Swift Observations of GRB 090929A

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1 Introduction

GRB 090929A was detected by the Fermi Gamma-Ray Burst Monitor, INTEGRAL SPI-ACS (Rau, GCN Circ. 9962) and Konus-RF and -Wind instruments (Golenetskii et al., GCN Circ. 9968, 9976). Swift was performing a preplanned slew at the time, but a source was later found during ground processing. No counterpart was detected by either the Swift-XRT or UVOT, so the best Swift position is that derived from the BAT: RA, Dec = 56.494, −5.952 deg, which is equivalent to

RA (J2000) = $03^{\rm h}$ $45^{\rm m}$ $57.9^{\rm s}$
Dec (J2000) = $-05^{\rm o}$ 57' 50"

with an uncertainty of 3 arcmin (radius, 90% confidence).

We note that GCN Circular 9964 (Goad et al.) refers to GRB 090929B, *not* this burst.

2 BAT Observation and Analysis

The BAT ground-calculated position (Cummings & Krimm, GCN Circ. 9966) is RA, Dec = 56.494, −5.952 or

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with an estimated 90% containment error radius of 3 arcmin. The partial coding was 73-90% during the burst.

The mask-weighted lightcurve shows multiple peaks and spikes, at T+1, T+2, T+4, T+5, and T+10 s (Figure 1), where T_0 is 04:33:07. T_{90} was 7 ± 2 seconds.

The time-averaged spectrum from T_0 to T+12 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is $\Gamma = 0.96 \pm 0.04$. The fluence in the 15–150 keV band is $(1.69 \pm 0.07) \times 10^{-6}$ erg cm^{-2}. The 1-s peak photon flux measured from T+0.5 s in the 15–150 keV band is 5.9 ± 0.3 ph 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 of GRB 090929A about 13 hours after the burst. This area of sky was a hot target for the XRT, so only a short observation was performed, with 1.4 ks of data being collected in Photon Counting mode.

We do not detect a source within the BAT error circle, to a 90% upper limit of 0.015 count s^{-1} over 0.3–10 keV. Assuming a typical counts to flux conversion of 3.8×10^{-11} erg cm^{-2} ct^{-1} (Evans et al., 2009, MNRAS, 397, 1177), this limit corresponds to an observed flux of 5.7×10^{-13} erg cm^{-2} s^{-1}. We note that this is not a very constraining upper limit, because of the greater than usual background caused by the high XRT CCD temperature and the short exposure time.

Filtering out all photons below 1 keV, a more stringent upper limit of 9×10^{-3} count s^{-1} (1–10 keV; observed flux of $\sim 3.4 \times 10^{-13}$ erg cm^{-2} s^{-1}) can be determined.

4 UVOT Observation and Analysis

UVOT also began settled observations of GRB 090929A about 13 hours after the burst. Due to the presence of a 9th magnitude (V) star 45 arcsec from the centre of the BAT error circle, data were only obtained in the uvm2 filter.

We do not detect any uncatalogued UV source within the BAT error circle. The 3σ upper limit and summed exposure is reported in Table 1. This magnitude is not corrected for the Galactic extinction corresponding to a reddening of $E_{B-V} = 0.07$ (Schlegel et al., 1998, ApJS, 500, 525). The photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).

Filter	Start (s since trigger)	Stop (s since trigger)	Exposure (s)	Magnitude
uvm2	47411	52924	2252	>21.26

Table 1: UVOT upper limit at the 3σ level in the uvm2 filter.

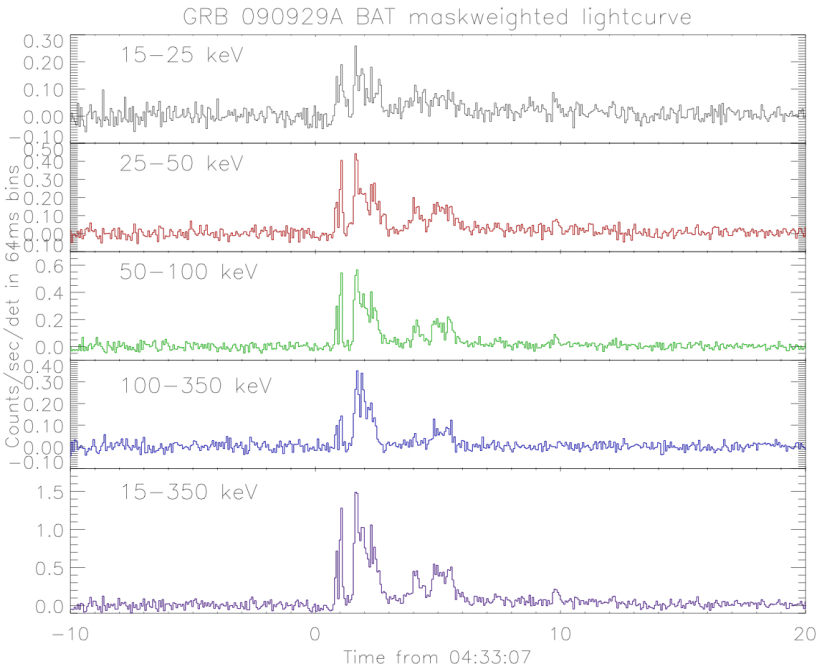

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are count s^{-1} (illuminated-detector)$^{-1}$; note illum-det = 0.16 cm^2.