Swift Observations of GRB 121125A

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1 Introduction

At 08:32:27 UT on 2012-11-25, the Swift Burst Alert Telescope (BAT) triggered and located GRB 121125A (trigger=539563). 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.* 13993). The burst was also detected by the Fermi GBM, with which an E_{peak} of 196 $\pm$ 26 keV was measured (McGlynn et al., *GCN Circ.* 13997), and INTEGRAL/SPI-ACS (V. Savchenko, priv. comm.)

The best *Swift* position ($0.5''$ uncertainty) is the UVOT position from Marshall et al. (*GCN Circ.* 14002):

RA (J2000) = 15h 14m 06.58s
Dec (J2000) = $+55^\circ$ $18'$ $48.0''$

An optical afterglow was successfully detected from the ground by the 1m telescope at Mt. Lemmon observatory in Arizona at R=19.29$\pm$0.14 mag about 4 hours after the trigger (Im et al., *GCN Circ.* 13995)

2 BAT Observation and Analysis

At 08:32:27 UT on 2012-11-25, the Swift Burst Alert Telescope (BAT) triggered and located GRB 121125A (trigger=539563; Barlow et al., *GCN Circ.* 13993). Using the data set from T$-$60 s to T+243 s, the BAT ground-calculated position is RA, Dec = 228.519, 55.318 deg, which is

RA(J2000) = 15h 14m 04.6s
Dec(J2000) = $+55^\circ$ $19'$ $03.5''$

with an uncertainty of 1.2 arcmin (radius, sys+stat, 90% containment). The partial coding was 80% (Barthelmy et al. *GCN Circ.* 13996).

The mask-weighted light curve shows two clusters of overlapping peaks that start at T$-$7 s, peaks at T+37 s, and ending at T+100 s. T_{90} (15-350 keV) is 52.2 $\pm$ 4.6 s (estimated error including systematics).

The time-averaged spectrum from T$-$6.31 s to T+77.64 s is best fit by a simple power-law model. This fit gives a photon index 1.52 $\pm$ 0.06,

For this model the total fluence in the 15-150 keV band is (4.7 $\pm$ 0.1) $\times$ 10^{-6} erg cm^{-2} and the 1-s peak flux measured from T+36.56 s in the 15-150 keV band is 4.1 $\pm$ 0.2 ph cm^{-2} s^{-1}. A fit to a simple power law gives a photon index of 2.9 $\pm$ 0.2. 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/539563/BA/

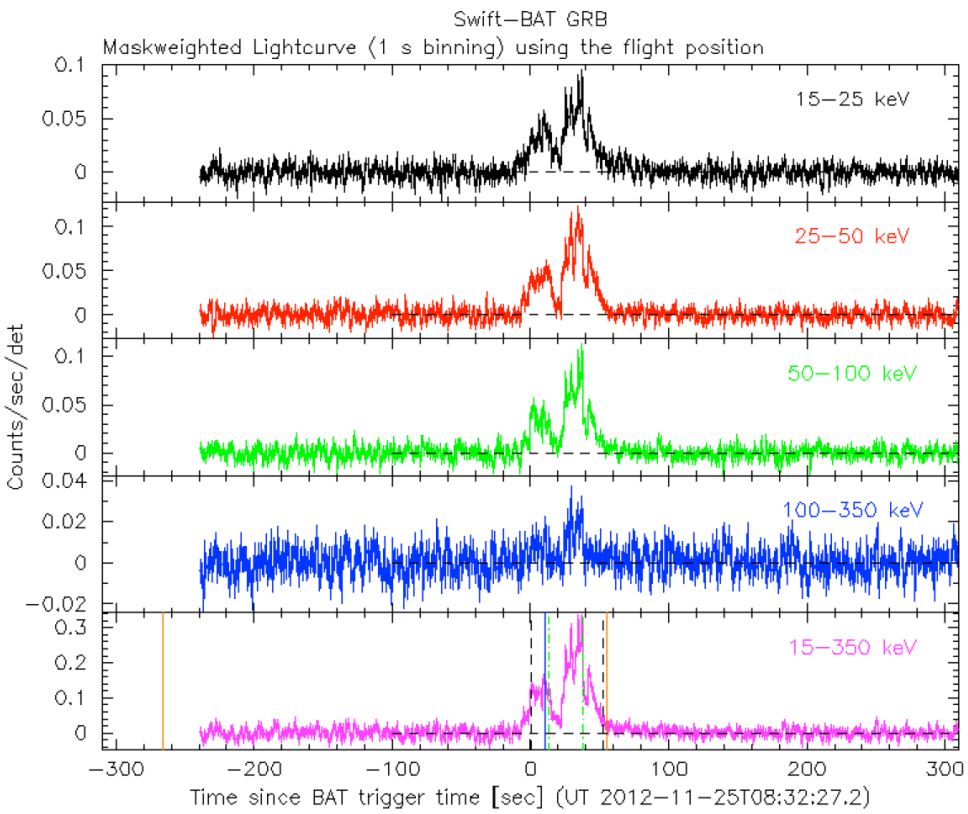

Figure 1: The mask–weighted BAT light curve of GRB 121125A in the 4 individual plus total energy bands.

