Swift Observations of GRB 121017A

D. Grupe (PSU), T. N. Ukwatta (MSU), A. Breeveld (MSSL-UCL), S. D. Barthelmy
(NASA/GSFC), J.A. Kennea (PSU), D.N. Burrows (PSU), M.H. Siegel (PSU), and N. Gehrels
(NASA/GSFC) for the Swift Team

1   Introduction

At 19:23:28 UT on 2012-10-17, the Swift Burst Alert Telescope (BAT) triggered and located GRB 121017A (trigger=536172). Swift slewed immediately to the burst. XRT and UVOT detections, however, were delayed due to entry into the SAA shortly after the initial trigger (Grupe et al., *GCN Circ.* 13875)

The best *Swift* position of this burst is the XRT position given in Goad et al. (*GCN Circ.* 13879) with RA-2000 = 19h 15m 19.26s, and Dec-2000 = $-01° 36' 15.0''$ with an uncertainty of $2.0''$.

Four ground-based observatories (BOOTES-2, SAI-MSU, 1.23m Calar Alto, and GROND; Jelinek et al. *GCN Circ.* 13876, Volnova & Moskvitin *GCN Circ.* 13877, Gorosabel & Mottola *GCN Circ.* 13878, and Kann, Nardini & Greiner *GCN Circ.* 13881, respectively) observed the field of GRB 121017A within 4 hours but none found an optical counter part and only upper limits were reported.

2   BAT Observation and Analysis

At 19:23:28 UT on 2012-10-17, the Swift Burst Alert Telescope (BAT) triggered and located GRB 121017A (trigger=536172, Grupe et al., *GCN Circ.* 13875). Using the data set from T-61 to T+242 s, the BAT ground-calculated position is RA, Dec = 288.820, –1.602 deg which is

RA(J2000) = 19h 15m 16.8s

Dec(J2000) = $-01° 36' 07.3''$

with an uncertainty of 1.5 arcmin, (radius, sys+stat, 90% containment). The partial coding was 35% (Ukwatta et al. *GCN Circ.* 11902).

The mask-weighted light curve (Figure 1) shows a single peak starting at T-3 s, peaking at T+1s, and ending at T+5s. The T_{90} (15-350 keV) is 4.2±0.5 s (estimated error including systematics).

The time-averaged spectrum from T-2.72 to T+2.53 s is best fit by a single power law. This fit gives a photon index of 1.74±0.17 ($\chi^2 = 34.0$ for 57 d.o.f.). For this model the total fluence in the 15-150 keV band is 6.6 ±0.7 × 10^{-7} erg cm^{-2}. The 1s peak flux measured from T-0.31 s in the 15-150 keV band is 3.3 ±0.4 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/536172/BA/

3   XRT Observations and Analysis

The XRT began observing the field of GRB 121017A at 19:25:03.3 UT on 2012-1017, 95.2 seconds after the BAT trigger. However, because *Swift* entered the SAA shortly after the trigger, no XRT data

were taken initially. After exiting the SAA, XRT started taking data 1.1 ks after the trigger. Using 388 s of XRT Photon Counting mode data and 1 UVOT image for GRB 121017A, Goad et al. (*GCN Circ.* 13879) found an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 288.83026, –1.60418 which is equivalent to:

RA (J2000): 19h 15m 19.26s

Dec (J2000): $-01° 36' 15.0''$

with an uncertainty of $2.0''$ (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 PC mode data can be fitted with an absorbed power-law with a photon spectral index of $\Gamma = 2.10^{+0.28}_{-0.27}$. The best-fitting absorption column is $6.00^{+1.7}_{-1.4} \times 10^{21}$ cm^{-2}, in excess of the Galactic value of 2.2×10^{21} cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 4.6×10^{-11} (9.1×10^{-11}) erg cm^{-2} count^{-1}.

Due to the late start of the XRT observation, we have only information of the X-ray afterglow behavior after 1.1 ks after the trigger. Therefore we missed the start of the plateau phase. A fit to the XRT $0.3 - 10\ keV$ light curve given below (Fig.2) can be modeled by a broken power-law model, with a decay slope during the plateau phase of $\alpha_2 = -0.1 \pm 1.0$, a break after the plateau phase at $T_{\text{break},2} = 2.0^{+4.0}_{-0.5}$ ks, and the decay slope during the normal decay phase $\alpha_3 = 1.1 \pm 0.09$.

