Swift Observations of GRB 111117A

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1 Introduction

BAT triggered on GRB 111117A at 12:13:41 UT, (trigger 507901, Mangano *et al.*, *GCN Circ.* 12559). This was a rate-trigger on a short burst with $T_{90} = 0.47 \pm 0.09$ s. Swift slewed immediately to the burst and found an X-ray counterpart to the burst in XRT. XRT began follow up observations at $T + 80$ s, and UVOT observations began at $T + 137$ s.

Our best available XRT position (using the promptly downlinked event data, the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is:
RA($J2000$) = 12.6926 *deg* (00^h 50^m 46.22^s) Dec($J2000$) = +23.0109 *deg* ($+23^d$ $00'$ $39.22"$) with an uncertainty of 2.1 arcsec (radius, 90% confidence, Mangano *et al.*, *GCN Circ.* 12559).

GRB 111117A has also been detected by the Fermi Gamma-Ray Burst Monitor at 12:13:42.03 UT on 17 November 2011 (Foley *et al.*, *GCN Circ.* 12573).

The field of GRB 111117A has been observed by some ground based optical telescopes: the 2.4m Gao-Mei-Gu telescope (GMG) equipped with YFOSC, 1.960 hrs after the burst (Zhao *et al.*, *GCN Circ.* 12560, Xu *et al.*, *GCN Circ.* 12625); the Nordic Optical Telescope (NOT) with ALFOSC, starting on 2011 November 20:49:50 UT (Andersen *et al.*, *GCN Circ.* 12563) and later on (Leloudas *et al.*, *GCN Circ.* 12572); the Magellan/Baade 6.5-m telescope with IMACS, starting on 2011 November 18.07 UT (13.5 hrs post-burst) (Fong *et al.*, *GCN Circ.* 12566); the Gemini-South telescope equipped with the GMOS instrument, on November 18.07 UT (Cucchiara *et al.*, *GCN Circ.* 12567) and ∼2.5 days after the Swift trigger (Cenko *et al.*, *GCN Circ.* 12577); the 3.6m TNG equipped with the Dolores camera, starting on Nov 17.801 UT (Melandri *et al.*, *GCN Circ.* 12570); the AZT-11 telescope of CrAO in R filter, starting ∼4 h after burst trigger (Rumyantsev *et al.*, *GCN Circ.* 12576). The best position of the optical counterpart is given in Fong *et al.*, *GCN Circ.* 12566.

The field of GRB 111117A has been observed in the Optical/NIR with GROND (Schmidl *et al.*, *GCN Circ.* 12568) and the afterglow have been detected in some filters.

Radio observations of the field of GRB 111117A have been performed with the EVLA beginning 2011 November 18.0 UT (11.8 hours post-burst) at a mean frequency of 5.8 GHz (Fong *et al.*, *GCN Circ.* 12571).

A 20 ks Chandra ToO observation has been approved for GRB 111117A (Sakamoto *et al.*, *GCN Circ.* 12562) and performed on 2011 Nov 20. Improved sub-arcsecond X-ray position from preliminary analysis of the Chandra data is given in Berger *et al.*, *GCN Circ.* 12588.

2 BAT Observation and Analysis

Using the data set from T−240 to T+963 s from telemetry downlinks, the refined analysis of BAT GRB 111117A was performed by the Swift team and reported in Sakamoto *et al.*, *GCN Circ.* 12561.

The BAT ground-calculated position is RA($J2000$) = 12.702 *deg* (00^h 50^m 49.9^s) Dec($J2000$) = +23.021 *deg* ($+23^d$ 00^m 11.0^s) with an uncertainty of 1.7 arcmin, (radius, sys+stat, 90% containment). The partial coding was 100%.

The mask-weighted light curve (Fig.1) shows two peaks, the first starts at ∼T+0.00, peaks at ∼T+0.15 and ends at ∼T+0.30 s. The second starts at ∼T+0.35, peaks at ∼T+0.50, and ends at ∼T+0.60 s.

T_{90} (15−350 keV) is 0.47±0.09 s (estimated error including systematics). The spectral lag is 0.6±2.4 ms using the 100−350 and 25−50 keV bands with 4-ms binning of the raw lightcurves. This clearly indicates a short burst.

The time-averaged spectrum from T−0.016 to T+0.520 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 0.65 ± 0.22. The total fluence in the 15−150 keV band is $(1.40\pm0.18)\times10^{-7}$ erg cm^{-2}. The 1−sec peak photon flux measured from T+115.23 s in the 15−150 keV band is 1.35 ± 0.20 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/507901/BA/

3 XRT Observations and Analysis

The whole Swift-XRT dataset for GRB 111117A (trigger 507901, Mangano *et al.*, *GCN Circ.* 12559), consists of 29.3 ks of data from 80 s to 203.4 ks after the BAT trigger. The data comprise 7 s in Windowed Timing (WT) mode (from T+80 to T+87 s) with the remainder in Photon Counting (PC) mode (from T+89.6 s). The best available XRT position (using the promptly downlinked event data, the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is RA($J2000$), Dec($J2000$) = 12.6926, +23.0109 which is equivalent to RA($J2000$) = $00^h\ 50^m\ 46.22^s$ Dec($J2000$) = $+23^d\ 00'\ 39.2"$ with an uncertainty of 2.1 arcsec (radius, 90% confidence, Melandri *et al.*, *GCN Circ.* 12565).

