Swift Observation of GRB 080516

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1 Introduction

BAT triggered on GRB 080516 on 2008 May 16 at 00:17:07 UT (Trigger 311762) (Holland, *et al.*, GCN Circ. 7733). This was a long burst with $T_{90} = 5.8 \pm 0.3$ s. *Swift* slewed to this burst immediately. XRT began follow-up observations at $T + 82.9$ s. UVOT began follow-up observations at $T + 81$ s. Our best position is the UVOT-enhanced XRT location, RA, Dec (J2000.0) = 120.°64196, −26.°15962, which corresponds to

RA (J2000.0) = $05^{\rm h}37^{\rm m}19\overset{\rm s}{.}14$
Dec (J2000.0) = $+05°05'05\overset{''}{.}4$

with an uncertainty of $1\overset{''}{.}7$ (radius, 90% containment).

An optical afterglow was discovered by GROND (Filgas *et al.*, 2008a, GCN Circ. 7740). The photometric redshift of the afterglow is $z_{\rm ph} = 3.2 \pm 0.3$ (Filgas *et al.*, 2008b, GCN Circ. 7747).

The Burst Advocate for this burst is Stephen Holland (`Stephen.T.Holland@nasa.gov`). Please contact the Burst Advocate by e-mail if you require additional information regarding *Swift* follow-up observations of this burst. In extremely urgent cases, after trying the Burst Advocate, you can contact the *Swift* PI by phone (see the *Swift* ToO Web site for information: `http://www.swift.psu.edu/too.html`).

2 BAT Observation and Analysis

Using the data set from $T - 240$ to $T + 962$ s we report our analysis of GRB 080516 (trigger 311762). The BAT ground-calculated position is RA, Dec (J2000.0) = 120.°661, −26.°146, which corresponds to

RA(J2000.0) = $08^{\rm h}02^{\rm m}38\overset{\rm s}{.}7$
Dec(J2000.0) = $+26°08'47''$

with an uncertainty of $2\overset{'}{.}1$, (radius, systematic + statistical errors, 90% containment). The partial coding was 38%.

The mask-weighted light curves (Fig. 1) show two well-separated peaks. The first peak starts at $T - 0.1$ s, peaks at $T + 0.3$ s, and ends at $T + 1.0$ s. The second peak starts at $T + 3.5$ s. peaks at $T + 5.5$ s, and ends at $T + 7.5$ s. T_{90} (15–350 keV) = 5.8 ± 0.3 s (estimated error including systematics).

The time-averaged spectrum from $T + 0.1$ to $T + 6.1$ s is best fit by a simple power-law model. The power-law index of the time-averaged spectrum is 1.82 ± 0.27. The fluence in the 15–150 keV band is $(2.6 \pm 0.4) \times 10^{-7}$ erg cm^{-2}. The 1-s peak photon flux measured from $T + 0.05$ s in the 15–150 keV band is 1.8 ± 0.3 ph cm^{-2} s^{-1}. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The *Swift*/XRT began observing GRB 080516 at 00:18:30 UT, 83 s after the BAT trigger. The UVOT-enhanced position is RA, Dec (J2000.0) = 120.°64196, −26.°15962, which corresponds to

RA (J2000.0) = $08^{\rm h}02^{\rm m}34\overset{\rm s}{.}07$
Dec (J2000.0) = $-26°09'34\overset{''}{.}6$

with an uncertainty of $1\overset{''}{.}7$ (radius, 90% containment).

