

Swift Observation of GRB 090201

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1 Introduction

BAT triggered on GRB 090201 at 17:47:02UT (Trigger 341749) (Oates, *et al.*, *GCN Circ.* 8865). This was a 1.024 s rate-trigger on a burst with $T_{90} = 83.4$ s. Due to an Earth limb constraint, Swift could not slew to this burst until ~ 64 minutes after the trigger, after which, the XRT and UVOT began follow-up observations. Our best position is the UVOT-enhanced XRT position at $RA(J2000) = 92.05202deg$ (06h08m12.48s), $Dec(J2000) = -46.59045deg$ ($-46d35'25.6s''$) with an error of 1.4 arcsec (90% confidence) (Beardmore, *et al.*, *GCN Circ.* 8872).

This GRB was also observed by Konus-Wind (Golenetskii, *et al.*, *GCN Circ.* 8878) and Integral/SPI-ACS (private communication with V. Beckmann). The GRB field was observed in the UV/optical/IR wavelengths with the UVOT (Schady, *et al.*, *GCN Circ.* 8874), ROTSE-III (Schaefer, *et al.*, *GCN Circ.* 8866) and the VLT (D'Avanzo, *et al.*, *GCN Circ.* 8869, 8871, 8873), but no optical/IR afterglow was found.

2 BAT Observation and Analysis

Using the data set from T-239 to T+363 sec, we report on the analysis of BAT GRB 090201 (Trigger 341749) (Oates, *et al.*, *GCN Circ.* 8865). The BAT ground-calculated position is RA, Dec = 92.051, -46.604 deg, which is $RA(J2000) = 06h 08m 12.3s$, $Dec(J2000) = -46d 36' 16.1''$ with an uncertainty of 1.0 arcmin, (radius, sys+stat, 90% containment). The partial coding was 8%.

The mask-weighted light curve, shown in Figure 1, shows two clusters of overlapping peaks. The first starting at T-20 sec and peaking at T+8 sec. The second peaks at T+39 sec and ends at T+120 sec. T_{90} (15-350 keV) is 83 ± 4 sec (estimated error including systematics).

The time-averaged spectrum from T-10.2 to T+102.2 sec is best fit by a power law with an exponential cutoff. This fit gives a photon index 0.88 ± 0.18 , and E_{peak} of 104 ± 16 keV ($\chi^2 = 39.5$ for 56 d.o.f.). For this model the total fluence in the 15-150 keV band is $(3.0 \pm 0.1) \times 10^{-5}$ erg cm^{-2} and the 1-sec peak flux measured from T+7.60 sec in the 15-150 keV band is 14.7 ± 1.0 ph $\text{cm}^{-2}\text{sec}^{-1}$. A fit to a simple power law gives a photon index of 1.50 ± 0.04 ($\chi^2 = 76.3$ for 57 d.o.f.). All the quoted errors are at the 90% confidence level.

The results of the batgrbproduct analysis are available at: http://gcn.gsfc.nasa.gov/notices_s/341749/BA/

3 XRT Observations and Analysis

The Swift-XRT started observing the field of GRB 090201 (Oates, *et al.*, *GCN Circ.* 8865) at 2009-02-01 18:50:40.7UT, 63.6 minutes after the trigger. The best XRT position is the UVOT-enhanced position:

$$RA(J2000) = 92.05202deg = 06h08m12.48s$$

$$Dec(J2000) = -46.59045deg = -46d35'25.6s''$$

with an error of 1.4 arcsec (90% confidence) (Beardmore, *et al.*, *GCN Circ.* 8872).

The X-ray light curve, shown in Figure 2, with a total exposure of 146 ks, spans from T+3.6 ks (2009-02-01T18:47) to T+820 ks after the trigger. The light curve can be described by a broken powerlaw, with initial decay slope of 1.03 ± 0.12 , break time of $10.8_{-6.1}^{+5.2}$ ks and final decay slope of 1.40 ± 0.04 .

