Swift Observations of GRB 121123A

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1 Introduction

At 10:02:41 UT on 2012-11-23, the Swift Burst Alert Telescope (BAT) triggered and located GRB 121123A (trigger=539358). Swift slewed immediately to the burst and found an X-ray counterpart in the XRT (Helder et al., *GCN Circ.* 13982).

The best *Swift* position of this burst is the UVOT position given in Holland et al. (*GCN Circ.* 14003) with RA-2000 = 20h 29m 16.30s, and Dec-2000 = -11° $51^{'}$ $35.6^{''}$ with an uncertainty of $0.44^{''}$.

The burst was also detected by Fermi-GBM (Foley et al. *GCN Circ.* 13985) as well as by Suzaku WAM (Yasuda et al *GCN Circ.* 14006).

GMG (Zhao et al., *GCN Circ. 13983*), MASTER-NET (Yurkov et al., *GCN Circ. 13984*), NOT (Xu et al., *GCN Circ. 13986*), BOOTES-4 & IAC80 (Guziy et al., *GCN Circ. 13987*), VT-50 & GAG-250 (Volnova et al., *GCN Circ. 13988*) and GROND (Schmidl et al., *GCN Circ. 13992*) have done ground-based follow-up observations. They confirmed the optical counterpart of a magnitude of ~ 19 as found by UVOT, and indicate a shallow decay of the optical light curve (Xu et al., *GCN Circ. 13986* and Guziy et al., *GCN Circ. 13987*).

2 BAT Observation and Analysis

At 10:02:41 UT on 2012-11-23, the Swift Burst Alert Telescope (BAT) triggered and located GRB 121123A (trigger=539358, Helder et al., *GCN Circ.* 13982). Using the data set from T-239 to T+ 963 s, the BAT ground-calculated position is RA, Dec = 307.334, -11.873 deg which is

RA(J2000) = 20h 29m 20.2s

Dec(J2000) = -11° $52^{'}$ $24.3^{''}$

with an uncertainty of 1.8 arcmin, (radius, sys+stat, 90% containment). The partial coding was 82% (Barthelmy et al. *GCN Circ.* 13990).

The mask-weighted light curve (Figure 1) shows the burst starting off at a weak level at $\sim$ T - 90 s, with the triggering peak at $\sim$ T+10 s, then a level period until $\sim$ T+200 s with the onset of a large FRED peak extending out to $\sim$ T+700 s. T_{90} (15-350 keV) is 317$\pm$14 s (estimated error including systematics).

The time-averaged spectrum from T-6.34 to T+419.00 s is best fit by a power-law model with an exponential cutoff. This fit gives a photon index 0.96 ± 0.20, and Epeak of 65.0 ± 5.1 keV (chi squared 45.4 for 56 d.o.f.). For this model the total fluence in the 15-150 keV band is $1.5 \pm 0.1 \times 10^{-5}$ ergs cm^{-2}. The 1s peak photon flux measured from T+232.56 s in the 15-150 keV band is 2.6$\pm$0.2 photons s^{-1} cm^{-2}. A fit to a simple power law gives a photon index of 1.78 ± 0.04 (chi squared 101.58 for 57

d.o.f.). 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/539358/BA/.

