Swift Observation of GRB 080210

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1 Introduction

At 07:50:05 UT on 2008 February 10, the Swift Burst Alert Telescope (BAT) triggered on GRB 080210 (Grupe et al. *GCN Circ.* 7281). The *Swift* XRT and UVOT began observing the field of GRB 080210 153 s after the burst. The burst was clearly detected in XRT and UVOT. The best *Swift* position of the afterglow is the UVOT position at RA-2000 =16h45m04.01s , Dec-2000 = $+13^\circ 49' 35.9''$.

The spectroscopic redshift of this burst is z=2.641 measured independently by Jakobsson et al. (*GCN Circ.* 7286) with the VLT and Cucchiara & Fox (*GCN Circ.* 7290) with the Hobby-Eberly-Telescope.

2 BAT Observation and Analysis

At 07:50:05 UT on 2008 February 10, the Swift BAT triggered on GRB 080210 (trigger #302888). The BAT ground-calculated position is RA, Dec = 251.259, 13.826 deg (Ukwatta et al. *GCN Circ.* 7289), which is

RA(J2000) = 16h 45m 02.5s

Dec(J2000) = $+13^\circ 49' 35''$

with an uncertainty of $1.1'$ (radius, 90% containment, including systematic uncertainty). The partial coding was 73%. The mask-weighted light curve shows 3-4 overlapping peaks starting at T-16 s, peaking at T+5 s, and ending at T+33 s (Figure 1). T_{90} (15-350 keV) is 45±11 s (estimated error including systematics).

The time-averaged spectrum from T-14.6 to T+47.7 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.77±0.12. The fluence in the 15-150 keV band is $(1.8\pm0.1)\times10^{-6}$ ergs cm^{-2}. The 1s peak photon flux measured from T-0.5 s in the 15-150 keV band is (1.6±0.2) photons cm^{-2} s^{-1}. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The XRT began observing the field at 07:52:38 UT, 153 seconds after the BAT trigger. XRT found a bright, uncatalogued X-ray source. The enhanced *Swift*-XRT position as reported by Evans et al. (*GCN Circ.* 7285) is RA-2000 = 251.26693, Dec-2000 = +13.82565 which is equivalent to:

RA (J2000): 16h 45m 4.06s

Dec (J2000): $+13^\circ\ 49'\ 35.6''$

with an uncertainty of $2.5''$ (radius, 90% confidence).

The $0.3 - 10$ *keV* light curve (Fig.2) shows a flare with a peak at about 190s after the burst and an initial decline after the peak with a slope of $\alpha_1 = 7.5 \pm 0.9$, following by a shallow slope of $\alpha_2 = 0.79 \pm 0.05$, beginning at $T + 290 \pm 20$s. After a third break at about 10ks after the burst the decay steepens again with a decay slope $\alpha_3 = 1.31 \pm 0.18$. There is a possible jet break at 46ks after the burst. The decay slope after this jet break is 2.6 ± 0.4.

As reported by Grupe (*GCN Circ.* 7287), the WT data (158-232 s after burst) can be modeled by an absorbed power-law with photon index $\Gamma = 2.85 \pm 0.25$ and a free-fit absorbing column of $N_{\rm H} = (21.5 + 4.8 - 5.4)^{20}$ cm^{-2} which is in excess of the Galactic value ($5.47{\times}10^{20}$ cm$^{-}2$ Dickey & Lockman 1990). According to the relation given by Grupe et al. (2007, AJ, 133,2216) this excess suggests that the redshift of this burst is z<3.9, which is consistent with the spectroscopic redshift z=2.64 reported by Jakobsson et al. and Cucchiara & Fox (*GCN Circ.* 7286 and *GCN Circ.* 7290, respectively). The PC mode data are consistent with this result.

4 UVOT analysis

The Swift/UVOT observed the field of GRB 080210 starting 160 seconds after the BAT trigger (Marshall & Grupe *GCN Circ.* 7292). A bright afterglow was seen in the initial exposures with the White and V filters at a position of RA (J2000) = 16h45m04.01s and Dec (J2000) = $+13{\circ}49'35.9''$ (J2000) with an estimated 90% confidence error radius of $0.6''$. This position is consistent with the optical position reported by Klotz et al. (*GCN Circ.* 7280) and the enhanced XRT position reported by Evans et al. (*GCN Circ.* 7285). There was no 3-sigma detection of the afterglow in any subsequent exposure in any of the UVOT filters. The non-detections in the UV filters is consistent with the redshift of 2.64. The lack of detection in the second exposure with the White filter indicates a decay slope of steeper than 0.7 assuming a power law decay model. This slope is consistent with the decay slope found in the X-ray data.