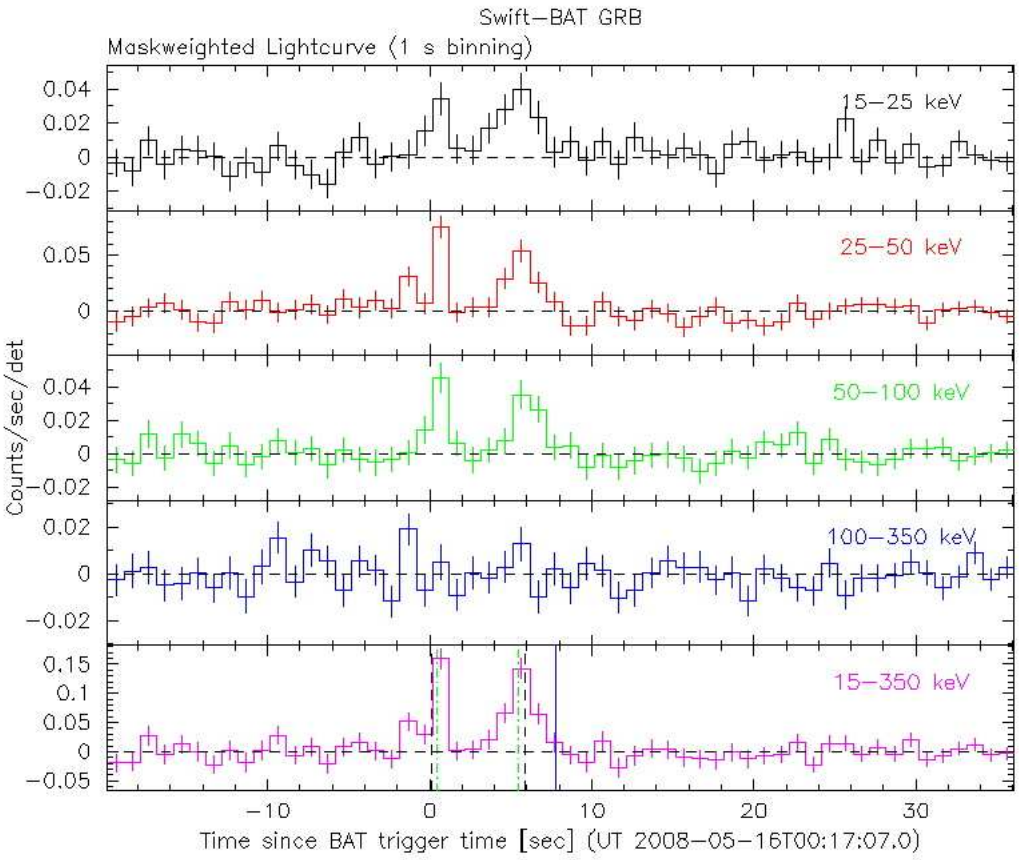

Figure 1: BAT light curves. The mask-weighted 1 s light curves in the four individual plus total energy bands. The units are count s^{-1} illuminated-detector^{-1} and T_0 is 00:17:07.0 UT.

The light curve begins relatively flat with a decay index of $\alpha_1 \sim -0.36 \pm 0.17$ until approximately 4800 s after the BAT trigger, at which point the slope steepens to $\alpha_2 = -1.04^{+0.20}_{-0.18}$ (see Fig. 2).

The first five orbits of Photon Counting mode can be modelled with an absorbed power law of photon index $\Gamma = 2.7 \pm 0.4$ and a total absorbing column of $N_{\rm H} = (1.3 \pm 0.3) \times 10^{22}$ cm^{-2}, which is considerably in excess of the Galactic value of 3.22×10^{21} cm^{-2}. Using the relation in Grupe *et al.* (2007, ApJ, 133, 2216), this implies an estimated upper limit on the redshift of the burst of $z < 1.0$. There is no evidence for spectral evolution across the temporal break. The observed (unabsorbed) flux over the time interval $T+90$ s to $T+25$ ks is 2.38×10^{-12} (1.06×10^{-11}) erg cm^{-2} s^{-1}. The counts to observed flux conversion is 5.8×10^{-13} erg cm^{-2} count^{-1}.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 080516 starting at $T + 81$ s. No source is detected in any of the UVOT observations at the location of the GROND afterglow (Filgas *et al.*, 2008 GCN Circ. 7740). The GROND position is $10\farcs6$ from the USNO-B1.0 star 638-018182, which has a magnitude of $B = 12$. The afterglow is located in the scattered light halo, and in the coincidence loss pattern of this star, which makes our photometry (presented in Table 1) somewhat uncertain. These upper limits are not corrected for the Galactic extinction along the line of sight to

