Swift Observations of GRB 110414A

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1 Introduction

The Swift Burst Alert Telescope (BAT) triggered on GRB 110414A (trigger=451343) at 07:42:14 UT on 2011 April 14 (Starling et al. 2011, GCN Circ. 11931). Swift slewed immediately to the burst. The afterglow was detected with XRT. Our best position is the enhanced XRT position (Osborne et al. 2011, GCN Circ. 11934): RA(J2000) = 06h 31m 29.43s Dec (J2000): +24d 21′ 44.7″ with an uncertainty of 1.5″ (radius, 90% containment).

2 BAT Observations and Analysis

The BAT light curve showed a multiple-peaked structure (Fig. 1). Using the data set from T−239 to T+963 s, the BAT ground-calculated position is RA, Dec = 97.876, 24.349 deg which is

RA(J2000) = 06h 31m 30.2s

Dec(J2000) = +24d 20′ 56.5″

with an uncertainty of 1.6′, (radius, sys+stat, 90% containment). The partial coding was 30%.

The mask-weighted lightcurve shows several overlapping peaks with the first starting at ∼T−100 s, the main peaks at T−33, T+0, T+10, T+25, and a small peak at ∼T+120 s, and ending at ∼T+130 s. T_{90} (15–350 keV) is 152.0±73.2 s (estimated error including systematics).

The time-averaged spectrum from T−38.4 to T+135.6 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.70±0.14. The fluence in the 15–150 keV band is $(3.5\pm0.3)\times10^{-6}$ erg cm^{-2}. The 1-s peak photon flux measured from T+8.62 s in the 15–150 keV band is 1.1±0.3 ph cm^{-2} s^{-1}. 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/451343/BA/`.

3 XRT Observations and Analysis

The XRT observed the field from 131.7 s to 226 ks after the BAT trigger for a total exposure time of 197.5 ks. The data comprise 83 s in Windowed Timing (WT) mode (the first 9 s were taken while Swift was slewing) with the remainder in Photon Counting (PC) mode. The enhanced XRT position for this burst was given by Osborne et al. (GCN. Circ 11934).

The light curve can be modelled with a power law with 4 breaks, with some flaring activity overlaid between T+300 and T+700 s (Fig. 2). The best-fitting parameters are: $\alpha_1 = -0.8^{+1.1}_{-1.2}$, $T_{bk1} = 154^{+2}_{-1}$, $\alpha_2 = 8.3^{+0.6}_{-0.5}$, $T_{bk2} = 211^{+7}_{-5}$, $\alpha_3 = 1.7\pm0.2$, $T_{bk3} = 805^{+202}_{-91}$, $\alpha_4 = 0.1^{+0.4}_{-0.7}$, $T_{bk4} = 2529^{+1110}_{-510}$ with final decay slope $\alpha_5 = 1.6\pm0.1$.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of $\Gamma = 2.72\pm0.15$. The intrinsic absorption column at an assumed redshift of z=0 is $N_H = (1.9\pm0.5)\times10^{21}$ cm^{-2}, while the Galactic value is 3.1×10^{21} cm^{-2} (Kalberla et al. 2005). The PC mode spectrum has a photon index of 2.4±0.2 and a best-fitting intrinsic absorption column at
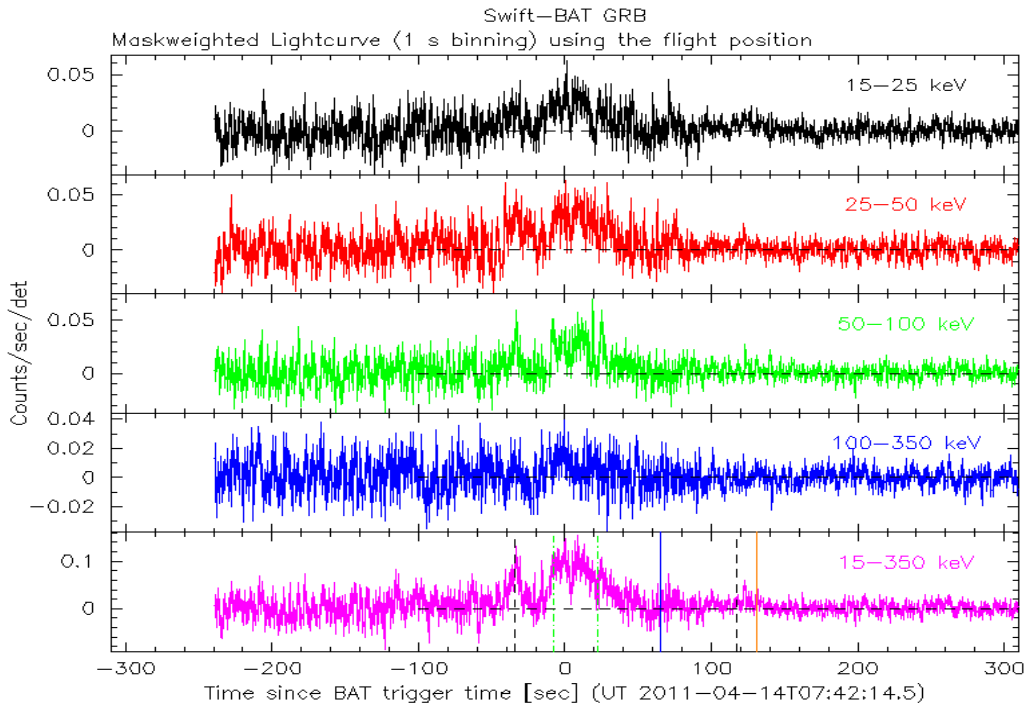
Figure 1: BAT maskweighted 1 s light curves in five energy bands, covering T−310 s to T+310 s.

z=0 of $(1.0\pm0.6)\times10^{21}$ cm^{-2}. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from the PC spectrum is 3.9×10^{-11} (8.8×10^{-11}) erg cm^{-2} count^{-1}.

