Swift Observation of GRB 080319B

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1 Introduction

BAT triggered on GRB 080319B at 06:12:49 UT (Trigger 306757) (Racusin, *et al.*, *GCN Circ.* 7427). This was rate-trigger on a intermediate length burst with $T_{90} > 50$ *sec*. Swift slewed to this burst immediately and XRT began follow-up observations at $T + 60.5$ *sec*, and UVOT at $T + 51$ *sec*. Our best position is the UVOT-enhanced XRT location (Evans *et al.*, *GCN Circ.* 7449) RA($J2000$) = $217.92113deg$ ($14h31m41.07s$), Dec($J2000$) = $+36.30269deg$ ($+36d18'09.7''$) with an uncertainty of 1.4 arcsec (radius, 90% confidence, including boresight uncertainties).

2 BAT Observation and Analysis

Using the data set from $T - 120$ to $T + 182$ *sec*, further analysis of BAT GRB 080319B has been performed by Swift team (Cummings, *et al.*, *GCN Circ.* 7462). The BAT ground-calculated position is RA($J2000$) = $217.919deg$ ($14h31m40.7s$), Dec($J2000$) = $+36.300deg$ ($+36d17'58.4''$) with an uncertainty of 1.0 *arcmin*, (radius, systematic and statistical, 90% containment). The partial coding was 100%.

The mask-weighted light curves (Fig.1) show a large long bump of a peak starting at $\sim T - 10$ *sec*, ramping up until $\sim T + 10$ *sec*, then mostly a flat top with some small structure superposed, then starting to decay at $\sim T+50$ *sec*. It returns nearly to background by $\sim T+64$ *sec* at which point there is a loss of data due to an on-board data product buffer overflow. The data resumes at $T + 120$ *sec*. There is still detectable emission in the BAT $15 - 350$ keV band out to $T + 180$ *sec*. From other count rate data products, we can say that there is no other peaks during the 60-sec missing event data window and that the low-level emission is about $10 - 15\%$ of the peak emission. Given the missing data, $T_{90}(15 - 350keV)$ has to be > 50 *sec* (estimated error including systematics).

The time-averaged spectrum from $T - 3.8$ to $T + 62.2$ *sec* and $T + 120$ to $T + 151$ *sec* is best fitted by a simple power law model. This fit gives a photon index of 1.04 ± 0.02. For this model the total fluence in the $15 - 150$ keV band is $(8.1 \pm 0.1) \times 10^{-5} ergs/cm^2$ and the 1-sec peak flux measured from $T + 16.87$ *sec* in the $15 - 150$ keV band is 24.8 ± 0.5 $ph/cm^2/sec$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using 1859 *sec* of overlapping XRT Photon Counting mode and UVOT data for GRB 080319B, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is RA($J2000$) = $217.92113deg$ ($14h31m41.07s$), Dec($J2000$) = $+36.30269deg$ ($+36d18'09.7''$) with an uncertainty of 1.4 arcsec (radius, 90% confidence, including boresight uncertainties, Evans *et al.*, *GCN Circ.* 7449). This position is within 7 *arcsec* of the initial XRT position, and 1.4 *arcsec* from the UVOT afterglow candidate, reported by Holland *et al.*(*GCN Circ.* 7428).

The $0.3 - 10$ keV light curve (Fig.2) shows an initial short plateau until ~ 80 *sec* followed by a decline with slope of 1.44 ± 0.07 breaking at $T + 2242 \pm 942$ to a steeper slope of 1.85 ± 0.10, followed by a shallower slope of $1.17^{+0.14}_{-0.23}$ beginning at $T + 4.1^{+2.8}_{-1.7} \times 10^4$ *sec*, and again breaking to a steeper slope of $2.61^{+2.04}_{-0.91}$ at $1.0 \pm 0.5 \times 10^6$ *sec*. The first two segments of the X-ray lightcurve can be modeled

