Swift Observations of the Short Burst GRB 070809

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1. INTRODUCTION

At 19:22:17 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 070809 (trigger 287344; Marshall *et al.* GCN Circ. 6728). Swift slewed immediately to the burst, and the XRT began taking data ~71 seconds after the trigger. The first UVOT finding chart began ~74 seconds after the trigger.

XRT determined the best Swift position for the burst (Evans *et al.,* GCN Circ. 6737). UVOT did not detect an afterglow (Chester & Marshall, GCN Circ. 6751). Perley *et al.* (GCN Circ. 6739) report a candidate afterglow at the edge of XRT error circle with R ~24.0 with the Keck telescope ~11 hours after the trigger, but it was not possible to tell if the object was fading.

2) BAT OBSERVATION AND ANALYSIS

The BAT ground-calculated position (Krimm et al. GCN Circ. 6732) is RA (J2000) = 13h 35m 04.2s and Dec (J2000) = -22° 07' 07" with an uncertainty of 1.7' (90% containment including both statistical and systematic errors). The partial coding was 74%.

The mask-weighted light curve consists of a single peak starting at ~T-0.3 and ending at ~T+1.2 sec. T90 (15-350 keV) is 1.3 ± 0.1 sec (estimated error including systematic uncertainties).

The time-averaged spectrum from T-0.4 to T+1.1 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.69 ± 0.22. The fluence in the 15-150 keV band is 1.0 ± 0.1 x 10^{-7} erg-cm^{-2}. The 1-sec peak photon flux measured from T+0.08 sec in the 15-150 keV band is 1.2 ± 0.2 photons-cm^{-2}-sec^{-1}. All the quoted errors are at the 90% confidence level. We note that the T_{90}-hardness_ratio for this burst falls in between the SHB and LSB clusters in the T_{90}-HR scatter plot for Swift-BAT.

3. XRT OBSERVATIONS AND ANALYSIS

Evans et al. (GCN Circ. 6737) reported the refined analysis of the XRT data. Using the first 11 ks of Swift XRT data (all of which was in Photon Counting (PC) mode), we find a refined XRT position of RA (J2000) = 13h 35m 4.78s and Dec (J2000) = -22° 08' 29.8" with an estimated uncertainty of 3.5" (radius, 90% containment including systematic uncertainties). This is 81.9" from the refined BAT position (Krimm et al. GCN Circ. 6732) and 4.2" from the XRT position reported in GCN Circ. 6728.

The XRT light curve shows fading behavior that is well fitted by a power-law with two breaks. The initial decay followed a slope of α=2.3 (+0.7/-1.1), and then broke at ~T+200 s to a shallower decay with α=0.28 (±0.13). The shallow phase ended at approximately T+10000 s, and the current decay follows a slope of α=1.35 (+0.80/-0.72).

The PC-mode spectrum from T+85-25000 s is well fitted by an absorbed power-law model with a column density of 6.7 (+7.0/-5.3) x10^{20} cm^{-2}, which is consistent with the Galactic value of 6.40x10^{20} cm^{-2} (Kalberla et al. 2005). The spectral slope was Γ=1.49 (+0.25/-0.22), consistent with the BAT value. The observed (unabsorbed) 0.3-10 keV flux is 1.64x10^{-12} (1.79x10^{-12}) erg cm^{-2}-sec^{-1}.

4. UVOT OBSERVATIONS AND ANALYSIS

UVOT took an initial 400-s finding chart exposure with the V filter starting at about T+74s, followed by short exposures with each of 6 filters, and then finding charts in V and UVM2. The white filter was not used because of a nearby bright star. Only the initial finding chart covers the XRT position because all of the exposures are centered on the erroneous on-board XRT position. Subsequent UVOT exposures are centered on the correct XRT position. No afterglow was detected in any of the observations. Table 1 gives the 3-σ upper limits for the early UVOT observations.