The results of the XRT-team automatic analysis are available at `http://www.swift.ac.uk/xrt_products/00451343`.

4 UVOT Observations and Analysis

The UVOT began settled observations of the field of GRB 110414A 151 s after the BAT trigger. No optical afterglow was detected. Upper limits (3σ) using the UVOT photometric system (Poole et al. 2008 MNRAS 383 627) are given in Table 1. The values quoted are not corrected for Galactic extinction due to the reddening of $E(B - V) = 0.33$ in the direction of the burst (Schlegel et al. 1998 ApJ 500 525).
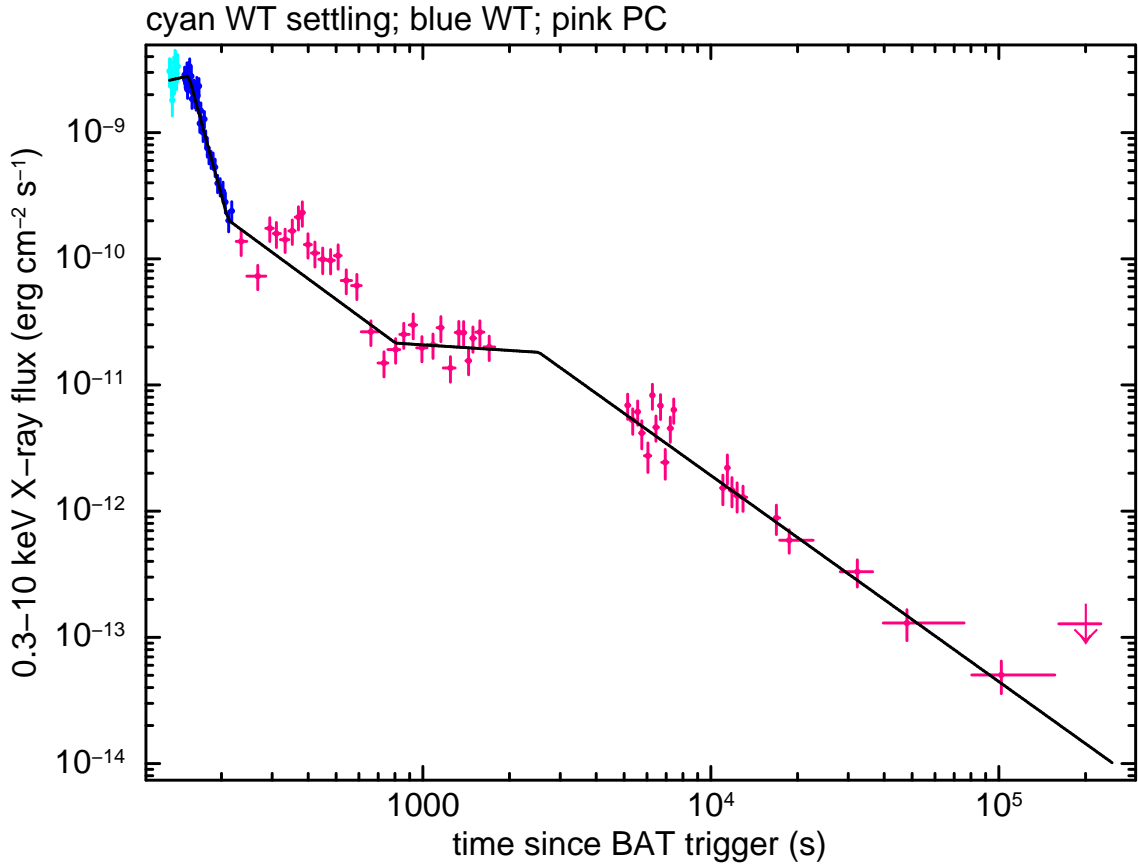
cyan WT settling; blue WT; pink PC

Figure 2: XRT fluxed light curve in the 0.3-10 keV band. The power law fit is described in the text. The approximate observed count rate to flux conversion is 1 count s^{-1} = 3.9×10^{-11} erg cm^{-2} s^{-1}, based on the time-averaged spectrum.

Filter	Start	Stop	Exposure	3σ UL
white	150	1013	334	>21.3
v	639	831	39	>18.4
b	565	758	39	>18.9
u	308	733	265	>19.5
uvw1	689	709	19	>18.5
uvm2	664	856	39	>18.8
uvw2	615	807	39	>19.2

Table 1: Upper limits from UVOT observations. Start and stop times are given in seconds since BAT trigger and exposure times in seconds.