Swift Observations of GRB 100213A

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1 Introduction

At 22:27:48 UT on 2010-02-13, the Swift Burst Alert Telescope (BAT) triggered and located GRB 100213A (trigger=412217). Swift slewed immediately to the burst and found an X-ray counterpart of the burst in the XRT (Grupe et al. GCN Circ. 10411)

The best Swift position of this burst is the XRT position given in Beardmore et al. (GCN Circ. 10418) with RA-2000 = 23h 17m 34.04s, and Dec-2000 = +43° 22′ 44.1″ with an uncertainty of 2.2″.

Due to the small sun-angle only two optical follow-up observations were reported by Updike et al. (GCN Circ. 10415) and Sakamoto et al. (GCN Circ. 10425) who could not detect any new source down to limiting magnitudes of R=20 mag and R=17.5 mag, respectively.

2 BAT Observation and Analysis

At 22:27:48 UT on 2010-02-13, the Swift Burst Alert Telescope (BAT) triggered and located GRB 100213A (trigger=412217, Grupe et al. GCN Circ. 10411). Using the data set from T-61 to T+242 s, the BAT ground-calculated position is RA, Dec = 349.379, 43.370 deg with RA(J2000) = 23h 17m 31.0s Dec(J2000) = +43° 22′ 13.1″ with an uncertainty of 1.4 arcmin, (radius, sys+stat, 90% containment). The partial coding was 59% (Barthelmy et al. GCN Circ. 10424).

The mask-weighted light curve shows four spikes between T-0.7 and T+2.5 s plus a low level tail out to T+40 s. T90 (15-350 keV) is 2.4±0.4 s (estimated error including systematics).

Temporal analysis of BAT data for GRB 100213A suggests that the burst is likely a member of the short, hard class (Norris et al. GCN Circ. 10427). Structures in the burst’s most intense pulse complex are as short as 10-25 ms, typical of most short bursts. Spectral lag analysis of this most intense pulse complex indicate a lag between BAT channels 4 (100-350 keV) and 2 (25-50 keV) of 5 ms ±15 ms. For the whole event, the lag between these same channels is 15 ms ±15 ms.

A Bayesian Block analysis reveals no significant emission after the T90 duration of 2.4 s (reported in Bartheimy et al., GCN Circ. 10424), for 400 s following the BAT trigger time. This is inconsistent only at the 2σ level with the finding in GCN Circ. 10424 that there was "low level emission out to T+40 s", and we further note that this emission is only in the 15-25 keV band.

The time-averaged spectrum from T-0.7 to T+2.2 s is best fit by a single power law model. The power law index of the time-averaged spectrum is 1.34±0.15 (χ² = 74 for 57 d.o.f.). For this model the total fluence in the 15-150 keV band is 2.7 ±0.3 × 10⁻⁷ ergs cm⁻². The 1s peak photon flux measured from
T+0.01 s in the 15-150 keV band is $2.1 \pm 0.2$ 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/412217/BA/

Figure 1: BAT Light curve of GRB 100213A.
3 XRT Observations and Analysis

The XRT began observing the field of GRB 100213A at 22:29:00.9 UT, 72.7 seconds after the BAT trigger. Using 273 s of XRT Photon Counting (pc) mode data and 1 UVOT image for GRB 100213A, Beardmore et al. (GCN Circ. 10418) found an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 349.39183, +43.37892 which is equivalent to:

RA (J2000): 23h 17m 34.04s
Dec (J2000): +43° 22′ 44.1″


A spectrum formed from the pc mode data (274s exposure) can be fitted with an absorbed single power-law model with a photon spectral index of 2.04$^{+0.45}_{-0.56}$ (Grupe GCN Circ. 10414) with the absorption column density fixed to the Galactic value of 1.1×10$^{21}$ cm$^{-2}$ (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 4.5×10$^{-11}$ (5.9×10$^{-11}$) ergs cm$^{-2}$ s$^{-1}$.

The 0.3 – 10 keV light curve given below (Fig.2). The afterglow was only detected during the 274s observation in the first orbit. Because Swift detected and slewed to GRB 100213B (Vetere et al. GCN Circ. 10416) about half an hour after the detection of GRB 100212A, the afterglow was observed only for an additional 8.7 ks between 3 to 11 hours after the burst in which the X-ray afterglow could not be detected anymore. The 3σ upper limit in this data set is 2×10$^{-3}$ counts s$^{-1}$ (1.2×10$^{-13}$ ergs s$^{-1}$ cm$^{-2}$).

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 100213A 77 s after the BAT trigger (Grupe et al., GCN Circ. 10411). Curran & Grupe (GCN Circ. 10420) reported on no optical afterglow detected within the enhanced XRT error circle position (Beardmore et al., GCN Circ. 10418) in the initial UVOT exposure and in all other summed exposures 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 100213A. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight of $E_{B-V} = 0.31$ mag. All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).
Figure 2: XRT flux light curve of GRB 100213A in the 0.3-10 keV band. The approximate conversion is 1 count s$^{-1} = \sim 5.9 \times 10^{-11}$ ergs s$^{-1}$ cm$^{-2}$. 