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 an 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($J2000$) = 176.53312$deg$ (11h46m07.95s), Dec($J2000$) = +68.06058$deg$ (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($J2000$) = 176.554$deg$ (11h46m13.0s), Dec($J2000$) = +68.061$deg$ (+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 $60 \pm 4$ 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/cm$^2$ and the 1-sec peak flux measured from $T + 0.96$ sec in the 15 – 150 keV band is $3.5 \pm 0.2$ ph/cm$^2$/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") ± 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 ± 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 ± 0.2) × 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 × 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/cm^{2}/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 ± 0.2) × 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/cm^{2}/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") ± 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.

<table>
<thead>
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<th>Start</th>
<th>Stop</th>
<th>Exposure</th>
<th>Magnitude</th>
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<td>393.1</td>
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<td>&gt;19.51 (3-sigma UL)</td>
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<tr>
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<td>6388.6</td>
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<td>6395.3</td>
<td>12274.3</td>
<td>643</td>
<td>19.34 ± 0.14</td>
</tr>
</tbody>
</table>

Table 1: Magnitude limits from UVOT observations

The absence of a detection in the uvw2 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 count/sec = $\sim 4.5 \times 10^{-11}$ ergs/cm$^2$/sec.