

## Swift Observation of GRB 080903

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### 1 Introduction

At 01:12:23 UT on 2008 September 03, the Swift Burst Alert Telescope (BAT) triggered on GRB 080903 (Grupe et al. *GCN Circ.* 8169). *Swift* slewed promptly and the *Swift* XRT and UVOT began observing the field of GRB 080903 58 s after the burst. A bright X-ray afterglow was discovered with the XRT. The best *Swift* position of the afterglow is from the UVOT at RA (J2000) = 05h 47m 10.07s, Dec (J2000) = +51°15'51.0" which is consistent with the position of the optical afterglow reported by de Ugarte Postigo et al. (*GCN Circ.* 8172).

### 2 BAT Observation and Analysis

At 01:12:23 UT on 2008 September 03, the Swift BAT triggered on GRB 080903 (trigger #323542). The BAT ground-calculated position is RA, Dec = 86.790, +51.256 deg (Tueller et al. *GCN Circ.* 8176), which is

$$\text{RA(J2000)} = 05\text{h } 47\text{m } 09.6\text{s}$$

$$\text{Dec(J2000)} = +51^\circ 15' 22.4''$$

with an uncertainty of 1.0' (radius, 90% containment, including systematic uncertainty). The partial coding was 100%. The mask-weighted light curve shows a single FRED peak starting at T-5 s and ending at T+80 s. There appears to be very low level emission out to T+500 s.  $T_{90}$  (15-350 keV) is 66±11 s (estimated error including systematics).

The time-averaged spectrum from T-10.5 to T+68.0 s is best fit by a power-law with an exponential cut-off. This gives a photon index  $\Gamma=0.84\pm0.52$  and a peak energy  $E_{\text{peak}}=60\pm15$  keV ( $\chi^2/\nu=63/56$ ). The fluence in the 15-150 keV band is  $(1.4\pm0.1)\times10^{-6}$  ergs  $\text{cm}^{-2}$ . The 1s peak photon flux measured from T-2.46 s in the 15-150 keV band is  $(0.8\pm0.1)$  photons  $\text{cm}^{-2}$   $\text{s}^{-1}$ . A fit with a simple power law model gives a photon index  $\Gamma=1.72\pm0.10$  ( $\chi^2/\nu=73/57$ ). All the quoted errors are at the 90% confidence level. The results of the batgrbproduct analysis are available at [http://gcn.gsfc.nasa.gov/notices\\_s/323542/BA/](http://gcn.gsfc.nasa.gov/notices_s/323542/BA/)

### 3 XRT Observations and Analysis

The XRT began observing the field of GRB 080903 at 01:13:21.8 UT, 58.5 seconds after the BAT trigger. XRT found a bright, fading, uncatalogued X-ray source. The enhanced *Swift*-XRT position as reported by Goad al. (*GCN Circ.* 8177) is RA (J2000) = 86.79206, Dec (J2000) = +51.26433 which is equivalent to:

$$\text{RA (J2000): } 05\text{h } 47\text{m } 10.10\text{s}$$

Dec (J2000):  $+51^{\circ} 15' 51.6''$

with an uncertainty of  $1.6''$  (radius, 90% confidence). This position is  $30.3''$  away from the ground-processed BAT position given in Tueller et al. (*GCN Circ.* 8176), consistent with that position.

The  $0.3 - 10$  keV light curve (Fig.2) starts at a level of  $2 \times 10^{-9}$  ergs s $^{-1}$  cm $^{-2}$  (40 XRT counts s $^{-1}$ ) with a rather flat decay slope at these early times of  $\alpha=1.00\pm0.04$ . The light curve breaks at about T+1ks and steepens dramatically to  $\alpha=2.47\pm0.14$ .

As reported by Grupe & Evans (*GCN Circ.* 8178), the XRT Windowed Timing mode data can be modeled by an absorbed power-law with photon index  $\Gamma = 0.94 \pm 0.06$  and an absorbing column density consistent with the Galactic value ( $1.67 \times 10^{21}$  cm $^{-2}$ ; Kalberla et al. 2005). This photon index is unusually flat and consistent with that found by the BAT (see above).

