Swift Observations of GRB 080307

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1 Introduction

BAT triggered on GRB 080307 at 11:23:30 UT (Trigger 305011) (Holland *et al.*, 2008, *GCN Circ.* 7362). This was a long burst with $T_{90} = 125.9 \pm 24.6$ s. *Swift* slewed to this burst immediately. XRT began follow-up observations at $T + 99$ s, and UVOT began follow-up observations at $T = 105$ s. Our best position is the UVOT-enhanced XRT location, RA(J2000) = 136.°62799 ($09^{\rm h}06^{\rm m}30.^{\rm s}72$), Dec(J2000) = +35.°13896 ($+35°08'20.''3$) with an error of $1.''8$ (radius, 90% containment). This position agrees with the ground-based position found by Gemini North (Tanvir *et al.*, 2008, *GCN Circ.* 7369).

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 $T - 239$ to $T + 963$ s we report our analysis of GRB 080307 (Holland *et al.*, 2008 *GCN Circ.* 7362). The BAT ground-calculated position is RA, Dec = 136.°629, +35.°151, which is RA(J2000) = $09^{\rm h}06^{\rm m}31.^{\rm s}0$, Dec(J2000) = $+35°09'04''$, with an uncertainty of $1.'6$ (radius, systematic+statistical, 90% containment). The partial coding was 81%.

The mask-weighted light curves (Fig. 1) show a FRED-like peak starting at $T + 0$ s and ending at around $T + 140$ s. A strong spectral evolution can be seen in the BAT's four energy band light curves. T_{90} (15–350 keV) = 125.9 ± 24.6 s (estimated error including systematics).

The time-averaged spectrum from $T + 1.7$ to $T + 146.1$ s is best fit by a simple power-law model. The power-law index of the time-averaged spectrum is 1.78 ± 0.21. The fluence in the 15–150 keV band is $(8.7 \pm 1.2) \times 10^{-7}$ erg cm^{-2}. The 1-s peak photon flux measured from $T + 1.90$ s in the 15–150 keV band is 0.4 ± 0.1 ph cm^{-2} s^{-1}. All the quoted errors are at the 90% confidence level.

This burst satisfies Sakamoto/Ukwatta Swift/BAT possible high-z criteria (Ukwatta *et al.*, arXiv:0802.3815):

1. The power-law photon index (= 1.78) is less than 2,
2. The 1-s peak photon flux (= 0.4) is less than 1.0 ph cm^{-2} s^{-1},
3. The light curve variance (= 9.4×10^{-6}) is less than 0.0001,
4. The T_{90}/Peak_photon_flux (= 350) is greater than 100.

Based on a limited sample of bursts, these criteria yield an 85% chance it has $z > 3.5$.

3 XRT Observations and Analysis

The *Swift*/XRT began observing GRB 080307 at 11:25:10 UT, 99 s after the BAT trigger. The UVOT-enhanced position is RA, Dec (J2000) = 136.°62799, +35.°13896, which is RA(J2000) = $09^{\rm h}06^{\rm m}30.^{\rm s}72$, Dec(J2000) = $+35°08'20.''3$, with an estimated uncertainty of $1.''8$ (radius, 90% containment).

In the first orbit of the XRT data, the emission rises slowly, peaking at $T + 240^{+11}_{-15}$ s after the BAT trigger. The best model for the light curve is a linear rise followed by an exponential decay with an

