Swift Observation of GRB 111229A

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1   Introduction

BAT triggered on GRB 111229A at 22:37:52 UT (Trigger 510736) (Lien, *et al.*, *GCN Circ.* 12774). This was a 1.024 sec rate-trigger on a intermediate length burst with $T_{90} = 25.4 \pm 5.0$ sec. Swift slewed to this burst immediately and XRT began follow-up observations at $T + 84$ sec, and UVOT at $T + 87$ sec. Our best position is the UVOT location RA($J2000$) = 76.28692 deg $\sim$ (05h 05m 8.86s), Dec($J2000$) = -84.71085 deg $\sim$ (-84d 42' 39.1") with an error of 0.55 arcsec (radius, 90% confidence) (Oates *et al.*, *GCN Circ.* 12783). A redshift of 1.3805 is suggested by the spectroscopic observations of the optical afterglow using GMOS-South on the Gemini-South 8-m telescope (Cucchiara *et al.*, *GCN Circ.* 12777).

2   BAT Observation and Analysis

Using the data set from $T - 60$ to $T + 243$ *sec*, further analysis of BAT GRB 111229A has been performed by Swift team (Lien, *et al.*, *GCN Circ.* 12774). The BAT ground-calculated position is
RA($J2000$) = 76.561 deg $\sim$ (05h 06m 14.5s),
Dec($J2000$) = -84.687 deg $\sim$(-84d 41' 14.8")
with an uncertainty of 2.7 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 78% (the bore sight angle was 30.39 *deg*).

The masked-weighted light curves (Fig.1) shows an initial peak starting at $\sim$ T-2 sec, peaking at $\sim$ T+1 sec, and returning to baseline at $\sim$ T+7 sec. The second weaker peak starts at $\sim$ T+15 sec and ends at $\sim$ T+22 sec. T90 (15-350 keV) is 25.4 ± 5.0 sec (estimated error including systematics).

The time-averaged spectrum from T-0.97 to T+26.15 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.85 ± 0.33. The fluence in the 15-150 keV band is $3.4 \pm 0.7 \times 10^{-7}$ erg/cm^2. The 1-sec peak photon flux measured from T+0.12 sec in the 15-150 keV band is 1.0 ± 0.2 ph/cm^2/sec. All the quoted errors are at the 90% confidence level.

3   XRT Observations and Analysis

The XRT data for GRB 111229A (Lien et al. GCN Circ. 12774) from 93 s to 22.6 ks after the BAT trigger are analyzed. The data are entirely in Photon Counting (PC) mode. The enhanced XRT position for the burst is
RA($J2000$) = 76.28979 deg $\sim$ (05h 05m 9.55s),
Dec($J2000$) = -84.711 deg $\sim$ (-84d 42' 39.6")
with an error of 1.8 arcsec (90% confidence).

The late-time light curve (from T0+4.4 ks; Fig.2) can be modelled with a power-law decay with a decay index of alpha=1.54 (+0.14, -0.13).

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of 2.06 (+0.17, -0.14). The best-fitting absorption column is $1.9(\pm 0.5) \times 10^{21}$ cm^{-2}, in excess of the Galactic value of $1.0 \times 10^{21} cm^{-2}$ (Kalberla et al. 2005). The counts to observed

(unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 3.7×10^{-11} (5.5×10^{-11}) erg cm^{-2} count^{-1}.

A summary of the PC-mode spectrum is thus:
Total column: 1.9 (± 0.5) $\times 10^{21}$ cm^{-2}
Galactic foreground: 1.0×10^{21} cm^{-2}
Excess significance: 2.7 sigma
Photon index: 2.06 (+0.17, -0.14)

4   UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 111229A 87 s after the BAT trigger (Lien *et al.*, *GCN Circ.* 12774). A source consistent with the XRT position (Osborne *et al.*, *GCN Circ.* 12780) and the GROND optical position (Nicuesa Guelbenzu *et al.*, *GCN Circ.* 12780) is detected in the initial UVOT exposures.

