Swift Observations of GRB 140320A
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1 Introduction

At $T = 02:12:45$ UT, the BAT triggered and located GRB 140320A (trigger=592544; Cannizzo et al, GCN 16000). Swift slewed immediately to the burst. The BAT on-board calculated location is (RA, Dec) = (281.857, -11.173) deg, which is $\{18h 47m 26s; -11° 10' 21''\}$ (J2000) with $\sigma = 3$ arcmin (radius, 90% containment, including systematic uncertainty). Initially it was thought that the BAT light curve showed a double-peaked structure with two peaks separated by $\sim 140$ s and a total duration of $\sim 150$ s, but Fermi/GBM observations showed the second peak was due to activity from the (nearby) bursting pulsar GRO J1744-28. The BAT peak count rate was $\sim 3700$ c s$^{-1}$ (15–350 keV), at $\sim T + 0$ s.

The burst was also seen by Fermi/GBM (Younes et al., GCN 16001). It triggered at $T_0 = 02:12:46.11$ UT. The double peaked structure seen with BAT with $\sim 150$ s separation was also visible, however, location analysis shows that the two peaks are unrelated. The first peak (trigger peak) is most likely due to a short/hard GRB located at (RA, Dec) $\approx (284.6, -5.0)$ deg, consistent with the BAT location. The second peak, at $T_0 + 150$ s, is much softer and localizes to (RA, Dec) $\approx (265.0, -28.0)$ deg, the location of the bursting pulsar GRO J1744-28, which is currently active. Analysis of the GBM light curve (Younes et al., GCN 16014) reveals a single pulse with $T_{90} = 1$ s (50–300 keV). The time-averaged spectrum from $T_0 - 0.32$ to $T_0 + 0.704$ s is well fit by a simple power law function with index of $-1.5 \pm 0.1$. The fluence (0.010 – 1 MeV) in this time interval is $(4.0 \pm 0.5) \times 10^{-7}$ erg cm$^{-2}$. The 0.064 s peak photon flux measured starting from $T_0 - 0.128$ s in the 0.010 – 1 MeV band is $5.0 \pm 1.0$ ph s$^{-1}$ cm$^{-2}$.

2 BAT Observation and Analysis

Using the data set from $T - 240$ to $T + 962$ s, further analysis was performed (Palmer et al., GCN 16020). The BAT ground-calculated position is (RA, Dec) = (281.843, -11.188) deg, which is $\{18h 47m 22.4s; -11° 11' 18.5''\}$ (J2000) with an uncertainty of 2.4 arcmin, (radius, sys+stat, 90% containment). The partial coding was 88%.

The mask-weighted light curve shows a double short-peaked structure starts at $\sim T - 0.1$ s. The second peak starts immediately at the end of the first peak at $\sim T + 0.3$ s, and ends at $\sim T + 0.4$ s. $T_{90}$ (15 – 350 keV) is $0.45 \pm 0.07$ s (estimated error including systematics).

The time-averaged spectrum from $T - 0.08$ to $T + 0.44$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is $1.24 \pm 0.36$. The fluence in the 15 – 150 keV band is $(4.9 \pm 1.0) \times 10^{-8}$ erg cm$^{-2}$. The 1–s peak photon flux measured from $T - 0.32$ s in the 15 – 150 keV band is $0.6 \pm 0.2$ ph cm$^{-2}$ s$^{-1}$. All the quoted errors are at the 90% confidence level.

As noted in the Fermi/GBM circular (Younes et al., GCN Circ. 16001), the pulse at $\sim T + 140$ s initially reported in Cannizzo, et al. (GCN Circ. 16000) is originated from a different source, the bursting pulsar GROJ1744-28. Therefore, GRB 140320A is a short burst.
3 XRT Observation and Analysis

5 ks of XRT data from 93 s to 11.8 ks (Page et al., GCN 16010) in PC mode reveals a faint, uncatalogued X-ray source with a mean count rate $(5.9 \pm 1.3) \times 10^{-3} \text{ c s}^{-1}$, at a position of $(\text{RA, Dec}) = \{281.85583, -11.19333\}$, which is $\{18\text{h 47m 25.4s}; -11^\circ 11' 36.9''\}$ (J2000) with an uncertainty of 5.3 arcsec (radius, 90% confidence). This is 73 arcsec from the initial BAT position, within the BAT error circle.

715 s of PC mode data and 1 UVOT image (Page et al., GCN 16011) yields an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): $(\text{RA, Dec}) = \{281.85530; -11.19412\}$, which is $\{18\text{h 47m 25.27s}; -11^\circ 11' 38.8''\}$ (J2000) with an uncertainty of 4.9 arcsec (radius, 90% confidence).

9.8 ks of XRT data (Page et al., GCN 16016) between $T + 93$ s and $T + 33.5$ ks shows that the X-ray source has faded, with a $3\sigma$ upper limit on the count rate centered at $T + 27$ ks of $1.2 \times 10^{-3} \text{ c s}^{-1}$, confirming this source as the X-ray afterglow.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 140320A $T + 3723$ s (Oates et al., GCN 16018). No optical afterglow consistent with the enhanced XRT position (Page et al., GCN Circ 16011) is detected in the initial UVOT exposures.

Preliminary $3\sigma$ upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc. 1358, 373) for the first finding chart (FC) exposure and subsequent exposures are:

<table>
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<th>$T_{\text{stop}}$</th>
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<td>5153</td>
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</table>

The magnitudes in the table are not corrected for the Galactic extinction due to the reddening of $E(B - V) = 0.51$ in the direction of the burst (Schlegel et al. 1998).
Figure 1: BAT Lightcurve. The light curve in the 4 individual plus total energy bands (15 – 25 keV, 25 – 50 keV, 50 – 100 keV, 100 – 350 keV, and 15 – 350 keV).

Figure 2: XRT Lightcurve. A weak X-ray source was detected, and it faded rapidly.