Swift Observations of GRB 080430

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1   Introduction

BAT triggered on GRB 080430 at 19:53:02 UT (Trigger 310613) (Guidorzi *et al.*, *GCN Circ.* 7647). This was a 0.512-s rate-trigger on a long burst. XRT observations began at $T + 55$ s and discovered a bright and fading X-ray afterglow. UVOT began observing at $T + 58$ s and found the optical counterpart of 17.6±0.5 mag. A number of robotic, ground based telescopes promptly detected it: e.g., TAROT (Klotz *et al.*, *GCN Circ.* 7646); BOOTES (Jelinek *et al.*, *GCN Circ.* 7648). Our best position is that given by UVOT at RA(J2000)= 165.31108 deg ($11^h01^m14.66^s$), Dec(J2000)= +51.68567 deg ($+51^d41'08.4''$), with an estimated uncertainty of 0.5 arcsec (radius, 90% confidence).

A redshift estimate of $z \simeq 0.75$ was initially provided from spectroscopic observations by de Ugarte-Postigo *et al.* (*GCN Circ.* 7650) and later on refined to $z = 0.767$ by Cucchiara & Fox (*GCN Circ.* 7654).

GRB 080430 was also detected by SPI-ACS/*INTEGRAL* (Volker Beckmann, private comm.).

2   BAT Observations and Analysis

Using the data set from $T - 240$ to $T + 962$ s, the BAT ground-calculated position is RA(J2000) = 165.331 deg ($11^h01^m19.4^s$), Dec(J2000)= +51.682 deg ($+51^d40'55.5''$) with an uncertainty of 1.0 arcmin (radius, sys+stat, 90% containment). The partial coding was 100%.

The mask-weighted light curve shows a single FRED peak starting at $\sim T - 0.7$ s, peaking at $\sim T + 1.5$ s, and ending at $\sim T + 60$ s (see Fig. 1). T_{90} (15–350 keV) is 16.2 ± 2.4 s (estimated error including systematics).

The time-averaged spectrum from $T - 0.3$ to $T + 21.3$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.73 ± 0.09. The fluence in the 15–150 keV band is $(1.2 \pm 0.1) \times 10^{-6}$ erg cm^{-2}. The 1–s peak photon flux measured from $T + 1.70$ s in the 15–150 keV band is 2.6 ± 0.2 ph cm^{-2} s^{-1}. All the quoted errors are at the 90% confidence level (Stamatikos *et al.*, *GCN Circ.* 7656).

The results of the batgrbproduct analysis are available at
`http://gcn.gsfc.nasa.gov/notices_s/310613/BA/`.

3   XRT Observations and Analysis

The XRT began observing GRB 080430 in Windowed Timing mode, 55 s after the BAT trigger. Using 2 ks of overlapping XRT and UVOT data, the UVOT-enhanced XRT position was found to be RA(J2000)= 165.31104 deg ($11^h01^m14.65^s$), Dec(J2000)= +51.68558 deg ($+51^d41'08.1''$), with an uncertainty of 1.4 arcsec (radius, 90% confidence).

The light curve (Fig. 2), totalling 309 ks exposure and spanning from 55 to 3.5×10^6 s, can be modelled with a double broken power law with the following best-fitting parameters: $\alpha_{x1} = 2.35 \pm 0.14$, $t_{b1} = 294^{+40}_{-33}$ s, $\alpha_{x2} = 0.45^{+0.03}_{-0.04}$, $t_{b2} = 31.6^{+3.0}_{-5.0}$ ks, $\alpha_{x3} = 1.15 \pm 0.05$ (χ^2/dof $= 147/161$).

The WT mode spectrum spanning from 55 to 138 s can be fit by an absorbed power-law model, with a photon index of $2.42^{+0.27}_{-0.14}$ and column density of $4.6^{+3.2}_{-2.6} \times 10^{20}$ cm^{-2}, which is in excess of the average

Galactic column density in this direction of 9.6×10^{19} cm^{-2}. The PC mode spectrum of orbits 2 to 5, spanning from 5.6 to 24.7 ks, is fit with a higher column density, $(2.0 \pm 0.4) \times 10^{21}$ cm^{-2}, and a power-law index of 2.3 ± 0.2. The corresponding observed (unabsorbed) 0.3–10 keV flux is 5.0×10^{-12} (8.5×10^{-12}) erg cm^{-2} s^{-1} (Guidorzi *et al.*, *GCN Circ.* 7653).

Detailed light curves in both count rate and flux units are available in both graphical and ASCII formats at `http://www.swift.ac.uk/xrt_curves/`.

4   UVOT Observations and Analysis

The UVOT observed the field of GRB 080430 starting at 58 s after the BAT trigger. We detect the afterglow in all seven UVOT filters at the position RA(J2000)= 165.31108 deg ($11^{\mathrm{h}}01^{\mathrm{m}}14.66^{\mathrm{s}}$), Dec(J2000)= +51.68567 deg ($+51^{\mathrm{d}}41'08.4''$), with an estimated uncertainty of 0.5 arcsec (radius, 90% confidence). This position is consistent with the enhanced XRT position (Guidorzi *et al.*, *GCN Circ.* 7653) and the position reported from BOOTES observations by Jelinek *et al.* (*GCN Circ.* 7648). The detection in the UVW2 (1950 Å) filter is consistent with the redshift of 0.767 determined from spectroscopic observations by de Ugarte-Postigo *et al.* (*GCN Circ.* 7650) and Cucchiara & Fox (*GCN Circ.* 7654). The temporal slope in the white filter out to 30400 s is approximately $\alpha = 0.23$ (Landsman & Guidorzi, *GCN Circ.* 7660).

