

Swift Observation of GRB 110520A

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1 Introduction

BAT triggered on GRB yymmdd at 20:28:48 UT (Trigger 453747) (De Pasquale, *et al.*, *GCN Circ.* 12020). This was an intermediate length burst with $T_{90} = 15.7$ sec. Swift slewed to this burst immediately and XRT began follow-up observations at $T + 100.1$ sec, and UVOT at $T + 104$ sec. Our best position is the XRT location $RA(J2000) = 134.34074^\circ$ (08h57m21.78s), $Dec(J2000) = +56.42735^\circ$ (+56d25'38.5") with an error of 1.5 arcsec (90% confidence).

2 BAT Observation and Analysis

Using the data set from $T - 293$ to $T + 963$ sec, further analysis of BAT GRB 110520A has been performed by Swift team (Ukwatta, *et al.*, *GCN Circ.* 12030). The BAT ground-calculated position is $RA(J2000) = 134.363^\circ$ (08h57m27.1s), $Dec(J2000) = +56.418^\circ$ (+56d25'04.9") ± 1.1 arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 70%

The masked-weighted light curves (Fig.1) starts at trigger time $T + 2$ sec with a single FRED peak, and returns to background at about $T + 40$ sec. $T_{90}(15 - 350keV)$ is 15.7 ± 1.8 sec (estimated error including systematics).

The time-averaged spectrum from $T - 239$ to $T + 963$ sec is best fitted by a simple power law model. This fit gives a photon index of 1.13 ± 0.10 , ($\chi^2 = 52.5$ for 57 d.o.f.). For this model the total fluence in the 15 – 150 keV band is $(1.1 \pm 0.1) \times 10^{-6}$ ergs/cm² and the 1-sec peak flux measured from $T + 4.15$ sec in the 15 – 150 keV band is 1.1 ± 0.2 ph/cm²sec. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

Using data from the 1918 of XRT data in Photon Counting mode and 2 UVOT images for GRB 110520A, the refined XRT position is $RA(J2000) = 134.34074^\circ$ (08h57m21.78s), $Dec(J2000) = 56.42735^\circ$ (+56d25'38.5") ± 1.5 arcsec (90% confidence).

The 0.3 – 10 keV light curve (Fig.2) shows an fast decline with decay index $\alpha = 2$, followed by a flare, which peaks at 254 sec. After that, there is a decline with a slope of 1.31 ± 0.09 .

The spectrum formed from the PC mode data, from 156 sec to 25.2 ksec after the trigger can be modeled with an absorbed power-law with spectral indices of 1.77 ± 0.17 . The NH column density is 2.9×10^{21} cm⁻², in excess of Galactic column density, 2.7×10^{20} cm⁻² (Kalberla et al. 2005) The average observed (unabsorbed) flux for this spectrum is, in this interval and over 0.3 – 10 keV, 5.8×10^{-12} (8.4) ergs/cm²sec).

4 UVOT Observation and Analysis

The UVOT began observing the field of GRB 110520A at hh:mm:ss UT, 104 sec after the initial BAT trigger (De Pasquale, *GCN Circ.* 12032). No new source was detected within the XRT error circle in the white (150 sec) and u (250 sec) finding exposures, or in the co-added images in any filter down