The preliminary UVOT position is:
RA (J2000) = 05:05:08.86 = 76.28692 (deg.)
Dec (J2000) = -84:42:39.1 = -84.71085 (deg.)
with an estimated uncertainty of 0.55 arcsec (radius, 90 % confidence).

Preliminary detections and 3-sigma upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc. 1358, 373) for the early exposures are:

Filter	Start	Stop	Exposure	Mag
white (FC)	87	237	147	18.78 ± 0.10
white	5230	5430	200	20.48 ± 0.27
v	630	649	20	17.70 ± 0.49
b	554	574	20	18.75 ± 0.53
u (FC)	300	549	250	19.03 ± 0.23
u	4820	5020	200	20.67 ± 0.53
w1	679	6251	413	> 20.4
m2	4410	6046	393	> 20.4
w2	779	22585	1597	> 21.4

Table 1: Magnitudes and upper limits from UVOT observations

The magnitudes in the table are not corrected for the Galactic extinction due to the reddening of E(B-V) = 0.18 in the direction of the burst (Schlegel et al. 1998). The UVOT light curve is shown in Fig. 3.

References

[1] Breeveld et al. 2011, AIP Conf. Proc. 1358, 373

[2] Cucchiara, A. et al., 2011, GCN Circ. 12777

[3] Kalberla, P. M. W., et al., 2005, A&A, 440, 775

[4] Lien et al., 2011, GCN Circ. 12774

[5] Nicuesa Guelbenzu et al., 2011, GCN Circ. 12780

[6] Oates et al., 2011, GCN Circ. 12783

[7] Osborne et al., 2011, GCN Circ. 12780
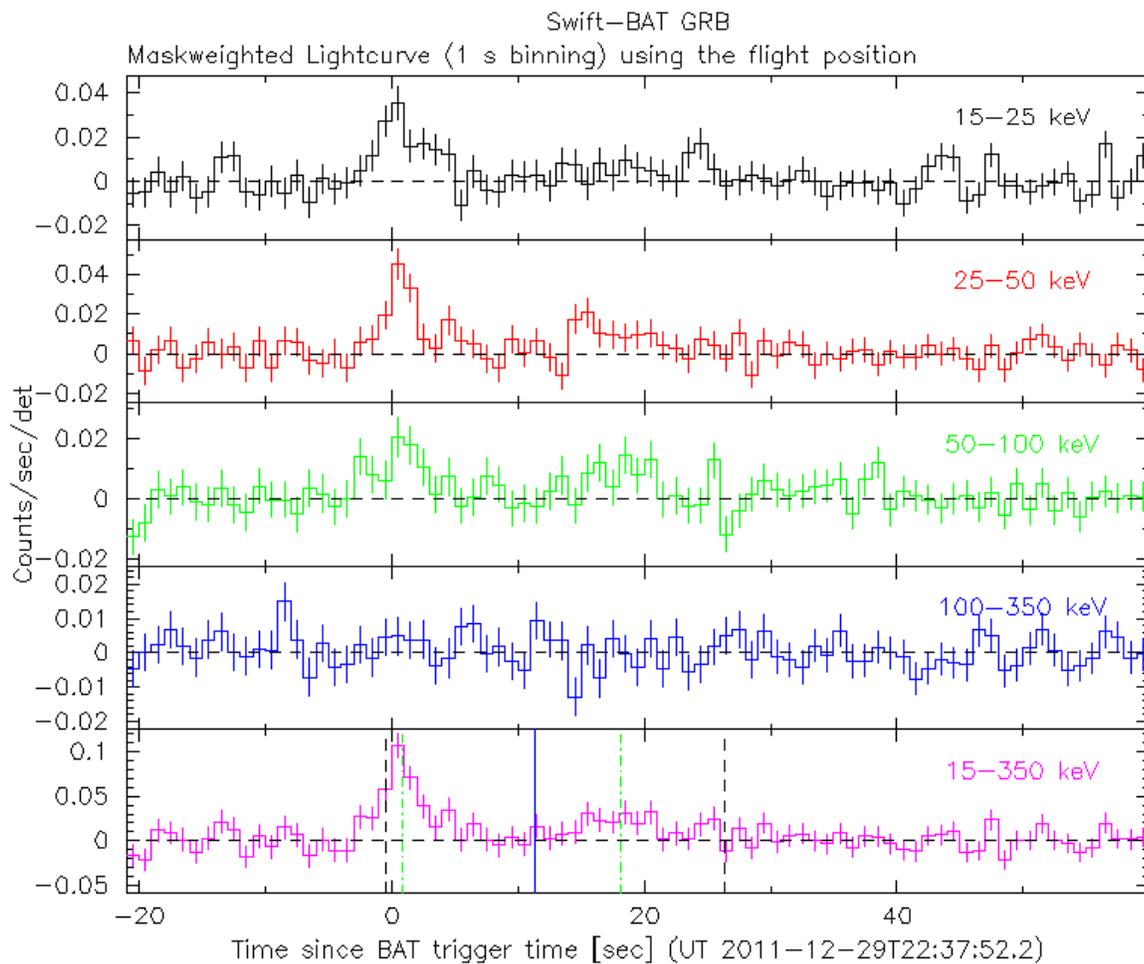
[8] X Schlegel, D. J., et al., 1998, ApJS, 500, 525

