Swift Observation of GRB 081211A

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1 Introduction

BAT triggered on GRB 081211A at 11:48:10 UT (Trigger 337115) (Krimm, *et al.*, *GCN Circ.* 8653). This was a 2.048-sec rate-trigger on a intermediate length burst with $T_{90} = 3.5 \pm 0.9$ sec. Swift slewed to this burst immediately and XRT began follow-up observations at T+109.9 sec, and UVOT at T+114 sec. Our best position is the UVOT location (Immler *et al.*, *GCN Circ.* 8656): RA($J2000$) = 328.11654° (21h 52m 27.97s), Dec($J2000$) = $-33.83565°(-33°50'08''.3)$ with an error of 0.7 arcsec (90% confidence).

2 BAT Observation and Analysis

Using the data set from T-239 to T+963 sec further analysis of GRB 081211A has been performed by Swift/BAT team (Baumgartner, et al., GCN 8658). The BAT ground-calculated position is RA($J2000$) = 328.082° (21h 52m 19.7s), Dec($J2000$) = $-33.818°(-33°49'06'') \pm 2.3$ *arcmin*, (radius, systematic and statistical, 90% containment). The partial coding was 42% (the bore sight angle was 42.69°).

The mask-weighted light curve (Figure 1) shows a single weak peak extending in time from T-1 to T+3 seconds. There is a possible precursor at $\approx T - 180$ sec (Figure 2). T_{90} (15-350 keV) is 3.5 ± 0.9 sec (estimated error including systematics).

The time-averaged spectrum from T-1.1 to T+2.7 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 2.34 ± 0.41. The fluence in the 15-150 keV band is $(1.3 \pm 0.3) \times 10^{-7}$ *erg cm*$^{-2}$. The 1-sec peak photon flux measured from T+0.19 sec in the 15-150 keV band is 0.8 ± 0.2 *ph cm*$^{-2}$*s*$^{-1}$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using 2165 s of XRT Photon Counting mode data and 3 UVOT images for GRB 081211, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue; Beardmore *et al.GCN Circ.* 8655): RA($J2000$) = 328.1163° (21h 52m 27.91s), Dec($J2000$) = $-33.8364°$ ($-33°50'10''.9$), with an uncertainty of 1.6 arcsec (radius, 90% confidence). This position is within 1.2 *arcsec* of the initial XRT position, and 2.1 *arcsec* from the UVOT optical afterglow.

Using data from the first 2 orbits of Swift XRT observations of GRB 081211 from 113 s to 24 ks after the BAT trigger, all collected in Photon Counting (PC) mode, we find that a power law fit to the light curve (Figure 3) results in a decay slope of $\alpha = 0.6 \pm 0.1$, but we note that flaring may be present from 350-1000 s, or there may be two components to the light curve, the second of which rises and turns over around 300 s. A power law fit to the data from 300 s to 112.5 ks (omitting data from 120-300 s) results in a decay slope of $\alpha = 1.00 \pm 0.06$.

The time-averaged spectrum can be fit with an absorbed power law with photon index $\Gamma = 2.4 \pm 0.3$. There is significant absorption above the Galactic value ($n_{H,Gal} = 1.9 \times 10^{20}$ *cm*$^{-2}$, Kalberla et al. 2005) amounting to a column of $n_H = (1.2 \pm 0.6) \times 10^{21}$ *cm*$^{-2}$ (at z=0). The observed (unabsorbed) 0.3-10 keV flux is $3.1(5.0) \times 10^{-12}$ *erg cm*$^{-2}$*s*$^{-1}$. The observed (unabsorbed) count rate to flux conversion derived from this spectrum is 1 count s^{-1} = $3.3(5.3) \times 10^{-11}$ *erg cm*$^{-2}$.

4 UVOT Observation and Analysis

Analysis of Swift Ultraviolet/Optical Telescope (UVOT) data of GRB 081211 gives a detection of an optical source (the position of which is given in the Introduction) in the white filters at 4.5σ level of confidence (Figure 4). The source is not present in DSS, the USNO-B1.0 catalogue, or the 2MASS point source catalogue. It is not detected in any of the other UVOT filters at the limiting magnitudes reported in Table 1. The values quoted in Table 1 are in the UVOT photometric system (Poole et al. 2008, MNRAS, 383, 627) and are not corrected for the expected Galactic extinction along the line of sight which corresponds to a reddening of E(B-V)=0.077 mag (Schlegel et al. 1998).

