Swift Observation of GRB 081008

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1 Introduction

BAT triggered on GRB 081008 at 19:58:09 UT (Trigger 331093) (Racusin, *et al.*, *GCN Circ.* 8344). This was a rate-trigger with $T_{90} = 185.5$ *sec*. Swift slewed to this burst immediately and XRT began follow-up observations at $T+87$ *sec*, and UVOT at $T+96$ *sec*. Our best position is the UVOT location RA($J2000$) $= 279.95833 deg$ ($18h39m49.877s$), Dec($J2000$) $= -57.431111 deg$ ($-57d25'52.87''$) with an uncertainty of 0.6 arcsec (radius, 90% confidence).

2 BAT Observation and Analysis

Using the data set from $T - 240$ to $T + 963$ *sec*, further analysis of GRB 081008 was performed by the Swift team (Palmer, *et al.*, *GCN Circ.* 8351). The BAT ground-calculated position is RA($J2000$) $= 279.968 deg$ ($18h39m52.4s$), Dec($J2000$) $= -57.433 deg$ ($-57d25'58.8''$) with an uncertainty of 1.1 *arcmin*, (radius, systematic and statistical, 90% containment). The partial coding was 81%.

The masked-weighted light curves (Fig.1) start at trigger time T showing two strong peaks at $T+0$ *sec* and $T + 110$ *sec*. $T_{90}(15 - 350 \ keV)$ is 185.5 ± 40.3 (estimated error including systematics).

The time-averaged spectrum from $T - 65$ to $T + 201$ *sec* is best fitted by a simple power law model. A cutoff-power law model is also an acceptable fit with an E_{peak} of 88 *keV*. The power law index of the time-averaged spectrum is 1.69 ± 0.07. The fluence in the $15 - 150 \ keV$ band is $(4.3 \pm 0.2) \times 10^{-6} ergs/cm^2$ and the 1-sec peak flux measured from $T + 7.52$ *sec* in the $15 - 150 \ keV$ band is $1.3 \pm 0.1 \ ph/cm^2/sec$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using 8661 *sec* of XRT Photon Counting mode data and 8 UVOT images for GRB 081008, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA($J2000$) $= 279.95776 deg$ ($18h39m49.86s$), Dec($J2000$) $= -57.43188 deg$ ($-57d25'54.8"$) with an uncertainty of 1.4 arcsec (radius, 90% confidence). This position is within 3.2 *arcsec* of the initial XRT position, and 3.0 *arcsec* from the optical afterglow candidate, reported by Schady *et al.*(*GCN Circ.* 8348).

The $0.3 - 10 \ keV$ light curve (Fig.2) shows an initial steep decline with a slope of $10.1^{+1.3}_{-1.5}$, followed by a shallow slope of 0.9 ± 0.1, beginning at $T + 296 \pm 17$ *sec*. At $(15.4^{+8.2}_{-7.3}) \times 10^3$ *sec* the light curve breaks with a slope of $1.8^{+0.5}_{-0.3}$ ($\chi^2/dof = 47.4/84$).