Figure 1: The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 22:37:52 UT.
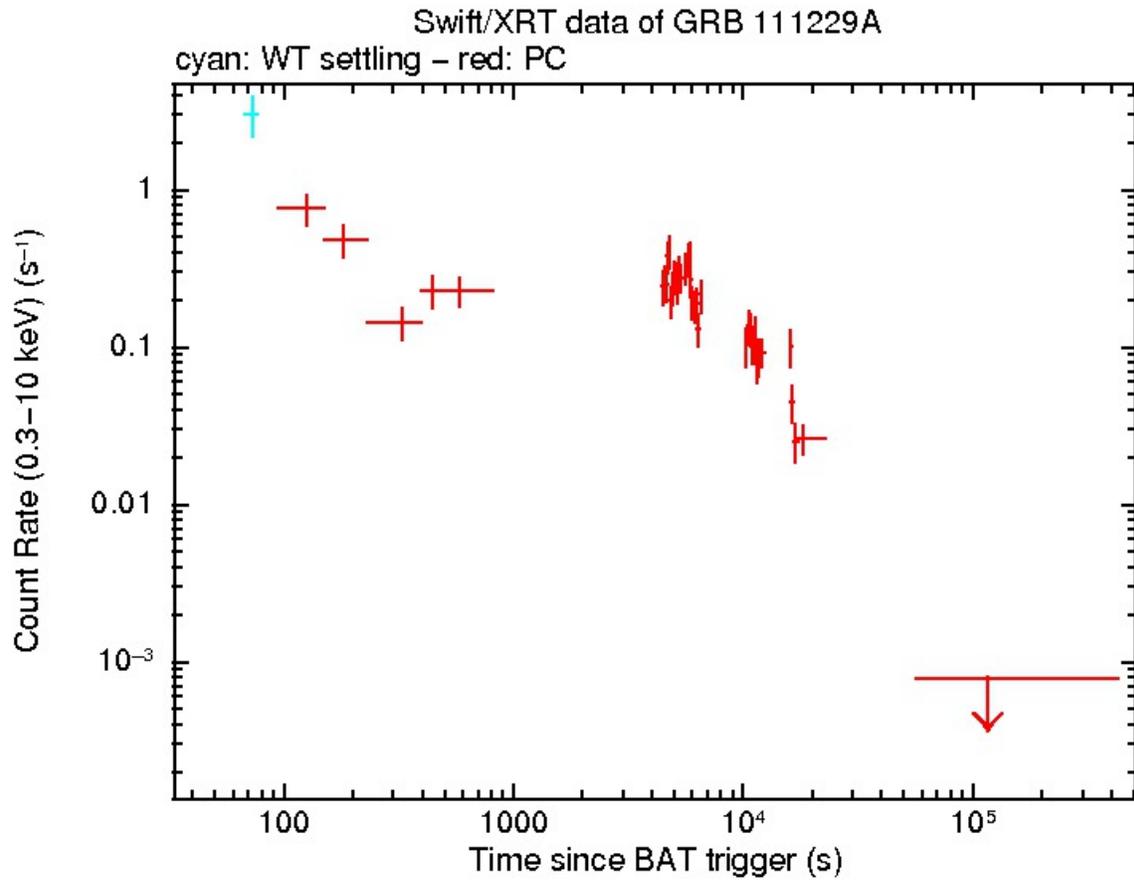
Figure 2: XRT light curve. Counts/sec in the 0.3-10 keV band: Window Timing mode (cyan), Photon Counting mode (red). The counts to observed (unabsorbed) flux conversion is 3.7×10^{-11} (5.5×10^{-11}) erg cm^{-2} count^{-1}.
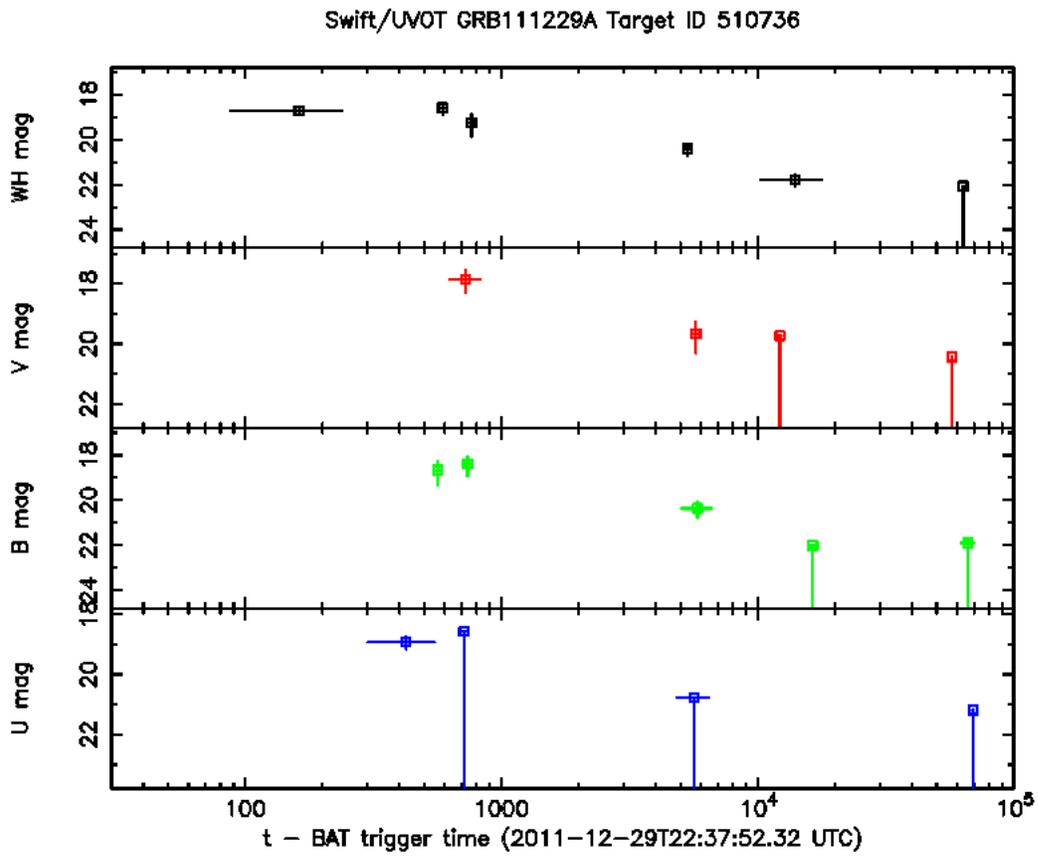
Figure 3: UVOT light curve.