Swift Observations of GRB 101117B

C.A. Wolf (PSU) D. Grupe (PSU), W.H. Baumgartner (GSFC/UMBC), D.M. Palmer (LANL),
S.T. Holland (CRESST/GSFC/USRA), S.D. Barthelmy (NASA/GSFC), D.N. Burrows (PSU), M.
Siegel (PSU), and N. Gehrels (NASA/GSFC) for the Swift Team

1 Introduction

At 19:13:23 UT on 2010-11-17, the Swift Burst Alert Telescope (BAT) triggered and located GRB 101117B (trigger=438675). Swift slewed immediately to the burst and found both X-ray (Wolf et al., *GCN Circ.* 11411) and optical (Wolf et al., *GCN Circ.* 11412) counterparts.

The best *Swift* position of this burst is the UVOT refined position given in Holland et al. (*GCN Circ.* 11420) with RA-2000 = 11h 32m 0.54s, and Dec-2000 = $-72°$ $39'$ $45.9''$ with an uncertainty of $0.43''$.

GRB 101117B was also detected by INTEGRAL/SPI-ACS (V. Beckmann, private communication). This observation confirmed the peak at T0+3s. Subsequent observations by GROND 34 hours after the burst produced optical and infrared magnitude upper limits (Elliott et al., 2010, GCN Circ. 11421).

2 BAT Observation and Analysis

At 19:13:23 UT on 2010-11-17, the Swift Burst Alert Telescope (BAT) triggered and located GRB 101117B (trigger=438675, Wolf et al., *GCN Circ.* 11411). Using the data set from T-60 to T+243 s, the BAT ground-calculated position is RA, Dec = 172.991, -72.651 deg which is

RA(J2000) = 11h 31m 57.8s

Dec(J2000) = $-72°$ $39'$ $04.7''$

with an uncertainty of 1.1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 46% (Baumgartner et al. *GCN Circ.* 11414).

The mask-weighted light curve (Figure 1) shows two overlapping peaks starting at -T-0.2 s, peaking at -T+1.0 s, and roughly exponentially decaying out to -T+40s. There is possible emission (at the 2σ c.l.) from around T+150 to T+220 s. T_{90} (15-350 keV) is 5.2±1.8 s (estimated error including systematics).

The time-averaged spectrum from T-0.1 to T+8.6 s is best fit by a single power law model. The power law index of the time-averaged spectrum is 1.50±0.09 ($\chi^2 = 39$ for 57 d.o.f.). For this model the total fluence in the 15-150 keV band is 1.1 ±0.1 × 10^{-6} ergs cm^{-2}. The 1s peak photon flux measured from T+0.74 s in the 15-150 keV band is 4.5±0.3 photons s^{-1} cm^{-2}. 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/438675/BA/

3 XRT Observations and Analysis

The XRT began observing the field of GRB 101117B at 19:14:40.9 UT, 77.0 seconds after the BAT trigger. Using 1061 s of XRT Photon Counting mode data and 1 UVOT image for GRB 101117B, Goad et al. (*GCN Circ.* 11413) found an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 173.00136, +72.66293 which is equivalent to:

RA (J2000): 11h 32m 0.33s

Dec (J2000): $-72° 39' 46.5''$

with an uncertainty of $1.7''$ (radius, 90% confidence).

A spectrum formed from the PC mode data can be fitted with an absorbed power-law model with a photon spectral index of 2.23±0.11 (Wolf and Grupe, *GCN Circ.* 11417). The best-fitting absorption column is 3.18×10^{21} cm^{-2}, in excess of the Galactic value of 1.33×10^{21} cm^{-2} (Kalberla et al. 2005). This excess absorption of 1.85×10^{21} cm^{-2} results in a maximum redshift of 3.5 regarding the relation given in Grupe et al. (2007, AJ, 133, 2216).

The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 5.7×10^{-11} (10.5×10^{-11}) erg cm^{-2} count^{-1}.

The $0.3 - 10 \ keV$ light curve given below (Fig.2) displays a decay slope of $0.77^{+0.08}_{-0.10}$. The light curve of the X-ray afterglow breaks at T+1220±10 s followed by a steeper decay slope of 1.24±0.08. This decay slope continued until the end of the observations on 2010-11-18.

