Swift Observations of GRB 100111A

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1. Introduction

At 04:12:49 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 100111A (trigger=382399). Swift slewed immediately to the burst and found X-ray and optical counterparts of the burst in the XRT and UVOT (Vetere et al. GCN Circ. 10317)

The best Swift position of this burst is the UVOT position given in Hoversten & Vetere (GCN Circ.10323) with RA, Dec (J2000) = 247.04833, 15.55064 which is equivalent to:

RA(J2000) = 16h 28m 11.60s
Dec(J2000) = +15d 33' 02.3 "

with a 90%-confidence error radius of about 0.51 arc sec.

The afterglow was observed also by Nordic Optical Telescope with R=19.46+/-0.05 mag (Xu et al. Circ.10318). GRB100111A was also detected by Fermi GBM (McBreen GCN Circ.10319)

2. BAT Observations and Analysis

Using the data set from T-239 to T+963 the BAT ground-calculated position is RA, Dec = 247.029, 15.539 deg which is

RA(J2000) = 16h 28m 06.9s
Dec(J2000) = +15d 32' 19.1"

with an uncertainty of 1.2 arcmin, (radius, sys+stat, 90% containment). The partial coding was 100%.

The mask-weighted light curve (Fig.1) shows a weak peak at ~T-30 sec and the main FRED-like peak from ~T-10 sec and ending at ~T+25 sec. T90 (15-350 keV) is 12.9 ± 2.1 sec (estimated error including systematics).

The time-averaged spectrum from T-7.5 to T+8.7 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.69 ± 0.13. The fluence in the 15-150 keV band is $6.7 ± 0.5$ x 10^{-7} erg cm^{-2}. The 1-sec peak photon flux measured from T+0.03 sec in the 15-150 keV band is 1.9 ± 0.2 ph cm^{-2} sec^{-1}. All the quoted errors are at the 90% confidence level.

3. XRT Observations and Analysis

The XRT began observing the field at 04:13:52.1 UT, 48.0 seconds after the BAT trigger. Using 5361 s of XRT Photon Counting mode data and 10 UVOT images for GRB 100111A, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 247.04845, +15.55083 which is equivalent to:

RA (J2000): 16h 28m 11.63s
Dec (J2000): +15d 33' 03.0"

with an uncertainty of 1.4 arcsec (radius, 90% confidence) (Beardmore et al. GCN Circ. 10321).
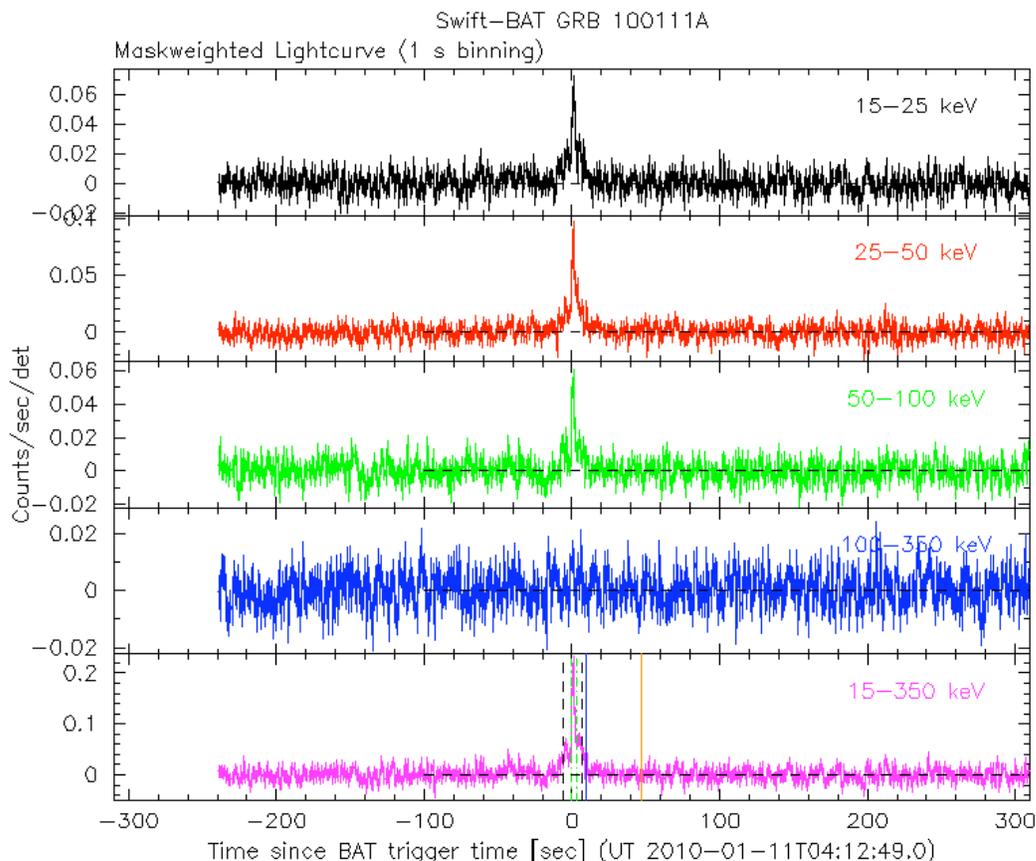
Fig.1: BAT Lightcurve. The light curve in the 4 individual plus total energy bands.