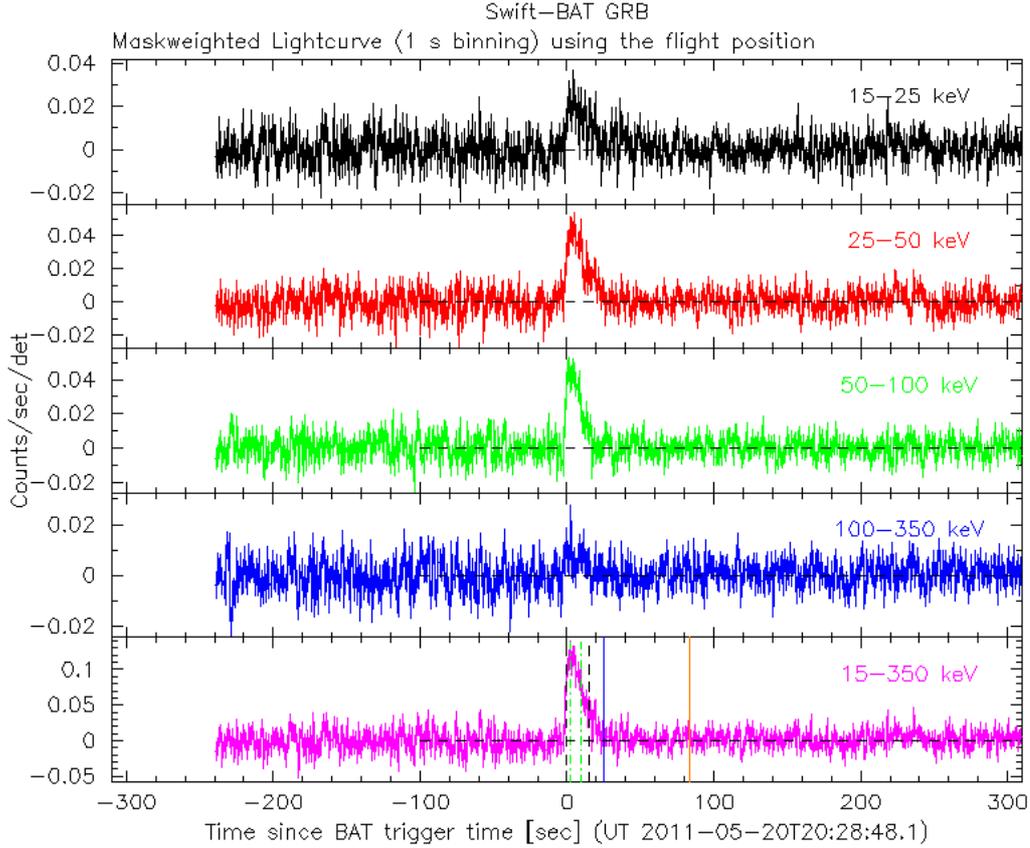


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector (note illum-det = 0.16 cm^2) and T_0 is 20:28:48.2 UT.

to 3-sigma magnitude. Upper limits are summarized in Table 1. These upper limits are not corrected for Galactic extinction $E(B-V) = 0.03$ (Schlegel et al. 1998)

5 Other observations

No optical afterglow was detected by ground based observatories. TAROT obtained upper limits down to $R > 19$ with observations up to 310 sec after the trigger (Klotz, *et al.*, *GCN Circ.* 12020). Liverpool Telescope obtained an upper limit of $r' > 23.5$ 1.36 hours after the trigger (Smith, *et al.*, *GCN Circ.* 12023). Skynet attained upper limits in the g' , r' , i' , and z' in the range of 17.8 and 19.7 within 1 hour after the trigger (LaCluyze, *et al.*, *GCN Circ.* 12024). IAC80 obtained an upper limit of $I > 22.1$ (LaCluyze, *et al.*, *GCN Circ.* 12029). WHT observation derived upper limits of $z > 22.1$, $J > 20.8$, $H > 20.1$, $K > 19.5$, 1.9 hours after the trigger for any new source inside the XRT refined error circle (Levan, *et al.*, *GCN Circ.* 12026). Subsequent observation carried out with NOT found a decaying source, from $R = 23.9 \pm 0.1$ to $R = 24.5 \pm 0.2$, but it is $4''$ far from the centre of the refined XRT error circle (Xu, *et al.*, *GCN Circ.* 12037)