The Window Timing (WT) mode spectrum can be modeled with an absorbed power-law with photon index of 1.81 ± 0.03, intrinsic N_H column density of $(6.7 \pm 0.7) \times 10^{21} \ cm^{-2}$ at a redshift of $z = 1.967$ (Cucchiara *et al.*, *GCN Circ.* 8346), and a Galactic N_H of $7.1 \times 10^{20} \ cm^{-2}$. The Photon Counting (PC) mode spectrum can be modeled with an absorbed power-law with photon index of $1.91^{+0.08}_{-0.08}$, intrinsic N_H column density of $(5.7^{+14.1}_{-5.7}) \times 10^{20} \ cm^{-2}$ at a redshift of $z = 1.967$ and the Galactic N_H. The average observed (unabsorbed) flux over $0.3 - 10 \ keV$ for the WT spectrum (93-410 seconds after the BAT trigger) is 3.1×10^{-9} (3.9×10^{-9}) $ergs/cm^2/sec$. The average observed (unabsorbed) flux over $0.3 - 10 \ keV$ for the PC spectrum ($420 - 6.9 \times 10^4$ seconds after the BAT trigger) is 3.4×10^{-11} (4.0×10^{-11}) $ergs/cm^2/sec$.
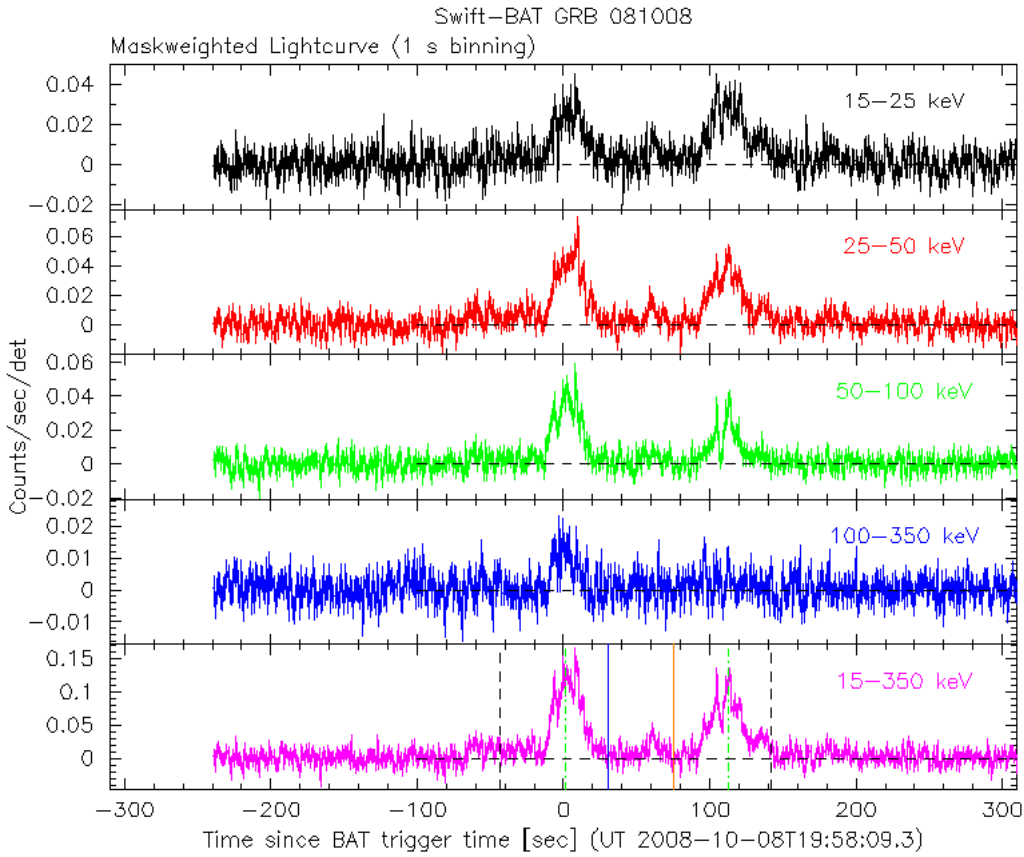
Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 19:58:09 UT.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 081008 96 *sec* after the BAT trigger (Schady *et al.*, *GCN Circ.* 8348). A new fading source was detected at the ROTSE position (Rykoff *et al.*, *GCN Circ.* 8343) in the white, v, b, u and uvw1 filters, consistent with a redshift of z=1.967 reported by Cucchiara *et al.*(*GCN Circ.* 8346). The light curve is best fit by a broken power-law with $\alpha_1 = 0.73 \pm 0.01$, $t_{break} = 3250^{+655}_{-711}$, and $\alpha_2 = 1.33 \pm 0.11$ (90% confidence). The UVOT refined position is RA($J2000$) = 279.95833deg (18h39m49.877s), Dec($J2000$) = $-57.431111deg$ ($-57d25'52.87$") with an estimated uncertainty of 0.6 *arcsec* (radius, 90% confidence).

The UVOT multiband light curve normalized to the white band filter (Fig. 3) is not corrected for the Galactic extinction corresponding to a reddening of E(B-V) = 0.10 mag (Schlegel et al., 1998, ApJS, 500, 525).