## 4 UVOT analysis

UVOT took a finding chart exposure of 400 s in V starting 75 s after the BAT trigger. The analysis of the full UVOT data set (Marshall & Grupe, *GCN Circ.* 8179) confirmed the optical afterglow discovered by de Ugarte Postigo et al. (*GCN Circ.* 8172). The afterglow was detected in the UVOT in v and marginally in u at  $19.8\pm0.24$  mag and  $20.0\pm0.47$ mag ( $1.8\sigma$ ), respectively. The position of this source in the v filter is

RA (J2000) = 05h 47m 10.07s

Dec (J2000) =  $+51^{\circ} 15' 51.0''$

with an estimated 90% confidence radius of  $0.9''$ . This position is consistent with the position of the optical afterglow reported by de Ugarte Postigo et al. (*GCN Circ.* 8172). The detection in u suggests a redshift  $z < 3.3$ . The magnitudes and  $3\sigma$  upper limits in the UVOT photometric system (Poole et al. 2008, MNRAS, 383, 627) for detecting the source are listed in Table 1. No correction has been made for the expected extinction corresponding to E(B-V) of 0.22 (Schlegel et al., 1998).

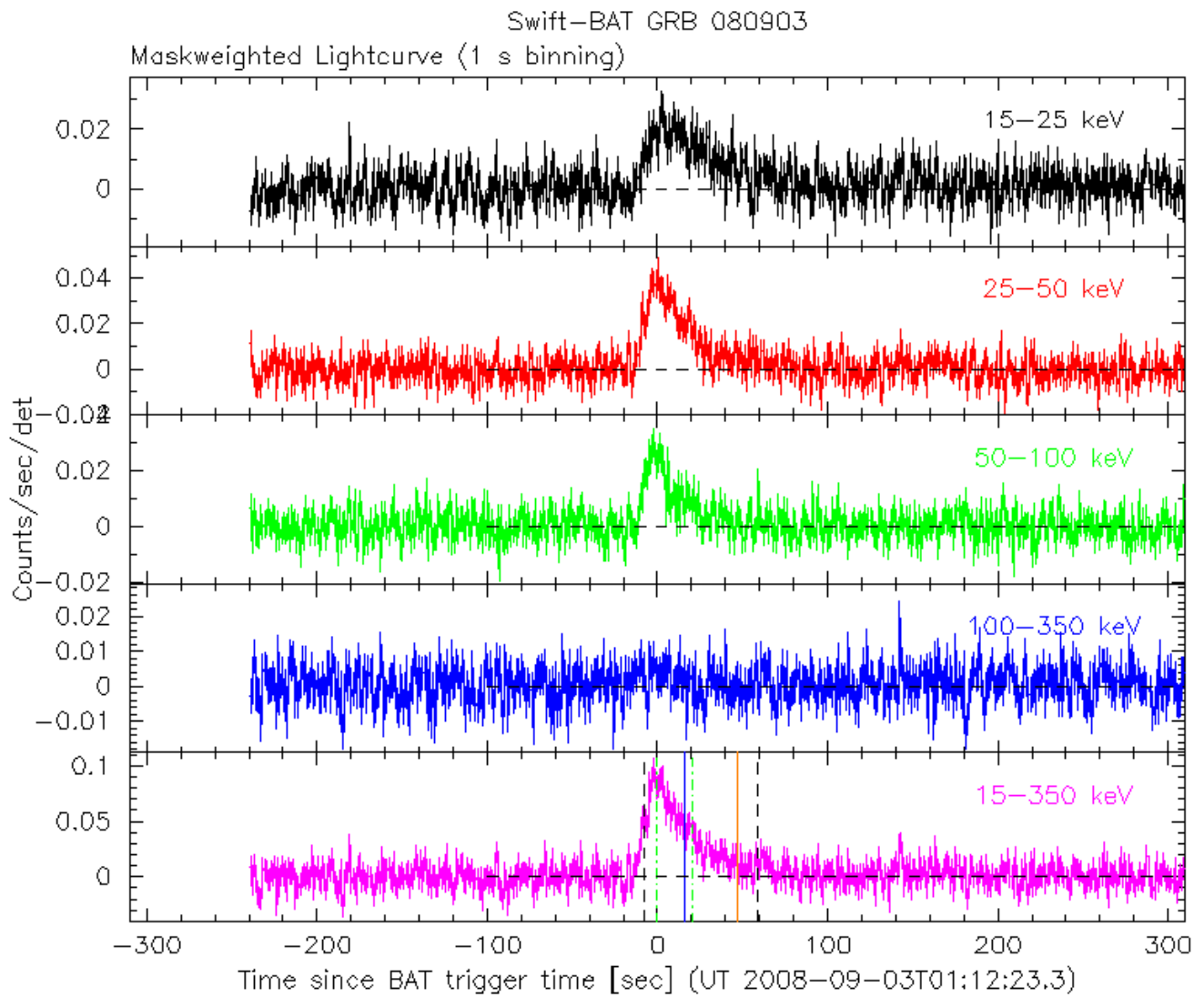


Figure 1: BAT Light curves of GRB 080903.

