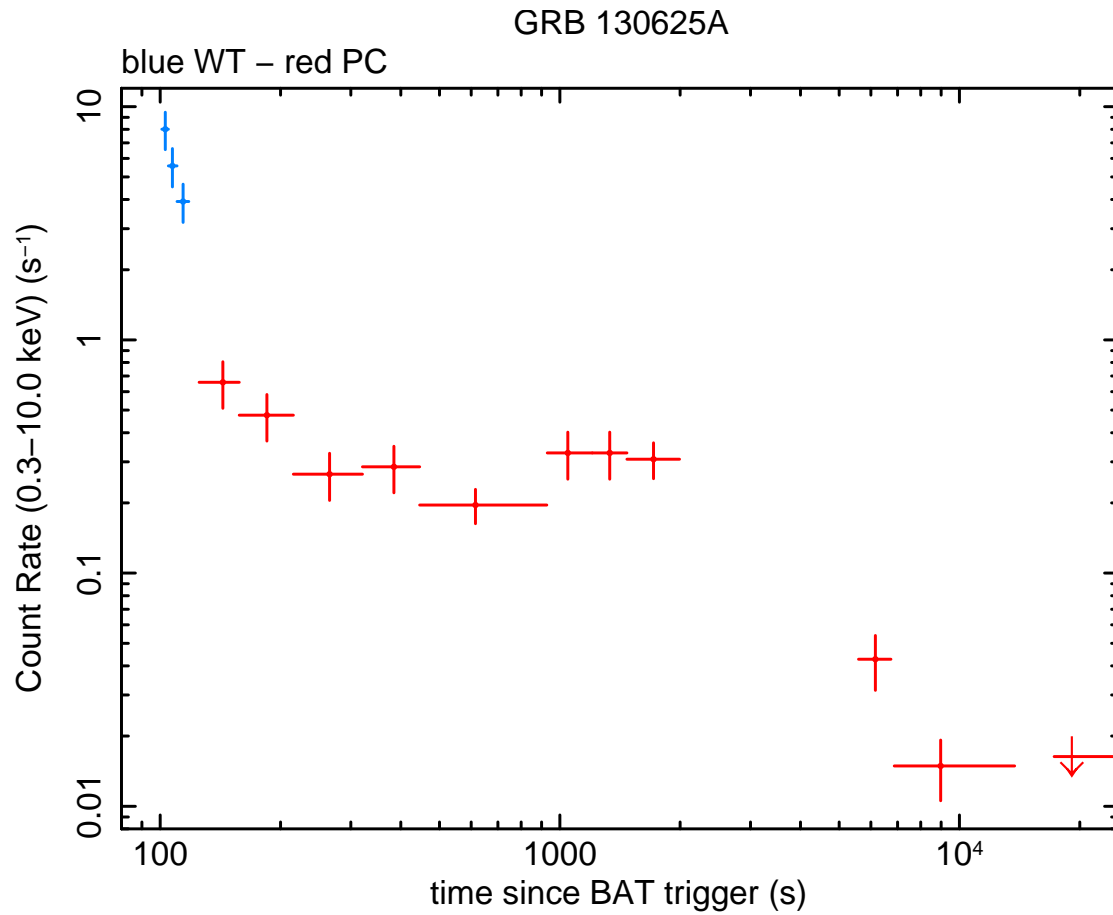
Figure 1: BAT Light curve of GRB 130625A.

Figure 2: XRT count rate light curve of GRB 130625A in the 0.3-10 keV band. The approximate conversion for the observed flux is 1 count s^{-1} = ~ 2.7 × 10^{-11}erg s^{-1} cm^{-2}.