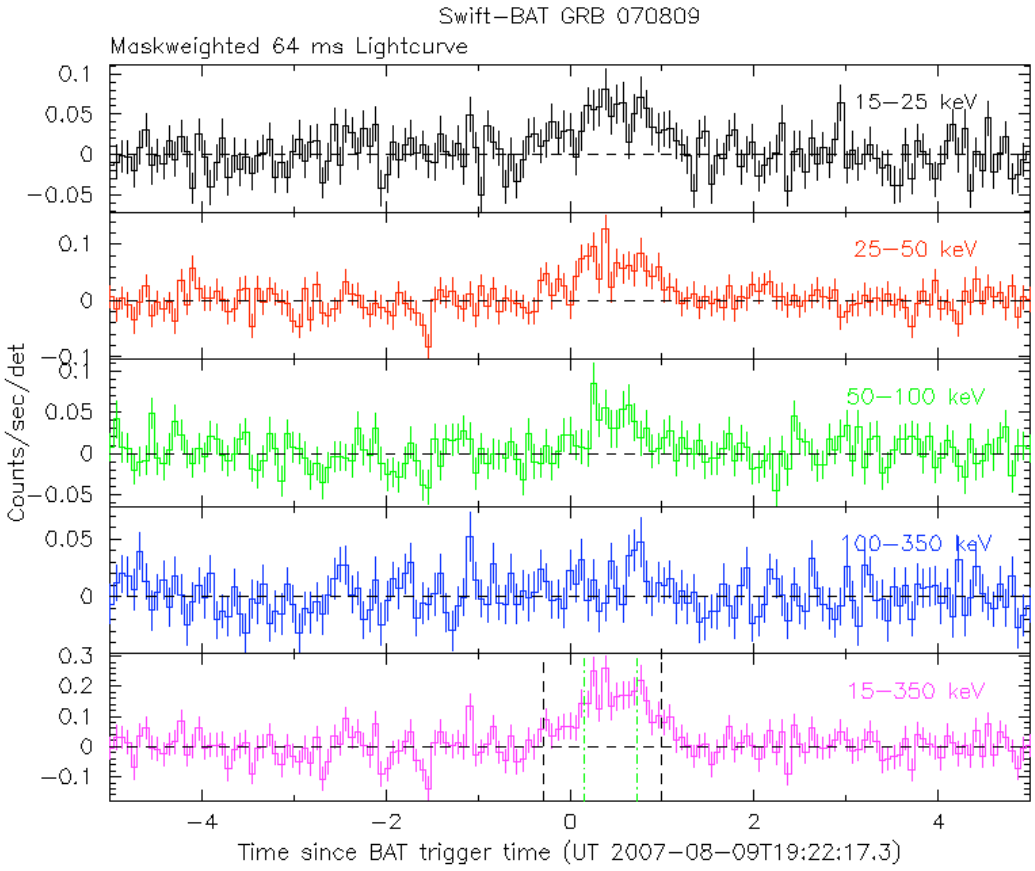

Fig.1: The BAT mask-weighted light curve in the 4 individual plus total energy bands. The units are counts s^{-1} illuminated-detector^{-1}. Each illuminated detector has an area of 0.16 cm^2.

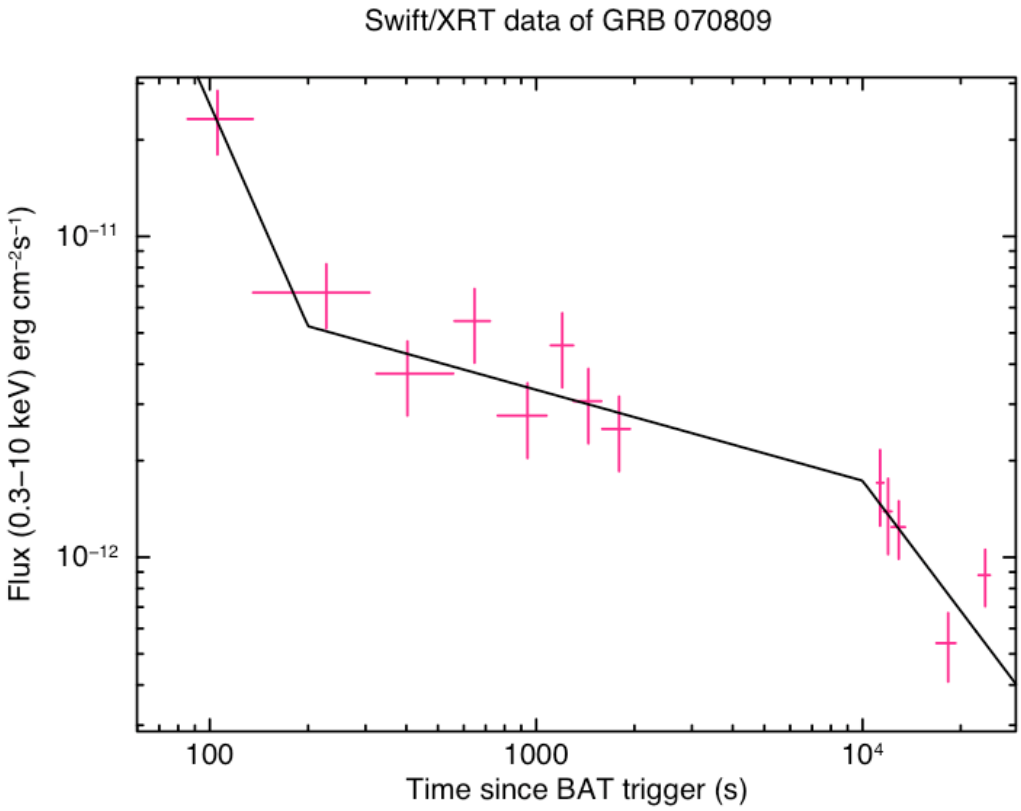

Fig. 2: XRT light curve. For the XRT, 1 cps is ~5.4 x 10^{-11} erg cm^{-2} s^{-1}.

Filter	Start Time (sec.)	Stop Time (sec.)	Exposure (sec.)	Upper Limit (Mag.)
v	74	474	394	19.1
v	6,344	18,560	1,251	20.2
b	5,932	24,592	614	20.4
u	5,727	24,363	1,911	20.6
uvw1	5,523	23,449	2,164	20.6
uvm2	5,317	19,316	2,018	21.0
uvw2	6,139	17,646	1,279	20.6

Table 1: UVOT Observations. The start and end times of the exposures are given in seconds since the BAT trigger. No corrections have been made for the expected extinction in the Milky Way corresponding to E(B-V) of 0.09 (Schlegel *et al.* 1998)