

Swift Observations of GRB 080328

M. Perri (ASDC), G. Stratta (ASDC), H. Krimm (GSFC/USRA), P. Ward (MSSL-UCL), S.D. Barthelmy (GSFC), D.N. Burrows (PSU), P. Roming (PSU), N. Gehrels (GSFC) for the Swift Team

1 Introduction

The Swift BAT triggered on and located GRB 080328 at 08:03:04 UT (trigger=307931) (Perri et al., GCN Circ. 7525). Swift slewed immediately to the burst and XRT and UVOT observations of the field started 100 and 110 seconds after the trigger, respectively. Our best position is the UVOT location at RA(J2000)= 80.482792 deg, Dec(J2000)= 47.510944 deg, RA(J2000)= 05^h21^m55.87^s, Dec(J2000)= +47^d 30' 39.4", with an error radius of 0.6 arcsec (90% confidence).

The burst was also detected by Konus-Wind (Golenetskii et al., GCN Circ. 7548) and the Suzaku Wide-band All-sky Monitor (Kodaka et al., GCN Circ. 7551). The optical afterglow was detected from the ground by the Faulkes North Telescope (Guidorzi et al., GCN Circ. 7526) and the BTA SAO-RAS telescope (Fatkulkin et al., GCN Circ. 7534).

2 BAT Observations and Analysis

Using the data set from T-120 to T+183 sec (Krimm et al. GCN Circ. 7533), the BAT ground-calculated position is RA(J2000)= 80.490 deg, Dec(J2000)= 47.523 deg, RA(J2000)= 05^h21^m57.7^s, Dec(J2000)= +47^d 31' 23.8", with an uncertainty of 1.0 arcmin, (radius, sys+stat, 90% containment). The partial coding was 37%.

The mask-weighted light curve (Figure 1) consists of about about ten major pulses spread over about 100 sec. T_{90} (15–350 keV) is 90.6 ± 1.5 sec (estimated error including systematics).

The time-averaged spectrum from T-2.2 to T+117.5 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.52 ± 0.04 . The fluence in the 15–150 keV band is $(9.4 \pm 0.2) \times 10^{-6}$ erg cm⁻². The 1-sec peak photon flux measured from T+9.3 sec in the 15–150 keV band is 5.5 ± 0.3 ph cm⁻² sec⁻¹. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Swift-XRT began observing the field of GRB 080328 at 08:04:44 UT, 100 seconds after the BAT trigger (Perri et al., GCN Circ. 7532).

Using all the XRT available data, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment with 5080 seconds of overlapping time and matching UVOT field sources to the USNO-B1 catalogue): RA(J2000)= 80.482542 deg, Dec(J2000)= +47.510556 deg, which is RA(J2000)= 05^h21^m55.81^s, Dec(J2000)= +47^d 30' 38.0", with an uncertainty of 1.4 arcsec, (radius, 90% confidence).

The 0.3–10 keV light curve (Figure 2) shows a rapid decay phase at early times (WT data, T+108s - T+259s). Starting from T+260s up to T+43ks (PC mode data) the light-curve is well fit by a broken power-law model with decay indices $\alpha_1 = -0.56^{+0.10}_{-0.08}$, $\alpha_2 = -1.16^{+0.05}_{-0.07}$ and a temporal break $t_b = 1.9^{+0.7}_{-0.4}$ ks.

The WT X-ray spectrum (0.3–10 keV) is well fit by an absorbed power-law model with a photon index $\Gamma = 2.1 \pm 0.1$ and a total column density of $N_H = (4.2 \pm 0.4) \times 10^{21}$ cm⁻². The average observed 0.3–10 keV flux for this spectrum is 9.3×10^{-10} erg cm⁻² s⁻¹. The PC X-ray spectrum (0.3–10 keV) during the first orbit, from T+260s to T+2106s, is well fit by an absorbed power-law model with a photon

index $\Gamma = 2.2 \pm 0.1$ and a total column density of $N_H = (5.0 \pm 0.6) \times 10^{21} \text{ cm}^{-2}$. The observed 0.3–10 keV flux for the PC spectrum is $1.5 \times 10^{-10} \text{ erg cm}^{-2} \text{ s}^{-1}$. We note the Galactic column density in the direction of the source is $3.4 \times 10^{21} \text{ cm}^{-2}$. All the quoted errors are at the 90% confidence level.

4 UVOT Observation and Analysis

The UVOT observed the field of GRB 080328 starting 110s after the BAT trigger (Ward et al., GCN 7530).

The afterglow is seen to decay in the white and *V* filters, while is not detected in any other filters, perhaps due to the high Galactic extinction value (see below). The corresponding magnitudes and 3-sigma upper limits are listed in Table 1. The values quoted above are not corrected for the expected Galactic extinction corresponding to a reddening of $E_{B-V} = 0.58$ mag in the direction of the GRB (Schlegel et al. 1998).