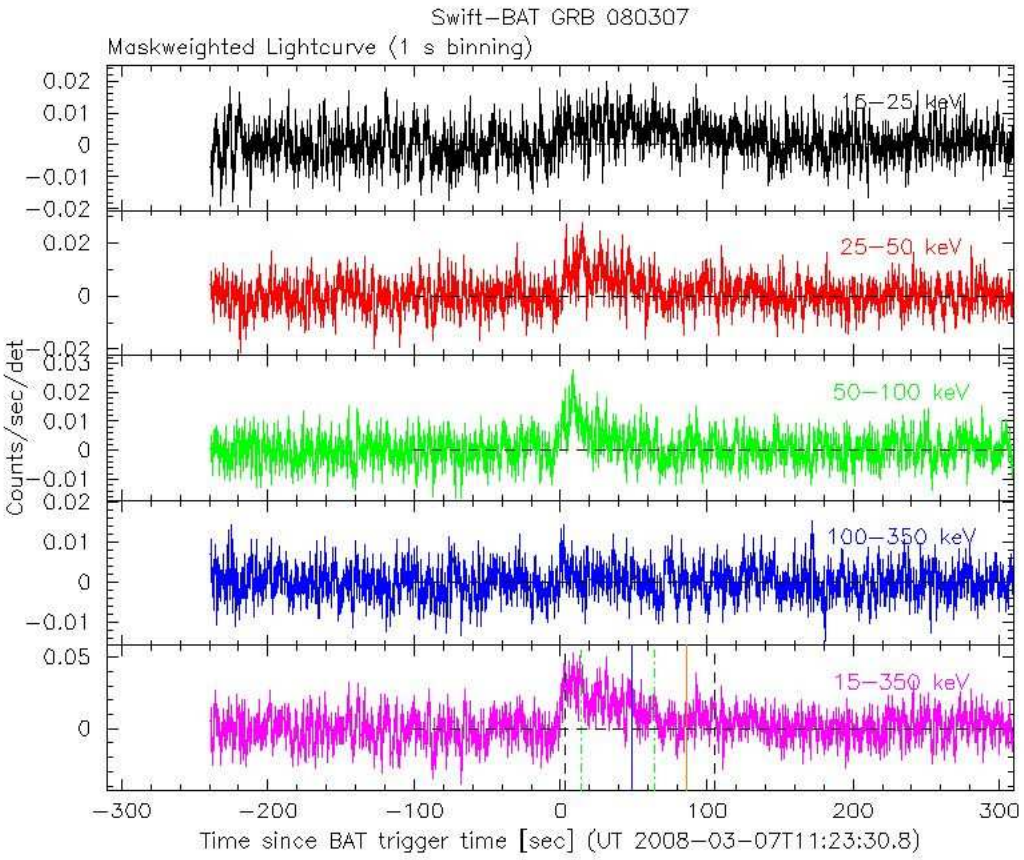

Figure 1: BAT light curves. The mask-weighted 1-s light curves in the four individual plus total energy bands. The units are count s^{-1} illuminated-detector^{-1} and T_0 is 11:23:30.8 UT.

e-folding time of 238^{+18}_{-15} s, which is followed by a broken power law decay with $\alpha_1 = +1.35^{+0.08}_{-0.11}$, a break at $T + 40^{+37}_{-9}$ ks, and $\alpha_2 = +0.49^{+0.10}_{-0.19}$. The shape of the early light curve is reminiscent of GRB 060218 (Campana, S. *et al.*, 2006, Nature, 442, 1008).

As the X-ray emission rises, it also softens. The hardness ratio then becomes close to constant as the light curve decay sets in. The PC data at the end of the first orbit can be fitted with an absorbed power law, with $\Gamma = 1.74^{+0.23}_{-0.21}$ and $N_{\rm H} = 1.5^{+0.8}_{-0.6} \times 10^{21}$ cm^{-2}, which is in excess of the Galactic value of 2.37×10^{20} cm^{-2}. The relation in Grupe *et al.* (2007, AJ, 133, 2216) indicates that $z < 4.0$.

The mean observed (unabsorbed) flux for the PC data at the end of the first orbit (615–1030 s) is 7.86×10^{-11} (9.83×10^{-11}) erg cm^{-2} s^{-1}.

4 UVOT Observation and Analysis

UVOT observed the field of GRB 080307 starting at $T + 105$ s. No source is detected in any of the UVOT observations at the location of the Gemini-North source (Tanvir, 2008 *GCN Circ.* 7369). The 3-sigma upper limits for detecting a source at this location in the co-added images are listed in Table 1. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight corresponding to a reddening of $E_{B-V} = 0.03$ mag. All photometry is on the UVOT flight system described in Poole et al. (2008, MNRAS, 383, 627).

