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 $T0$ =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 $T0+150$ 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 $T0-0.32$ to $T0+0.704$ s is well fit by a simple power law function with index of -1.5 ± 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 $T0 - 0.128$ s in the $0.010 - 1$ MeV band is $5.0 \pm 1.$ 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 ± 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 ± 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 ± 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 $(5.9 \pm 1.3) \times 10^{-3}$ c s^{-1}, at a position of (RA, Dec) = {281.85583, -11.19333}, which is {18h 47m 25.4s; -11° 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): (RA, Dec) = {281.85530; -11.19412}, which is {18h 47m 25.27s; -11° 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 3σ upper limit on the count rate centered at $T + 27$ ks of 1.2×10^{-3} 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 3σ 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:

Filter	T_start(s)	T_stop(s)	Exp(s)	Mag
v	3723	5358	393	>19.2
b	4543	10186	1149	>20.8
u	4338	5973	393	>19.7
w1	4133	5768	393	>19.8
m2	3928	5563	393	>20.0
w2	3518	5153	393	>20.2

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).

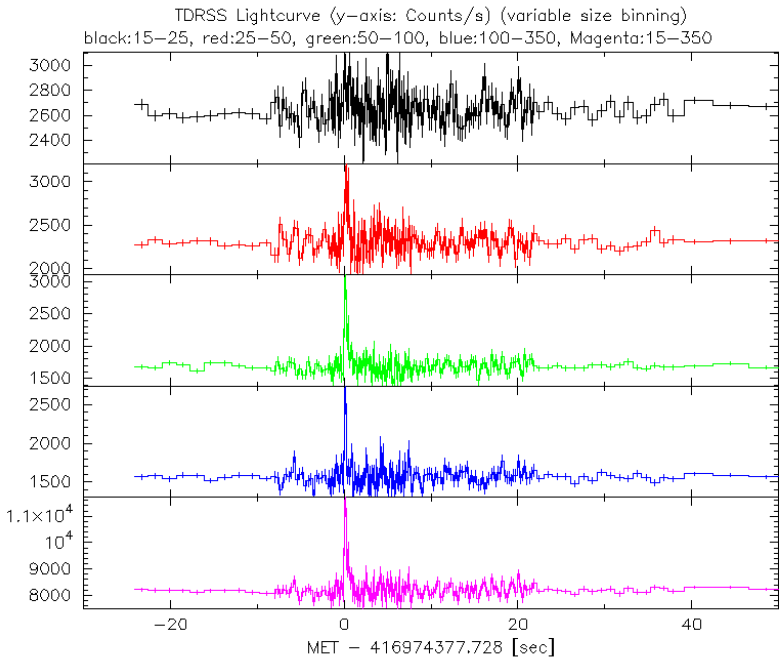

Figure 1: BAT Lightcurve. The light curve in the 4 individual plus total energy bands ($15-25$ keV, $25-50$ keV, $50-100$ keV, $100-350$ keV, and $15-350$ keV).

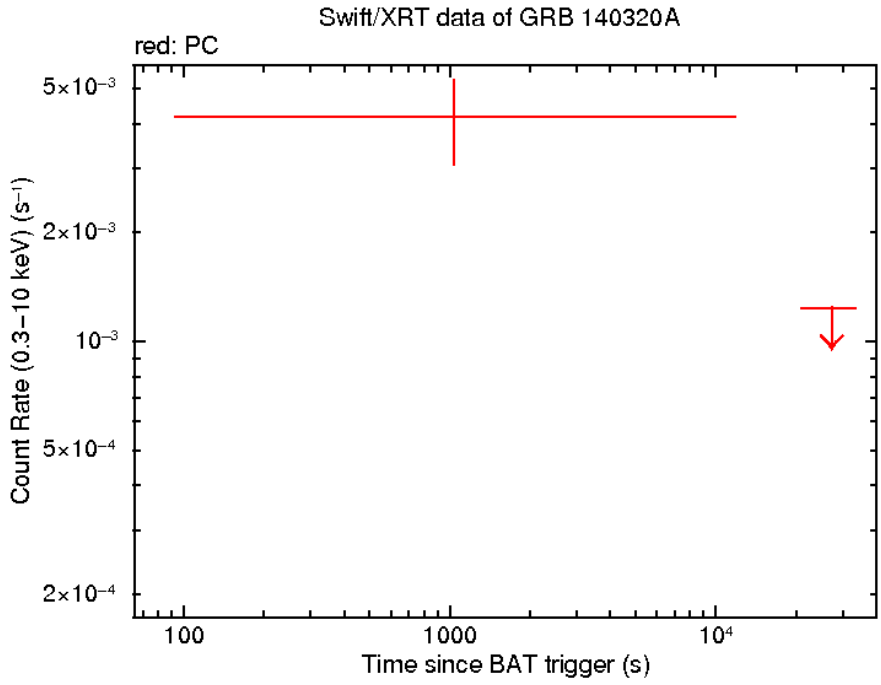

Figure 2: XRT Lightcurve. A weak X-ray source was detected, and it faded rapidly.