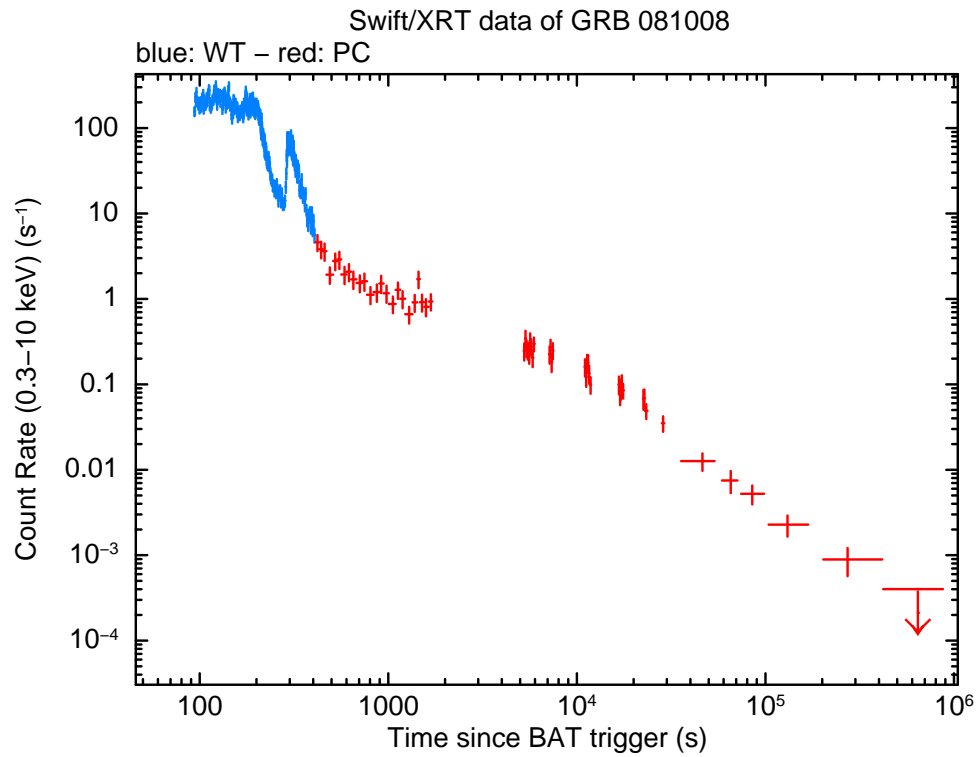Swift/XRT data of GRB 081008

blue: WT – red: PC

Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is 1 count/sec = $\sim 5.0 \times 10^{-11}$ $ergs/cm^2/sec$.
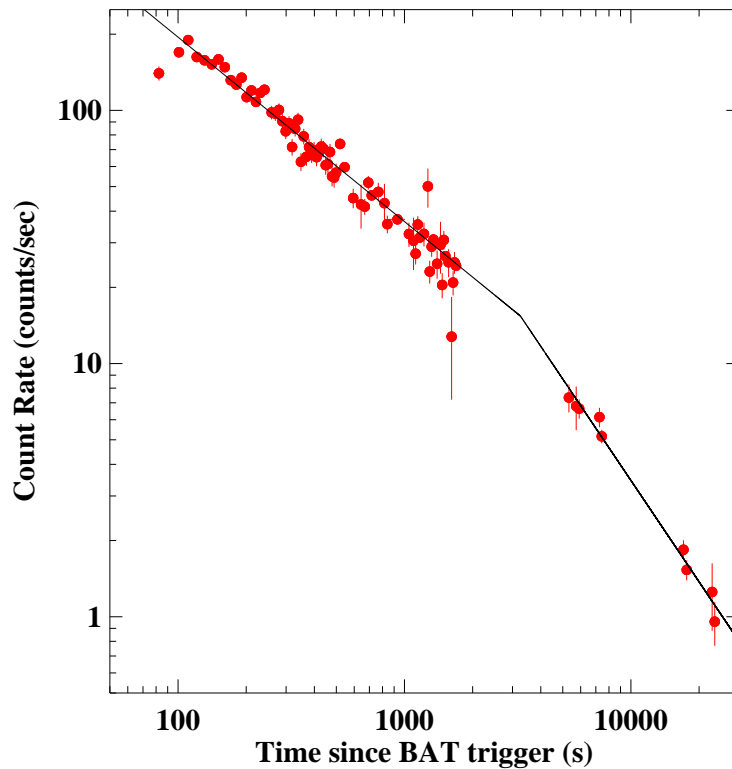

Figure 3: UVOT multiband light curve normalized to the white band filter in observed Counts/sec. The optical transient was detected in white, v, b, u, and uvw1.