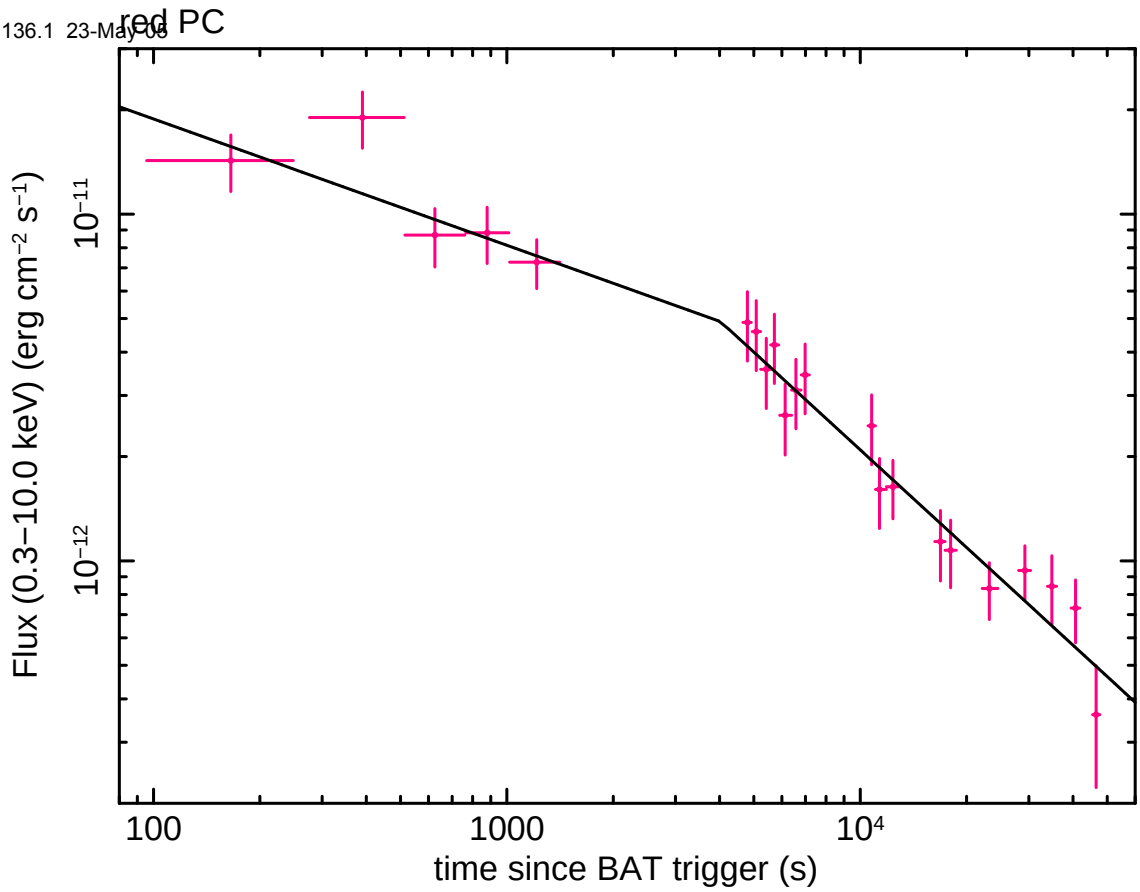

Figure 2: XRT light curve in erg cm^{-2} s^{-1} in the 0.3–10 keV band: Photon Counting mode (red).

the source corresponding to a reddening of $E_{B-V} = 0.40$ mag (Schlegel *et al.*, 1998, ApJS, 500, 525). The photometry is on the UVOT flight system described in Poole *et al.*, (2008, MNRAS, 383,627).

Filter	$T_{\rm start}$	$T_{\rm stop}$	Exp(s)	UL	
v	81	41 277	2950	> 21.1	3-σ UL
b	560	47 700	2243	> 22.2	3-σ UL
u	536	47 184	4409	> 22.3	3-σ UL
uvw1	511	46 278	4913	> 22.1	3-σ UL
uvm2	486	41 915	3648	> 22.1	3-σ UL
uvw2	576	40 364	2223	> 21.8	3-σ UL

Table 1: UVOT 3-σ upper limits. $T_{\rm start}$ and $T_{\rm stop}$ are the times, in seconds since the BAT trigger, of the start and stop of the observations. Exp is the total exposure time during the observation.