

Swift Observations of GRB 111107A

M. H. Siegel (PSU), J. P. Osborne (U. Leicester), N. P. M. Kuin (MSSL-UCL), B.-B. Zhang (PSU), S.D. Barthelmy (NASA/GSFC), D.N. Burrows (PSU), and N. Gehrels (NASA/GSFC) for the Swift Team

1 Introduction

At 00:50:24 UT on 7 November 2011, the Swift Burst Alert Telescope (BAT) triggered and located GRB 111107A (trigger=507185). Swift slewed immediately to the burst and identified both X-ray and optical afterglows (Siegel et al., *GCN Circ.* 12534). Optical observations by GROND (Kruehler et al., *GCN Circ.* 12536) and Skynet (LaCluyze et al., *GCN Circ.* 12544) confirmed the optical afterglow and spectroscopic observations measured a redshift of 2.893 (Chornock et al., *GCN Circ.* 12537, D'Avanzo et al. *GCN Circ.* 12542). The burst was simultaneously detected by Fermi (Pelassa, *GCN Circ.* 12545). It was not detected in the radio (Postigo et al., *GCN Circ.* 12541, Hancock et al., *GCN Circ.* 12558, 12564).

The best *Swift* position for this burst is the initial UVOT position given in Siegel et al. (*GCN Circ.* 12534): RA, Dec (J2000) = 129.4775 (08h 37m 54.66s), -66.52009 ($-66^{\circ} 31' 12.3''$) with an uncertainty of $0.65''$.

2 BAT Observation and Analysis

At 00:50:24 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 111107A. Using the data set from T-240 to T+963 sec for further analysis¹, the BAT ground-calculated position is RA, Dec (J2000) = 129.487 (08h 37m 56.8s), -66.520 deg ($-66^{\circ} 31' 12.0''$) with an uncertainty of 1.2 arcmin, (radius, sys+stat, 90% containment). The partial coding was 71% (Barthelmy et al., *GCN Circ.* 12539).

The mask-weighted light curve (Figure 1) shows a FRED peak starting at $\sim T-1$ sec, peaking at $\sim T+2$ sec, and returning to baseline at $\sim T+55$ sec. At the 2σ level, there is a possible peak from T+130 to T+180 sec. There is no hint of a peak in the T+250 to T+400 sec range corresponding to the flare seen in the XRT afterglow lightcurve. T_{90} (15-350 keV) is 26.6 ± 6.6 sec (estimated error including systematics).

The time-averaged spectrum from T-0.06 to T+32.83 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.49 ± 0.14 . The fluence in the 15-150 keV band is $8.8 \pm 0.8 \times 10^{-7}$ erg cm^{-2} . The 1-sec peak photon flux measured from T+2.16 sec in the 15-150 keV band is 1.2 ± 0.2 $\text{cm}^{-2} \text{sec}^{-1}$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The XRT began observing the field at 00:51:28.8 UT, 64.8 seconds after the BAT trigger. Using promptly downlinked data we found a fading, uncatalogued X-ray source. Using the methods described

¹The results of the batgrbproduct analysis are available at http://gcn.gsfc.nasa.gov/notices_s/507185/BA/

