Swift Observations of GRB 110128A

1 Introduction

At 01:44:33 UT on 2011-01-28, the Swift Burst Alert Telescope (BAT) triggered and located GRB 110128A (trigger=443861). Swift slewed immediately to the burst and found an X-ray counterpart in the XRT (Grupe et al., GCN Circ. 11603). The best Swift position of this burst is the UVOT position given in Oates & Grupe. (GCN Circ. 11612) with RA-2000 = 12h 55m 35.10s, and Dec-2000 = +28° 03′ 54.1″ with an uncertainty of 1.3″.

There were several ground-based optical/NIR follow-up observation reported on this burst. Most notably are the VLT/X-shooter spectroscopic redshift measurement of z=2.339 by Sparre et al. (GCN Circ. 11607) and the redshift measurements of two galaxies in the line of sight at z=0.639 and z=0.109 which might have caused absorption in the afterglow as reported by Tanvir et al. (GCN Circ. 11608). The burst was also detected by the FERMI GBM (Chaplin, GCN Circ. 11628). Due to the faintness of this burst only a single power law model with Γ = 1.5 ± 0.1 could be fitted to the GBM spectrum.

2 BAT Observation and Analysis

At 01:44:33 UT on 2011-01-28, the Swift Burst Alert Telescope (BAT) triggered and located GRB 110128A (trigger=443861, Grupe et al., GCN Circ. 11603). Using the data set from T-240 to T+962 s, the BAT ground-calculated position is RA, Dec = 193.871, +28.108 deg which is RA(J2000) = 12h 55m 39.0s, Dec(J2000) = +28° 06′ 28.7″ with an uncertainty of 2.3 arcmin, (radius, sys+stat, 90% containment). The partial coding was 37% (Cummings et al. GCN Circ. 11614).

The mask-weighted light curve (Figure 1) shows a single broad peak starting at T-3 s to T+40 s. \(T_{90}\) (15-350 keV) is 30.7±18.1 s (estimated error including systematics).

The time-averaged spectrum from T-1.4 to T+48.3 s is best fit by a single power law model. The power law index of the time-averaged spectrum is 1.31±0.30 (\(\chi^2 = 61.8\) for 57 d.o.f.). For this model the total fluence in the 15-150 keV band is 7.2 \(\pm 1.4 \times 10^{-7}\) ergs cm\(^{-2}\). The 1s peak photon flux measured from T+3.58 s in the 15-150 keV band is 0.8±0.2 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/443681/BA/
3 XRT Observations and Analysis

The XRT began observing the field of GRB 110128A at 01:46:53.5 UT, 140.5 seconds after the BAT trigger. Using 920 s of XRT Photon Counting mode data and 1 UVOT image for GRB 110128A, Osborne et al. (GCN Circ. 11606) found an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 193.89661, +28.06511 which is equivalent to:

RA (J2000): 12h 55m 35.19s
Dec (J2000): +28° 03′ 54.4″


A spectrum formed from the PC mode data (11 ks exposure) can be fitted with an absorbed single power-law model with a photon spectral index of 1.64±0.22 (Grupe, GCN Circ. 11610). The best-fitting absorption column is consistent with the Galactic value of 9.0×10^{19} cm\(^{-2}\) (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 4.0×10^{-11} \(\text{erg cm}^{-2}\text{count}^{-1}\).

The 0.3 – 10 keV light curve given below (Fig.2) displays an initial steep decay slope after the initial flare of 2.3±0.5. The light curve of the X-ray afterglow breaks at T+700^{+600}_{-200} s followed by a flatter decay slope of 0.69^{+0.09}_{-0.12}. This decay slope continued until the end of the observation on 2011-02-07.

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 110128A 144 s after the BAT trigger (Grupe et al., GCN Circ. 11603) with the finding chart in white filter. Oates & Grupe (GCN Circ. 11612) reported that the afterglow was detected in the first white and u exposures. The refined UVOT position is RA(J2000) = 193.89625 deg, DEC(J2000) = 28.06503, which is:

RA (J2000): 12h 55m 35.10s
Dec (J2000): +28° 03′ 54.1″

with an estimated uncertainty of 1.3 arcsec (radius, 90% confidence). This position is consistent with the optical afterglow detection by NOT (de Ugarte Postigo. et al, GCN Circ. 11605) and the enhanced XRT position (Osborne et al., GCN Circ. 11606).

The white and u magnitudes and the 3σ upper limits for the summed images are listed in Table 1.
Table 1: Magnitudes from UVOT observations of GRB 110128A. The quoted values have not been corrected for the expected Galactic extinction along the line of sight of $E_{B-V} = 0.01$ mag. All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).
Figure 1: BAT Light curve of GRB 110128A.
Figure 2: XRT flux light curve of GRB 110128A in the 0.3-10 keV band. The approximate conversion is 1 count s^{-1} = \sim 4.1 \times 10^{-11}\text{ergs s}^{-1}\text{ cm}^{-2}.