Swift Observations of GRB 110208A

V. D'Elia (ASDC), J. Cummings, W. Baumgartner (GSFC/UMBC),
G. Stratta (ASDC), M. De Pasquale (MSSL-UCL)
S.D. Barthelmy (GSFC), D.N. Burrows (PSU),
M. Siegel (PSU), N. Gehrels (GSFC) for the Swift Team

1 Introduction

The Swift BAT triggered on and located GRB 110208A at 21:10:46 UT (trigger=445038) (D'Elia et al., GCN Circ. 11674). Swift slewed immediately to the burst and XRT and UVOT observations of the field started 80 and 84 seconds after the trigger, respectively. The best Swift position is the XRT localization at RA(J2000)= 22.46219 deg, Dec(J2000)= −20.59279 deg, RA(J2000)= $01^{\rm h}29^{\rm m}50.93^{\rm s}$, Dec(J2000)= $-20^{\rm d}$ 35' 34.0", with an error radius of 1.5 arcsec (90% confidence).

The optical afterglow was detected from the ground by the Magellan telescope, the reported magnitude being $i = 22.5$ (Berger al., GCN Circ. 11681, Fong et al., GCN Circ. 11685).

The prompt emission of GRB 110208A was also detected by INTEGRAL/SPI-ACS.

2 BAT Observations and Analysis

Using the data set from T-240 s to T+962 s (Sakamoto et al., GCN Circ. 11677), the BAT ground-calculated position is RA(J2000)= 22.487 deg, Dec(J2000)= −20.561 deg, RA(J2000)= $01^{\rm h}29^{\rm m}56.9^{\rm s}$, Dec(J2000)= $-20^{\rm d}$ 33' 40.5", with an uncertainty of 1.8 arcmin, (radius, sys+stat, 90% containment). The partial coding was 100%.

The mask-weighted light curve (Figure 1) shows a single peak starting at ∼T-2 s and peaking at ∼T+0.5 s and ending at ∼T+20 s. T_{90} (15–350 keV) is 37.4 ± 7.9 s (estimated error including systematics).

The time-averaged spectrum from T-1.5 s to T+40.7 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 2.08 ± 0.31. The fluence in the 15–150 keV band is $(2.7 \pm 0.6) \times 10^{-7}$ erg cm^{-2}. The 1-second peak photon flux measured from T+0.46 s in the 15–150 keV band is 0.6 ± 0.1 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/424733/BA/

3 XRT Observations and Analysis

Swift-XRT began observing the field of GRB 110208A at 21:12:06.5 UT, 80.1 seconds after the BAT trigger (D'Elia et al., GCN Circ. 11674, D'Elia, GCN Circ. 11693).

Using 5594 s of XRT Photon Counting mode data and 7 UVOT images for GRB 110208A, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA(J2000)= 22.46219 deg, Dec(J2000)= −20.59227 deg, RA(J2000)= $01^{\rm h}29^{\rm m}50.93^{\rm s}$, Dec(J2000)= $-20^{\rm d}$ 35' 34.0", with an uncertainty of 1.5 arcsec (radius, 90% confidence).

We analyzed 26.06 ks of XRT data for GRB 110102A (D'Elia, et al., GCN Circ. 11674), from 80 s to 100 ks after the BAT trigger. The data comprise 10 s in Windowed Timing (WT) mode (slewing) with the remainder in Photon Counting (PC) mode.

The 0.3–10 keV light curve (Figure 2) can be modelled with an initial power law decay with an index

$\alpha_1 = 3.1(+0.8, -1.3)$, followed by a break at T+150 s to an alpha of $\alpha_2 = 0.40(+0.26)(-0.27)$. A second break is found at t+1.9 ks to a final power law decay with an index $\alpha_3 = 1.1 \pm 0.2$. At later times there are no more observations.

A spectrum formed with the 25.2 s of PC mode data can be fitted with an absorbed power-law with a photon spectral index of $\Gamma = 2.32(+0.15, -0.26)$. The best-fitting absorption column is $N_H = 1.12(+0.42, -5.5) \times 10^{21}$ cm^{-2} in excess to the Galactic one in the direction of the source ($N_H = 2.3 \times 10^{20}$ cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) $0.3 - 10$ keV flux conversion factor deduced from the PC spectrum is 3.3×10^{-11} (4.8×10^{-11}) erg cm^{-2} count^{-1}.

All the quoted errors are at the 90% confidence level.

4 UVOT Observation and Analysis

The UVOT observed the field of GRB 110208A starting 84 s after the BAT trigger (D'Elia, et al., GCN Circ. 11674).

Settled observations started at 85 s. No optical afterglow consistent with the enhanced XRT position (Evans et al, GCN Circ. 11678) or the Magellan position (Berger et al., GCN Circ. 11681) is detected in the initial UVOT exposures or in the summed ones. Preliminary 3-sigma upper limits for detecting a source in the finding charts and in the following exposures are listed in Table 1. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight corresponding to a reddening of $E_{(B-V)} = 0.02$ mag (Schlegel, et al., 1998, ApJS, 500, 525). All photometry is on the UVOT photometry system described in Poole et al. (2008, MNRAS, 383, 627).