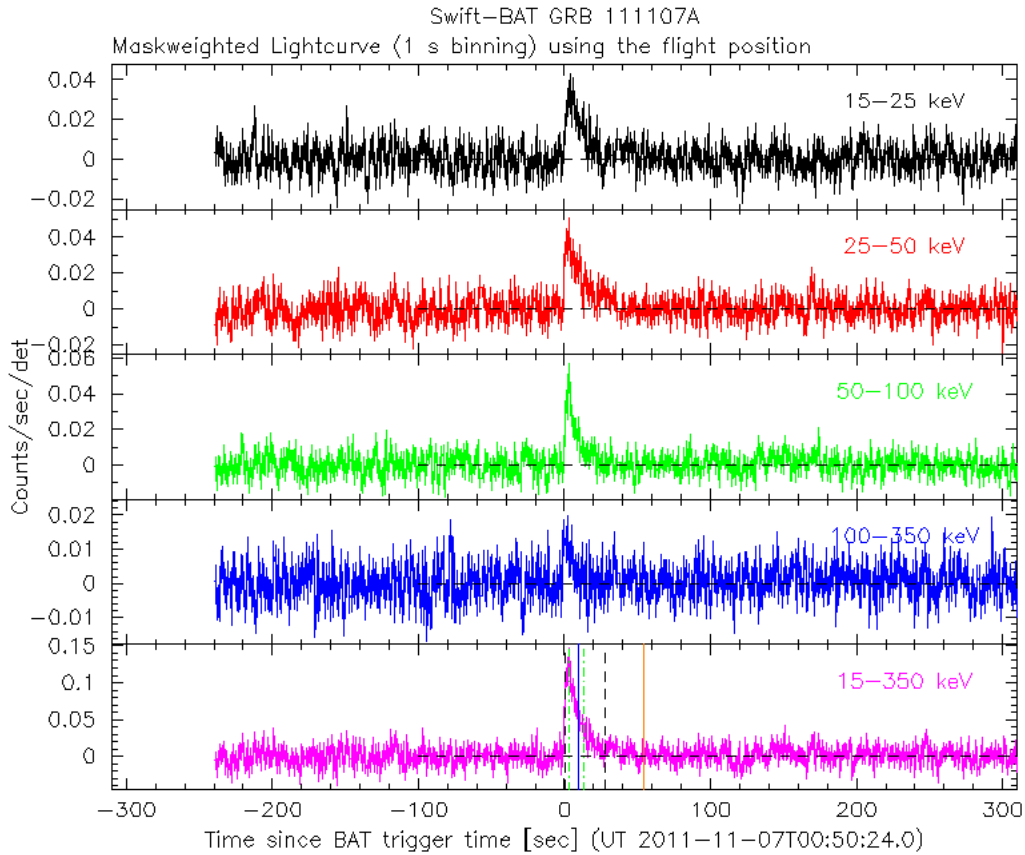


Figure 1: BAT Light curve of GRB 111107A.

by Goad et al. (2007, *A&A*, 476, 1401) and Evans et al. (2009, *MNRAS*, 397, 1177), we measure an enhanced XRT position of RA, Dec (J2000) = 129.47666 (08h 37m 54.40s), -66.51988 ($-66^{\circ} 31' 11.6''$) with an uncertainty of 1.7 arcseconds (radius, 90% containment. Osborne et al., *GCN Circ.* 12538). This location is 51 arcseconds from the BAT onboard position.

We collected 45.8 ks of XRT data from 55 s to 76.2 ks after the BAT trigger. The data comprised 42 s in Windowed Timing (WT) mode (partially taken while Swift was slewing), with the remainder in Photon Counting (PC) mode (Zhang, *GCN Circ.* 12543). The early light curve shows a rapid decay with a flare at $\sim T_0=250-400$ s. The late-time light curve (from $T_0+5.1$ ks) can be modelled with a power-law decay with a decay index of $\alpha=0.92$ (+0.15, -0.15).

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of 2.15 (+0.12, -0.16). The best-fitting absorption column is 3.5 (+6.0, -3.5) $\times 10^{21}$ cm^{-2} , in excess of the Galactic value of 8.9×10^{20} cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 3.3×10^{-11} (4.5×10^{-11}) erg cm^{-2} count^{-1} .

