

## Swift Observation of GRB 080916B

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### 1 Introduction

At 14:44:47 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 080916B (trigger=324907)(Stratta, et al., *GCN Circ.* 8240). The BAT light curve showed a multi-peaked structure with a duration of about 50 sec. The peak count rate was  $\sim 750$  counts/sec (15-350 keV), at  $\sim 0$  sec after the trigger. Due to the Earth-limb observing constraint, Swift did not slew until  $T + 18.9$  minutes and no XRT or UVOT data are available before this time. The X-ray afterglow was clearly detected while the optical counterpart was inferred by UVOT with a detection in the white filter only. No detection from ground-based facilities has been reported.

### 2 BAT Observation and Analysis

Using the data set from  $T - 239$  to  $T + 617$  sec the BAT ground-calculated position is RA, Dec = 163.632, 69.061 deg, which corresponds to RA(J2000) =  $10^h 54^m 31.6^s$  and Dec(J2000) =  $+69^d 03' 38.2''$  with an uncertainty of 2.1 arcmin (radius, sys+stat, 90% containment). The partial coding was 53%.

The mask-weighted light curve shows a weak FRED-like peak starting at  $\sim T - 4$  sec, peaking at  $\sim T + 3$  sec, and ending at  $\sim T + 50$  sec. There is a possibility of very weak emission lasting out to at least  $T + 350$  sec, at which time the spacecraft slewed away from the burst location (Figure 1).  $T_{90}$  (15-350 keV) is  $32 \pm 8$  sec (estimated error including systematics).

The time-averaged spectrum from  $T - 3.3$  to  $T + 35.7$  sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is  $1.49 \pm 0.23$ . The fluence in the 15-150 keV band is  $(6.3 \pm 0.9) \times 10^{-7}$  erg  $\text{cm}^2$ . The 1-sec peak photon flux measured from  $T + 3.30$  sec in the 15-150 keV band is  $0.6 \pm 0.2$  ph  $\text{cm}^2 \text{sec}^{-1}$ . All the quoted errors are at the 90% confidence level (Barthelmy et al., *GCN Circ.* 8250).

### 3 XRT Observations and Analysis

Using 1049 s of XRT Photon Counting mode data and 1 UVOT images for GRB 080916B, the astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is: RA, Dec = 163.66512, +69.06545 which is equivalent to RA (J2000):  $10^h 54^m 39.63^s$  and Dec (J2000):  $+69^d 03' 55.6''$  with an uncertainty of 5.1 arcsec (radius, 90% confidence) (Goad et al., *GCN Circ.* 8247).

During the first two orbits of Swift XRT data of GRB 080916B, consisting of 2.8 ks of Photon Counting data collected starting from  $T_0+1.4$  ks to  $T_0+8.5$  ks, the source shows a fading behaviour from 0.08 counts/s to 0.02 counts/s. Assuming a power law model,  $F(t) \propto t^{-\alpha}$ , the best fit decay index is  $\alpha = 1.0 \pm 0.2$  (Figure 2).

The 0.3-10 keV spectrum (2.8 ks of integration time) is consistent with an absorbed power law model. Fixing the column density to the Galactic value ( $N_H = 1.8 \times 10^{20} \text{ cm}^{-2}$  from Kalberla et al. 2007) the best fit photon index is  $2.0 \pm 0.5$ . The average 0.3-10.0 keV observed flux for this spectrum is  $(1.0 \pm 0.6) \times 10^{-12}$  erg  $\text{cm}^{-2} \text{s}^{-1}$  which corresponds to an unabsorbed flux of  $1.1 \times 10^{-12}$  erg  $\text{cm}^{-2} \text{s}^{-1}$ .

The count to observed flux conversion factor is  $6.6 \times 10^{-11}$  erg cm $^{-2}$  count $^{-1}$  (Stratta et al., *GCN Circ.* 8260).

## 4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 080916B, 1359s after the BAT trigger (Stratta et al., *GCN Circ.* 8240). There is a possible detection of an afterglow in the UVOT white filter at RA (J2000)  $10^h 54^m 39.78^s$  and Dec (J2000)  $69d 3' 57.9''$  with an estimated uncertainty of 0.8 arcsec (radius, 90% confidence). This position is consistent with the UVOT enhanced XRT position (Goad et al., *GCN Circ.* 8247). The afterglow candidate does not appear in the DSS images, and photometry from the second orbit of Swift observations suggests that it has faded. UVOT magnitudes and 3-sigma upper limits are reported in the following table. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight of  $E_{B-V} = 0.02$  mag. All photometry is on the UVOT flight system described in Poole et al. (2008, *MNRAS*, 383, 627) (Hoversten et al., *GCN Circ.* 8252).