4 UVOT analysis

The Swift/UVOT began observing the field of GRB 101117B starting 63 s after the BAT triger (Wolf et. al., 2010, GCN Circ. 11411). Settled observations started at 82 s. The optical afterglow (Holland, 2010, GCN Circ. 11412) was detected in the U, B, and white filters. The refined UVOT position (Holland et al., *GCN Circ.* 11420) is:

RA (J2000) 11:32:00.54 = 173.00225 (deg)

Dec (J2000) -72:39:45.90 = -72.66275 (deg)

with an estimated uncertainty of 0.43 arcsec (radius, 90% confidence, statistical + systematic). This is 1.16 arcsec northwest of the UVOT-enhanced XRT position (Goad, et al., 2010, GCN Circ 11413).

Preliminary magnitudes, and 3σ upper limits for detecting a source in the finding charts and in the co-added images are listed in Table 1.

The quoted magnitudes and upper limits have not been corrected for the expected Galactic extinction along the line of sight corresponding to a reddening of $E_{B-V} = 0.38$ mag (Schlegel, et al., 1998, ApJS, 500, 525). All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).

The non-detection in the UVOT uvw1 filter, and the observed UVOT spectral energy distribution at 600 s, is consistent with GRB 101117B having a redshift of approximately z ≤ 3, although we can

not rule out the non-detection in the ultraviolet being due to extinction in the host galaxy. This is consistent with the redshift upper limit found in the XRT analysis. The white light curve exhibits a power-law decay with an index of alpha = -0.8±0.1 between 82 and 6005 s after the BAT trigger.

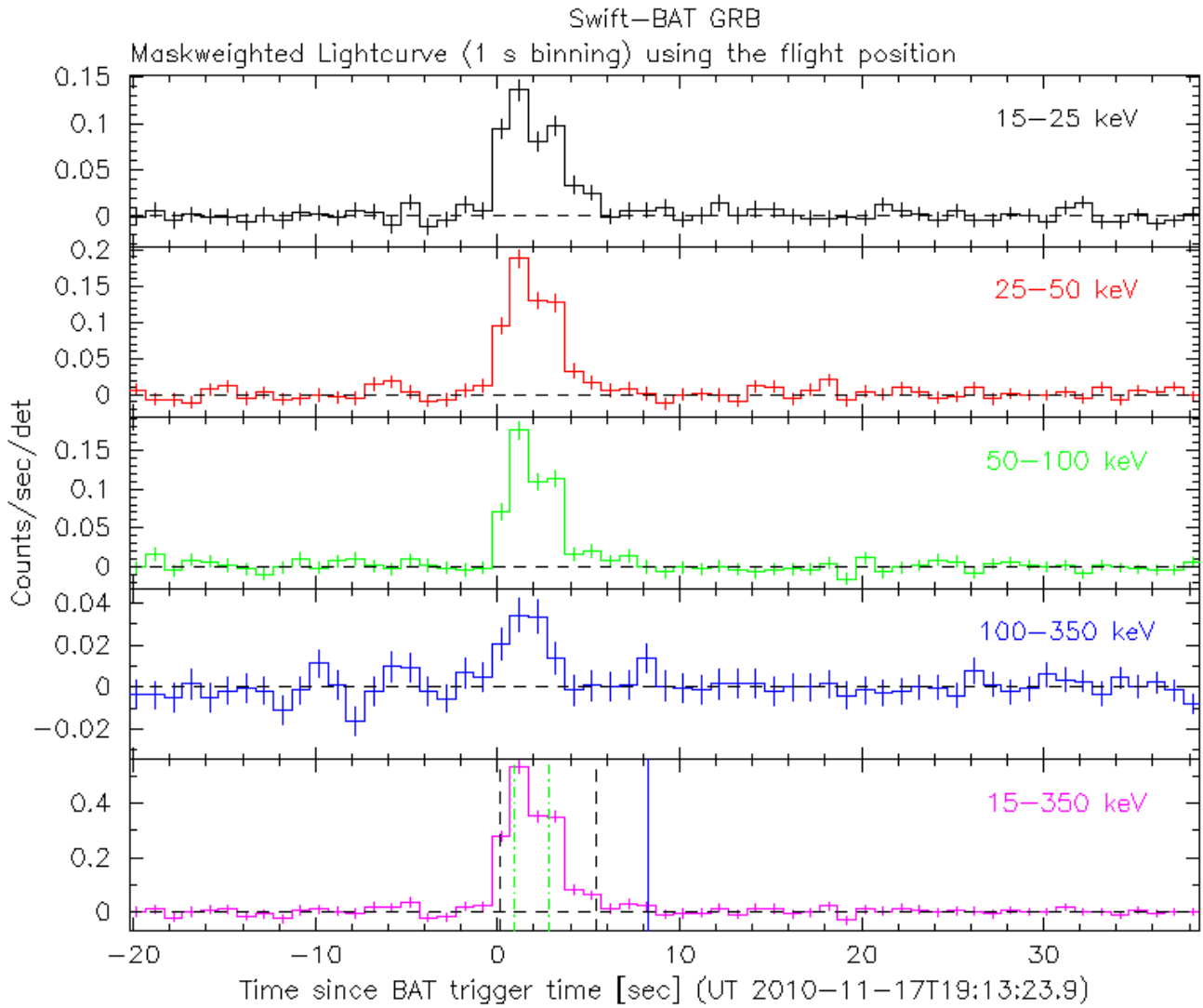| Filter	T_{Start}	T_{stop}	Exposure	Mag
white_FC	82	232	147	17.81±0.08
u_FC	295	545	246	18.68±0.15
v	626	646	255	>17.9
b	551	571	319	18.22±0.27
u	700	1325	659	>19.1
uvw1	675	1300	413	>19.3
uvm2	825	1275	197	>18.7
uvw2	601	1051	255	>19.0
white	575	595	530	19.20±0.34