We have analysed all the Swift XRT data collected for GRB 100111A, totalling 32.1 ks of data out to ~2.4×10^5 s after the BAT trigger. The 0.3-10 keV light curve (Fig.2) can be modelled with a broken power-law decay with an index of $\alpha_1 = 0.53$ +/- 0.15 followed by a break at T + 1500 s and then an index of $\alpha_2 = 1.0$ +/- 0.1.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of 2.10 (+0.29, -0.26). The best-fitting absorption column is 1.7 (+0.8, -0.7) x 10^{21} cm^{-2}, in excess of the Galactic value of 4.1 x 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 3.8 x 10^{-11} (5.7 x 10^{-11}) erg cm^{-2} count^{-1}.

4. UVOT Observations and Analysis

 The Swift UltraViolet/Optical Telescope (UVOT) began settled observations of the field of GRB 100111A 67 s after the BAT trigger (Vetere, et al., GCN Circ. 10317). A new optical source was found by the UVOT at 17.62 magnitudes in the initial white finding chart at the position RA, Dec (J2000) = 247.04833, 15.55064 which is equivalent to:

       RA(J2000) = 16h 28m 11.60s

       DEC(J2000) = +15d 33' 02.3 "

with a 90%-confidence error radius of about 0.51 arc sec.

GRB 100111A
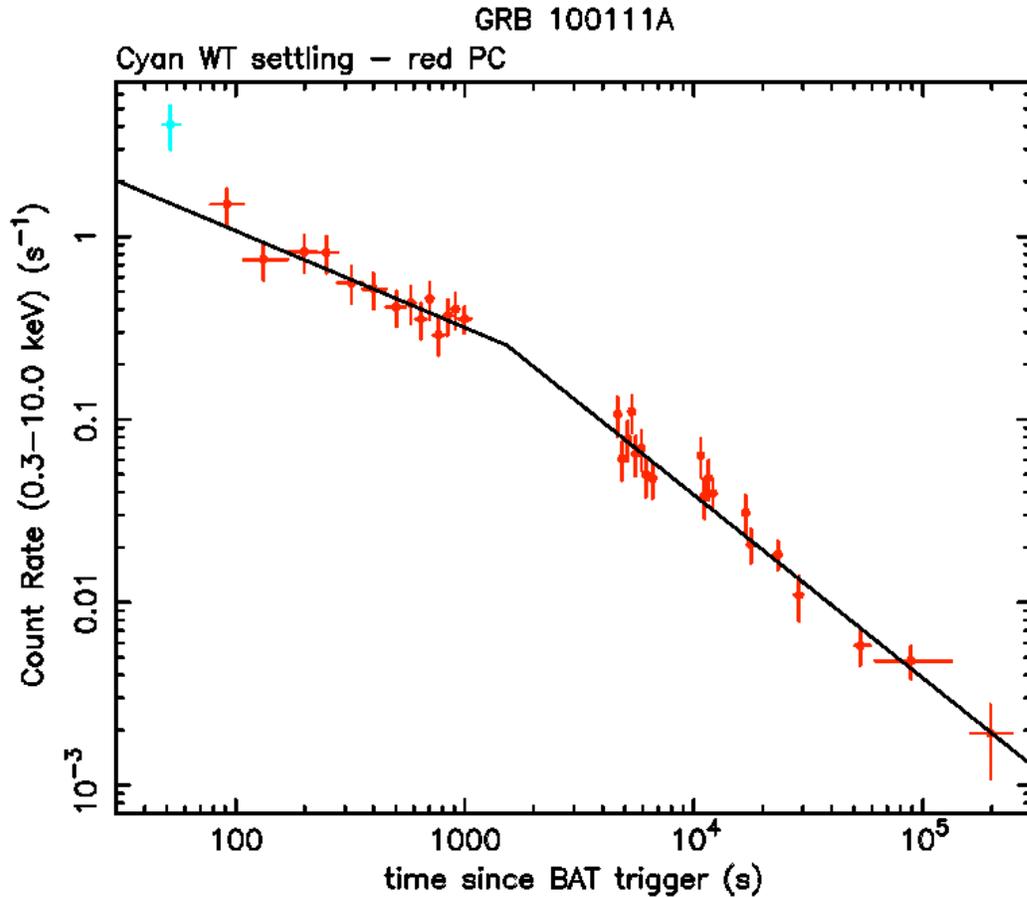

Fig. 2: XRT Lightcurve. Counts s^{-1} in the 0.3-10 keV band taken in Photon Counting mode. The approximate conversion is 1 count s $^{-1}$ ~3.8e^{-11} erg cm^{-2} count^{-1}.

