

Swift Observations of GRB 110610A

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1. INTRODUCTION

At 15:21:32 UT the Swift Burst Alert Telescope (BAT) triggered on GRB 110610A (trigger 455155). Swift slewed immediately to the burst and found a bright, uncatalogued X-ray source (Marshall *et al.* GCN Circ. 12065). The best Swift position for this burst is the XRT enhanced position (Goad *et al.* GCN Circ. 12069) of RA (J2000) = 20h 32m 42.97s and Dec (J2000) = +74d 49' 31.2" with an uncertainty of 1.9". The burst was also detected with the Fermi GBM instrument (Xiong GCN Circ. 12073), the Suzaku WAM instrument (Sugita *et al.* GCN Circ. 12074), and the INTEGRAL SPI-ACS instrument (Beckmann, private communication).

No optical afterglow was detected with UVOT, and no optical afterglow was reported from ground-based observatories.

Standard analysis products for this burst are available at http://gcn.gsfc.nasa.gov/swift_gnd_ana.html.

2) BAT OBSERVATION AND ANALYSIS

The BAT ground-calculated position (Cummings *et al.* GCN Circ. 12068) is RA (J2000) = 20h 32m 49.1s and Dec (J2000) = 74° 49' 37" with an uncertainty of 1.0' (90% containment radius including both statistical and systematic errors).

The mask-weighted light curve (Figure 1) shows several overlapping peaks starting at $\sim T-15$ sec, with the first peak at $\sim T+3$ sec, the highest peak at $\sim T+35$ sec, and ending at $\sim T+55$ sec. T_{90} (15-350 keV) is 46.4 ± 5.7 sec (estimated error including systematics).

The time-averaged spectrum from T-11.1 to T+58.0 sec is best fit by a simple power-law model. The power law index is 1.51 ± 0.105 . The fluence in the 15-150 keV band is $14.9 \pm 0.1 \times 10^{-6}$ erg cm⁻². The 1-sec peak photon flux measured from T+34.42 sec in the 15-150 keV band is 4.2 ± 0.2 ph cm⁻² sec⁻¹. All the quoted errors are at the 90% confidence level.

3. XRT OBSERVATIONS AND ANALYSIS

The XRT began observing GRB 110610A about 62 sec after the BAT trigger (Rowlinson & Marshall GCN Circ. 12071). The initial 79 sec of data were taken in Windowed Timing (WT) mode, and the remainder were taken in Photon Counting (PC) mode. The best XRT position is reported in Section 1. The light curve can be modelled with a series of power-law decays. The initial decay index is $\alpha=2.8 \pm 0.4$. At T+174 s the decay flattens to an $\alpha=0.18$ (+0.21, -0.32) before breaking again at T+984 s to a final decay with index $\alpha=1.33$ (+0.12, -0.10).

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of 2.18 (+0.20, -0.19). The best-fitting absorption column is 8.2 (+1.3, -1.2) $\times 10^{21}$ cm⁻², in excess of the Galactic value of 1.3×10^{21} cm⁻² (Kalberla *et al.* 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced for this spectrum is 5.1×10^{-11} (1.2×10^{-10}) erg cm⁻² count⁻¹.

4. UVOT OBSERVATIONS AND ANALYSIS

A nearby bright star delayed settled UVOT observations of the field of GRB 110610A until 4356 sec after the BAT trigger, and no observations were made with the white, b, and u filters (Marshall GCN Circ. 12070). No afterglow was detected. The preliminary 3- σ upper limits using the UVOT photometric system (Poole *et al.* 2008, MNRAS, 383, 627) are given in Table 1. No correction has been made for the expected

extinction in the Milky Way corresponding to a reddening of $E_{B,V}$ of 0.44 mag. in the direction of the GRB (Schlegel *et al.* 1998).

