Swift Observations of GRB 090727

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1 Introduction

Swift-BAT triggered on GRB 090727 at 22:42:18 UT (Trigger 358520) (Evans, *et al.*, *GCN Circ.* 9718). The burst has $T_{90} = 300$ *sec*. Swift slewed to this burst immediately and XRT began follow-up observations at $T + 88$ *sec*, and UVOT at $T + 91$ *sec*. Our best position is the enhanced XRT location RA($J2000$) = $315.96078deg$ (21h03m50.59s), Dec($J2000$) = $+64.92481deg$ ($+64d55'29.3''$) with an error of $1.6''$ (radius, 90% confidence).

2 BAT Observation and Analysis

Using the data set from $T - 240$ to $T + 962$ *sec*, analysis of GRB 090727 has been performed by Swift team (Markwardt *et al.*, *GCN Circ.* 9724). The BAT ground-calculated position is RA($J2000$) = $315.917deg$ (21h03m40.0s), Dec($J2000$) = $+64.937deg$ ($+64d56'12.7''$) ± 2.2 *arcmin*, (radius, systematic and statistical, 90% containment). The partial coding was 83% .

The mask-weighted light curve (Fig.1) shows an initial FRED-like peak starting at $\sim T - 7$ *sec*, peaking at $T \sim 0$ *sec* and ending at $\sim T + 20$ *sec*. A second, weaker, peak starts at $\sim T + 130$ *sec* to $\sim T + 150$ *sec*. A third peak starts at $\sim T + 180$ *sec*, peaks at $\sim T + 270$ *sec*, and ends at $\sim T + 320$ *sec*. This third peak corresponds to the flare seen by the XRT. $T_{90}(15 - 350keV)$ is 302 ± 23 *sec* (estimated error including systematics).

The time-averaged spectrum from $T - 1.3$ to $T + 318.9$ *sec* is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.24 ± 0.24. The fluence in the $15 - 150$ *keV* band is $(1.4 \pm 0.2 \times 10^{-6}$ *ergs/cm^2*. The 1-sec peak photon flux measured from $T + 0.12$ *sec* in the $15 - 150$ *keV* band is 0.5 ± 0.1 *ph/cm^2/sec*. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Swift-XRT observed the field of GRB 090727 for 308 *ksec*, from 88 *sec* to 2.1 *Msec* after the BAT trigger. The data comprise 40 *sec* in Windowed Timing (WT) mode, with the remainder in Photon Counting (PC) mode. The enhanced XRT position is RA($J2000$) = $315.96078deg$ (21h03m50.59s), Dec($J2000$) = $+64.92481deg$ ($+64d55'29.3''$) with an error of $1.6''$ (radius, 90% confidence).

The XRT initially observed the GRB for only 210 *sec* before slewing away (Fig. 2). The data in this interval are dominated by a flare, making it impossible to determine the underlying decay rate. Fitting only the data from the second snapshot (beginning at $T + 3.9$ *ksec*) onwards, the light curve can be described as a power-law decay, with a long-lived shallow decay segment with decay index $0.51(+0.13, -0.10)$, which broke at $T + 1.8(+4.5, -0.6) \times 10^5$ *ksec* to a steeper decay with index $1.1(+0.9, -0.2)$.

The PC mode spectrum can be fitted with an absorbed power-law, with a photon index of 1.68 (+0.16, -0.17). The absorption column is consistent with the Galactic value of 2.5×10^{21} *cm^{-2}* (Kalberla *et al.* 2005). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 5.1×10^{-11} (6.8×10^{-11}) *erg/cm^2/count*.
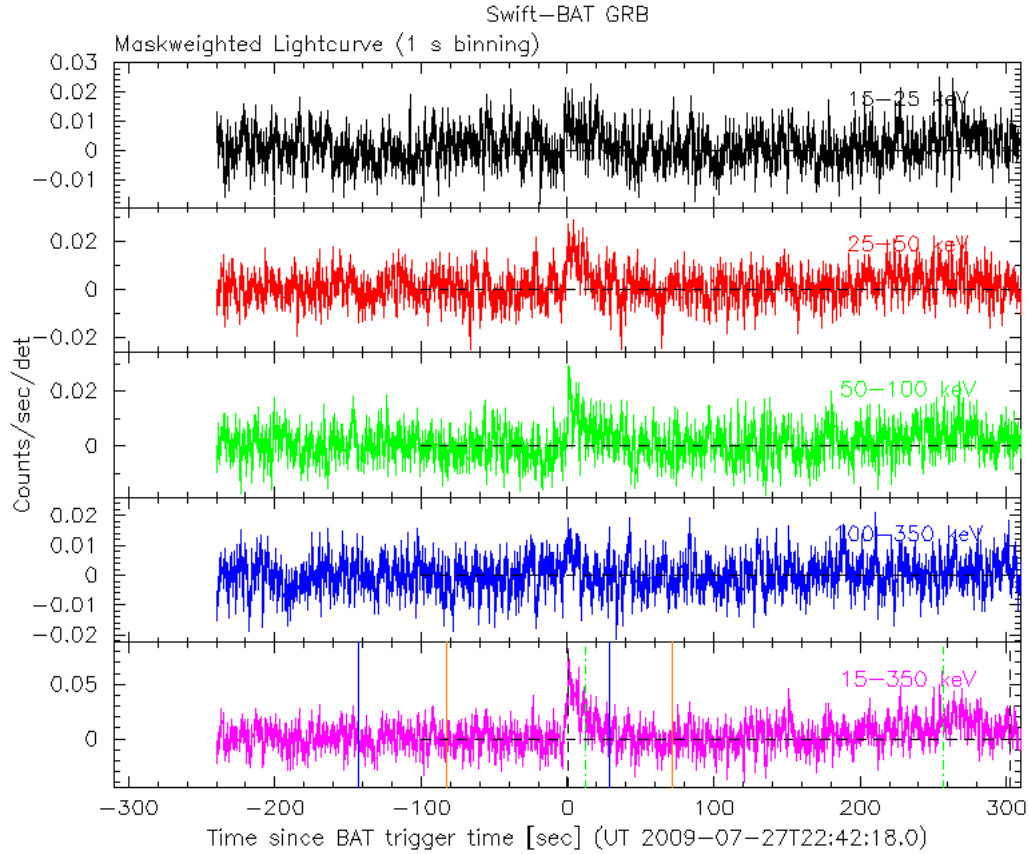
Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector.