This position is 0.8 arcsec from the UVOT-enhanced XRT position (Beardmore, et al. GCN Circ. 10321) and the two positions agree within the error bars. The source faded by more than a magnitude in the *white* filter over the first orbit of observations (Fig.3). Additionally the source is detected in the *b*, *u*, and *uvw1* filters, with a marginal 2.4-sigma detection in *v* and a 2.1-sigma detection in *uvm2*. Given the detection in the *uvw1* filter the redshift of this burst is less than 1.9.

The initial magnitude observed in the UVOT filters are given in Table 1. The values quoted in the table are on the UVOT Photometric System (Poole, et al, 2008). They are not corrected for the expected galactic reddening of E(B − V) = 0.05 in the direction of the burst (Schlegel, Finkbeiner, & Davis, 1998).
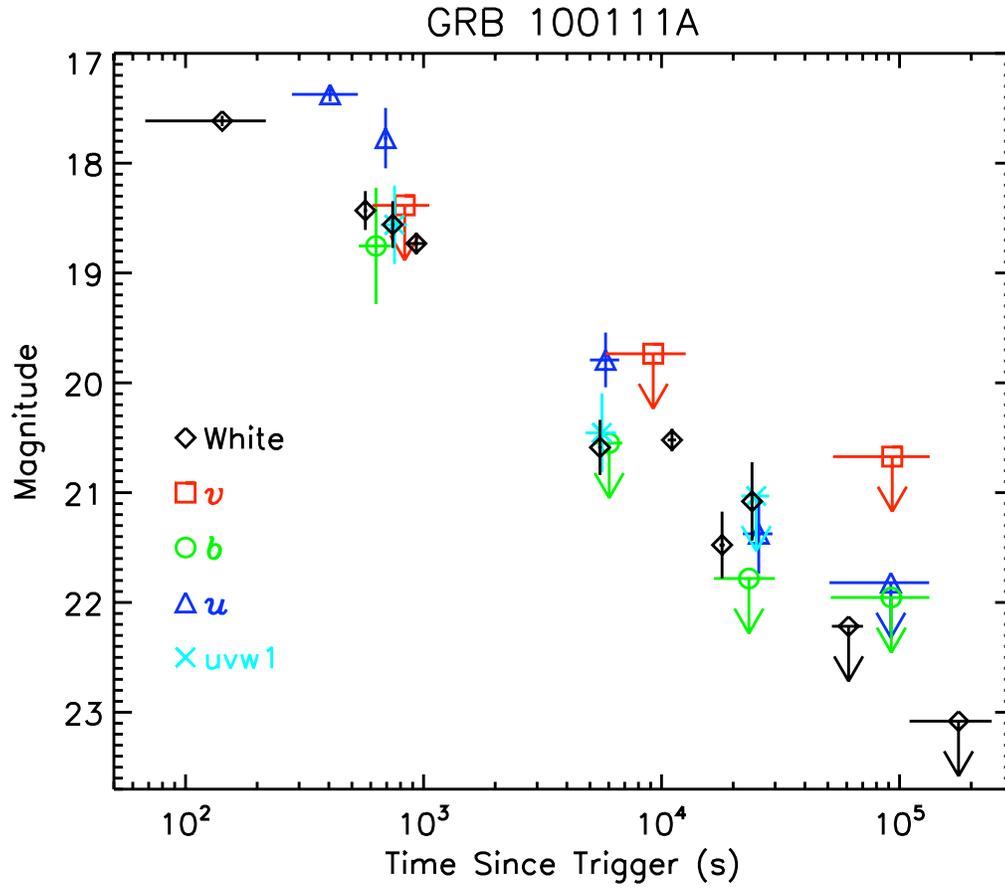
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Fig. 3: UVOT Lightcurve.

Table 1: UVOT Observations.

Filter	T_start(s)	T_stop(s)	Exp(s)	Mag
white	67	217	147	17.62 +/- 0.05
white	858	1007	147	18.73 +/- 0.10
v	609	1057	58	> 18.41
b	535	727	39	18.76 +/- 0.27
u	279	529	245	17.37 +/- 0.07
uvw1	658	851	38	18.57 +/- 0.36
uvm2	633	827	38	> 18.99
uvw2	584	1033	58	> 19.04