Filter	Start	Stop	Exposure	Magnitude
White (finding)	113	7134	588	21.23 ± 0.39
v	656	11966	386	$> 19.38(3\sigma$ UL)
b	582	741	293	$> 20.24(3\sigma$ UL)
u	326	6724	265	$> 20.23(3\sigma$ UL)
uvw1	706	6519	196	$> 19.87(3\sigma$ UL)
uvm2	681	6314	136	$> 19.58(3\sigma$ UL)
uvw2	632	7318	371	$> 20.40(3\sigma$ UL)

Table 1: Magnitude limits from UVOT observations

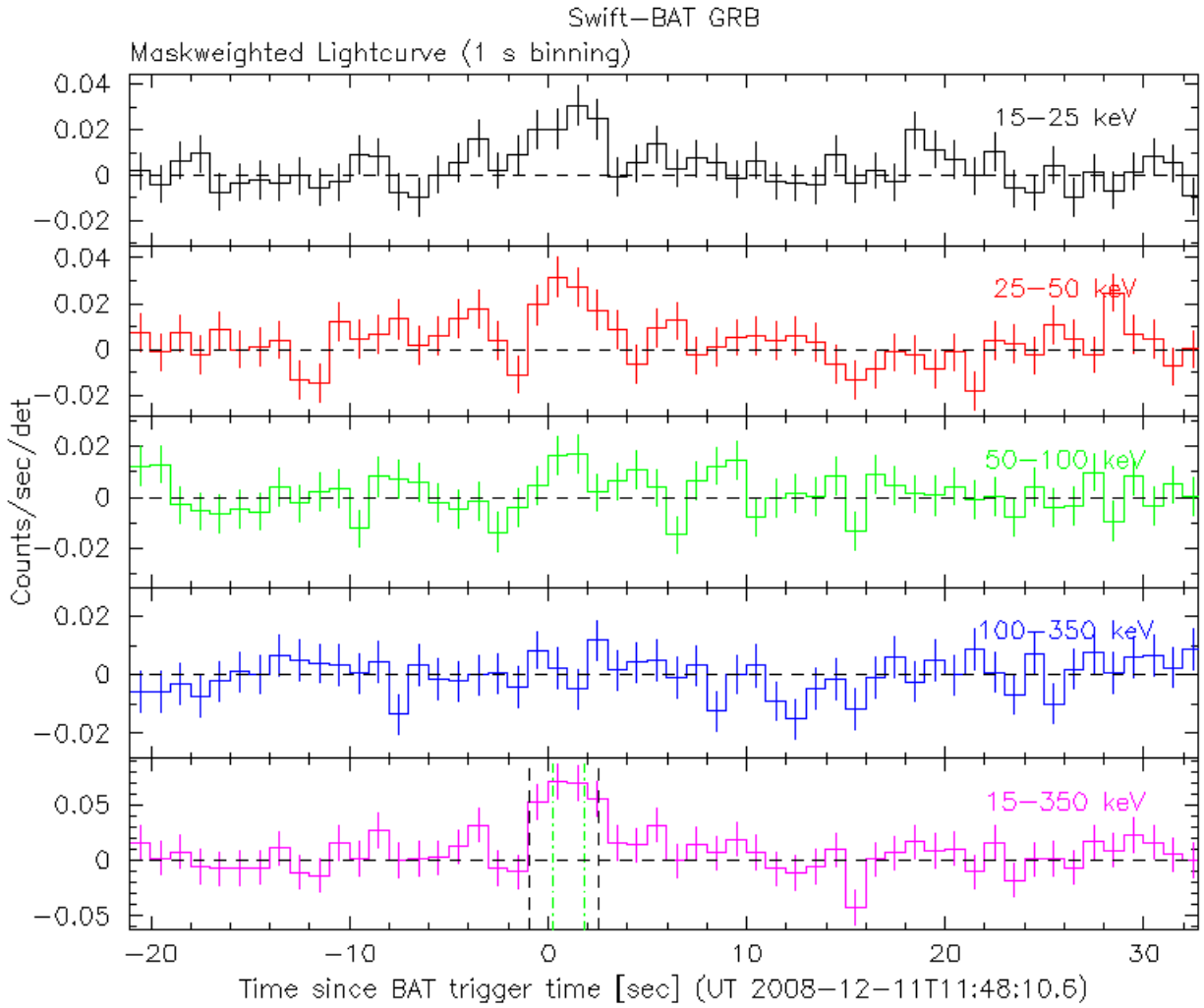

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector (note illum-det = 0.16 cm^2).

