

Swift Observation of GRB 080603B

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1 Introduction

BAT triggered on GRB 080603B at 19:38:13 UT (Trigger 313087) (Mangano *et al.*, *GCN Circ.* 7794). This was a 0.512 sec rate-trigger on a intermediate length burst with $T_{90} = 60$ sec. Swift slewed to this burst immediately and XRT began follow-up observations at $T + 61.8$ sec, and UVOT at $T + 63$ sec. Our best position is the XRT location $RA(J2000) = 176.53312deg$ (11h46m07.95s), $Dec(J2000) = +68.06058deg$ (68d03'38.11") with an error of 3.7 arcsec (90% confidence, including boresight uncertainties).

GRB 080603B has also been seen by Konus Wind (Golenetskii *et al.*, *GCN Circ.* 7812) and by INTEGRAL/SPI-ACS, confirming the multi-peak structure reported by you in Mangano *et al.*, *GCN Circ.* 7794 (Beckmann, private communication).

The optical afterglow was detected by a number of ground based telescopes, e.g.: ROTSE III (Rujopakarn *et al.*, *GCN Circ.* 7792), TAROT robotic telescope (Klotz *et al.*, *GCN Circ.* 7795), TLS Tautenburg 1.34m Schmidt telescope (Kann *et al.*, *GCN Circ.* 7829), BOOTES2/TELMA (Castro-Tirado *et al.*, *GCN Circ.* 7796), RTT150 (Zhuchkov *et al.*, *GCN Circ.* 7803), Liverpool Telescope (Melandri *et al.*, *GCN Circ.* 7813), Xinglong EST (Xin *et al.*, *GCN Circ.* 7814).

An infrared afterglow detection has been provided by PARITEL (Miller *et al.*, *GCN Circ.* 7827), and a radio upper limit has been set by the VLA (Frail *et al.*, *GCN Circ.* 7840).

A redshift estimate $z = 2.69$ was provided by the NOT telescope based on the detection of Lyman-alpha and a number of relatively strong metal lines detected on the afterglow spectrum (Fynbo *et al.*, *GCN Circ.* 7797). The redshift has been confirmed by the Marcario LRS spectrograph on the Hobby-Eberly Telescope (Cucchiara *et al.*, *GCN Circ.* 7815).

2 BAT Observation and Analysis

Using the data set from $T - 239$ to $T + 470$ sec, further analysis of BAT GRB 080603B has been performed by Swift team (Tueller *et al.*, *GCN Circ.* 7806). The BAT ground-calculated position is $RA(J2000) = 176.554deg$ (11h46m13.0s), $Dec(J2000) = +68.061deg$ (+68d03'40.5") ± 1.0 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 100%.

The mask-weighted light curves (Fig.1) show three main clusters of peaks. The first starts at $T - 1$ sec, peaks at $T + 1$ sec, and ends at $\sim T + 7$ sec. The second starts at $T + 8$ sec and ends at $T + 20$ sec. The third starts at $\sim T + 42$ sec and ends at $\sim T + 80$ sec. $T_{90}(15 - 350$ keV) is 60 ± 4 sec (estimated error including systematics).

The time-averaged spectrum from $T - 0.1$ to $T + 68.6$ sec is best fitted by a power law with an exponential cutoff. This fit gives a photon index 1.21 ± 0.30 , and E_{peak} of 71.0 ± 16.0 keV (chi squared 63.16 for 56 d.o.f.). For this model the total fluence in the 15 - 150 keV band is $(2.4 \pm 0.1) \times 10^{-6}$ ergs/cm² and the 1-sec peak flux measured from $T + 0.96$ sec in the 15 - 150 keV band is 3.5 ± 0.2 ph/cm²/sec. A fit to a simple power law gives a photon index of 1.78 ± 0.07 (chi squared 75.18 for 57 d.o.f.). 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/313087/BA/

3 XRT Observations and Analysis

Using the data from the first three orbits of XRT data of GRB 080603B (990 *sec* in Photon Counting mode starting 274 *sec* after the trigger), the refined XRT position is $RA(J2000) = 176.53312deg$ (11h46m07.95s), $Dec(J2000) = +68.06058 deg$ (+68d03'38.11") $\pm 3.7 arcsec$ (90% confidence, including boresight uncertainties). This position is within 3.2 *arcsec* of the initial XRT position, and 0.7 *arcsec* from the optical afterglow candidate, reported by Kuin *et al.*, *GCN Circ.* 7808.

The initial XRT data from $T + 68 sec$ to $T + 274 sec$ are in Windowed Timing mode. The 0.3 – 10 *keV* light curve (Fig.2) shows an initial steep decline with a slope of 3.4 ± 0.1 , followed by a shallow slope of 0.8 ± 0.1 , beginning at $T + (161 \pm 6) sec$.

