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Swift Observations of GRB 091208A

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1 Introduction

At 08:46:00 UT on 8 December 2009 BAT triggered on and located GRB 091208A (Hoversten, *et al.*, *GCN Circ.* 10253, Trigger #378554). Due to an observing constraint Swift did not slew to the GRB position until $T + 3.1$ ks. Upon slewing observations were interrupted by the BAT trigger on GRB 091208B after less than 200 s. Our best position is the BAT ground-calculated position at RA($J2000$) = 0.295 deg ($00h01m10.9s$), Dec($J2000$) = 65.680 deg ($65d40'47.7''$) with an uncertainty of 1.1 arcmin (radius, 90% confidence). GRB 091208A was not detected by XRT. We note that the Galactic lattitude of this burst is +3.3°. Although all indicators point to a GRB nature the possiblility exists that it was a Galactic transient.

GRB 091208A was also detected by INTEGRAL SPI/ACS confirming the FRED-like structure of the lightcurve (V. Beckmann, private communication). Additionally it was detected by Suzaku WAM (Nishioka, *et al.*, *GCN Circ.* 10278). Photometric upper limits were reported by ROTSE-III (Yuan, *et al.*, *GCN Circ.* 10254), RIMOTS (Noda, *et al.*, *GCN Circ.* 10261) and the Gunma Astronomical Observatory 1.5 m telescope (Kinugasa, *et al.*, *GCN Circ.* 10277).

2 BAT Observation and Analysis

Using the data set from $T-61$ to $T+242$ s further analysis of GRB 091208A was performed by the Swift team (Barthelmy, *et al.*, *GCN Circ.* 10264). The BAT ground-calculated position is RA($J2000$) = 0.295 deg ($00h01m10.9s$), Dec($J2000$) = +65.680 deg (+$65d40'47.7$") with an uncertainty of 1.1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 88%.

The mask-weighted light curve shows a single FRED with some additional structure on the decaying side. The tail appears to be quite long at low energy, with emission detectable for up to 200 seconds after the trigger. T_{90} ($15 - 350keV$) is 29.1 ± 2.5 s (estimated error including systematics). The BAT lightcurve is shown in Figure 1.

The time-averaged spectrum from $T - 0.3$ to $T + 32.8$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 0.81 ± 0.10. The fluence in the 15-150 keV band is $1.5 \pm 0.1 \times 10^{-6}$ $erg\ cm^{-2}$. The 1-second peak photon flux measured from $T + 0.15$ s in the 15-150 keV band is 1.8 ± 0.2 $photon\ cm^{-2}\ s^{-1}$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

XRT observed the field of GRB 091208A from 3.1 ks to 3.3 ks after the BAT trigger and again from 26 ks to 27 ks after the BAT trigger (Pagani, *et al.*, *GCN Circ.* 10270). The first observation was delayed due to an observing constraint and then cut short by the BAT trigger on GRB 091208B.

During the first observation no X-ray afterglow was detected inside the BAT error circle in 180 seconds of Photon Counting (PC) data. The corresponding 3-sigma upper limit is 0.04 counts s^{-1}. For comparison, the median XRT count rate for long GRB afterglows at 3 ks after the BAT trigger is approximately 0.1 counts s^{-1}.

During the second observation no X-ray afterglow was detected inside the BAT error circle in 694