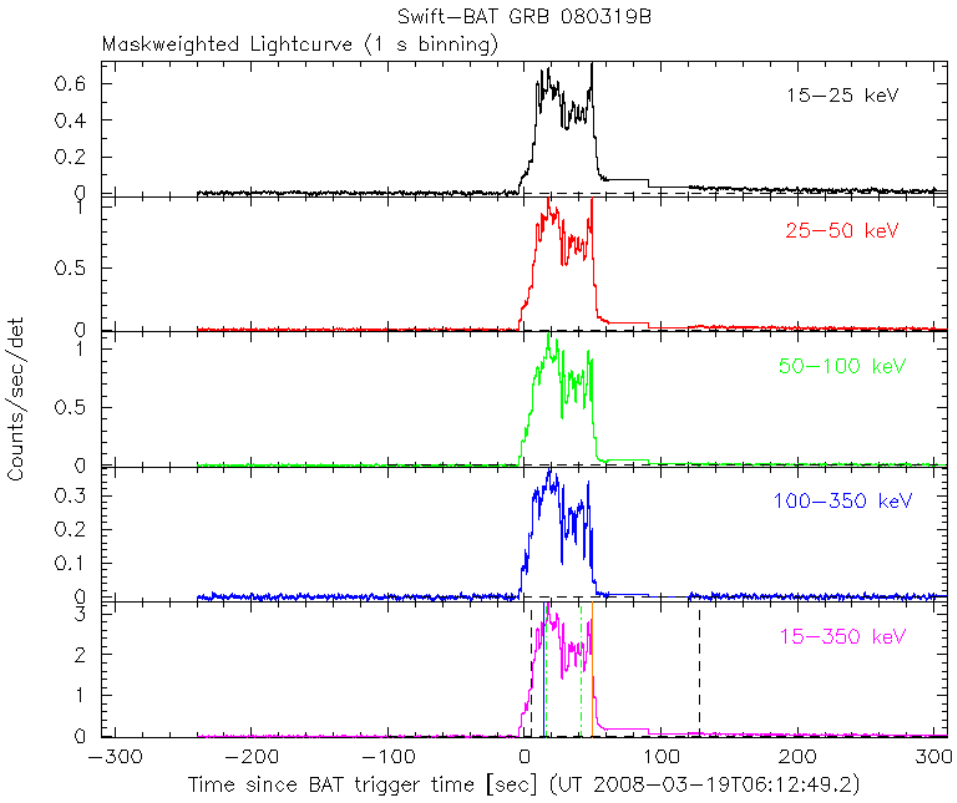

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 06:12:49 UT.

with an absorbed power-law with spectral index of 1.76 ± 0.10, and the third and forth segments with spectral index of 1.98 ± 0.10. The NH column density is in excess of the Galactic column density for both spectra. For more details on the temporal and spectral XRT analysis, see Racusin *et al.*(2008, ArXiv:0805.1557v1).

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 080319B 51 sec after the initial BAT trigger (Racusin *et al.*, *GCN Circ.* 7427). The afterglow was detected in all filters (Holland *et al.*, *GCN Circ.* 7496), but was highly saturated and the data was not recoverable in the v-band before $T + 350$ *sec* and white before $T + 1000$ *sec*. The UVOT light curve is given in Figure 3. For more details on the temporal and spectral UVOT analysis, see Racusin *et al.*(2008, ArXiv:0805.1557v1).

