Swift Observation of GRB 080913

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1 Introduction

BAT triggered on GRB 080913 at 06:46:54 UT (Trigger 324561) (Schady, et al., *GCN Circ.* 8217), and *Swift* slewed immediately to this burst. This was a 1.024 sec rate-trigger with a significance of 13.92. GRB 080913 showed a multiple-peaked structure, with $T_{90} = 8 \pm 1$ sec. The afterglow was detected by XRT at the UVOT-enhanced position, RA($J2000$) = 65.72775 deg ($04h22m54.66s$), Dec($J2000$) = -25.12950 deg ($-25d07'46.2''$) with a 90% error circle of 1.9 arcsec (Beardmore, et al., *GCN Circ.* 8219). No new source was detected by UVOT (Oates, et al., *GCN Circ.* 8224).

A faint afterglow was detected by the ground based telescope GROND (Rossi, et al., *GCN Circ.* 8218) at RA($J2000$) = 65.72808 deg ($04h22m54.74s$), Dec($J2000$) = -25.12950 deg ($-25d07'46.2''$) with an error circle of 0.5 arcsec (Greiner, et al., *GCN Circ.* 8223). From spectra acquired with the VLT (Fynbo, et al., *GCN Circ.* 8225), a redshift estimate of $z = 6.7$ was inferred from the detection of the Lyman edge. This makes GRB 080913 a short, hard GRB in the rest-frame (Sakamoto, et al., *GCN Circ.* 8256), which is consistent with the negligible spectral lags measured for GRB 080913 (Xu, et al., *GCN Circ.* 8267).

2 BAT Observation and Analysis

Using the data set from $T - 239$ to $T + 963$ sec, the BAT ground-calculated position is RA($J2000$) = 65.741 deg ($04h22m57.9s$), Dec($J2000$) = -25.127 deg ($-25d07'38.6''$) $\pm$ 1.5 arcmin, (radius, systematic and statistical, 90% containment) (Stamatikos, et al., *GCN Circ.* 8222). The partial coding was 39%.

The masked-weighted light curve (Fig.1) consists of multiple, overlapping peaks, somewhat smooth in character. T_{90} ($15 - 350$ keV) is 8 ± 1 sec (estimated error including systematics).

The time-averaged spectrum from $T-3.8$ to $T+5.2$ sec is best fitted by a power-law with an exponential cutoff. This fit gives a photon index 0.46 ± 0.70, and $E_{peak} = 93.1 \pm 56.1$ keV (χ^2 38.53 for 56 d.o.f.). For this model the total fluence in the 15–150 keV band is $(5.6 \pm 0.6) \times 10^{-7}$erg cm^{-2} and the 1-sec peak flux measured at $T + 0.11$ sec in the 15–150 keV band is 1.4 ± 0.2 ph cm^{-2} sec^{-1}. A fit to a simple power law gives a photon index of 1.36 ± 0.15 (χ^2 44.56 for 57 d.o.f.). All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The XRT began observations of GRB 080913 94 sec after the BAT trigger and detected a fading, uncatalogued X-ray source. Using 2223 sec of XRT Photon Counting PC mode and 1 UVOT image of GRB 080913, the astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is RA($J2000$) = 65.72775 deg ($04h22m54.66s$), Dec($J2000$) = -25.12950 deg ($-25d07'46.2''$) $\pm$ 1.9 arcsec (radius, 90% confidence).

The $0.3 - 10$ keV light curve (Fig.2) shows a number of small flares in the first orbit, with the largest giving a factor of ~ 5 increase in count rate at $T + 1.8$ ks, on top of a power-law decay of index $\alpha_X = 1.20^{+0.16}_{-0.13}$.

The X-ray spectrum, using 2.7 ks of Photon Counting data from T+108 sec and T+7.6 ks can be

fit by an absorbed power-law with a photon index of $\Gamma = 1.69^{+0.46}_{-0.41}$, absorbed by a column density consistent with the Galactic value of 3.2×10^{20} cm^{-2} (Kalberla, et al., 2005) in the direction of the burst, and by a column of $N_H \approx 10^{22}$ cm^{-2}. All errors are at the 90% confidence level.

4 UVOT Observation and Analysis

The UVOT began settled observations of the field of GRB 080913 105 s after the BAT trigger. No new source was detected in any of the UVOT filters inside the UVOT-enhanced XRT error circle. The measured 3 σ upper limits in the UVOT photometric system (Poole, et al., 2008) for detecting a source in co-added frames are given in Table 1.

