Swift Observation of GRB 091208B

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1 Introduction

BAT triggered on the long GRB 091208B at 09:49:57.9 UT (Trigger 378559) (Pagani, *et al.*, *GCN Circ.* 10256), a burst with $T_{90} = 14.9 \pm 3.7$ *sec*. *Swift* slewed immediately to the burst. The XRT detected the afterglow in observations starting 115.2 *sec* after the trigger. The UVOT detect the optical afterglow (De Pasquale, *et al.*, *GCN Circ.* 10267). The optical afterglow was also detected in observations by the BOOTES-3 robotic telescope (de Ugarte Postigo, *et al.*, *GCN Circ.* 10255), by the MITSuME telescope (Yoshida, *et al.*, *GCN Circ.* 10258), by the Faulkes Telescopes North and South (Cano, *et al.*, *GCN Circ.* 10262), by the Nordic Optical Telescope equipped with ALFOSC (Xu, *et al.*, *GCN Circ.* 10269), by the GROND telescope (Updike,*et al.*,*GCN Circ.* 10271), by the Z-600 telescope (Andreev, *et al.*, *GCN Circ.* 10273), by the GAO telescope (Kinugasa, *et al.*, *GCN Circ.* 10275) and by the Xinglong TNT (Xin, *et al.*, *GCN Circ.* 10279). Upper limits were measured by RIMOTS (Noda, *et al.*, *GCN Circ.* 10257). The burst was also deteced by *Fermi GBM* (McBreen, *et al.*, *GCN Circ.* 10266) that measured a peak energy of 144.20 (+18.00, -13.90) keV and by the *INTEGRAL* SPI Anti-Coincidence System (Beckmann, private communication; all SPI-ACS events can be found under http://isdc.unige.ch/Soft/ibas/ibas_acs_web.cgi). The spectroscopic redshift of this burst is $z = 1.063$, measured using the GMOS-N spectrograph on Gemini North (Wiersema, *et al.*, *GCN Circ.* 10263) and confirmed with HIRES-r on the 10m Keck I telescope (Perley, *et al.*, *GCN Circ.* 10272).

2 BAT Observation and Analysis

Using the data set from $T-60$ to $T+243$ *sec*, further analysis of BAT GRB 091208B has been performed by the *Swift* team (Baumgartner, *et al.*, *GCN Circ.* 10265). The BAT ground-calculated position is RA($J2000$) = $29.411deg$ ($01h57m38.5s$), Dec($J2000$) = $16.881deg$ ($16d52'50.7''$)± 1.2 $arcmin$, (radius, systematic and statistical, 90% containment). The partial coding was 10%.

The mask-weighted light curve (Fig.1) shows two separated FRED peaks. The first at T0 was weaker and softer than the second at T+8 sec. $T_{90}(15-350keV)$ is 14.9 ± 3.7 *sec* (estimated error including systematics).

The time-averaged spectrum from $T-0.2$ to $T+22.3$ *sec* is best fitted by a simple power law model. The power law index of the time-averaged spectrum is 1.74 ± 0.11. For this model the total fluence in the $15-150$ keV band is $(3.3 \pm 0.2) \times 10^{-6} ergs/cm^2$, and the 1-sec peak flux measured from $T+8.1$ *sec* in the $15-150$ keV band is 15.2 ± 1.0 $ph/cm^2/sec$. All the quoted errors are at the 90% confidence level considering the statistical and usual systematic effects.