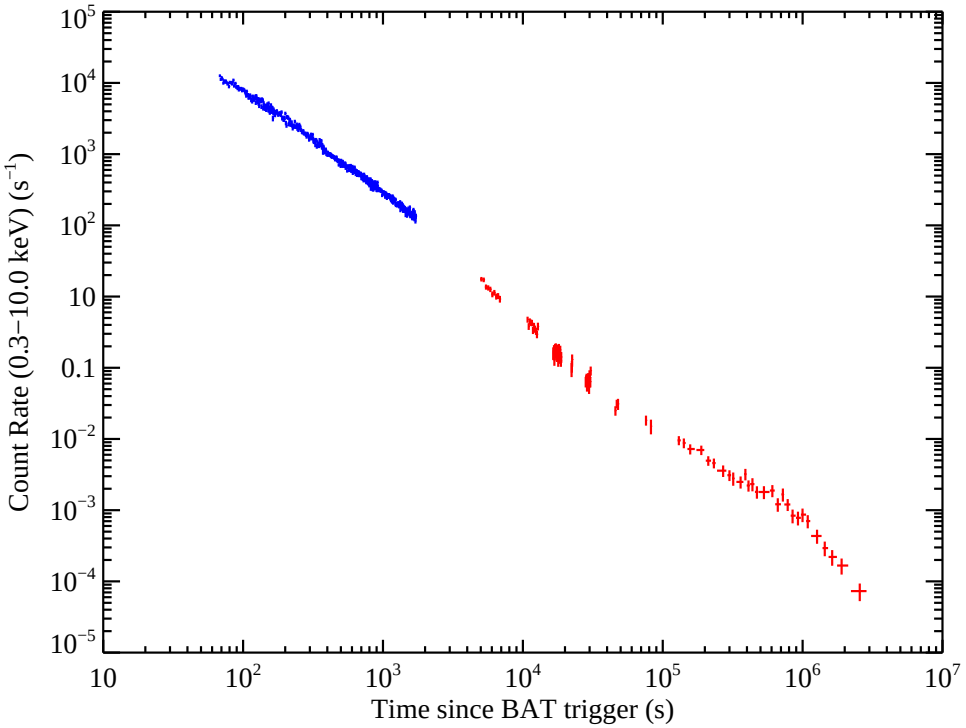

Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is 1 count/sec = $\sim 5.0 \times 10^{-11}$ $ergs/cm^2/sec$.

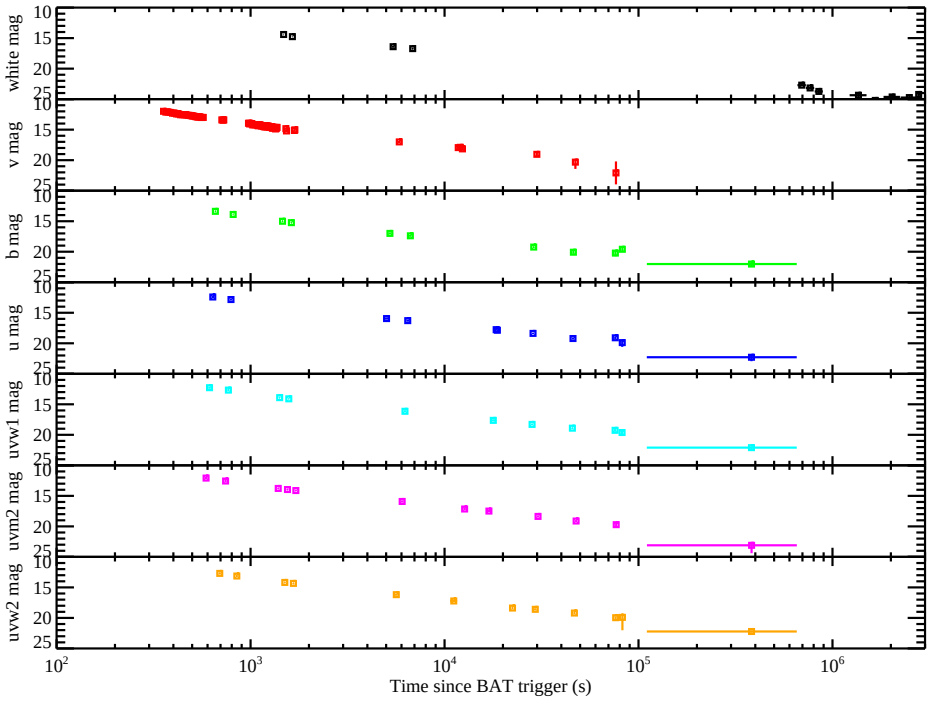

Figure 3: UVOT Lightcurve. Due to saturation, white data before 1000 *sec* and v band data before 350 *sec* were lost. Photometry was extracted using a 5" radius circular aperture when the count rate was above 0.5 *counts* s^{-1}, and a 3" aperture when the count rate dropped below 0.5 *counts* s^{-1}.