3 XRT Observations and Analysis

The XRT began observing the field of GRB 121125A at 08:33:34.1 UT, 66.8 seconds after the BAT trigger. Using 4397 s of XRT Photon Counting mode data and 10 UVOT images for GRB 121125A, Goad et al. (*GCN Circ.* 13998) 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 = 228.52806, +55.31335 which is equivalent to:

RA (J2000): 15h 14m 6.73s
Dec (J2000): +55° 18′ 48.1″

with an uncertainty of 1.5 arcsec (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 $\Gamma = 2.02^{+0.10}_{-0.09}$. The best-fitting absorption column is $1.49^{+0.23}_{-0.22} \times 10^{21}$ cm^{-2}, in excess of the Galactic value of 1.3×10^{20} cm^{-2} (Kalberla et al. 2005). The PC mode spectrum has a photon

index of $\Gamma = 2.14 \pm 0.13$ and a best–fitting absorption column density of $N_{\rm H} = 1.02^{+0.28}_{-0.26} \times 10^{21}$ cm^{-2}. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 3.4×10^{-11} (4.6×10^{-11}) erg cm^{-2} 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 $\alpha = 2.69^{+0.15}_{-0.12}$ with a break at T+195.4 s followed by a flattening of the decay slope to α of 0.2 ± 0.5. The light curve breaks again near T+1200 s and continues with a normal decay slope of $\alpha = 1.28 \pm 0.08$.

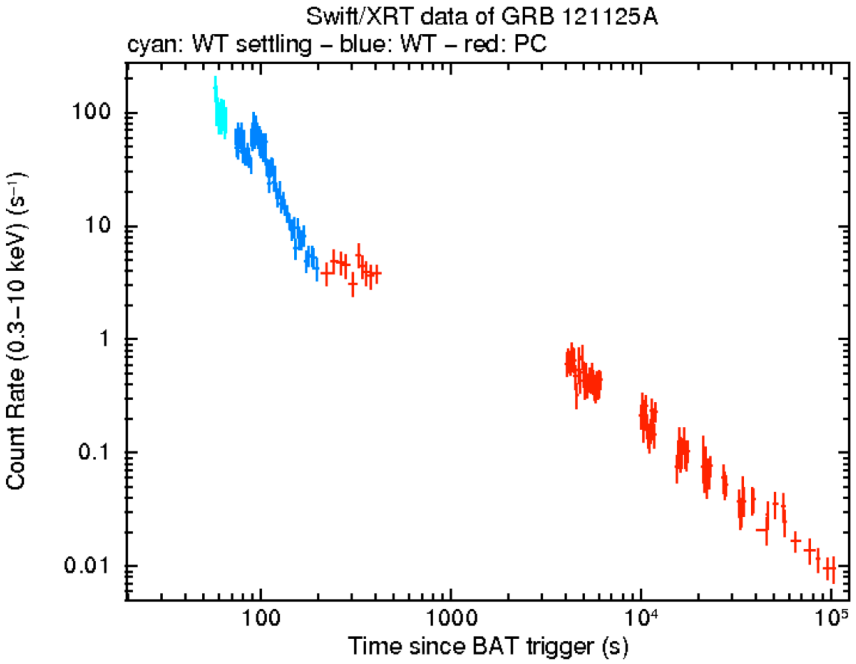

Figure 2: XRT flux light curve of GRB 121125A in the 0.3-10 keV band. The approximate conversion is 1 count s^{-1} = $\sim 3.4 \times 10^{-11}$ergs s^{-1} cm^{-2}.

The XRT–team analysis results are available at http://www.swift.ac.uk/xrt_products/00539563.

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 121125A 75 s after the BAT trigger (Barlow et al., *GCN Circ.* 13993) with the white–filter finding chart. A source consistent with the XRT position (Evans et al., *GCN Circ.* 13998) was detected in the initial UVOT exposures at the position:

RA (J2000) = 15:14:06.58 = 228.52740 (deg.)
Dec (J2000) = +55:18:48.0 = 55.31332 (deg.)

with an estimated uncertainty of 0.50 arcsec. (radius, 90% confidence).

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

Filter	$T_{\rm Start}$ [s]	$T_{\rm stop}$ [s]	Exposure [s]	Mag
white	75	225	147	16.35 ± 0.03
v	4693	4892	197	19.11 ± 0.19
b	4076	4276	197	19.31 ± 0.13
u	288	423	134	16.21 ± 0.04
w1	5103	5302	197	20.06 ± 0.32
m2	4897	11750	1082	>21.9
w2	4488	6123	393	>21.6

Table 1: 3σ upper limits from UVOT observations of GRB 121125A. The quoted values have not been corrected for the expected Galactic extinction along the line of sight of $E_{\rm B-V} = 0.01$ mag (Schlegel et al. 1998). 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)