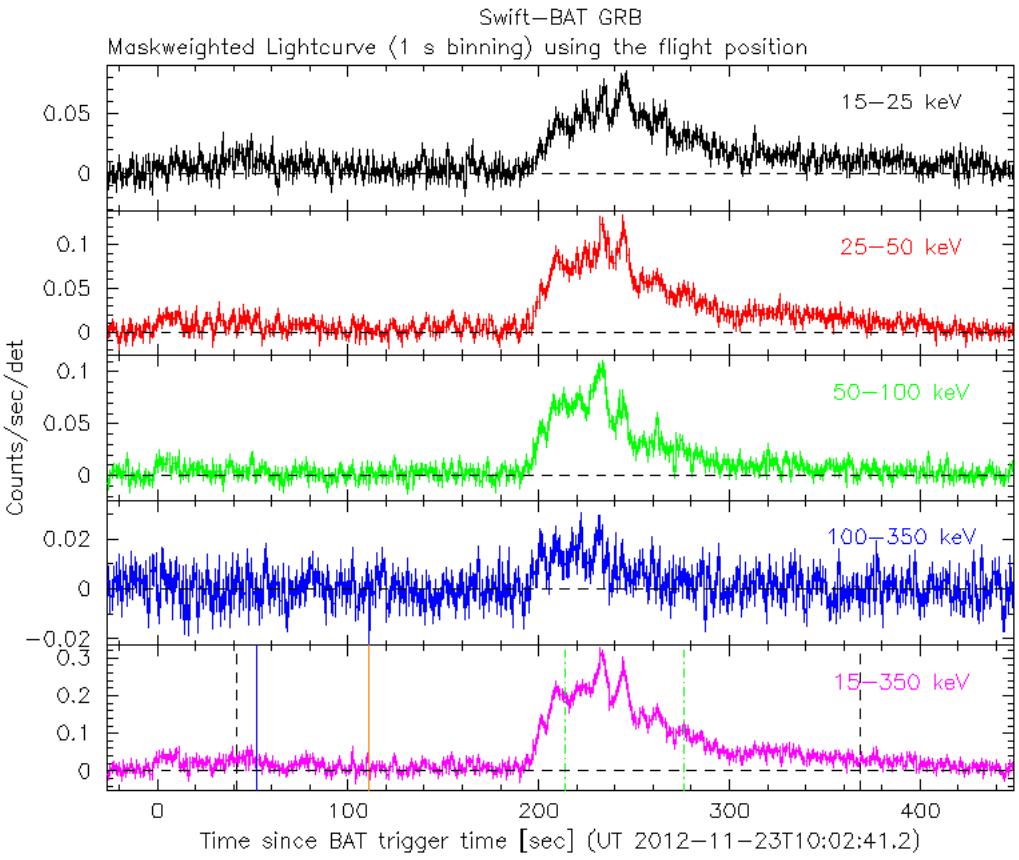

Figure 1: BAT Light curve of GRB 121123A.

3 XRT Observations and Analysis

The XRT began observing the field of GRB 121123A at 10:04:44.3 UT, 123.0 seconds after the BAT trigger. Using 12254 s of XRT Photon Counting mode data and 15 UVOT images for GRB 121123A, Evans et al. (*GCN Circ.* 13991) found an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 307.31813, -11.86023 which is equivalent to:

RA (J2000): 20h 29m 16.35s

Dec (J2000): $-11^\circ\ 51'\ 36.8''$

with an uncertainty of $1.4''$ (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 $\Gamma = 1.44 \pm 0.02$. The best-fitting absorption column is $8.9 \pm 0.6 \times 10^{20}$ cm^{-2}, in excess of the Galactic value of 4.0×10^{20} cm^{-2} (Kalberla et al. 2005). The PC mode spectrum has a photon index of $\Gamma = 1.97 \pm 0.11$ and a best-fitting absorption column density of $N_{\rm H} = 5.8^{+2.3}_{-1.8}$ cm^{-2}. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is $3.6{\times}10^{-11}$ ($4.2{\times}10^{-11}$) 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 plateau phase starts at T+$2.1^{+0.9}_{-0.4} \times 10^3$ s and has a slope of $\alpha = 0.37^{+0.12}_{-0.14}$. The light curve breaks at T+$1.66^{+0.27}_{-0.18} \times 10^4$ s and continues with a decay slope of $\alpha = 1.36^{+0.10}_{-0.09}$.

