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 1.33 ± 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 ± 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 3.2×10^{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 3 σ 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.
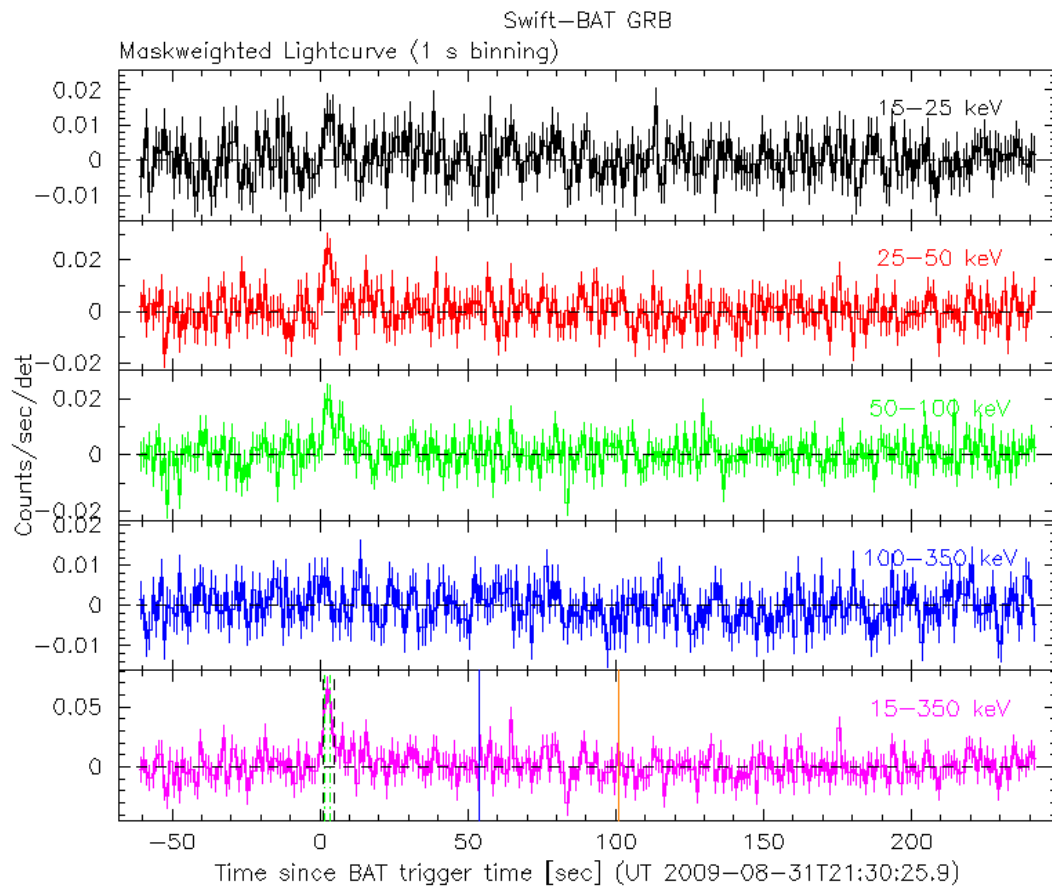

Figure 1: BAT Light curve. The mask-weighted 1-sec light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T is 21:30:25 UT.
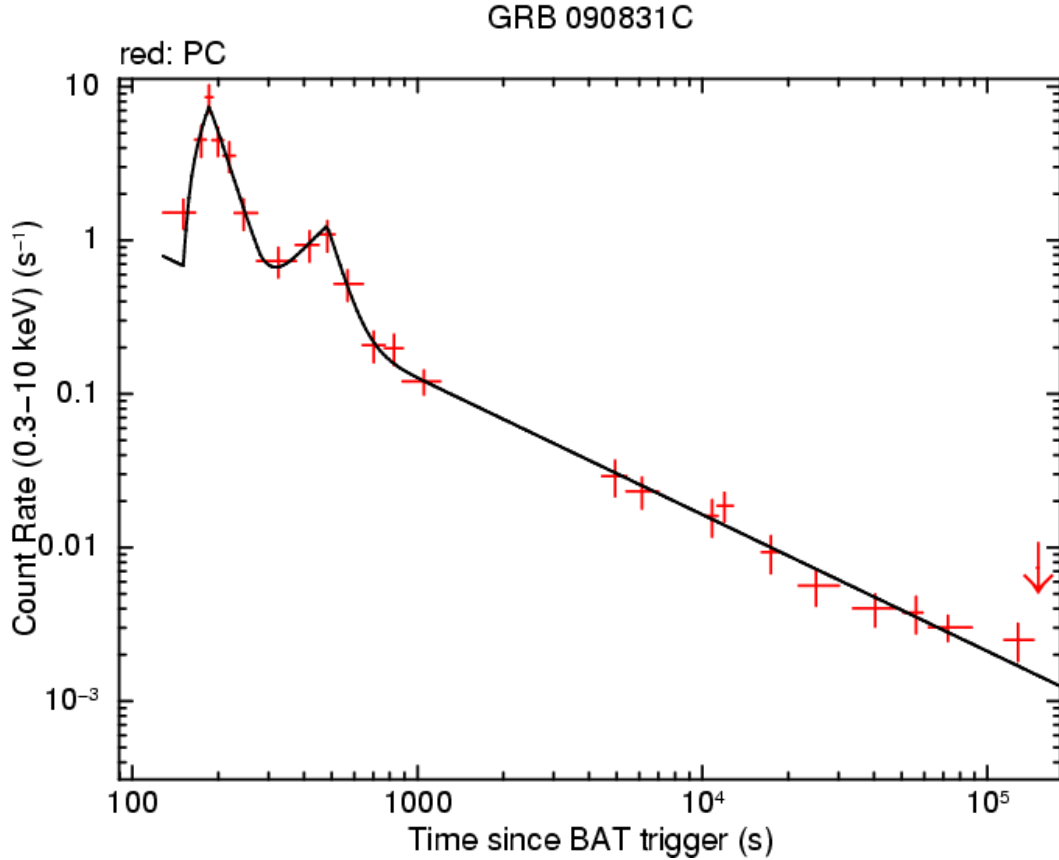
GRB 090831C

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}.

Filter	T_{start} (sec)	T_{stop} (sec)	Exposure (sec)	$3\,\sigma$ UL
white (fc)	121	270	147	> 20.78
white	561	1183	206	> 20.73
v	610	1060	58	> 18.47
b	536	1159	58	> 19.30
u	279	1134	285	> 19.95
uvw1	660	1109	58	> 18.74
uvm2	635	1084	58	> 18.48
uvw2	586	1209	78	> 18.95

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).