The detections and upper limits are summarized in Table 1. These magnitudes are not corrected for Galactic extinction E(B-V) = 0.063 (Schlegel et al. 1998).

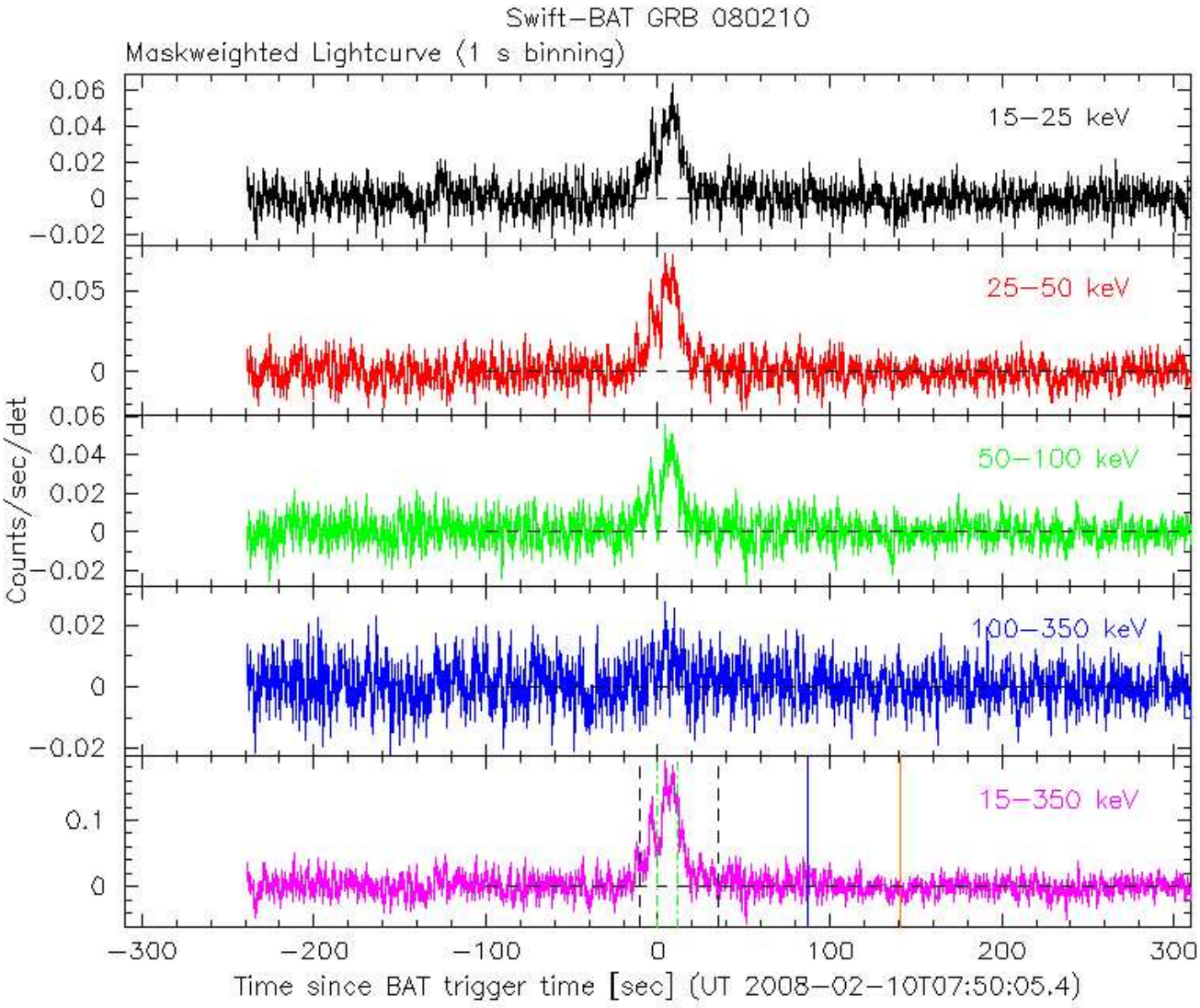

Figure 1: BAT Light curve of GRB 080210.