The spectrum from T+3.6ks to T+39.2ks can be fit by an absorbed powerlaw, with a photon index of 2.20 ± 0.10 and column density of $4.78 \pm 0.42 \times 10^{21} \text{cm}^{-2}$, compared with the Galactic column of $4.9 \times 10^{20} \text{cm}^{-2}$ in the direction of the burst. The observed (unabsorbed) 0.3-10 keV flux is $(1.00 \pm 0.06) \times 10^{-11} [(2.02 \pm 0.12) \times 10^{-11}] \text{erg cm}^{-2} \text{s}^{-1}$.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 090201 3668s after the BAT trigger (Oates, *et al.*, *GCN Circ.* 8865). A new source was not detected in any filter of the UVOT at the enhanced Swift XRT position (Beardmore, *et al.*, *GCN Circ.* 8872). The 3-sigma upper limits can be found in Table 1. These upper limits have not been corrected for the expected Galactic extinction along the line of sight of $E_{(B-V)} = 0.07 \text{ mag}$. All photometry is on the UVOT photometric system described in Poole *et al.* (2008, *MNRAS*, 383, 627).

Filter	Start (sec)	Stop (sec)	Exposure (sec)	3σ Upper Limits
White	3668	5051	344	21.53
v	3825	10589	1159	20.63
b	4646	16906	834	21.38
u	4440	16245	1082	21.15
uvw1	4235	14730	448	20.16
uvm2	4030	11123	717	20.53
uvw2	5056	5256	197	20.03