Table 1 reports UVOT photometry from early individual images.

Filter	T_{mid} (s)	Exposure (s)	Mag
White	108	98	17.08 ± 0.03
White	928	98	18.23 ± 0.05
v	364	393	17.64 ± 0.06
v	1184	393	18.50 ± 0.09
b	5989	197	20.05 ± 0.21
u	5784	197	18.92 ± 0.12
w1	7014	197	18.89 ± 0.16
m2	6809	197	18.88 ± 0.22
w2	5684	197	19.24 ± 0.20

Table 1: Magnitudes from UVOT observations.

These magnitudes are not corrected for the Galactic extinction corresponding to a reddening of $E_{B-V} = 0.012$ mag (Schlegel *et al.*, 1998). The photometry is on the UVOT flight system described in Poole *et al.* (2008, MNRAS, 383, 627).
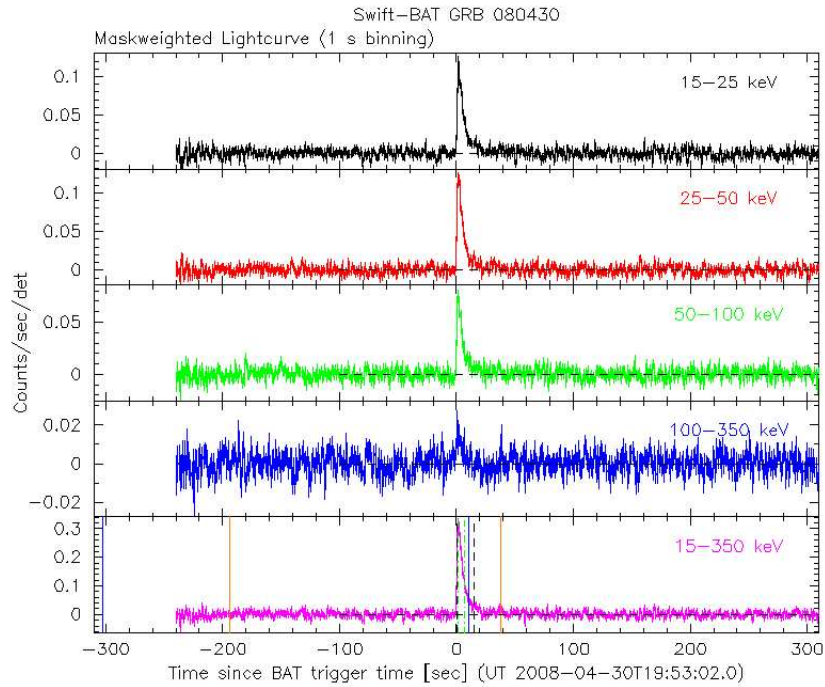
Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/s/illuminated-detector (note illum-det = 0.16 cm^2) and T_0 is 19:53:02 UT.
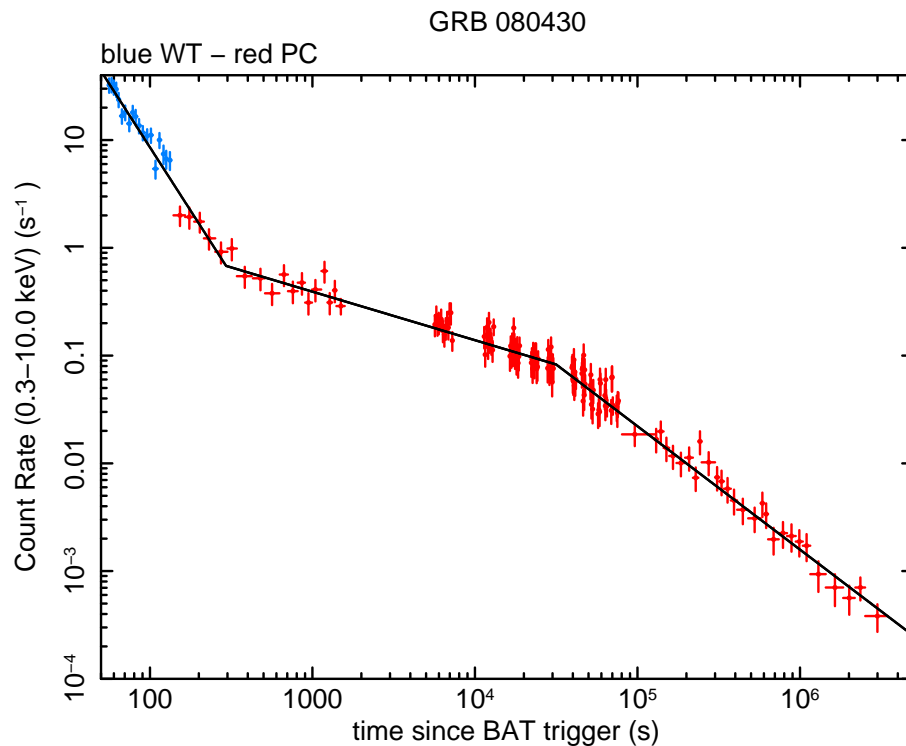

Figure 2: XRT Lightcurve. Flux in the 0.3-10 keV band: Windowed Timing (blue) and Photon Counting (red) modes. The approximate conversion is 1 count/s $\sim 4.6 \times 10^{-11}$ erg cm^{-2} s^{-1}.