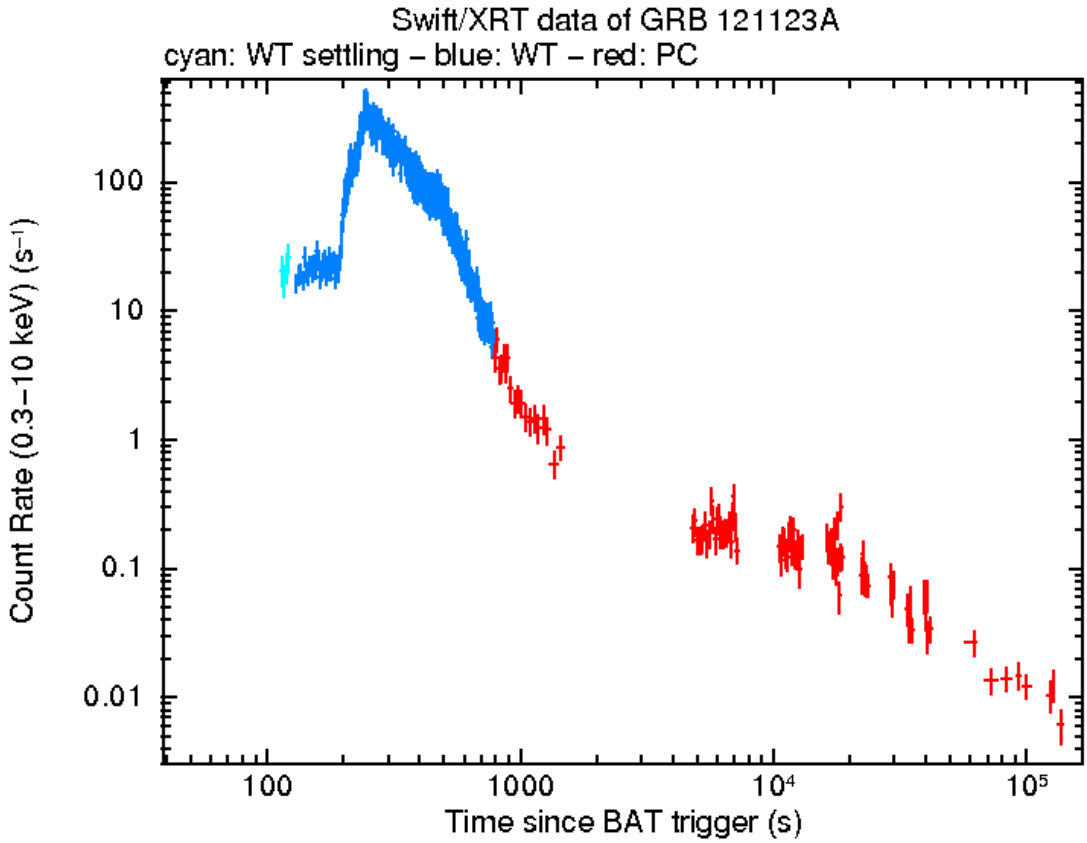

Figure 2: XRT flux light curve of GRB 121123A in the 0.3-10 keV band. The approximate conversion is 1 count s^{-1} = $\sim 3.6 \times 10^{-11}$ergs s^{-1} cm^{-2}.

The results of the XRT-team automatic analysis are available at http://www.swift.ac.uk/xrt_products/00539358.

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 121123A 131 s after the BAT trigger. The refined UVOT position is reported in Holland et al., *GCN Circ.* 13982:

RA (J2000): 20h 29m 16.30s = 307.31792 (deg.)

Dec (J2000): $-11^\circ\ 51'\ 35.6''$ = -11.85989 (deg.)

with an estimated uncertainty of 0.44 arcsec (radius, 90% confidence, statistical + systematic).

Swift observed a slow decay of the optical afterglow, consistent with that reported by Xu et al., (2012, *GCN Circ* 13986). The afterglow is weakly detected in white at approximately 40 ks after the BAT trigger. However, the UVOT photometry is affected by a bright (B $\sim$ 14 mag) star (USNO B1.0 0781-0714667) located approximately 22 arcsec north of the afterglow, so the late-time behavior of the optical afterglow's light curve requires further analysis. Preliminary UVOT photometry, and 3-σ upper limits, for the afterglow are presented in Table 1 and the light curve is shown in Figure 3.