The spectrum of the Windowed Timing data can be modeled by an absorbed power-law, with a photon index of 1.68 ± 0.06 and an intrinsic NH column density of $(7.9 \pm 0.2) \times 10^{21} cm^{-2}$ at $z = 2.69$ (Fynbo *et al.*, *GCN Circ.* 7797) in excess over the galactic column density in this direction of $1.2 \times 10^{20} cm^{-2}$ (Kalberla *et al.* 2005). The average observed (unabsorbed) flux over 0.3 – 10 *keV* for this spectrum (spanning a time of 68-274 *sec* after the trigger) is 7.0×10^{-10} (7.7×10^{-10}) *ergs/cm²/sec*

The Photon Counting mode spectrum is also well modelled by an absorbed powerlaw, with a photon index of 2.0 ± 0.2 and an intrinsic NH column density of $(1.3 \pm 0.2) \times 10^{22} cm^{-2}$. The average observed (unabsorbed) flux over 0.3 – 10 *keV* for this spectrum (spanning a time of 274 *sec*-12.2 *ksec* after the trigger) is 1.55×10^{-11} (1.91×10^{-11}) *ergs/cm²/sec*.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 080603B on June 3, 2008, at 19:39:07 UT, 63 seconds after the initial Swift BAT trigger (Mangano *et al.*, *GCN Circ.* 7794).

The refined UVOT position is $RA(J2000) = 176.5316deg$ (11h46m07.66s), $Dec(J2000) = +68.061105 deg$ (+68d03'39.99") $\pm 0.3 arcsec$ (90% confidence, including boresight uncertainties).

The first finding chart in the wh filter has problems due to the brightness of the image, and needs detailed analysis. We report on the following finding chart.

The magnitudes with 1-sigma errors for GRB080603B are given in Table 1 for the initial observation sequence.

Filter	Start	Stop	Exposure	Magnitude
v	187.8	393.1	202	16.48 ± 0.06
uvw2	5778.0	5977.8	197	> 19.51 (3-sigma UL)
uvw1	5983.9	6183.7	197	20.02 ± 0.56
u	6188.8	6388.6	197	18.80 ± 0.23
b	6395.3	12274.3	643	19.34 ± 0.14

Table 1: Magnitude limits from UVOT observations

The absence of a detection in the uvm2 filter is consistent with the reported redshift of 2.69 (Fynbo *et al.*, *GCN Circ.* 7797).

Magnitude variation in the b observations show evidence of flaring or rebrightening.

The values quoted above are on the UVOT Photometric System (Poole *et al.*, 2008, MNRAS 383,627). They are not corrected for the expected galactic reddening of $E(B-V) = 0.013$ in the direction of the burst (Schlegel *et al.* 1998).