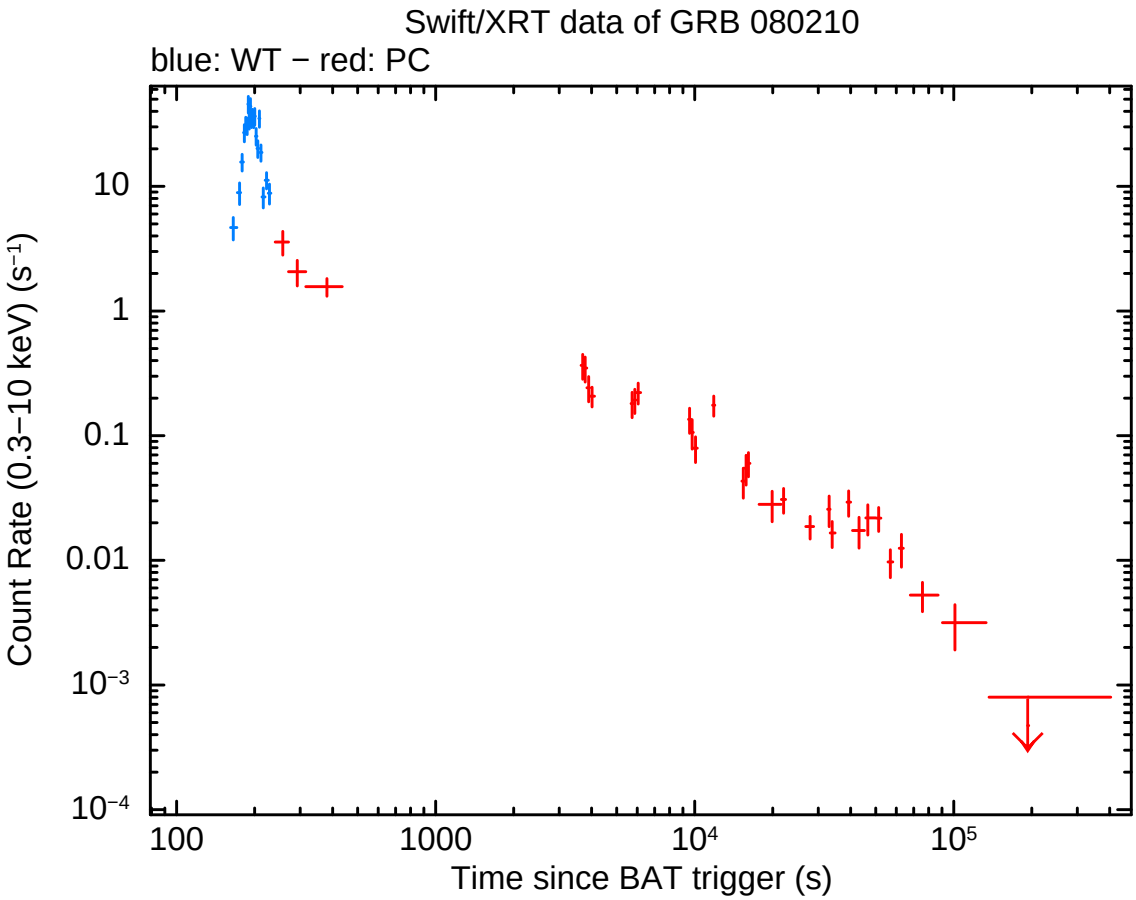

Figure 2: XRT Lightcurve in Counts s^{-1} in the 0.3-10 keV band: Windowed Timing data (blue) and Photon Counting mode (red). The approximate conversion is 1 count $s^{-1} = \sim 3.0{\times}10^{-11}$ $ergs\ s^{-1}cm^{-2}$ for an unabsorbed flux corrected for photon pileup.

Filter	$T_{\rm Start}$	$T_{\rm stop}$	Exposure	Mag
white	160	260	98	18.2±0.1
white	6081	6244	161	>20.5
v	267	460	190	17.6±0.1
b	5877	64094	2625	>21.2
u	5671	69878	4779	>21.3
uvw1	3846	69140	5453	>22.3
uvm2	3639	68241	4447	>21.8
uvw2	9469	74958	4171	>22.3

Table 1: Magnitude from UVOT observations of GRB 080210