Swift Observation of GRB 080426

H. Ziaeepour (UCL/MSSL), W. Baumgartner (GSFC/UMBC), J. Cummings (GSFC/UMBC), A. P. Beardmore (U Leicester), S.R. Oates (UCL/MSSL), C. Guidorzi (INAF) for the Swift Team

1 Introduction

BAT triggered on GRB 080426 at 13:23:22 UT (Trigger 310219) (Ziaeepour, et al., *GCN Circ.* 7639). This was a 0.064 sec rate-trigger with significance of 25.25 on an apparently short burst with $T_{90} = 1.1724$ sec in $15 - 350$ keV band. Swift slewed to this burst and XRT began its observations at $T+230$ sec, and UVOT began its finding chart exposure at $T+226$ sec. The XRT found a faint varying afterglow (Beardmore and Ziaeepour, *GCN Circ.* 7643). The Swift-XRT enhanced position of this source is: RA ($J2000$) = 26.49890 deg ($01h45m59.74s$), Dec($J2000$) = +69.46823 deg ($+69d28'05.6$"). The UVOT didn't find an afterglow for this burst and its magnitude limit in all filter is $\sim$ 20. This burst is also detected in the ground analysis of INTEGRAL/SPI-ACS data (Volker Beckmann communication).

Due to relative closeness of this burst to the Sun, 56 deg (Sun angle = 0.5 hour West of Sun) its follow-up was difficult. The observation by Calar Alto Observatory (de Ugarte Postigo, et al., *GCN Circ.* 7644) found no afterglow.

2 BAT Observation and Analysis

Using the data set from $T - 119$ to $T + 183$ sec, further analysis of BAT GRB 080426 has been performed by Swift team (Cummings, et al., *GCN Circ.* 7640). The BAT ground-calculated position is RA($J2000$) = 26.510 deg ($01h46m02.4s$), Dec($J2000$) = +69.469 deg ($+69d28'07.9$") $\pm$ 1.1 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 43% (the offset angle was 50.12 deg).

The mask-weighted 64-msec binned light curves (Fig.1) show that the burst activity started at about $T - 0.084$ sec, arrived to its maximum at $\sim T + 0.5$ sec, and ended at about $T + 0.916$ sec. The burst was not observed in $100 - 300$ keV band.

The time-averaged spectrum from $T+0.1$ to $T+2.3$ sec is best fitted by a power law model. The photon index is 1.98 ± 0.13 ($\chi^2 = 45.86$ for 57 d.o.f.). For this model the total fluence in the $15-150$ keV band is $(3.7 \pm 0.3) \times 10^{-7}$ergs cm^{-2}and the 1-sec peak flux measured from $T - 0.08$ sec in the $15 - 150$ keV band is 1.2 ± 0.3 ph cm^{-2} sec^{-1}. A fit to a power law with a cutoff gives a photon index of 1.8 ± 0.5 and $E_{peak} = 54.87$ keV ($\chi^2 = 45.53$ for 56 d.o.f.). All the quoted errors are at the 90% confidence level.

The lag analysis for this burst yields: $\mathrm{Lag}_{31} = 88 \pm 9$ msec ($50 - 100$ to $15 - 25$ keV bands) and $\mathrm{Lag}_{21} = 74 \pm 6$ msec ($25-50$ to $15-25$ keV bands). While the T_{90} value puts this burst in the middle of the long and short bursts distribution peaks, the lag value puts it in the long burst class. Therefore, this is an unusual burst. The T_{90} for the $50 - 300$ keV BATSE range is 1.3 sec which would put this burst in the short class. However, the long lags and soft spectrum lead us to believe it is in the long class

3 XRT Observations and Analysis

Using 894 sec of overlapping XRT Photon Counting (PC) mode and UVOT data, the XRT for GRB 080426, the enhanced Swift-XRT position is RA ($J2000$) = 26.49890 deg ($01h45m59.74s$), Dec($J2000$) = +69.46823 deg ($+69d28'05.6$") $\pm$ 1.8 arcsec (90% confidence) (Beardmore, et al., *GCN Circ.* 7641). This position is within 1.30 arcsec of the initial XRT position (Ziaeepour, et al.*GCN Circ.* 7639).

During ground data analyis with the latest version of xrtpipeline software, due to a higher than usual value of the Swift star tracker loss function, the constraint on this parameter was relaxed to two times the default value to prevent too much loss of data. The $0.3 - 10$ keV light curve (Fig.2) shows a possible rise of the X-ray emission before slew to a maximum at $\sim T + 300$ sec. Then a shallow decline with a slope of $\sim 0.72 \pm 0.12$ begins and lasts until a break at $T + 3.23 \pm 1.6$ ksec to a steeper slope of 1.56 ± 0.23. This continues until the end of the XRT observations at $\sim T + 10^5$ sec.

The spectrum of the first three orbits is well fitted by an absorbed power-law model, with a photon index of 2.01 ± 0.25 and column density of $(5.3 \pm 1.3) \times 10^{21}$ cm^{-2}, which is slightly in excess of the average Galactic column density in this direction of 3.7×10^{21} cm^{-2}. The observed (unabsorbed) 0.3-10 keV flux is $5.1 \times 10^{-12}(9.1 \times 10^{-12})$ ergs cm^{-2} sec^{-1}.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 080426 about 226 sec after the initial BAT trigger (Oates & Ziaeepour, *GCN Circ.* 7642). No afterglow is detected at the enhanced XRT position (Beardmore, et al.., *GCN Circ.* 7641) in any of the UVOT filters. The 3 sigma upper limits are given in Table 1. They are not corrected for the Galactic extinction in the line of sight, corresponding to a reddening of E(B-V)= 0.798 mag (Schlegel et al., *ApJS.* **500** (1998) 525). The photometry is based on the UVOT photometric system (Poole, et al., *MNRAS* **383** (2008) 627).