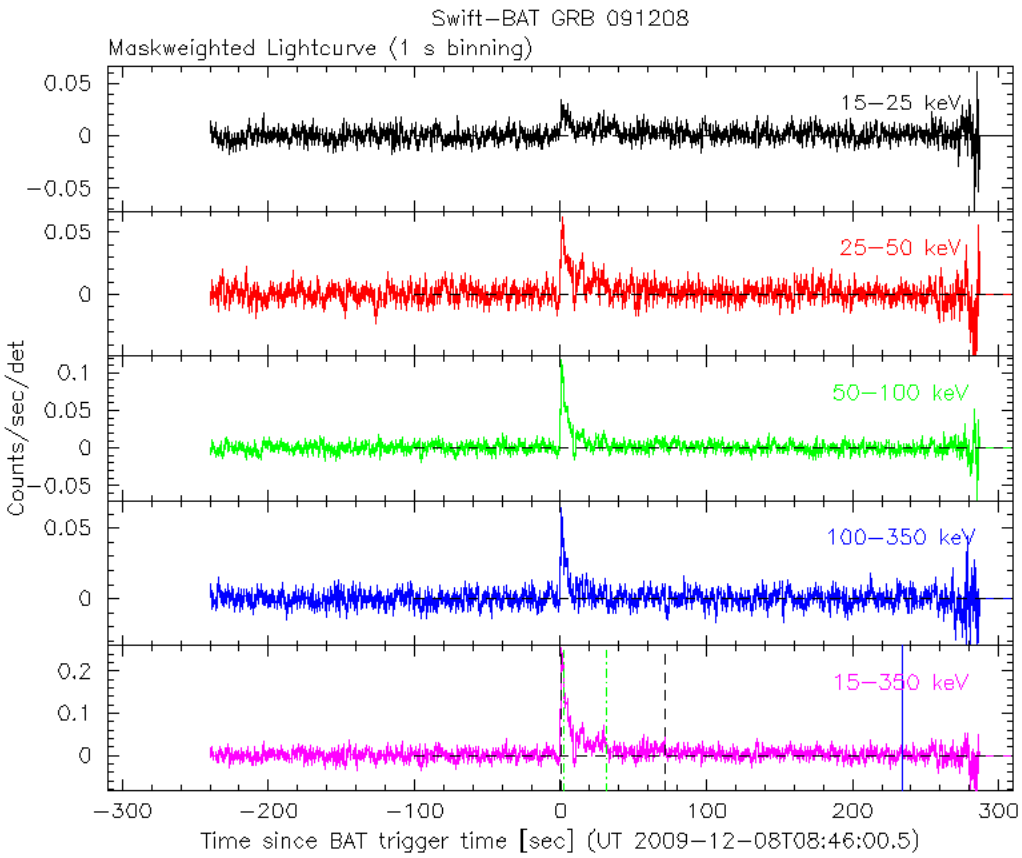

Figure 1: BAT Light curve. The mask-weighted light curve over all energy bands. The units are counts/s/illuminated-detector (note illum-det = 0.16 cm^2) and T_0 is 08:46:00.5 UT.

seconds of PC data. The corresponding 3-sigma upper limit is 0.01 counts s^{-1}. For comparison, the median XRT count rate for long GRB afterglows at 25 ks after the BAT trigger is approximately 0.02 counts s^{-1}. Based on the count rates of the XRT afterglows observed during the Swift mission the chance of detecting a long GRB with the XRT in a 1 ks observation 25 ks after the BAT trigger is 61%.

4 UVOT Observation and Analysis

Swift/UVOT observed the field of GRB 091208A from 4.32 ks to 4.33 ks after the BAT trigger in the v filter and then from 26.01 to 26.71 ks after the trigger in u, v and white filters (De Pasquale & Hoversten, *GCN Circ.* 10274). No new source is detected in the BAT error circle (Barthelmy et al., GCN Circ. 10264). We caution though that a small fraction of BAT error circle is not covered by UVOT exposures. 3 sigma upper limits on magnitudes are as follows:

The magnitudes quoted above are on the UVOT Photometric System (Poole et al., 2008, MNRAS 383,627). They are not corrected for the expected strong Galactic extinction, corresponding to a reddening of E(B-V)=1.6 (Schlegel, Finkbeiner, & Davis, 1998).

References

[1] Barthelmy, S. D., et al. 2009, *GCN Circ.* 10264

[2] De Pasquale, M. & Hoversten, E. A. 2009, *GCN Circ.* 10274

[3] Hoversten, E. A., et al. 2009, *GCN Circ.* 10253

[4] Kinugasa, K., et al. 2009, *GCN Circ.* 10277

[5] Nishioka, Y., et al. 2009, *GCN Circ.* 10278

[6] Noda, K., et al. 2009, *GCN Circ.* 10261

[7] Poole, T. S., et al. 2008, *MNRAS*, 383, 627

[8] Schlegel, D. J., Finkbeiner, D., & Davis, M. 1998, *ApJ.*, 500, 525

[9] Yuan, F., et al. 2009, *GCN Circ.* 10254

Filter	Start	Stop	Exposure	Magnitude
v	4318	4328	10	> 17.4
v	26513	26717	200	> 19.4
WHITE	26261	26507	243	> 21.1
u	26008	26255	243	> 20.1

Table 1: UVOT observations