Filter	$T_{\rm Start}$	$T_{\rm stop}$	Exposure	Mag
white (finding)	131	281	147	19.43 ± 0.15
u (finding)	289	539	246	19.35 ± 0.23
white (finding)	869	1019	147	19.13 ± 0.12
v	619	1070	58	18.29 ± 0.33
b	546	1169	58	19.12 ± 0.29
u	695	1145	39	18.58 ± 0.32
w1	669	18,011	2137	>21.5
m2	645	17,104	1376	>21.3
w2	595	22,980	1376	>21.5
white	570	590	19	>19.7

Table 1: The quoted values have not been corrected for the expected Galactic extinction along the line of sight of $E_{\rm B-V} = 0.05$ mag (Schlafly et al., 2011, ApJS, 737, 103). 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).

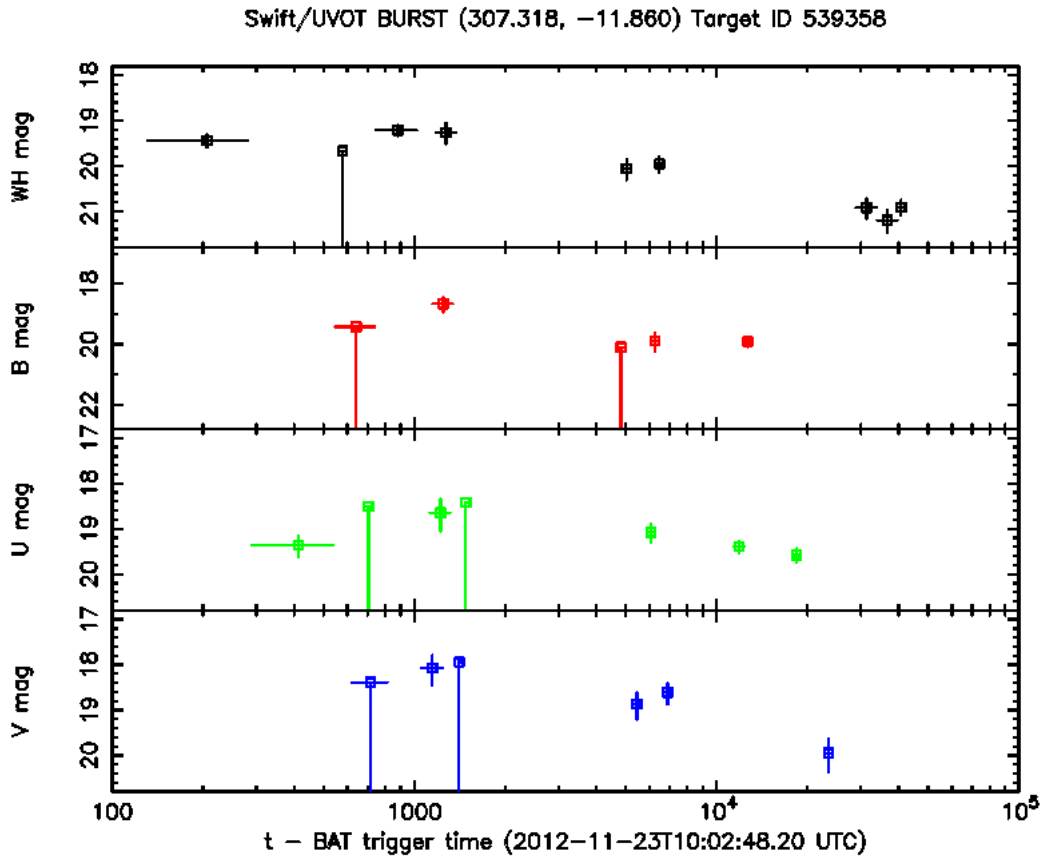

Figure 3: UVOT Light curve of GRB 121123A.