Swift Observation of GRB 090123

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1   Introduction

At 07:51:56 UT on 2009 January 23, the Swift Burst Alert Telescope (BAT) triggered on GRB 090123 (Grupe et al. *GCN Circ.* 8842). *Swift* slewed promptly and the *Swift* XRT and UVOT began observing the field of GRB 090123 about 100 s after the burst. The best *Swift* position of the afterglow is from the UVOT at RA (J2000) =00h 27m 08.74s, Dec (J2000) = $-23°30'04.1"$

Because of its small sun-angle, GRB 090123 was only observed from ground by GROND (Rossi & Greiner *GCN Circ.* 8849) which detected it in g', r', i', and z', but not in JHK.

2   BAT Observation and Analysis

At 07:51:56 UT on 2009 January 23, the Swift BAT triggered on GRB 090123 (trigger #340895). The BAT ground-calculated position is RA, Dec = 6.794, −23.503 deg (Ukwatta et al. *GCN Circ.* 8844), which is

RA(J2000) = 00h 27m 10.5s

Dec(J2000) = $-23°30'12.6''$

with an uncertainty of $1.5'$ (radius, 90% containment, including systematic uncertainty). The partial coding was 30%.

The mask-weighted light curve shows multiple overlapping peaks starting at $\sim$T+3 s, and ending at $\sim$T+120 s. T_{90} (15-350 keV) is 131±23 s (estimated error including systematics).

The time-averaged spectrum from T-49.6 to T+117.9 s is best fit by a simple power-law model. The photon index of the time-averaged spectrum is Γ=1.74±0.12. The fluence in the 15-150 keV band is $(2.9\pm0.2)\times10^{-6}$ ergs cm^{-2}. The 1s peak photon flux measured from T+0.08 s in the 15-150 keV band is (1.7±0.3) photons cm^{-2} s^{-1}. The results of the batgrbproduct analysis are available at http://gcn.gsfc.nasa.gov/notices_s/337914/BA/

3   XRT Observations and Analysis

The XRT began observing the field of GRB 090123 at 07:53:36.2 UT, 99.9 seconds after the BAT trigger. XRT found a fading, uncatalogued X-ray source. The *Swift*-XRT position as reported by Osborne al. (*GCN Circ.* 8843) is RA (J2000) = 6.78599, Dec (J2000) = −23.50156 which is equivalent to:

RA (J2000): 00h 27m 08.64s

Dec (J2000): $-23°\ 30'\ 05.6''$

with an uncertainty of $1.7''$ (radius, 90% confidence). This position is $27.0''$ away from the ground-calculated BAT position and within the BAT error circle.

The $0.3 - 10 \; keV$ light curve (Fig.2) can be modeled by an initial decay slope $\alpha=1.78^{+0.06}_{-0.08}$ and a break at $\text{T}+1530^{+720}_{-220}$s followed by a decay slope $\alpha=1.15\pm0.11$ (Grupe *GCN Circ.* 8847).

The XRT Windowed Timing mode data can be modeled by an absorbed single power-law with photon index $\Gamma = 1.65 \pm 0.05$ and an absorbing column density fixed to the Galactic column density at the position of the burst of $N_{\text{H,gal}} = 1.79 \times 10^{20}$ cm^{-2} (Kalberla et al. 2005). The spectrum of the Photon Counting mode data is consistent with this result.

4   UVOT analysis

UVOT took a finding chart exposure of 150s in White starting 107 s after the BAT trigger (Marshall & Grupe, *GCN Circ.* 8846). The analysis of the full UVOT data set shows an the optical afterglow detected in all UVOT filters. The 3.4σ detection in uvw2 indicates that the redshift of this burst is less than 1.4. The position of the afterglow is

RA (J2000) = 00h 27m 08.73s

Dec (J2000) = $-23° \; 30' \; 04.1''$

corresponding to RA-2000=6.78639, Dec-2000=–23.50113 with an estimated 90% confidence radius of $0.5''$. There is a broad peak in the light curve at about 600s after the burst.

The magnitudes in the UVOT photometric system (Poole et al. 2008, MNRAS, 383, 627) for detecting the source are listed in Table 1. No correction has been made for the expected extinction corresponding to E(B-V) of 0.02 (Schlegel et al., 1998).