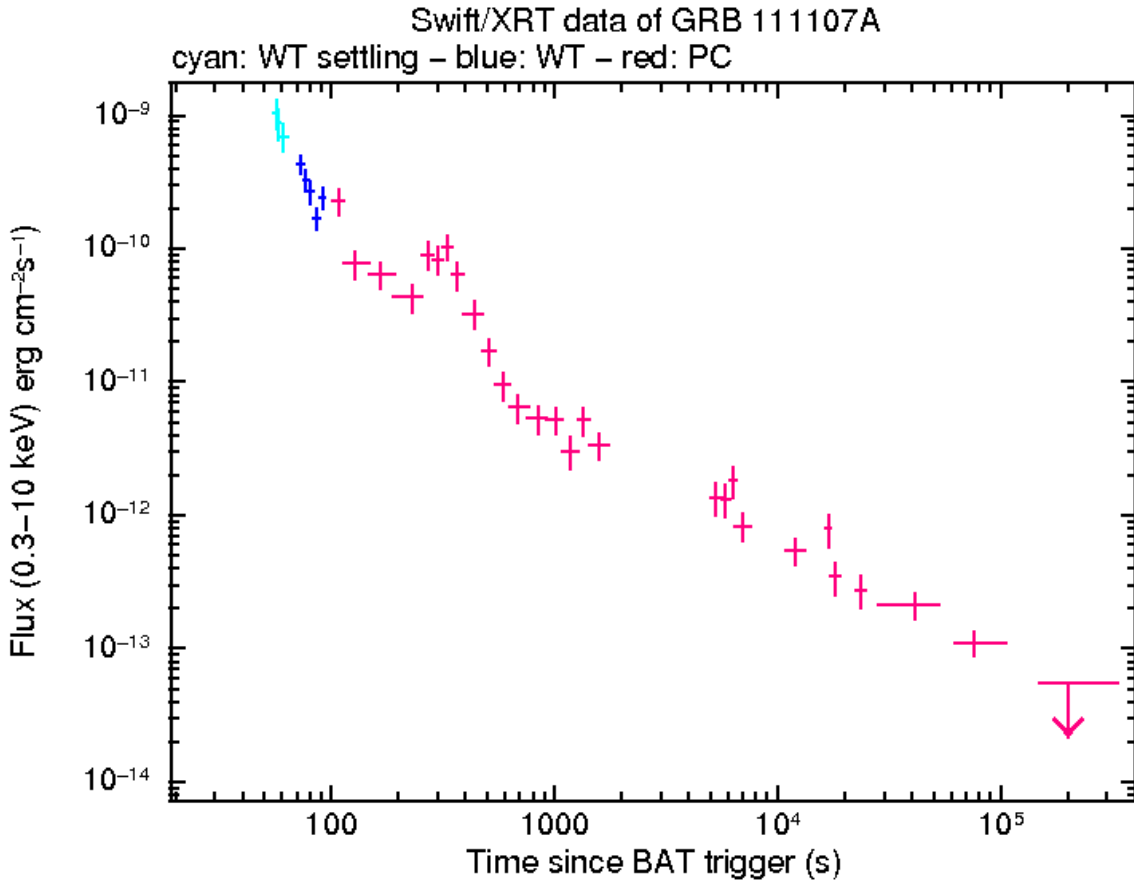


Figure 2: XRT flux light curve of GRB 111107A in the 0.3-10 keV band. The approximate conversion is $1 \text{ count s}^{-1} = \sim 3.4 \times 10^{-11} \text{ ergs s}^{-1} \text{ cm}^{-2}$.

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 111107A 73 s after the BAT trigger (Kuin & Siegel, *GCN Circ.* 12540). A faint afterglow consistent with the XRT position was detected in the initial white UVOT finding chart but not detected in later exposures. Detections and 3-sigma upper limits using the UVOT photometric system (Poole et al. 2008, *MNRAS*, 383, 627) for the first finding chart (FC) exposure and subsequent exposures are listed in Table 1.

Filter	T_{Start}	T_{stop}	Exposure	Mag
white (FC)	73	223	147	19.45 ± 0.10
u	615	1755	136	$>_{\text{i}} 18.7$
b	540	1681	117	$>_{\text{i}} 20.0$
v	285	1656	343	$>_{\text{i}} 19.9$
w1	664	1631	117	$>_{\text{i}} 19.2$
m2	639	5231	299	$>_{\text{i}} 19.7$
w2	590	1730	136	$>_{\text{i}} 20.0$

Table 1: Magnitudes from UVOT observations of GRB 111107A. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight of $E_{B-V} = 0.14$ mag. All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).