Swift Observation of GRB 090831C

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1 Introduction

BAT triggered on GRB 090831C at 21:30:25 UT (Trigger 361489) (Schady, et al., GCN Circ. 9854), and Swift slewed immediately to this burst. This was a 5.504 sec rate-trigger with a significance of 10.0. GRB 090831C was a long, single-peaked burst, with $T_{90} = 3.3 \pm 1.0$ sec. The afterglow was detected by the XRT, although there was no optical counterpart detected by the UVOT. Our best position is the XRT location, RA(J2000) = 108.29453 deg (07h13m10.69s), Dec(J2000) = −25.11859 deg (−25d07′06.9″) with a 90% error circle of 1.8 arcsec.

2 BAT Observation and Analysis

Using the data set from $T - 61$ to $T + 242$ sec, the BAT ground-calculated position is RA(J2000) = 108.294 deg (07h13m10.6s), Dec(J2000) = −25.112 deg (−25d06′44.0″) ± 2.1 arcmin, (radius, systematic and statistical, 90% containment) (Markwardt, et al., GCN Circ. 9863). The partial coding was 84%.

The masked-weighted light curve (Fig.1) consists of a single, roughly symmetrical peak. $T_{90}$ (15–350 keV) is 3.3 ± 1.0 sec (estimated error including systematics).

The time-averaged spectrum from $T + 0.6$ to $T + 4.9$ sec is best fitted by a simple power-law model. The power law index of the time-averaged spectrum is $\Gamma = 1.33 \pm 0.29$. The fluence in the 15–150 keV band is $(1.5 \pm 0.3) \times 10^{-7}$ erg cm$^{-2}$ and the 1-sec peak flux measured at $T + 1.94$ sec in the 15–150 keV band is $0.5 \pm 0.1$ ph cm$^{-2}$ sec$^{-1}$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The XRT began observations of GRB 090831C 117.5 sec after the BAT trigger and detected a fading, uncatalogued X-ray source. Using 3607 sec of XRT Photon Counting PC mode and three UVOT images for GRB 090831C, the astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is RA(J2000) = 108.29453 deg (07h13m10.69s), Dec(J2000) = −25.11859 deg (−25d07′06.9″) ± 1.8 arcsec (radius, 90% confidence).

The 0.3–10 keV light curve (Fig.2) has two flares at $T + 186$ sec and $T + 482$ sec, while the underlying decay can be modelled with a power-law decay index of $\alpha = 0.89^{+0.08}_{-0.10}$.

The X-ray spectrum, using 8.4 ks of Photon Counting data from 121 sec to 21.8 ks after the BAT trigger, is well fitted with an absorbed power-law spectrum with a photon spectral index of $\Gamma = 1.84^{+0.21}_{-0.15}$. The best-fitting absorption column is $3.254^{+1.001}_{-0.014}$ cm$^{-2}$, consistent with the Galactic value of $3.2 \times 10^{21}$ cm$^{-2}$ (Kalberla, et al., 2005). All errors are at the 90% confidence level.

4 UVOT Observation and Analysis

The UVOT began settled observations of the field of GRB 090831C 121 s after the BAT trigger (Schady, et al., GCN Circ. 9859). No new source was detected within the XRT error circle (Evans et al., GCN Circ 9855) in any of the individual or combined UVOT filters.
The 3σ upper limit magnitudes in the UVOT photometric system (Poole, et al., 2008) of detecting a source at the position of the X-ray afterglow in the first white band finding chart (fc) observations and in consecutive observations for each of the UVOT filters are given in Table 1.

Figure 1: BAT Light curve. The mask-weighted 1-sec light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and $T$ is 21:30:25 UT.
Figure 2: XRT Light curve. Counts/sec in the 0.3 – 10 keV band taken in Photon Counting mode. The power law fit is shown in black. The approximate conversion of the absorbed flux is 1 count/sec $= 4.9 \times 10^{-11}$ erg cm$^{-2}$ sec$^{-1}$.

Table 1: Magnitudes from UVOT observations. The values quoted are not corrected for the expected Galactic extinction corresponding to the large reddening of $E$(B-V)$=0.38$ mag in the direction of the burst (Schlegel, Finkbeiner & Davis, 1998).