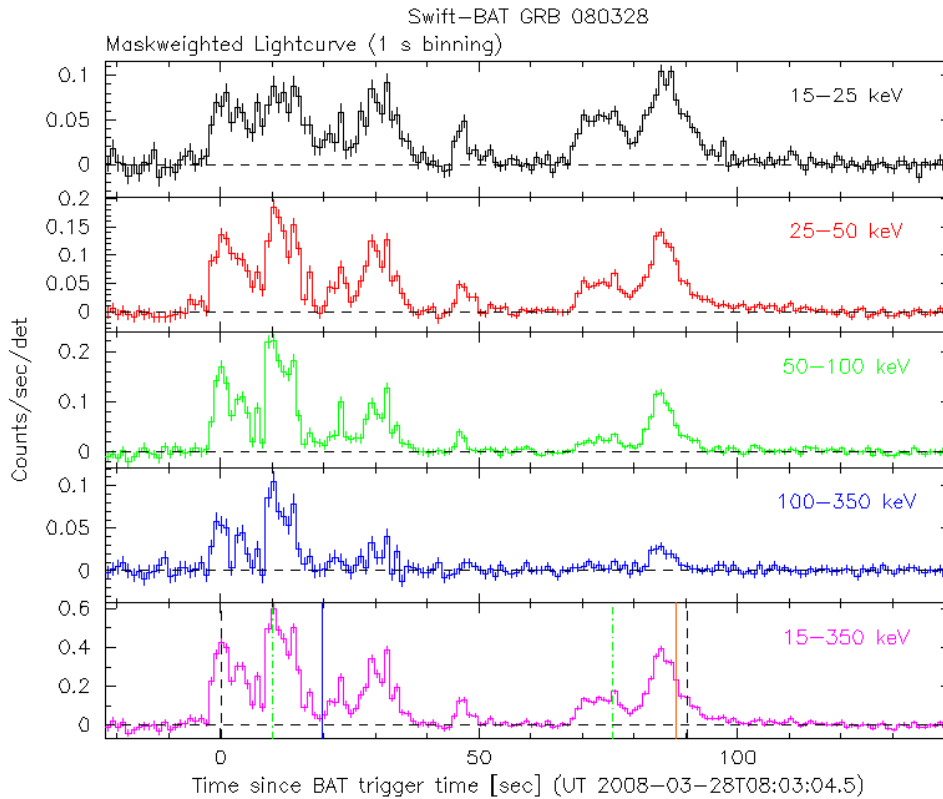


Figure 1: BAT light-curve. The mask-weighted light curve in the 4 individual plus total energy bands. Green dotted line: T_{50} , Black dotted line: T_{90} . Blue: Slew start, Orange: Slew end Time. The units are $\text{counts s}^{-1} \text{ illuminated-detector}^{-1}$ (note $\text{illum-det} = 0.16 \text{ cm}^2$) and T_0 is 2008-03-28 08:03:04 UT.

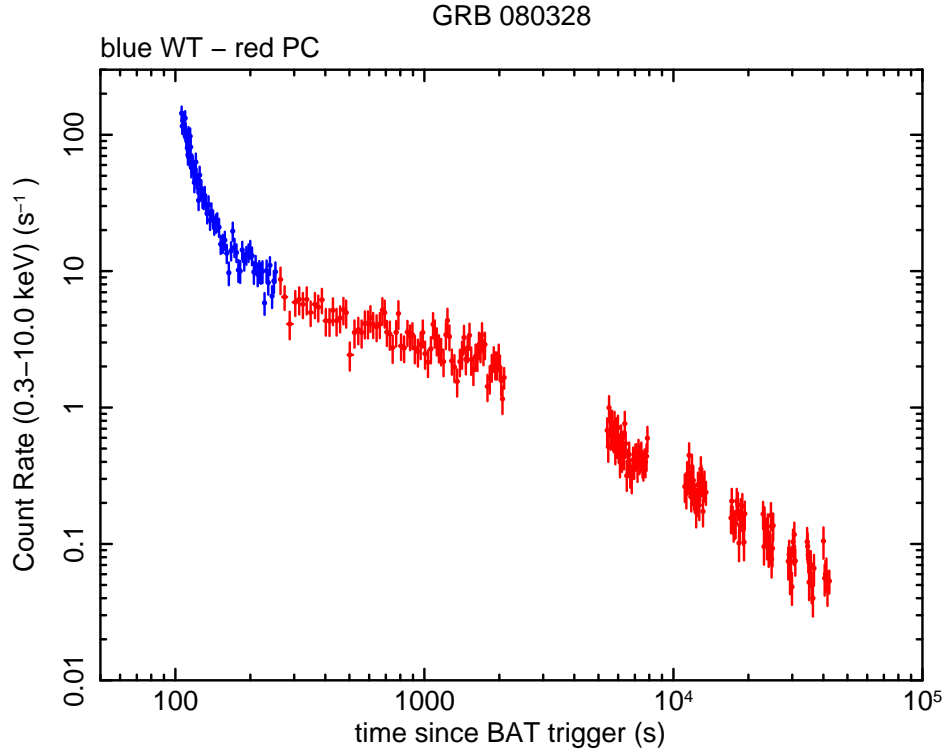


Figure 2: XRT light-curve. Count rates in the 0.3–10 keV band taken in Windowed Timing (blue) and Photon Counting (red) modes are plotted. The approximate conversion of the 0.3–10 keV observed flux is 1 count/sec $\sim 4.7 \times 10^{-11}$ erg cm^{-2} s^{-1} .

Filter	T_start (s)	Exp (s)	3-sigma UL mag
White	110	99.8	17.84 ± 0.05
White	867	99.8	20.43 ± 0.27
White	5611	399.8	> 21.6
V	217	399.8	17.90 ± 0.08
V	973	399.8	19.25 ± 0.20
V	6023	399.8	> 20.00
B	851	493.6	> 20.96
U	673	338.5	> 20.59
UVW1	648	362.8	> 20.54
UVM2	623	393.2	> 20.38
UVW2	728	498.5	> 20.88

Table 1: Magnitude and 3-sigma upper limits from UVOT observations.