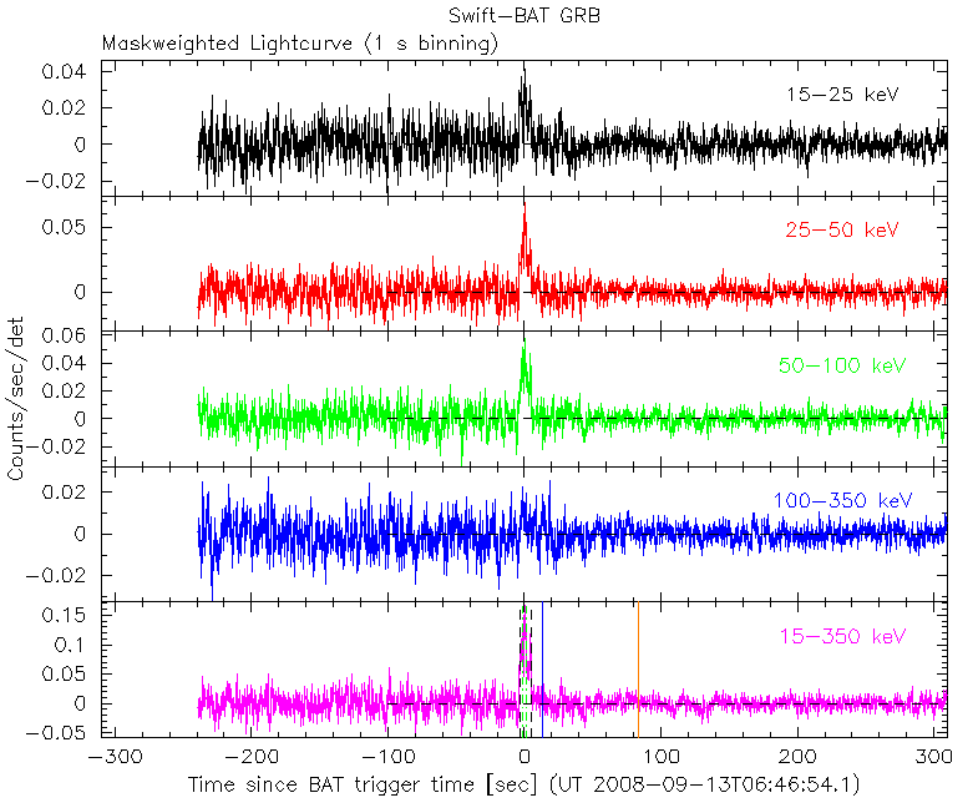

Figure 1: BAT Light curve. The mask-weighted 1-sec light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T is 06:46:54.1 UT.

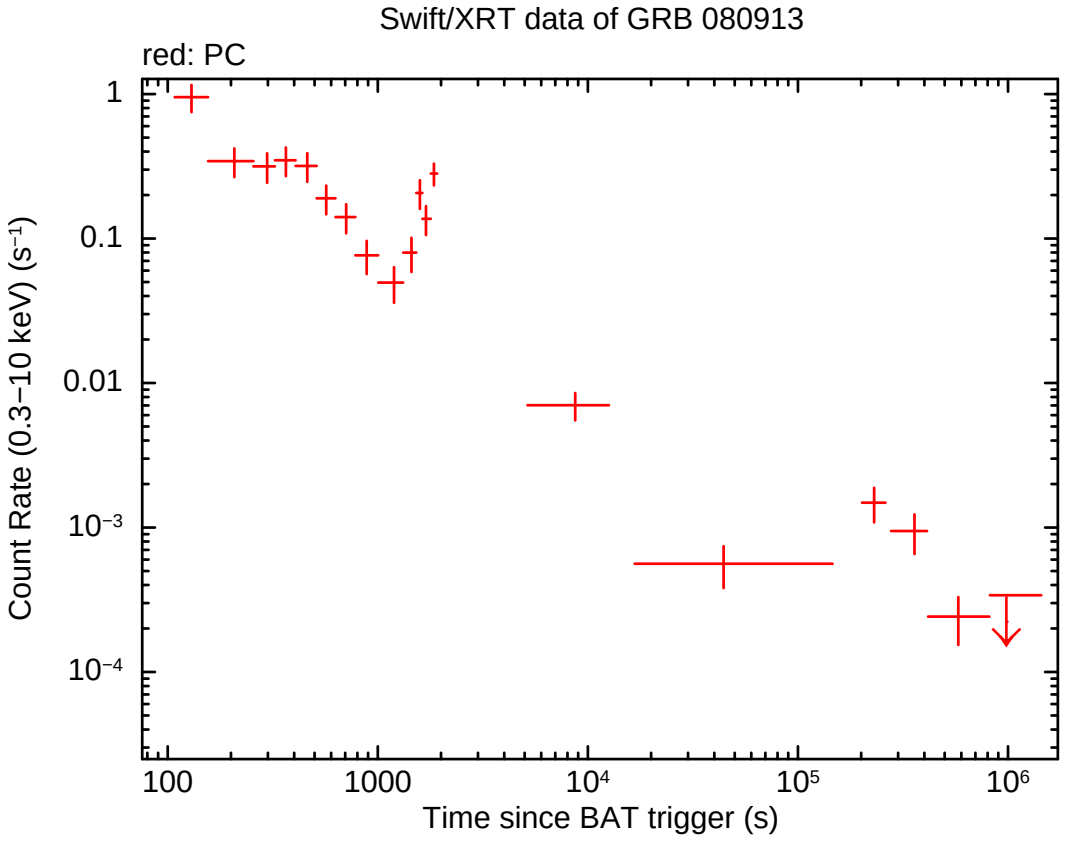

Figure 2: XRT Light curve. Counts/sec in the $0.3 - 10$ keV band taken in Photon Counting mode. The approximate conversion of the absorbed flux is 1 count/sec $=4.6 \times 10^{-11}$ erg cm^{-2} sec^{-1}.

Filter	T_{start} (sec)	T_{stop} (sec)	Exposure (sec)	3σ UL
white (fc)	105	205	98	> 21.92
white	105	1964	238	> 21.26
v (fc)	211	611	393	> 20.08
v	211	1858	865	> 20.39
b	691	1957	97	> 19.62
u	666	1932	117	> 19.36
uvw1	641	1907	117	> 19.48
uvm2	616	1882	78	> 18.84
uvw2	721	1833	58	> 18.99

Table 1: Magnitudes from UVOT observations. The values quoted are not corrected for the expected Galactic extinction corresponding to a reddening of E(B-V)=0.04 mag in the direction of the burst (Schlegel, Finkbeiner & Davis, 1998).