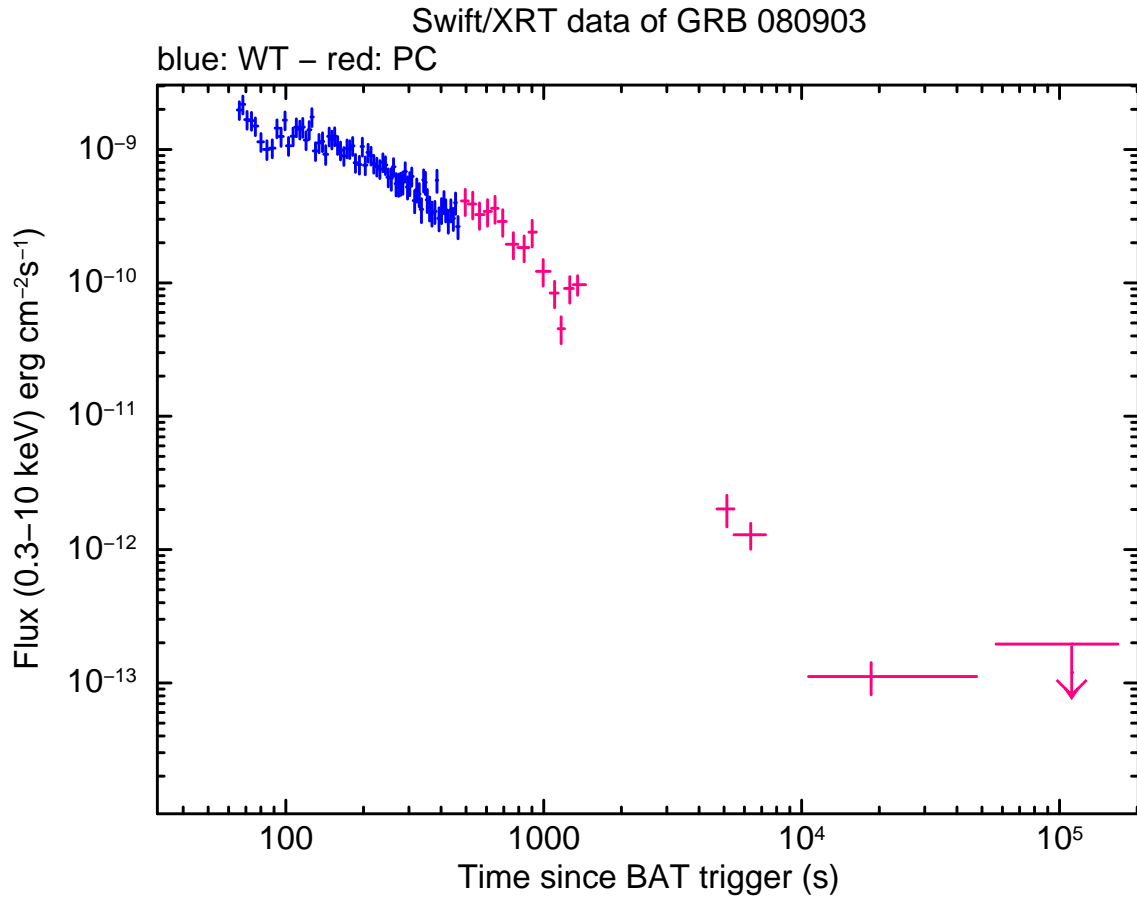


Figure 2: XRT flux light curve in the 0.3-10 keV band. The approximate conversion is  $1 \text{ count s}^{-1} = \sim 6.2 \times 10^{-11} \text{ ergs s}^{-1} \text{ cm}^{-2}$  for an unabsorbed flux corrected for photon pileup

Filter	$T_{\text{Start}}$	$T_{\text{stop}}$	Exposure	Mag
v (FC)	75	475	400	$19.80 \pm 0.24$
v	595	28705	2596	$> 21.5$
b	555	12429	1307	$> 21.8$
u	530	829	58	$20.00 \pm 0.47$
u	4906	34528	3049	$> 21.8$
uvw1	506	7268	551	$> 21.0$
uvm2	481	7160	655	$> 20.7$
uvw2	571	6750	452	$> 21.2$

Table 1: Magnitude from UVOT observations of GRB 080903