The results of the batgrbproduct analysis are available at:
http://gcn.gsfc.nasa.gov/notices_s/378559/BA/

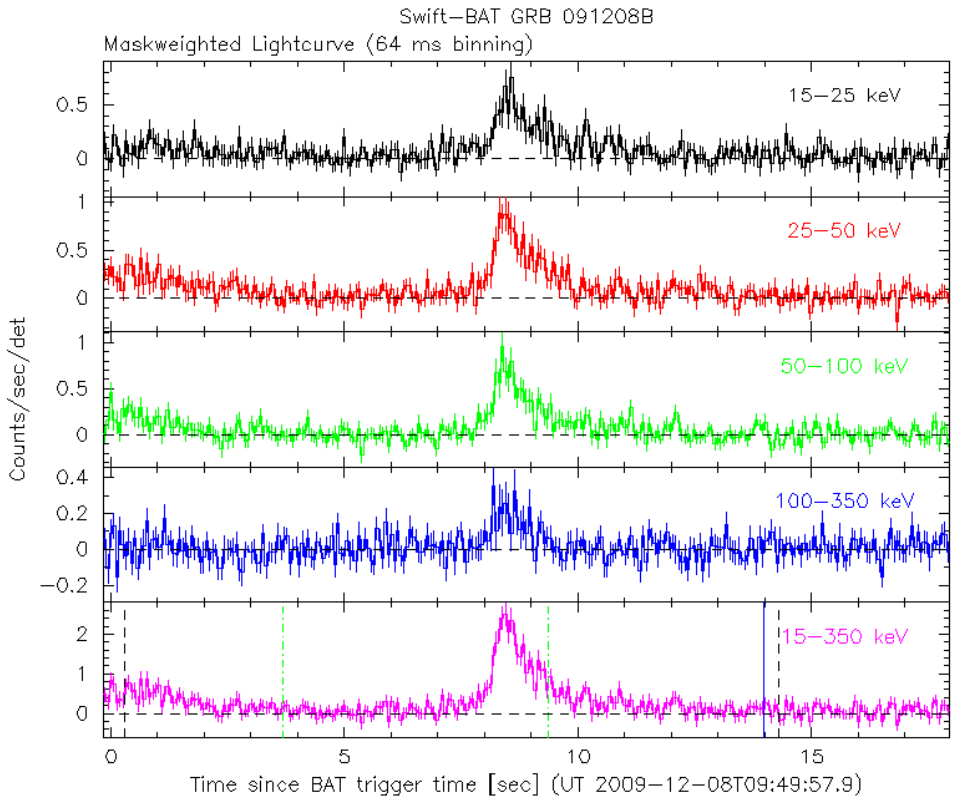

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and T_0 is 09:49:57.9 UT.

3 XRT Observation and Analysis

Using 466 *sec* of overlapping XRT Photon Counting mode and UVOT data for GRB 091208B, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA($J2000$) = 29.39223deg ($01h57m34.13s$), Dec($J2000$) = 16.88965 deg ($16d53'22.7''$) $\pm$ 1.8 $arcsec$ (radius, 90% confidence) (Osborne, *et al.*, *GCN Circ.* 10259).

The $0.3 - 10$ keV light curve (Fig.2) shows bumps and mini-flares during the first orbit, with the strongest emission of $\sim 1.6 \times 10^{-10} ergs/cm^2/sec$ at $T + 156$ *sec*. The following orbits can be modeled with a broken power-law decay with an initial decay index of alpha=1.10 ± 0.06 and a jet break after $\sim$ 3.1×10^5 *sec* with decay index alpha=$2.3^{+1.6}_{-0.6}$.

The X-ray spectrum formed from the Photon Counting mode data can be fitted with an absorbed power-law with a photon spectral index of 2.32 ± 0.18 and a best-fitting absorption column of $(2.9 \pm 0.5) \times 10^{21} cm^{-2}$, in excess of the Galactic value of $4.8 \times 10^{20} cm^{-2}$ in that direction (Kalberla et al. 2005). The average absorbed flux over $0.3-10$ keV for the PC spectrum is 6.83×10^{-12} $ergs/cm^2/sec$, which corresponds to an unabsorbed flux of 1.3×10^{-11} $ergs/cm^2/sec$.

