Swift Observations of GRB 100212A

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1 Introduction

At 14:07:22 UT on 2010-02-12, the Swift Burst Alert Telescope (BAT) triggered and located GRB 100212A (trigger=412081). Swift slewed immediately to the burst and found an X-ray counterpart of the burst in the XRT (Grupe et al. GCN Circ. 10401)

The best Swift position of this burst is the XRT position given in Osborne et al. (GCN Circ. 10403) with RA-2000 = 23h 45m 40.39s, and Dec-2000 = +49° 29′ 39.6″ with an uncertainty of 2.0″.

Due to the small sun-angle only two optical follow-up observations were reported with detections in R by Malesani et al. (GCN Circ. 10402) and Im & Urata (GCN Circ. 10407).

The FERMI GBM measured a hard X-ray photon spectral index $\Gamma=1.15\pm0.20$ and a peak energy at $E_{\text{peak}}=159\pm45$ keV (Guiriec & Tierney, GCN Circ. 10406).

2 BAT Observation and Analysis

At 14:07:22 UT on 2010-02-12, the Swift Burst Alert Telescope (BAT) triggered and located GRB 100212A (trigger=412081, Grupe et al. GCN Circ. 10401). Using the data set from T-61 to T+243 s, the BAT ground-calculated position is RA, Dec = 356.445, 49.492 deg deg which is RA(J2000) = 23h 45m 46.9s
Dec(J2000) = +49° 29′ 30.5″

with an uncertainty of 2.1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 86% (Ukwatta et al. GCN Circ. 10404).

The mask-weighted light curve shows multiple peaks. The main peak starts with weak emission at $\approx$T-45 s with the peak at $\approx$T+0.2 s and ends at $\approx$T+30 s. A second peak starts at $\approx$T+75 and ends at $\approx$T+135 s. $T_{90}$ (15-350 keV) is 136±14 s (estimated error including systematics).

The time-averaged spectrum from T-4.8 to T+134.0 s is best fit by a single power law model. The power law index of the time-averaged spectrum is $2.20\pm0.22$ ($\chi^2 = 62.3$ for 57 d.o.f.). For this model the total fluence in the 15-150 keV band is $9.1 \pm 1.2 \times 10^{-7}$ ergs cm$^{-2}$. The 1s peak photon flux measured from T+0.34 s in the 15-150 keV band is $2.2\pm0.2$ 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/412081/BA/
3 XRT Observations and Analysis

The XRT began observing the field of GRB 100212A at 14:08:19.8 UT, 57.7 seconds after the BAT trigger. Using 699 s of XRT Photon Counting mode data and 3 UVOT images for GRB 100212A, Osborne et al. (GCN Circ. 10403) found an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 356.41830, +49.49432 which is equivalent to:

RA (J2000): 23h 45m 40.39s
Dec (J2000): +49° 29′ 39.6″


A spectrum formed from the WT mode data (407s exposure) can be fitted with an absorbed single power-law model with a photon spectral index of 2.03±0.03 (Grupe GCN Circ. 10405) with an absorption column density of $1.97\pm0.08\times10^{21}\,\text{cm}^{-2}$ which is in excess of Galactic value of $1.3\times10^{21}\,\text{cm}^{-2}$ (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is $3.8\times10^{-11}$ (5.6 $\times10^{-11}$) ergs cm$^{-2}$ counts$^{-1}$.

The 0.3 – 10 keV light curve given below (Fig.2) displays several bright flares within the first few hundred seconds after the burst. The underlying X-ray afterglow can be modelled with a multiple broken power-law model with the following decay slopes and break times:

$$\alpha_1 = 2.57 \pm 0.40$$
$$T_{\text{break1}} = 1550^{+1750}_{-525}\,\text{s}$$
$$\alpha_2 = 0.29^{+0.66}_{-0.15}$$
$$T_{\text{break2}} = 5890^{+3500}_{-1960}\,\text{s}$$
$$\alpha_3 = 1.31 \pm 0.15$$

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 100212A 68 s after the BAT trigger (Grupe et al., GCN Circ. 10401) with the finding chart in white filter. De Pasquale & Grupe (GCN Circ. 10408) reported on no optical afterglow detected within the enhanced XRT error circle position (Osborne et al., GCN Circ. 10403) in the initial UVOT exposure and in all other summed exposures at 3 sigma level. The optical source detected by NOT (Malesani et al, GCN Circ. 10402) is not detected either at 3σ level.

3σ upper limits for the summed images are listed in Table 1.
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Table 1: Magnitudes from UVOT observations of GRB 100212A. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight of $E_{B-V} = 0.18$ 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 100212A.
Figure 2: XRT flux light curve of GRB 100212A in the 0.3-10 keV band. The approximate conversion is 1 count s$^{-1} = \sim 5.6 \times 10^{-11}$ ergs s$^{-1}$ cm$^{-2}$.