Preliminary refined analysis has been reported in Melandri *et al.*, *GCN Circ.* 12565. The 0.3−10 keV XRT light curve (Fig.2) can be modeled with a single power-law with decay slope: $\alpha_1=1.303^{+0.1437}_{-0.121}$.

The spectrum formed from the 7 s WT mode data has very low statistics. A spectrum formed from the initial 9.0 ks of PC mode data (from T+86.9 s to T+41.06 ks) can be fitted with an absorbed power-law with a photon spectral index of $2.2^{+0.41}_{-0.37}$. The best-fitting intrinsic absorption column is $1.8^{+1.2}_{-1.0}\times10^{21}$ cm^{-2} in excess of the Galactic value of 3.7×10^{20} cm^{-2} (Kalberla *et al.*, 2005). The counts to observed (unabsorbed) 0.3−10 keV flux conversion factor deduced from this spectrum is 3.5×10^{-11} (5.8×10^{-11}) erg cm^{-2} s^{-1}.

The results of the XRT-team automatic analysis are available at
http://www.swift.ac.uk/xrt_curves/00507901.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 111117A approximately 137 s after the BAT detection (Mangano *et al.*, *GCN Circ.* 12559). No optical afterglow consistent with the Swift-XRT position (Melandri *et al.*, *GCN Circ.* 12565) or the optical position (Andersen *et al.*, *GCN Circ.* 12563, Fong *et al.*, *GCN Circ.* 12566) is detected in the initial UVOT exposures.

Preliminary 3-sigma upper limits for the first finding chart (FC) exposure and subsequent exposures are given in the following Table 1 where T_{start} and T_{stop} are the start and stop time of the observation (Oates *et al.*, *GCN Circ.* 12569).

The above magnitudes are not corrected for the Galactic extinction corresponding to a reddening of E(B-V) = 0.05 (Schlegel et al., 1998, ApJS, 500, 525). The photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).

Filter	T_{start}(s)	T_{stop}(s)	Exp(s)	Upper Limit
u (FC)	137	387	246	>20.4
v	443	1241	97	>19.3
b	392	1191	117	>20.0
u	137	1315	490	>20.7
uvw1	493	1290	97	>20.4
uvm2	468	1117	78	>19.5
uvw2	419	1217	97	>21.5

Table 1: 3-sigma upper limits from UVOT observations. (FC) stands for Finding Chart.