Filter	T_{Start}	T_{stop}	Exposure	Mag
white (FC)	107	257	150	17.8±0.1
v	649	669	20	15.2±0.1
b	575	595	20	15.8±0.1
u	320	570	250	16.4±0.1
uvw1	698	718	20	17.3±0.23
uvm2	1251	8112	294	19.6±0.25
uvw2	1547	7843	413	20.5±0.29

Table 1: Magnitudes from UVOT observations of GRB 090123
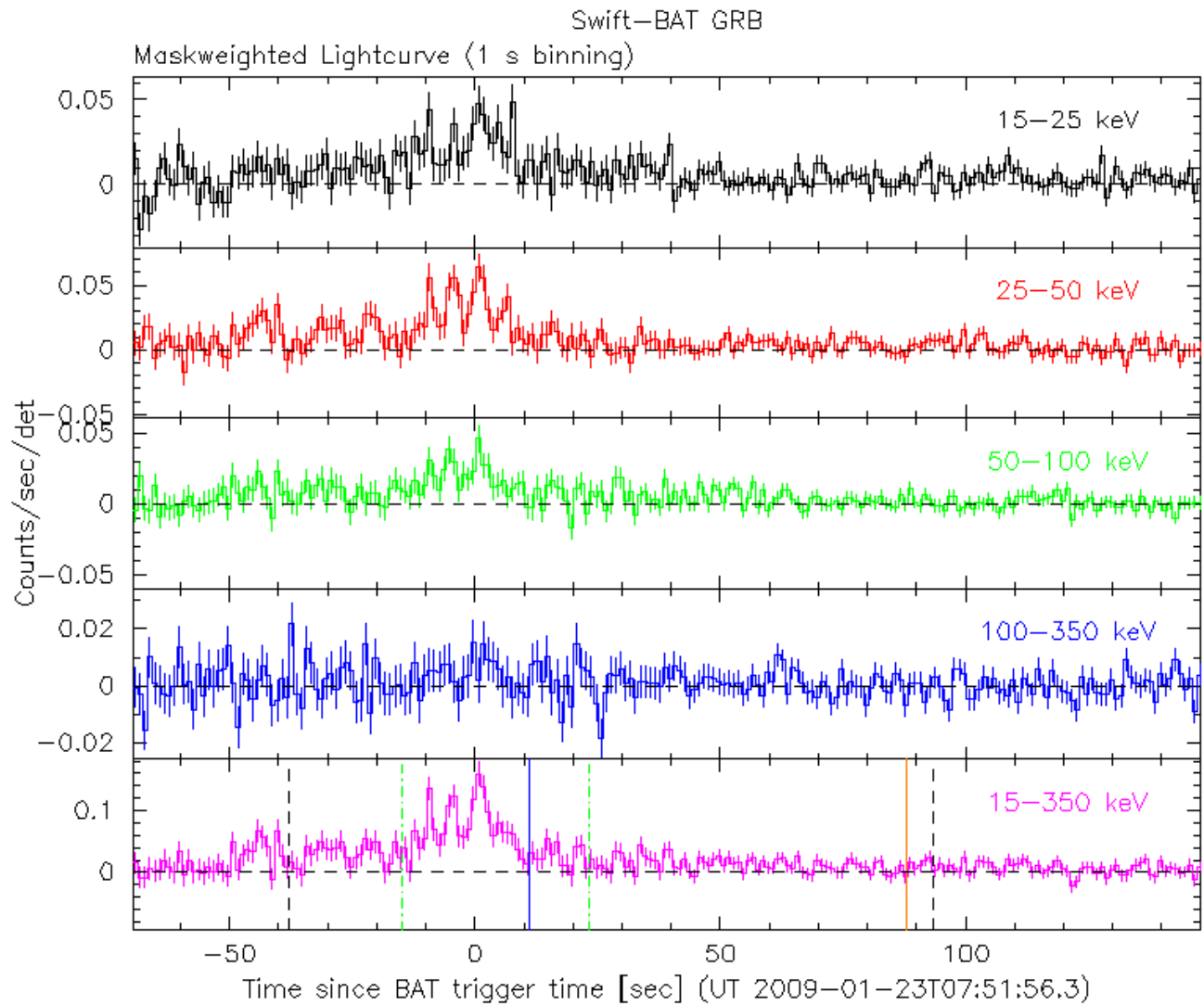
Figure 1: BAT Light curves of GRB 090123.