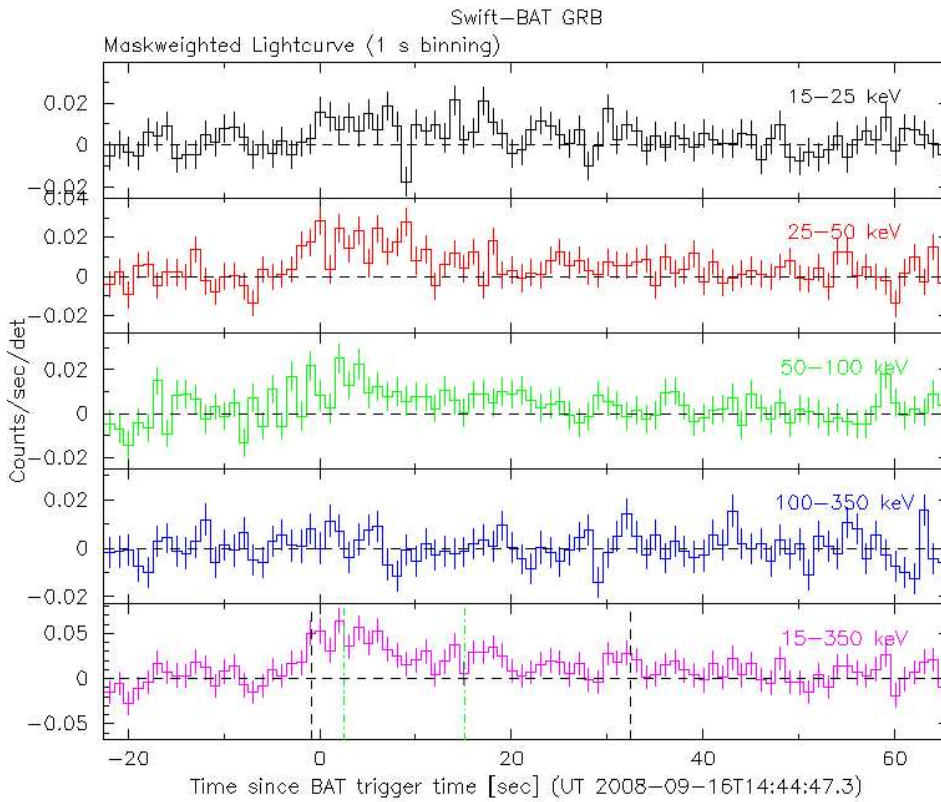


Figure 1: BAT Light curve. The mask-weighted 1-s binned light curve in the 4 individual plus total energy bands. The units are counts s $^{-1}$  illuminated-detector $^{-1}$  (note illum-det = 0.16 cm $^2$ ).

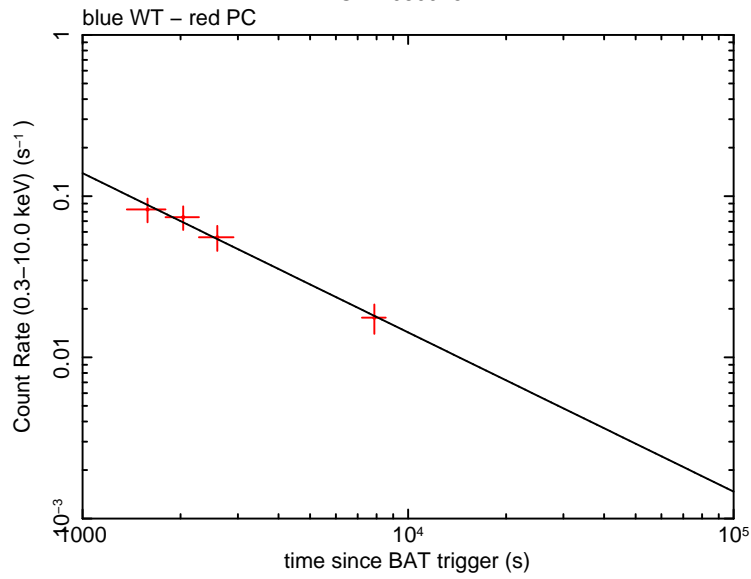


Figure 2: XRT Lightcurve. Counts  $s^{-1}$  in the 0.3-10 keV band taken in Photon Counting mode. The count rate to flux conversion factor is  $1 \text{ count } s^{-1} \sim 6.6 \times 10^{-11} \text{ erg cm}^{-2} s^{-1}$ .

Filter	T_start (s)	T_stop (s)	Exp (s)	magnitudes
white	1359.0	1458.8	98.2	$20.50 \pm 0.21$
white	7826.0	8025.7	196.6	$> 21.27$
v	1340.9	2920.7	342.1	$> 19.62$
b	1516.3	2676.5	155.6	$> 20.32$
u	1491.6	2651.7	155.6	$> 19.91$
uvw1	1467.3	2627.3	155.5	$> 19.91$
uvm2	1604.9	3076.8	285.0	$> 20.06$
uvw2	1556.0	2716.0	155.5	$> 19.91$

Table 1: Apparent magnitudes and  $3\sigma$  upper limits from UVOT observations.