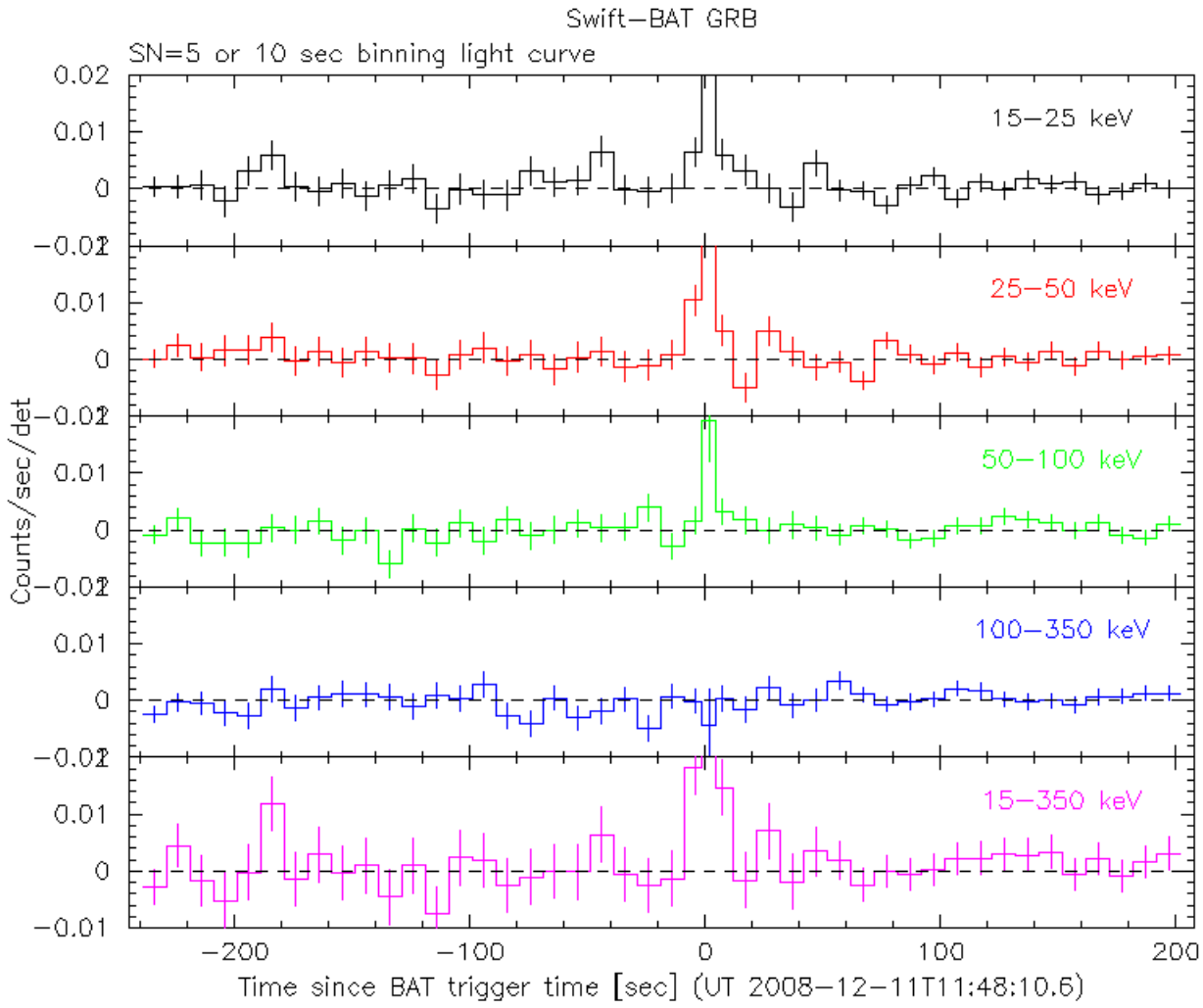

Figure 2: BAT Light curve showing the possible precursor. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector (note illum-det = 0.16 cm^2).