Swift/XRT data of GRB 090123

blue: WT – red: PC

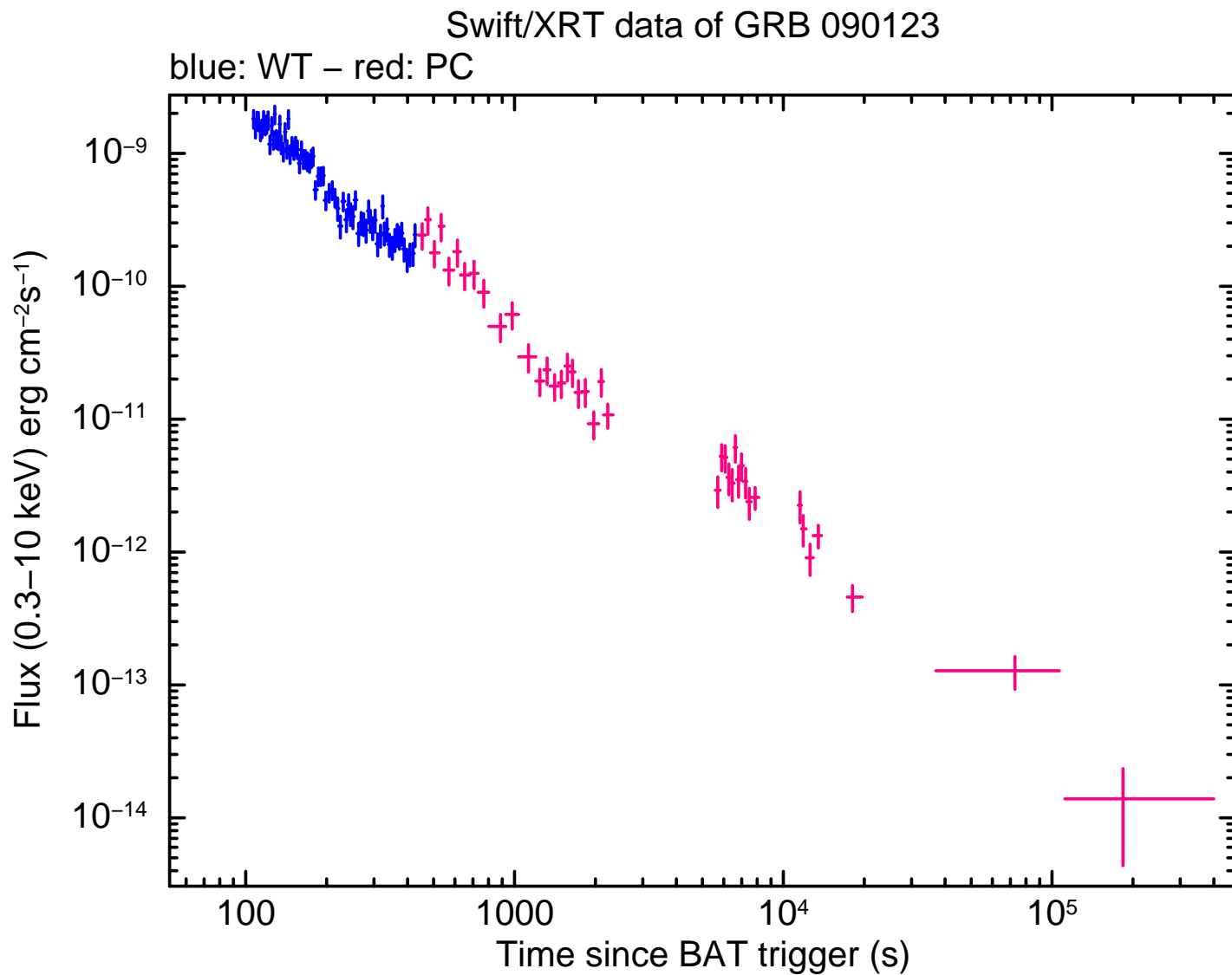

Figure 2: XRT flux light curve in the 0.3-10 keV band. The approximate conversion is 1 count s^{-1} = $\sim 4.2 \times 10^{-11}$ $ergs$ $s^{-1}cm^{-2}$ for an observed flux.