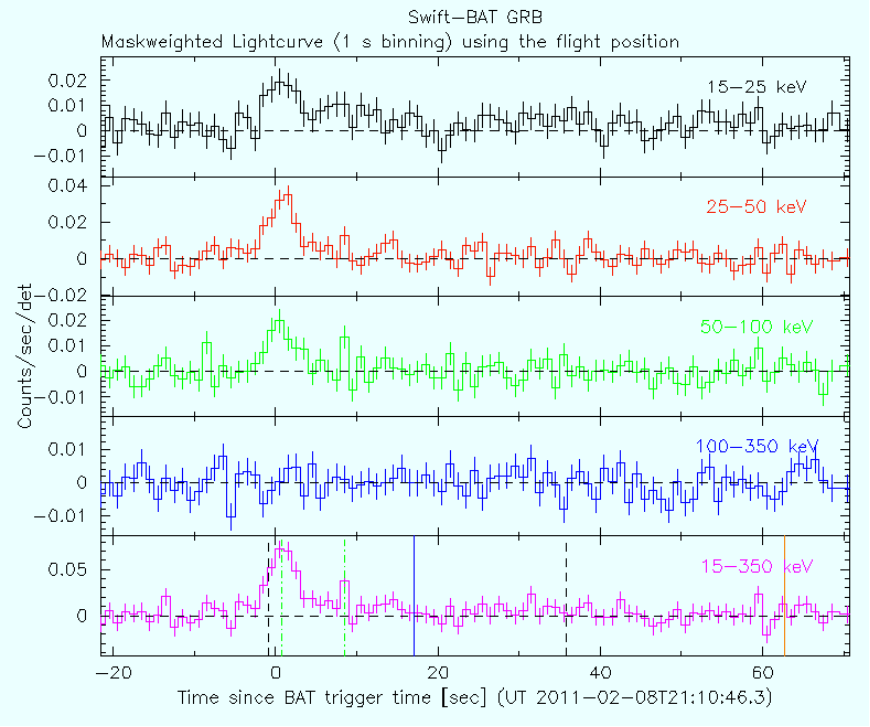

Figure 1: BAT light-curve. The mask-weighted light curve in the 4 individual plus total energy bands. Green dot-dashed lines: T_{50} and T_{90}. Blue: Slew start, Orange: Slew end Time. The units are counts s^{-1} illuminated-detector^{-1} (note illum-det = 0.16 cm^2).

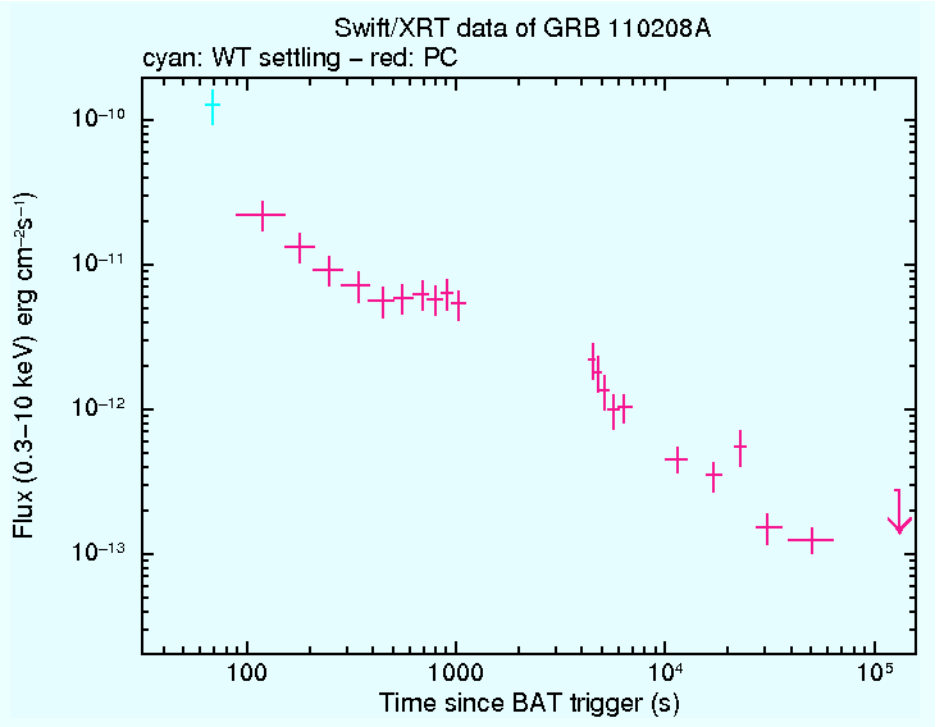

Figure 2: XRT light-curve. Count rates in the 0.3–10 keV band taken in Windowed Timing (WT) and Photon Counting (PC) mode are plotted. The approximate conversion of the 0.3–10 keV observed flux is 1 count/s $\sim 3.3 \times 10^{-11}$ erg cm^{-2} s^{-1}.

Filter	T_start (s)	T_stop (s)	Exp (s)	Mag
white (fc)	85	240	147	> 20.6
	85	18443	1425	> 21.5
u (fc)	298	548	246	> 20.0
u	298	30010	3111	> 21.2
v	628	11030	1190	> 20.0
b	553	24229	2021	> 21.4
uvw1	703	29283	2919	> 21.3
uvm2	652	28376	1771	> 21.1
uvw2	603	6810	393	> 20.5

Table 1: 3-sigma upper limits from UVOT observations.