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

http://www.swift.ac.uk/xrt_products/00536172.

4   UVOT analysis

The Swift/UVOT began observations of the field of GRB 121017A 1141 s after the BAT trigger (Grupe et al., GCN Circ. 13875) with the finding chart in the white filter. Breeveld & Grupe (*GCN Circ.* 13883) reported that no optical counter part was found at the XRT position (Goad et al, *GCN Circ.* 13879).

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

Filter	T_{Start}	T_{stop}	Exposure	Mag
white_FC	1142	1291	147	>21.1
white	1142	1442	167	>21.2
v	1298	1492	39	>18.5
b	1397	1417	19	>19.1
u	1347	1392	19	>18.5
w1	1347	1367	19	>18.1
w2	1448	1468	19	>18.1

Table 1: 3σ upper limits from UVOT observations of GRB 121017A. The quoted values have not been corrected for the expected Galactic extinction along the line of sight of $E_{\text{B}-\text{V}} = 0.44$ 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)
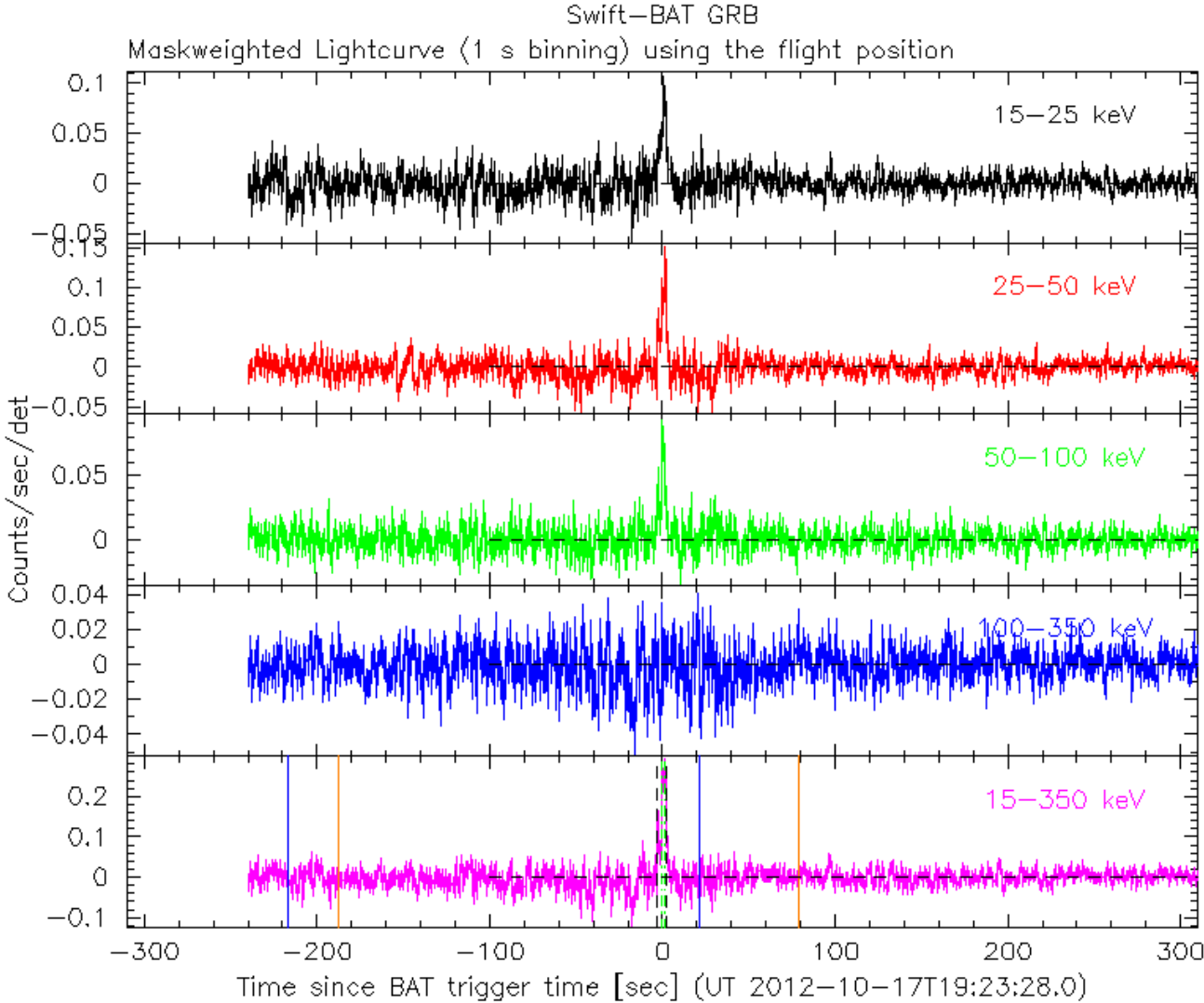
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Figure 1: BAT Light curve of GRB 121017A.
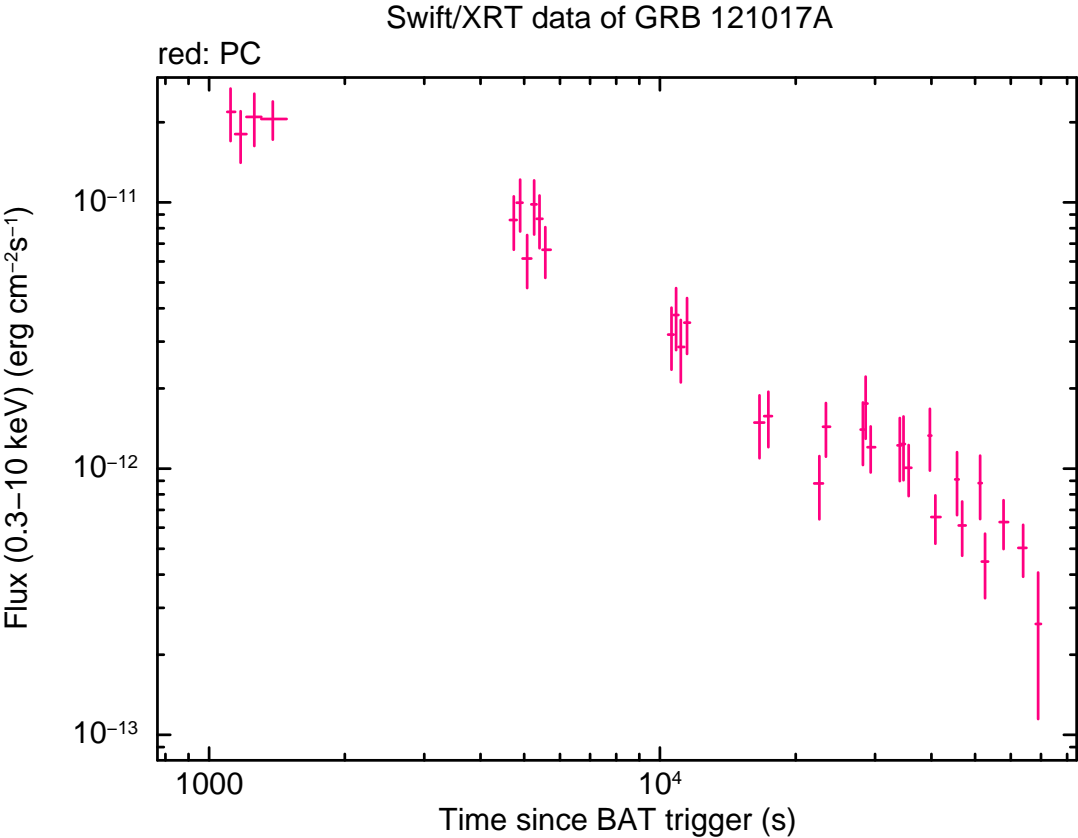
Figure 2: XRT flux light curve of GRB 121017A in the 0.3-10 keV band. The approximate conversion is 1 count s^{-1} = $\sim 4.6 \times 10^{-11}$erg s^{-1} cm^{-2}.