Filter	T_{start} (sec)	T_{stop} (sec)	Exposure (sec)	3-Sigma UL
White	226	326	98	> 20.38
White	446	7457	362	> 20.86
V	333	7868	1316	> 19.98
B	431	7253	303	> 20.01
U	407	7047	333	> 19.79
UVW1	382	6843	352	> 19.99
UVM2	357	7969	407	> 19.94
UVW2	462	7663	510	> 20.26

Table 1: Upper limits from UVOT observations

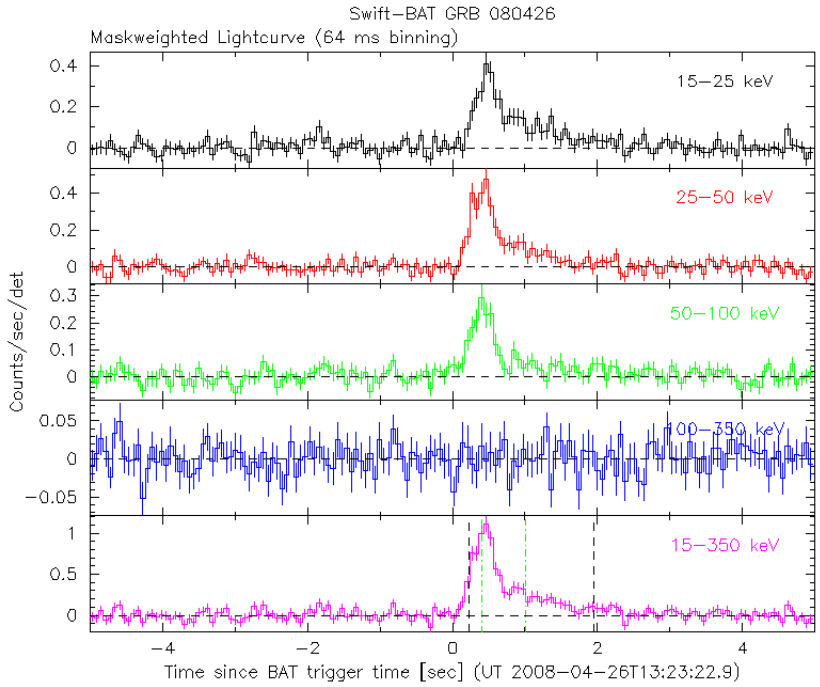

Figure 1: BAT light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 13 : 23 : 22.9 UT.

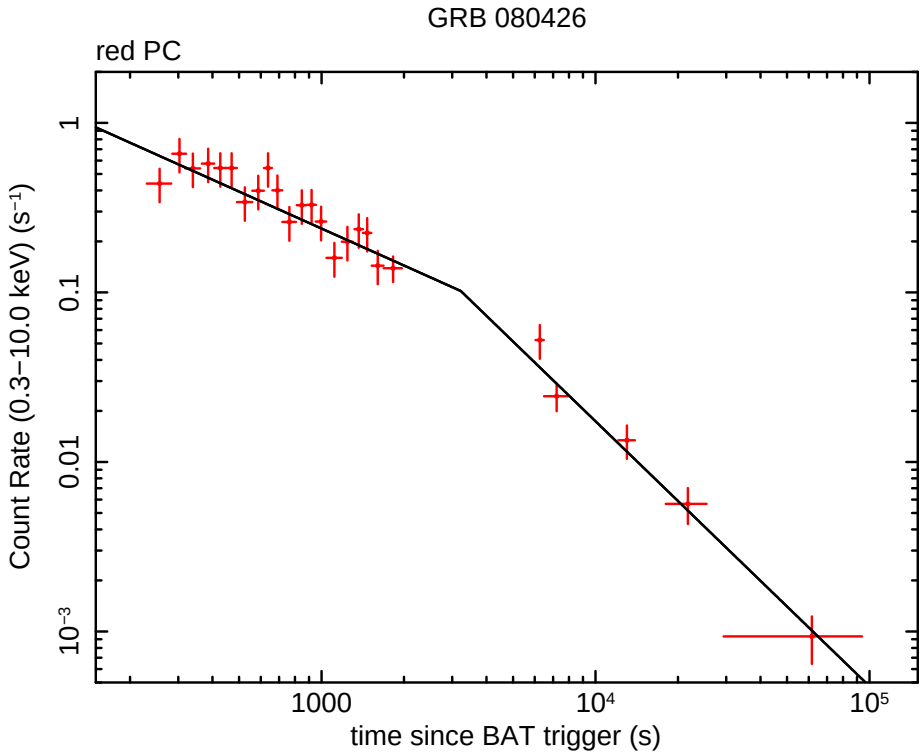

Figure 2: XRT light curve in the $0.3 - 10$ keV band: Photon Counting (PC) mode (red). The approximate conversion factor to absorbed flux is 1 count/sec $\sim 5.3 \times 10^{-11}$ ergs cm^{-2} sec^{-1} and to unabsorbed flux 1 count/sec $\sim 9.5 \times 10^{-11}$ ergs cm^{-2} sec^{-1}.