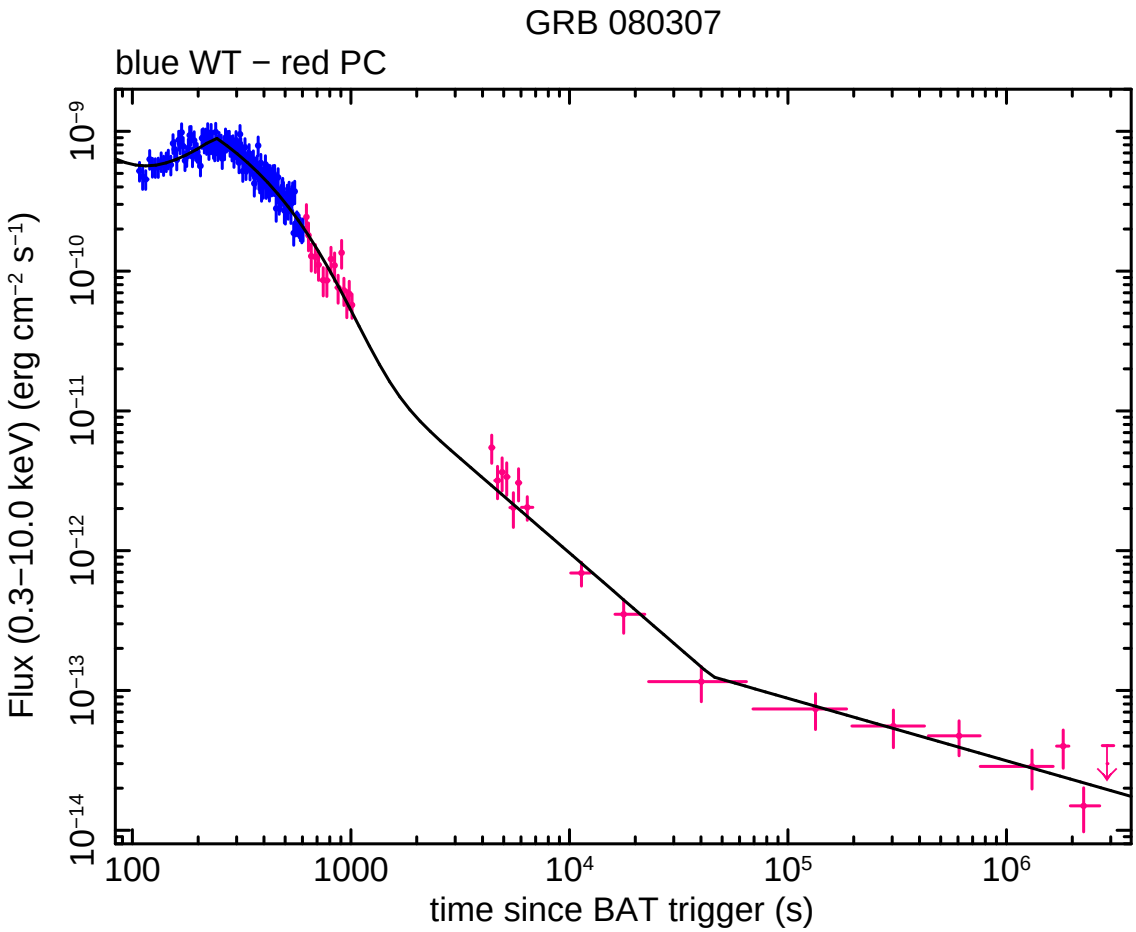

Figure 2: XRT flux light curve in count s^{-1} in the 0.3–10 keV band: Window Timing mode (blue) and Photon Counting mode (red). The corresponding counts to (observed) flux conversion is 1 count $s^{-1} = 4.9 \times 10^{-11}$ erg cm^{-2} s^{-1}.

Filter	T_{start}	T_{stop}	Exp(s)	UL
v	212	5754	676	> 20.7
b	691	6574	412	> 21.4
u	666	6369	432	> 21.1
uvw1	642	6164	432	> 20.9
uvm2	618	5959	413	> 20.6
uvw2	721	6816	245	> 20.7
white	105	6779	599	> 22.3

Table 1: UVOT 3-σ upper limits. T_{start} and T_{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.