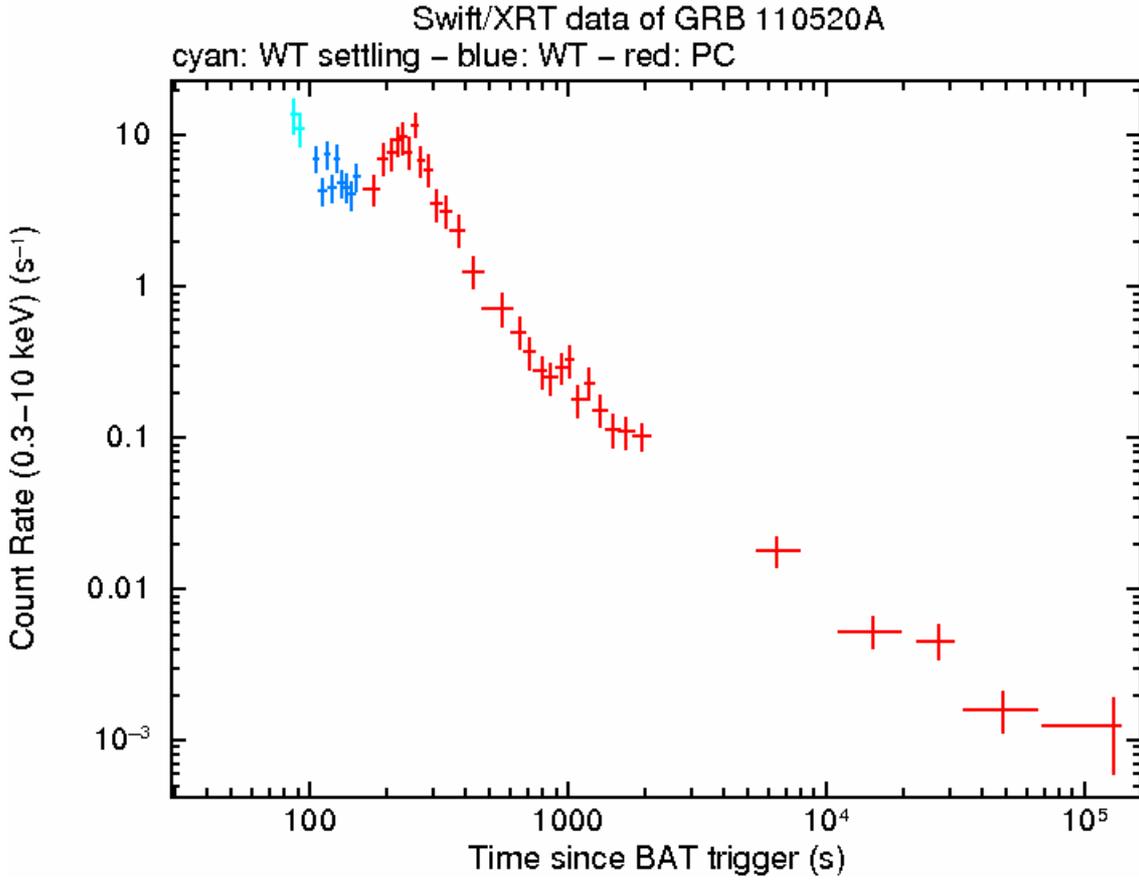


Figure 2: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Window Timing mode (cyan during the settling; after that, blue), Photon Counting mode (red). The approximate conversion is 1 count/sec = $\sim 5.1 \times 10^{-11}$ *ergs/cm²sec*.

Filter	Start	Stop	Exposure	3-Sigma UL
WHITE (finding)	104	253	147	21.1
U (finding)	316	23608	246	20.4
V	645	23608	2083	21.0
B	571	36751	2946	22.1
U	316	42529	3178	21.8
UVW1	694	41871	2965	21.8
UVM2	842	40964	2262	21.8
UVW2	621	19418	1911	21.8
WHITE	104	30973	3040	22.9

Table 1: Magnitude limits from UVOT observations