

Swift Observations of GRB 090308

P.A. Evans (U. Leicester), C.B. Markwardt (GSFC/UMD), F.E. Marshall (NASA/GSFC) and K.L. Page (U. Leicester), for the Swift Team

1 Introduction

Swift-BAT triggered on GRB 090308 at 18:01:23 UT (Trigger 345777) (Evans, *et al.*, *GCN Circ.* 8948). This was an image trigger with $T_{90} = 48$ sec. Swift slewed to this burst immediately, and XRT began follow-up observations at $T + 127$ sec, UVOT at $T + 131$ sec. Our best position is the enhanced XRT position $RA(J2000) = 183.50120deg$ (12h14m0.28s), $Dec(J2000) = -48.81710deg$ ($-48d49'01.6''$) with an error of 1.6 arcsec (radius, 90% confidence).

2 BAT Observation and Analysis

Using the data set from $T - 60$ to $T + 243$ sec, analysis of GRB 090308 has been performed by the Swift team (Markwardt, *et al.*, *GCN Circ.* 8949). The BAT ground-calculated position is $RA(J2000) = 183.545deg$ (12h14m10.7s), $Dec(J2000) = -48.754deg$ ($-48d45'13.8''$) ± 3.4 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 89% .

The mask-weighted light curve (Fig.1) shows a weak pulse starting at $\sim T - 10$ sec, peaking at $\sim T + 30$ sec and ending at $\sim T + 65$ sec. $T_{90}(15 - 350keV)$ is 48 ± 22 sec (estimated error including systematics).

The time-averaged spectrum from $T + 4.0$ to $T + 52.0$ sec is best fitted by a simple power law model. This fit gives a photon index of 2.33 ± 0.37 . For this model the total fluence in the 15 – 150 keV band is $(2.6 \pm 0.6) \times 10^{-7}$ ergs/cm² and the 1-sec peak flux measured from $T + 27.50$ sec in the 15 – 150 keV band is 0.1 ± 0.0 ph/cm²/sec. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Swift-XRT observed the field of GRB 090307 for 71 ksec, from 135 sec to 300 ksec after the BAT trigger. The data comprise 55 sec in Windowed Timing (WT) mode, with the remainder in Photon Counting (PC) mode. The enhanced XRT position is $RA(J2000) = 183.50120deg$ (12h14m0.28s), $Dec(J2000) = -48.81710deg$ ($-48d49'01.6''$) with an error of 1.6 arcsec (radius, 90% confidence).

The light curve (Fig. 2) shows a power-law decay, with an initial decay index of 2.6 (± 0.2) with a break at $T + 1800$ sec to a decay index of 0.4 ($+0.2, -0.3$). Very few photons are detected after $T + 10^5$ sec suggesting that the light curve breaks again at late times, however we are unable to constrain such a break.

The PC mode spectrum can be fitted with an absorbed power-law, with a photon index of 2.16 ($+0.16, -0.27$) and an absorbing column of $3.7 (\pm 0.9) \times 10^{21}$ cm⁻², in excess of the Galactic value of 8.5×10^{20} cm⁻². The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 4.3×10^{-11} (7.9×10^{-11}) erg/cm²/count.

4 UVOT Observation and Analysis

The UVOT began observations of the field of GRB 090308 132 s after the BAT trigger. No optical afterglow is detected in the initial UVOT exposures at the position of the X-ray afterglow. Three-