4 UVOT Observation and Analysis

The UVOT began settled observations of the field of GRB 090727 92 sec after the BAT trigger. We do not detect any source at the enhanced Swift XRT position. Upper limits are summarized in Table 1. These upper limits are not corrected for Galactic extinction $E(B - V) = 0.54$.
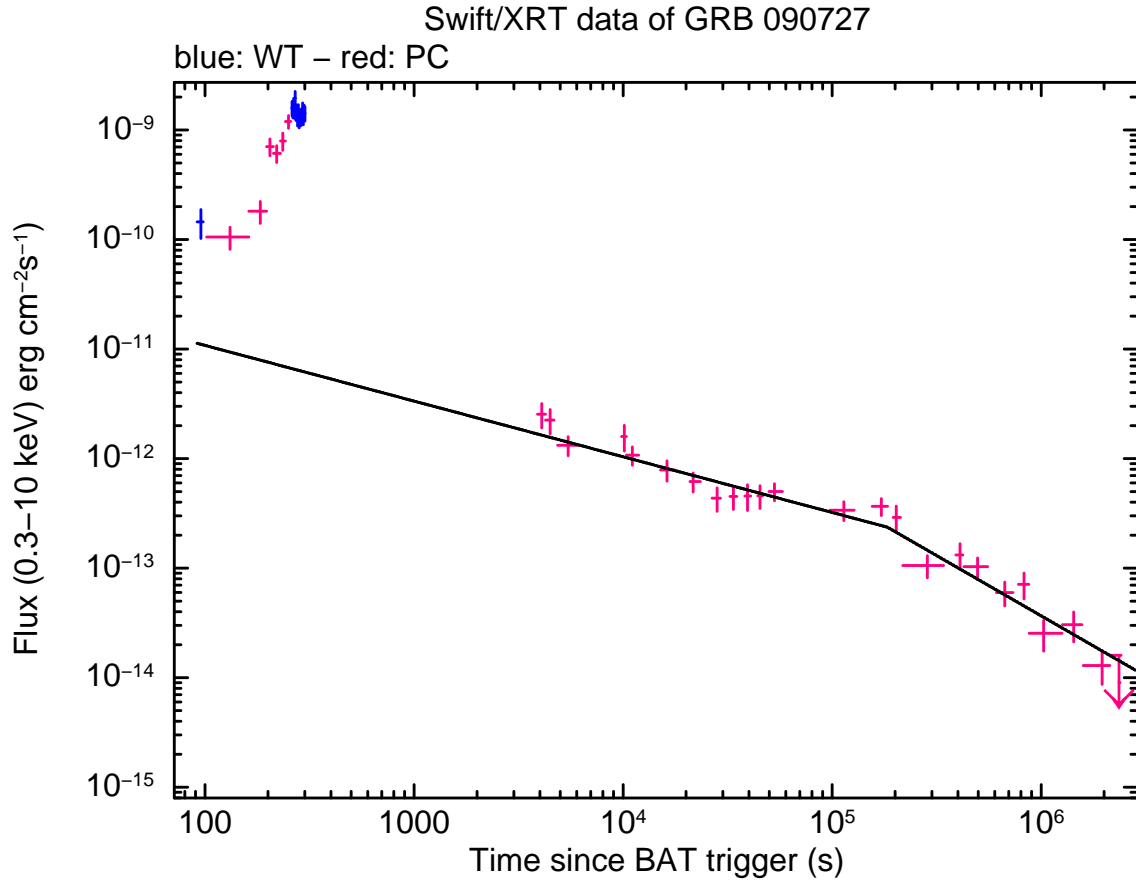
Figure 2: XRT light curve. Flux in the 0.3-10 keV band. The counts-to-flux conversion is 1 $count/sec$ $= 5.1 \times 10^{-11} \ ergs/cm^2/sec$.

Filter	Start	Stop	Exposure	3-Sigma UL
white_FC	92	241	147	20.6
white	92	5987	541	21.5
v	4760	57429	3737	21.1
b	4145	46543	1752	21.3
u	3939	52323	4261	21.8
w1	5171	51651	4625	22.1
m2	4965	57845	4989	22.3
w2	4556	56519	3825	21.7

Table 1: Magnitude limits from UVOT observations