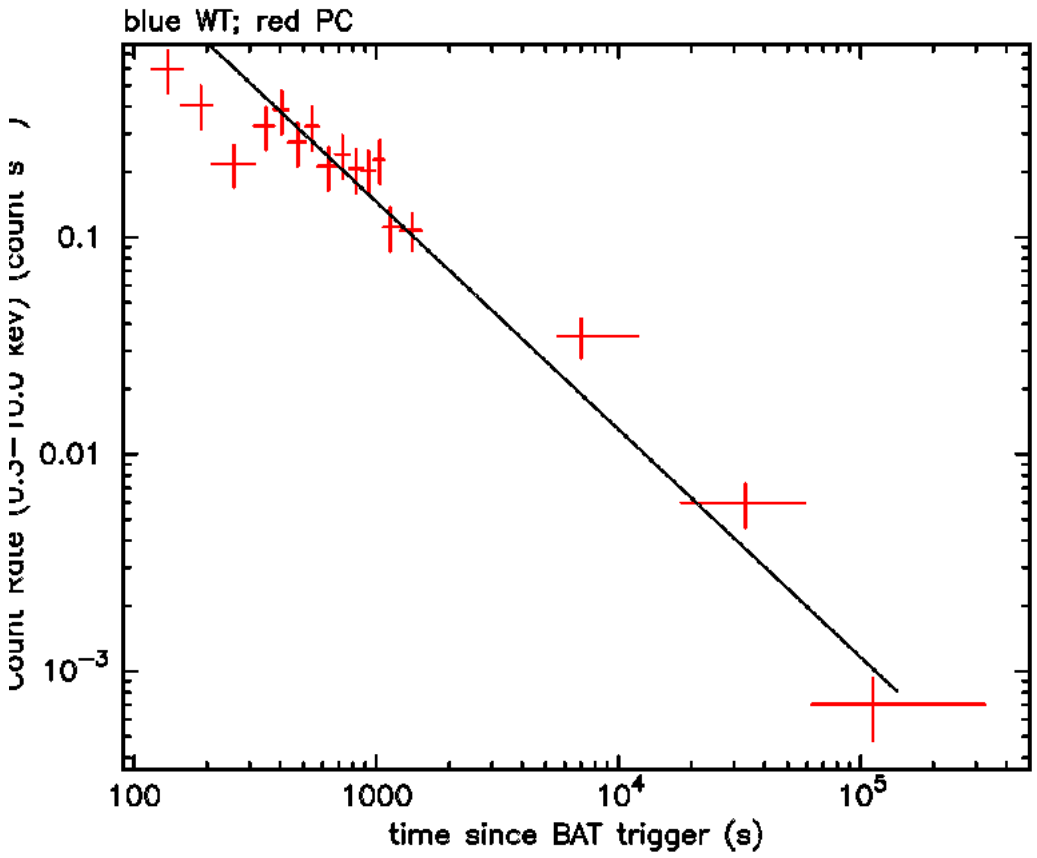

Figure 3: XRT Lightcurve. Count rate in the 0.3-10 keV band – Photon Counting mode (red). The observed (unabsorbed) count to flux conversion is 1 count $s^{-1} = 3.3(5.3) \times 10^{-11}$ $erg\ cm^{-2}$.

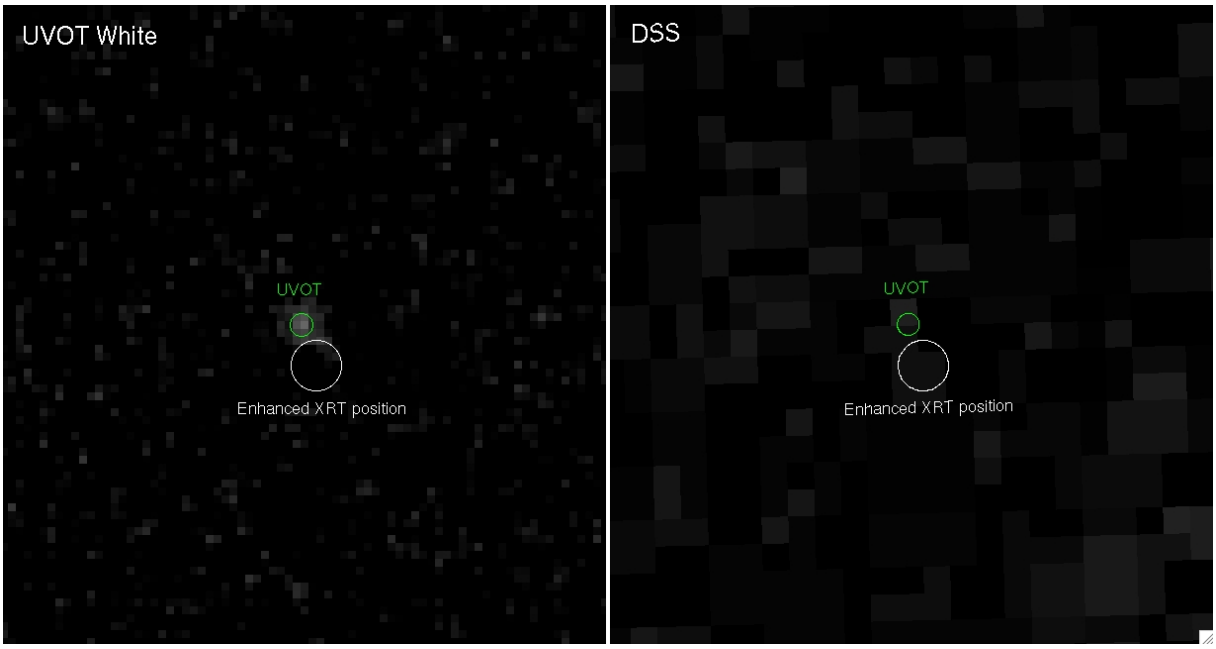

Figure 4: UVOT white and DSS images.