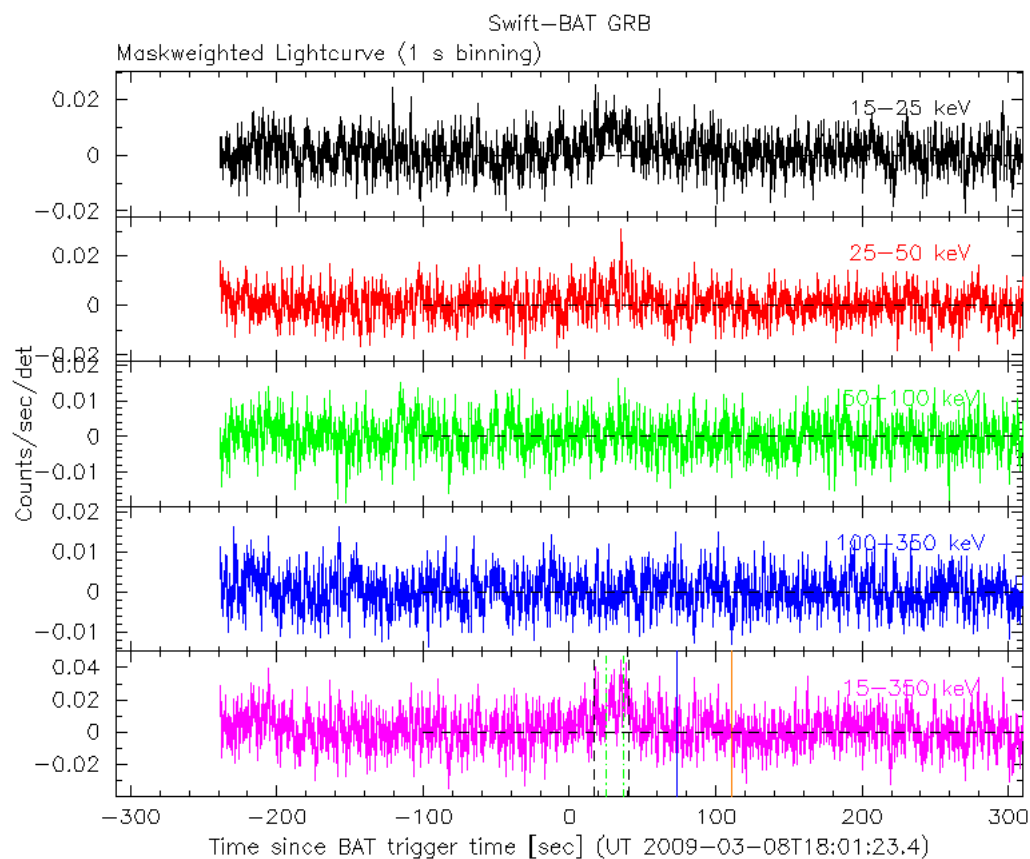


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector.

sigma upper limits are summarized in Table 1. These upper limits are not corrected for Galactic extinction $E(B - V) = 0.11$.

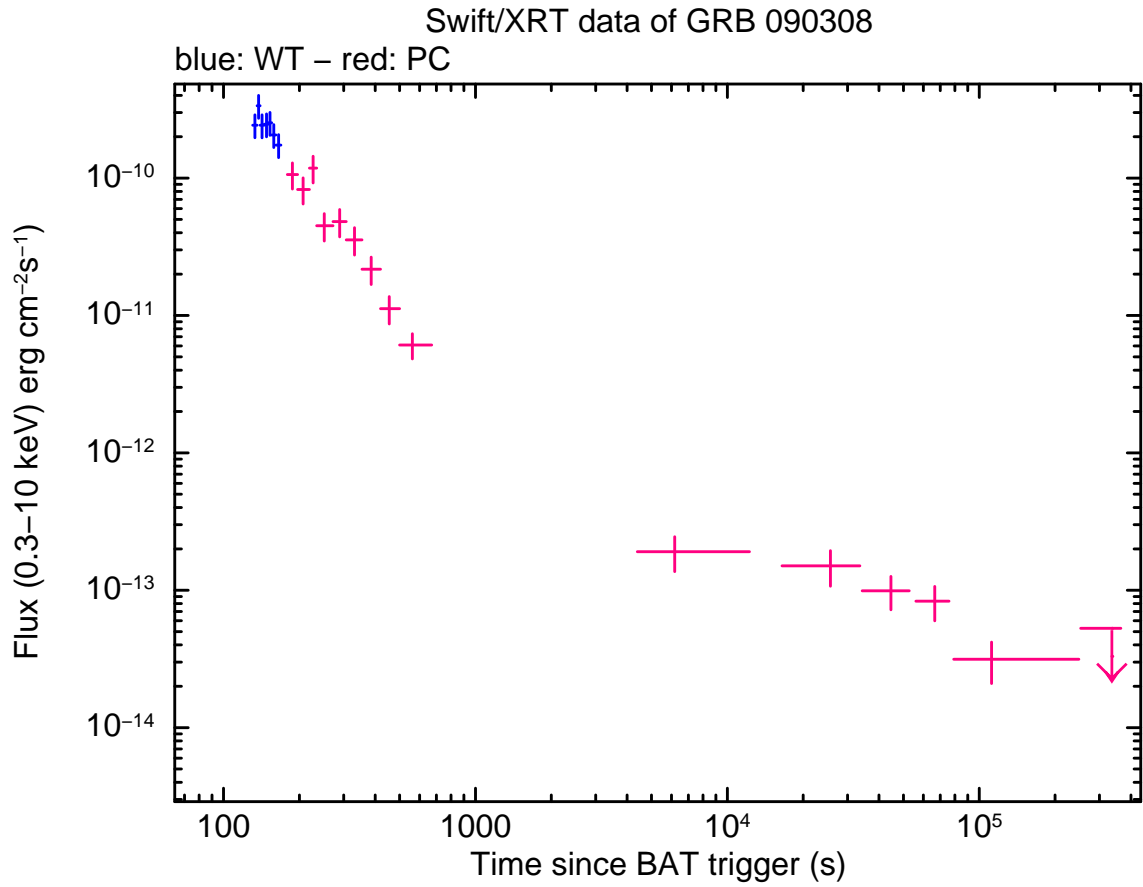


Figure 2: XRT Lightcurve. Flux in the 0.3-10 *keV* band. The counts-to-flux conversion is 1 *count/sec* = 4.3×10^{-11} *ergs/cm²/sec*.

Filter	Start	Stop	Exposure	3-Sigma UL
white (FC)	132	282	147	21.1
white	570	11390	1102	22.2
v	620	17423	1101	20.6
b	545	6455	382	20.8
u	290	6281	639	20.7
uvw1	669	6077	399	20.6
uvm2	644	18019	798	20.8
uvw2	595	12237	1044	21.2

Table 1: Magnitude limits from UVOT observations