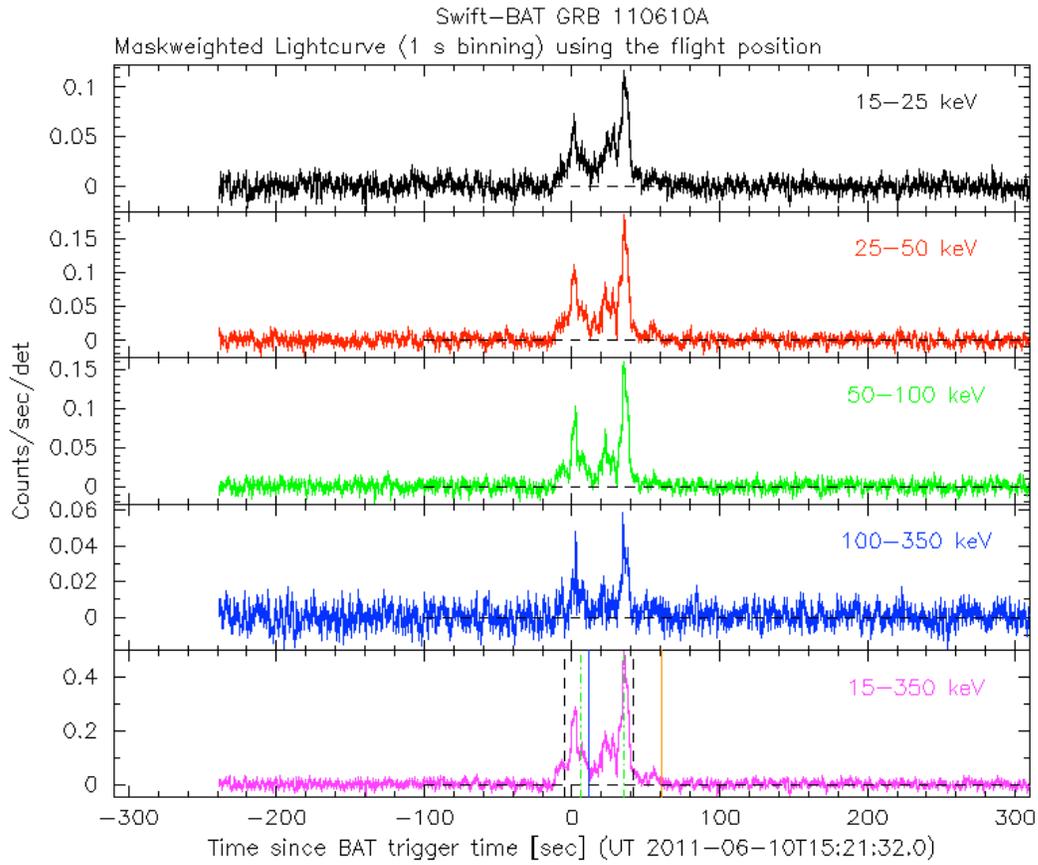


Figure 1: The BAT light curve in multiple energy bands.

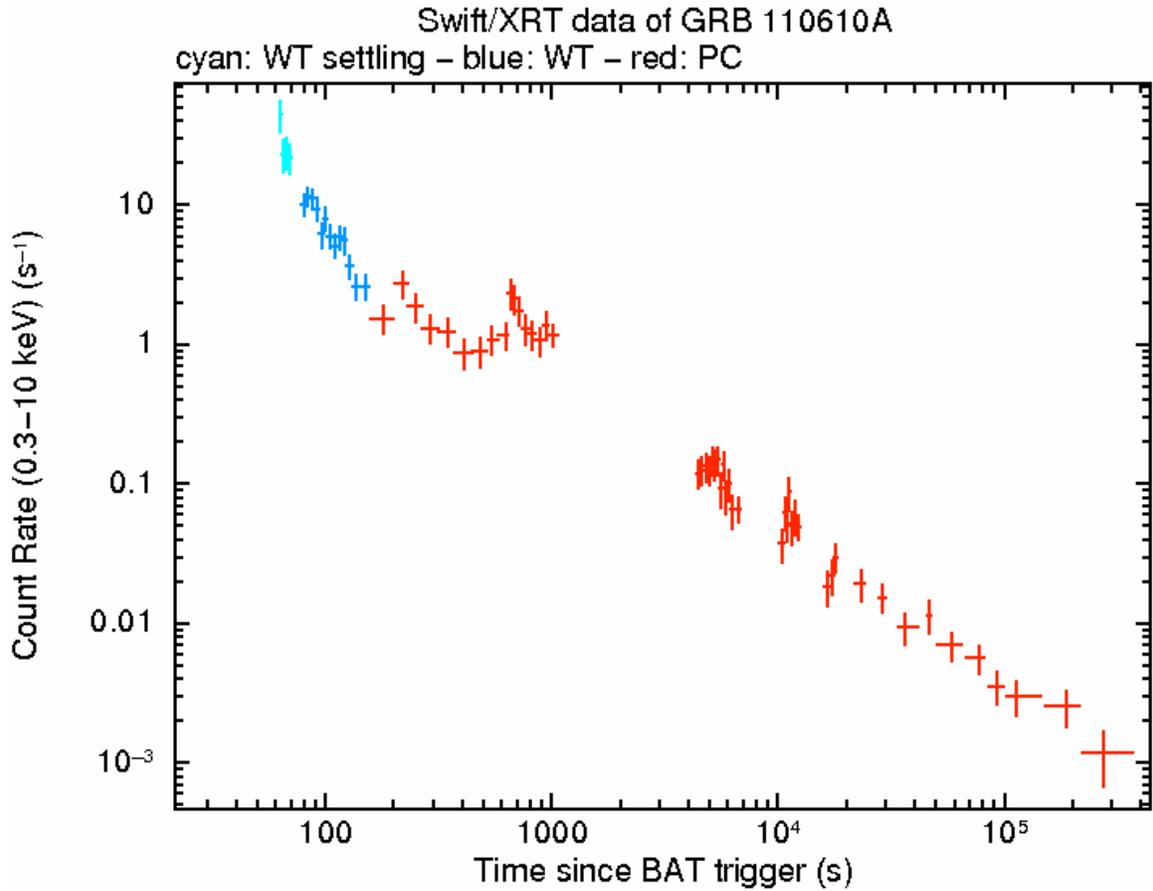


Figure 2: The XRT light curve. The WT settling data are in cyan, the WT mode data are in blue, and the PC mode data are in red.

Filter	T_{start}	T_{stop}	Exposure	Magnitude
	(seconds)	(seconds)	(seconds)	
v	4561	6408	590	>19.7
uvw1	4971	6817	590	>20.5
uvm2	4766	6612	590	>20.8
uvw2	4356	6203	590	>20.5

Table 1: UVOT Observations for 4 filters. The start and stop times of the exposures are given in seconds since the BAT trigger. The preliminary 3- σ upper limits are given. No correction has been made for the expected extinction in the Milky Way (Schlegel *et al.* 1998).