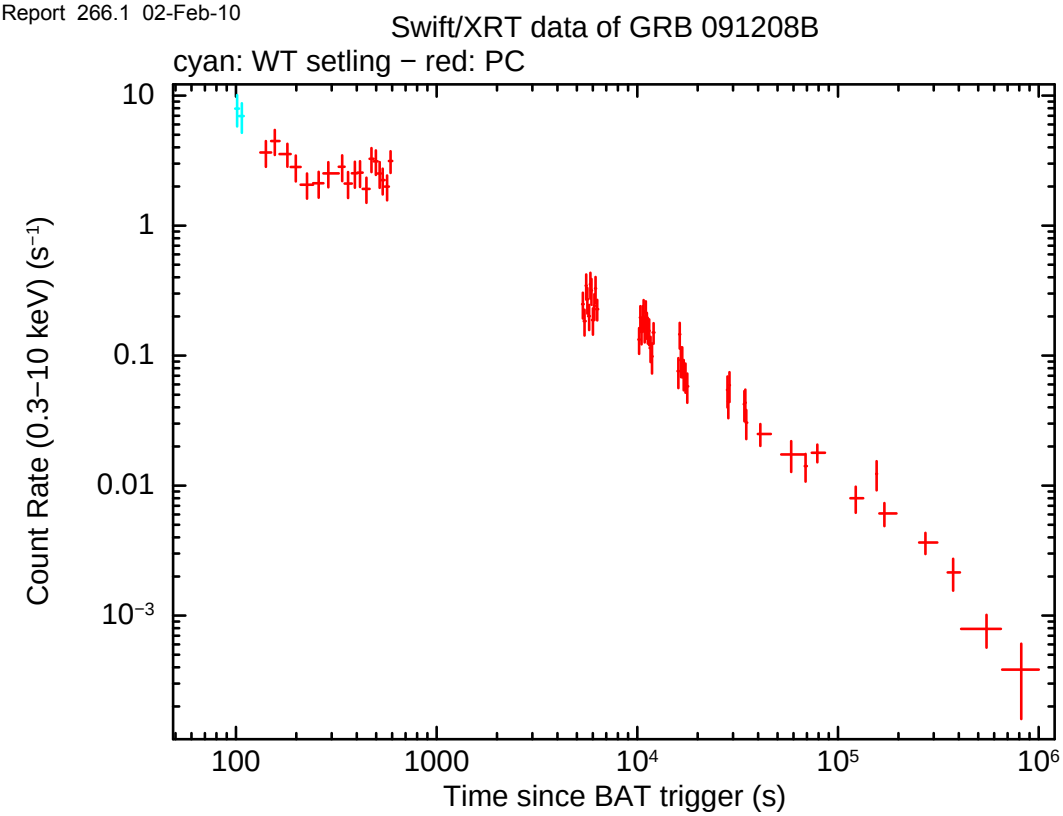

Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Settling Window Timing mode (cyan), Photon Counting mode (red). The approximate conversion is 1 count/sec = $\sim$ 3.7×10^{-11} $ergs/cm^2/sec$.

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 091208B 119 *sec* after the BAT trigger (De Pasquale *et al.*, *GCN Circ.* 10267).

The optical afterglow is detected at position:

RA($J2000$) = $29.39204deg$ ($01h57m34.09s$), Dec($J2000$) = 16.88967 deg ($16d53'22.82''$),

consistent with the XRT enhanced position.

The magnitudes of the afterglow are reported in Table 1. These values are on the UVOT Photometric System described in Poole et al. (2008, *MNRAS*, 383,627). These values are not corrected for the Galactic extinction in the direction of the burst corresponding to a reddening of $E_{B-V} = 0.5$ mag (Schlegel *et al.*, *ApJ.* 500:525-553, 1998).

Filter	T_{start}	T_{stop}	Exposure	Mag
White	119	269	150	17.92 ± 0.5
B	588	605	17	18.38 ± 0.29
U	333	583	250	18.63 ± 0.09

Table 1: Magnitudes from UVOT observations.