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 $0.5 \pm 0.1 \ ph/cm^2/sec$. 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 $2.5 \times 10^{21}$ cm$^{-2}$ (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is $5.1 \times 10^{-11} (6.8 \times 10^{-11}) \ erg/cm^2/count$. 
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 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector.
Figure 2: XRT light curve. Flux in the 0.3-10 keV band. The counts-to-flux conversion is 1 count/sec = 5.1 × 10^{-11} ergs/cm²/sec.

Table 1: Magnitude limits from UVOT observations