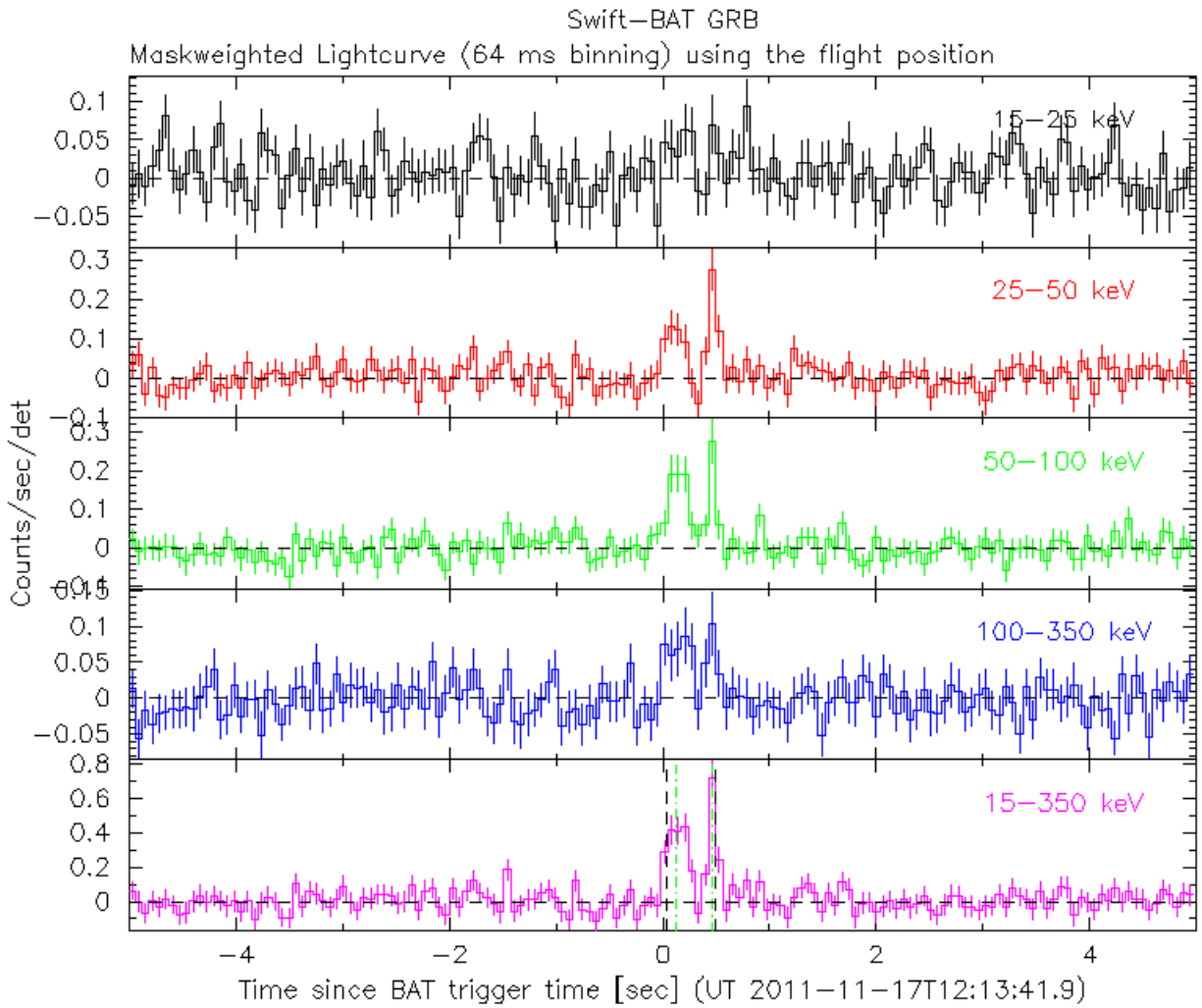

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts s^{-1} illuminated-detector^{-1} (note illum-det = 0.16 cm^2) and T_0 is 2011 Nov 17 12:13:41 UT.

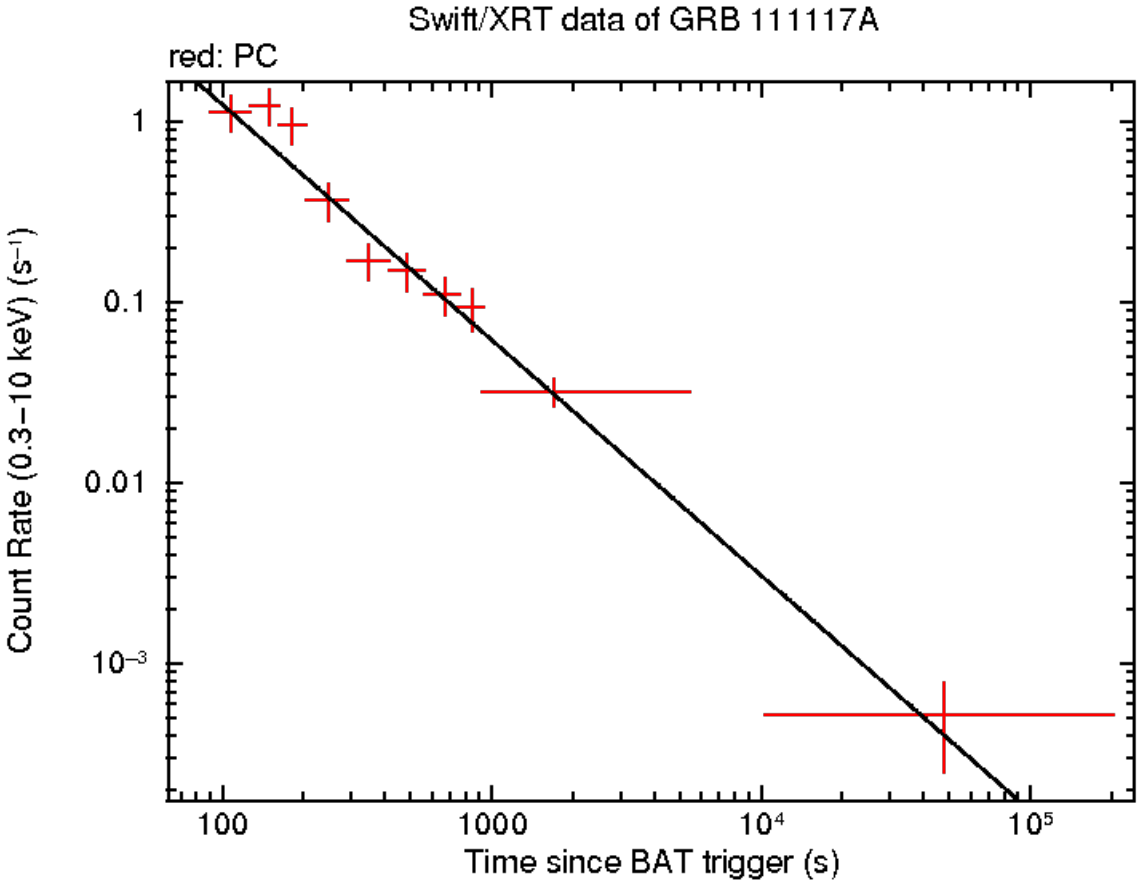

Figure 2: XRT Light curve. Counts/s in the 0.3−10 keV band: Photon Counting mode (red). The WT data (7 s exposure only) have not been included because of low statistics. The approximate conversion is 1 count/s = $\sim 5.8 \times 10^{-11}$ erg cm^{-2} s^{-1}.