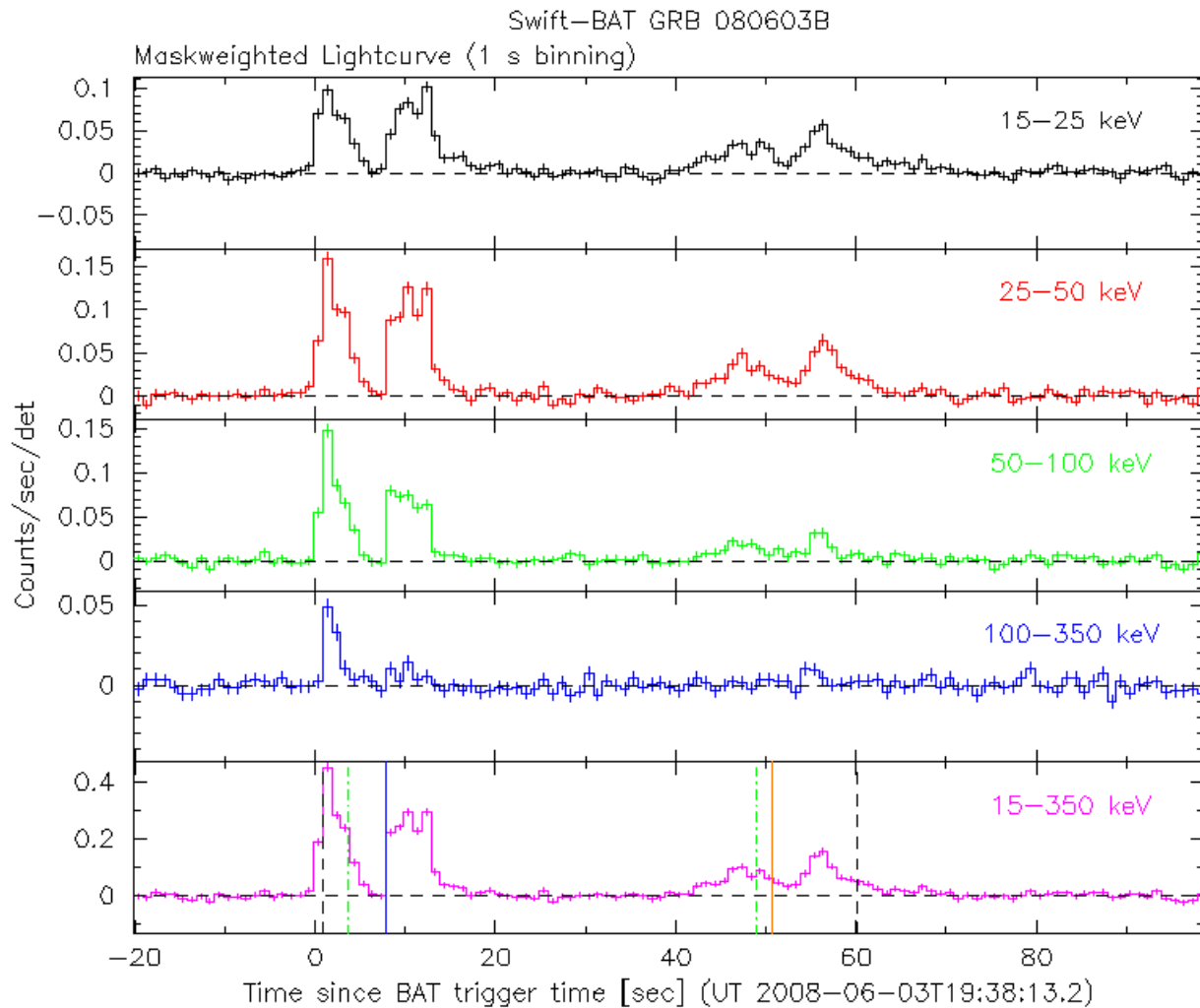


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts s^{-1} illuminated-detector $^{-1}$ (note illum-det = 0.16 cm^2) and T_0 is 2008-06-03 19:38:13 UT

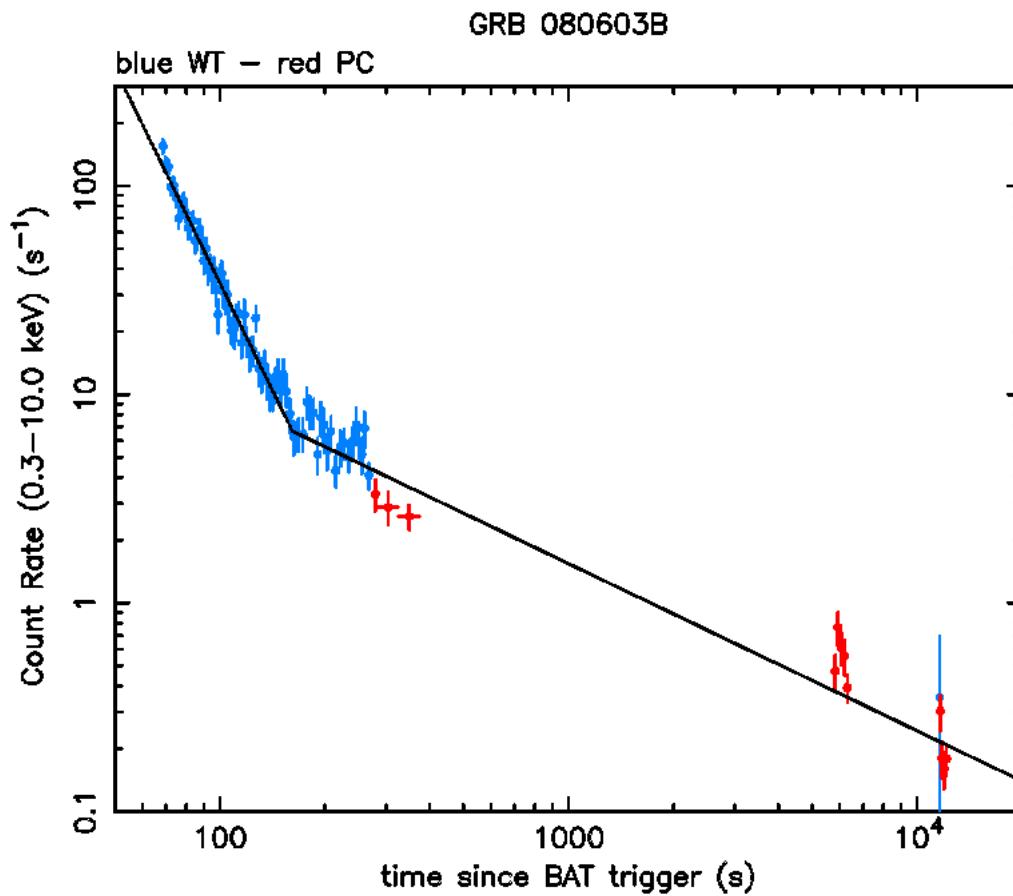


Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is $1 \text{ count/sec} = \sim 4.5 \times 10^{-11} \text{ ergs/cm}^2/\text{sec}$.