Table 1: 3σ upper limits from UVOT observations

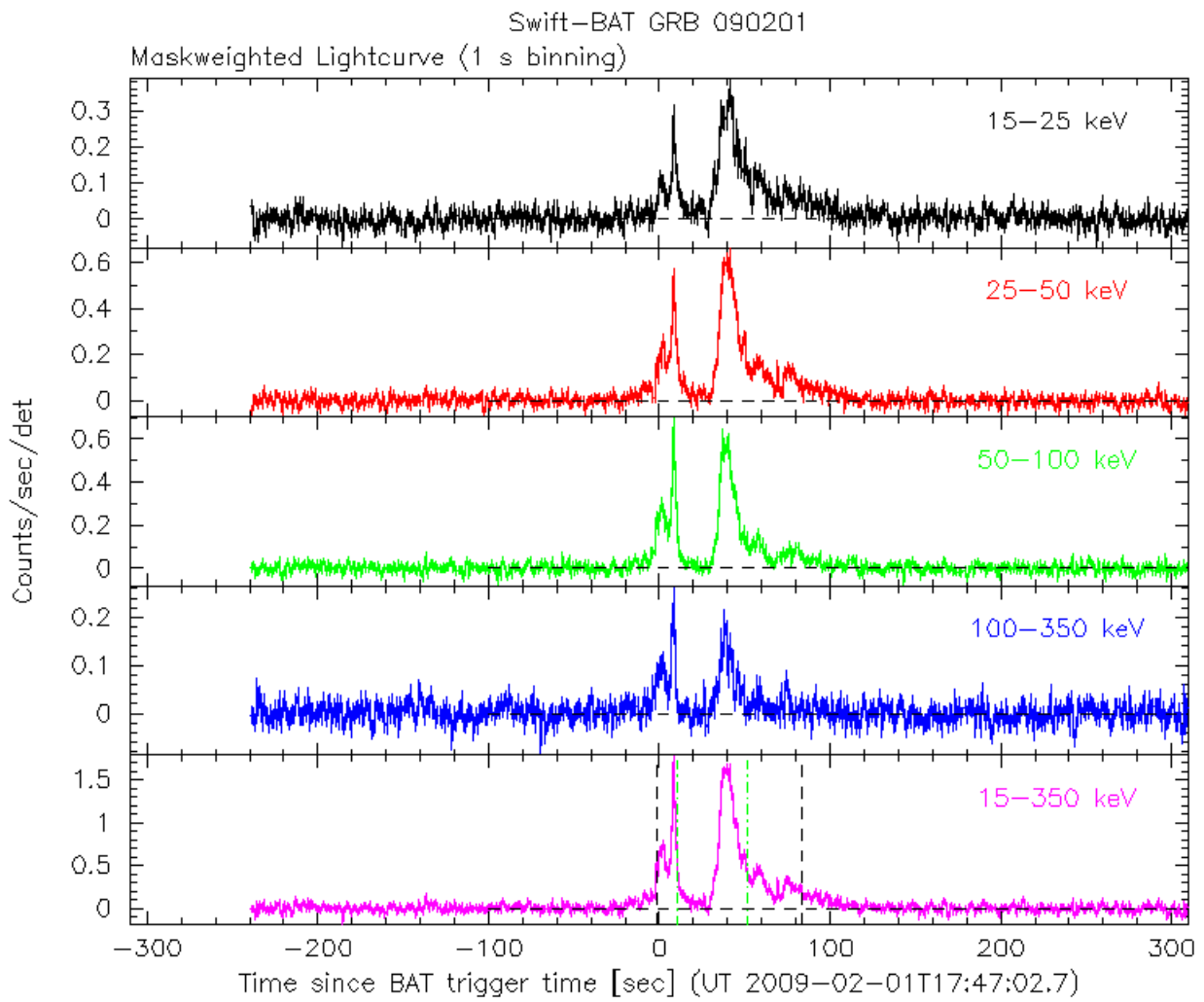


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector

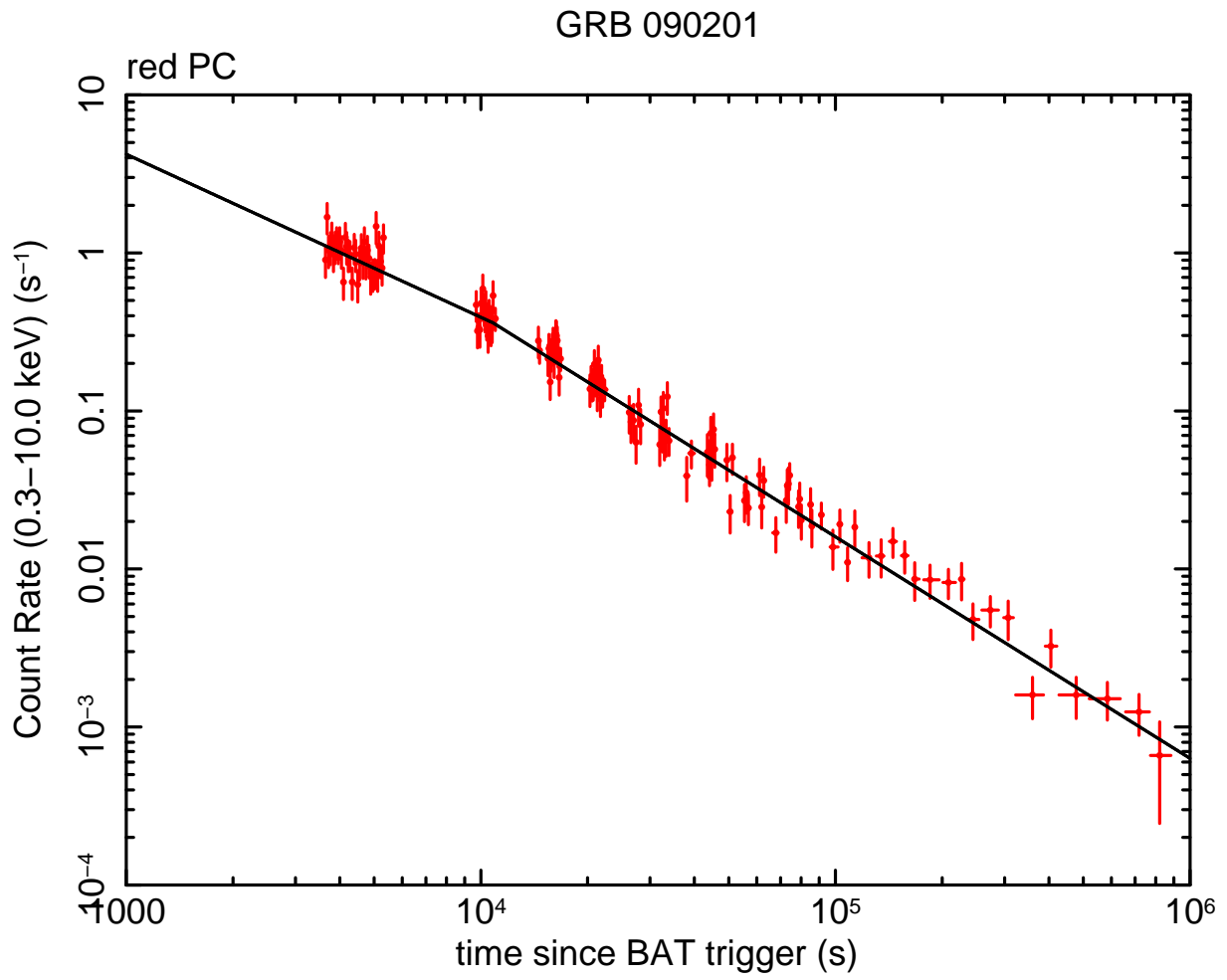


Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band.