Table 1: Magnitudes from UVOT observations of GRB 101117B.
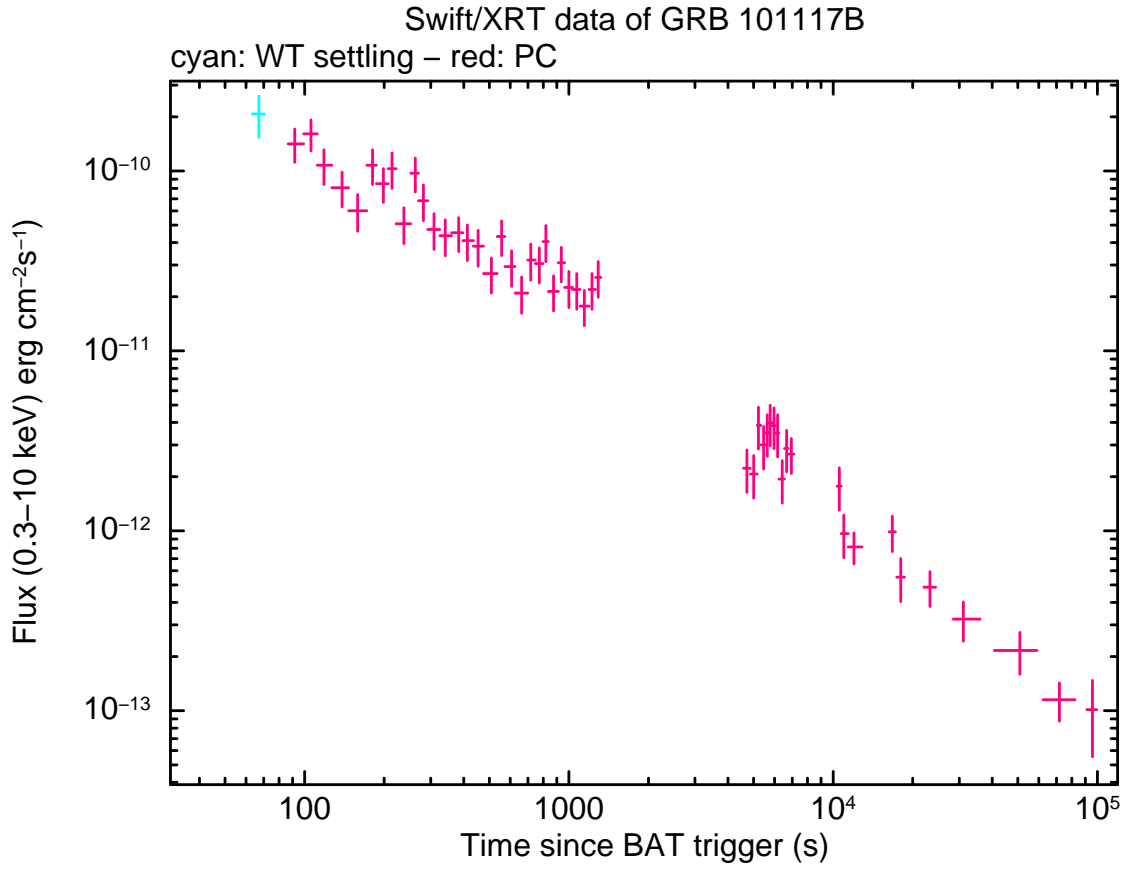
Figure 1: BAT Light curve of GRB 101117B.

Figure 2: XRT flux light curve of GRB 101117B in the 0.3-10 keV band. The approximate conversion is 1 count s^{-1} = $\sim 5.7 \times 10^{-11}$ergs s^{-1} cm^{-2}.