Swift Observations of GRB 110305A

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1 Introduction

At 06:38:01 UT on 2011-03-05, the Swift Burst Alert Telescope (BAT) triggered and located GRB 110305A (trigger=448229). Swift slewed immediately to the burst and found an X-ray counterpart in the XRT (Grupe et al., *GCN Circ.* 11773)

The best *Swift* position of this burst is the XRT position given in Goad et al. (*GCN Circ.* 11777) with RA-2000 = 17h 23m 31.37s, and Dec-2000 = -15° $48^{'}$ $08.7^{''}$ with an uncertainty of $1.7^{''}$.

There were a few ground-based optical/NIR follow-up observation reported on this burst. Most notably was the detection by GROND (Nicuesa Guelbenzu et al, *GCN Circ.* 11774) who reported of a fading source in the *Swift* XRT error circle.

2 BAT Observation and Analysis

At 06:38:01 UT on 2011-01-28, the Swift Burst Alert Telescope (BAT) triggered and located GRB 110305A (trigger=448229, Grupe et al., *GCN Circ.* 11773). Using the data set from T-61 to T+242 s, the BAT ground-calculated position is RA, Dec = 260.877, –15.810 deg which is

RA(J2000) = 17h 23m 30.4s

Dec(J2000) = -15° $48^{'}$ $37.6^{''}$

with an uncertainty of 1.9 arcmin, (radius, sys+stat, 90% containment). The partial coding was 22% (Cummings et al. *GCN Circ.* 11776).

The mask-weighted light curve (Figure 1) shows a single pulse starting at T-1 s to T+12 s. T_{90} (15-350 keV) is 12.0±2.2 s (estimated error including systematics).

The time-averaged spectrum from T-0.9 to T+12.1 s is best fit by a single power law model. The power law index of the time-averaged spectrum is 1.62±0.19 (χ^2 = 55.4 for 57 d.o.f.). For this model the total fluence in the 15-150 keV band is 8.0 $\pm 1.0 \times 10^{-7}$ ergs cm^{-2}. The 1s peak photon flux measured from T+6.06 s in the 15-150 keV band is 1.2±0.3 photons s^{-1} cm^{-2}. 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/448229/BA/

3 XRT Observations and Analysis

The XRT began observing the field of GRB 110305A at 06:39:50.2 UT, 109.0 seconds after the BAT trigger. Using 451 s of XRT Photon Counting mode data and 1 UVOT image for GRB 110305A, Goad et al. (*GCN Circ.* 11777) found an astrometrically corrected X-ray position (using the XRT-UVOT

alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 260.88069, –15.80241 which is equivalent to:

RA (J2000): 17h 23m 31.37s

Dec (J2000): $-15^\circ\ 48'\ 08.7''$

with an uncertainty of $1.7''$ (radius, 90% confidence). The latest position can be viewed at http://www.swift.ac.uk/xrt_positions. Position enhancement is described by Goad et al. (2007, A&A, 476, 1401) and Evans et al. (2009, MNRAS, 397, 1177).

A spectrum formed from the PC mode data (34 ks exposure) can be fitted with an absorbed single power-law model with a photon spectral index of $1.98^{+0.22}_{-0.20}$ (Grupe, *GCN Circ.* 11778). The best-fitting absorption column is consistent with the Galactic value of 1.7×10^{21} cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 4.9×10^{-11} (6.8×10^{-11}) erg cm^{-2} count^{-1}.

The $0.3-10\ keV$ light curve given below (Fig.2) displays a single decay slope α=$1.12^{+0.07}_{-0.06}$.

4 UVOT analysis

The Swift/UVOT began settled observations of the field of GRB 110305A 113 s after the BAT trigger (Grupe et al., GCN Circ. 11774) with the finding chart in white filter. Immler & Grupe (*GCN Circ.* 11779) reported that no optical counter part was found at the GROND position (Nicuesa Guelbenzu et al, *GCN Circ.* 11774). Note that the UVOT analysis is complicated by the nearby bright star and the fact that the field is very crowded.

The 3σ upper limits for the summed images are listed in Table 1.

Filter	$T_{\rm Start}$	$T_{\rm stop}$	Exposure	Mag
white_FC	113	263	147	>20.5
u_FC	271	521	246	>19.6
white	113	18938	1608	>22.3
v	601	11519	1203	>19.7
b	527	24719	2136	>20.9
u	271	30501	3468	>21.5
w1	650	29759	2976	>20.9
m2	632	28858	2261	>20.8
w2	749	7376	426	>19.8

Table 1: 3σ upper limits from UVOT observations of GRB 110305A. The quoted values have not been corrected for the expected Galactic extinction along the line of sight of $E_{\rm B-V}$ = 0.39 mag. All photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627).

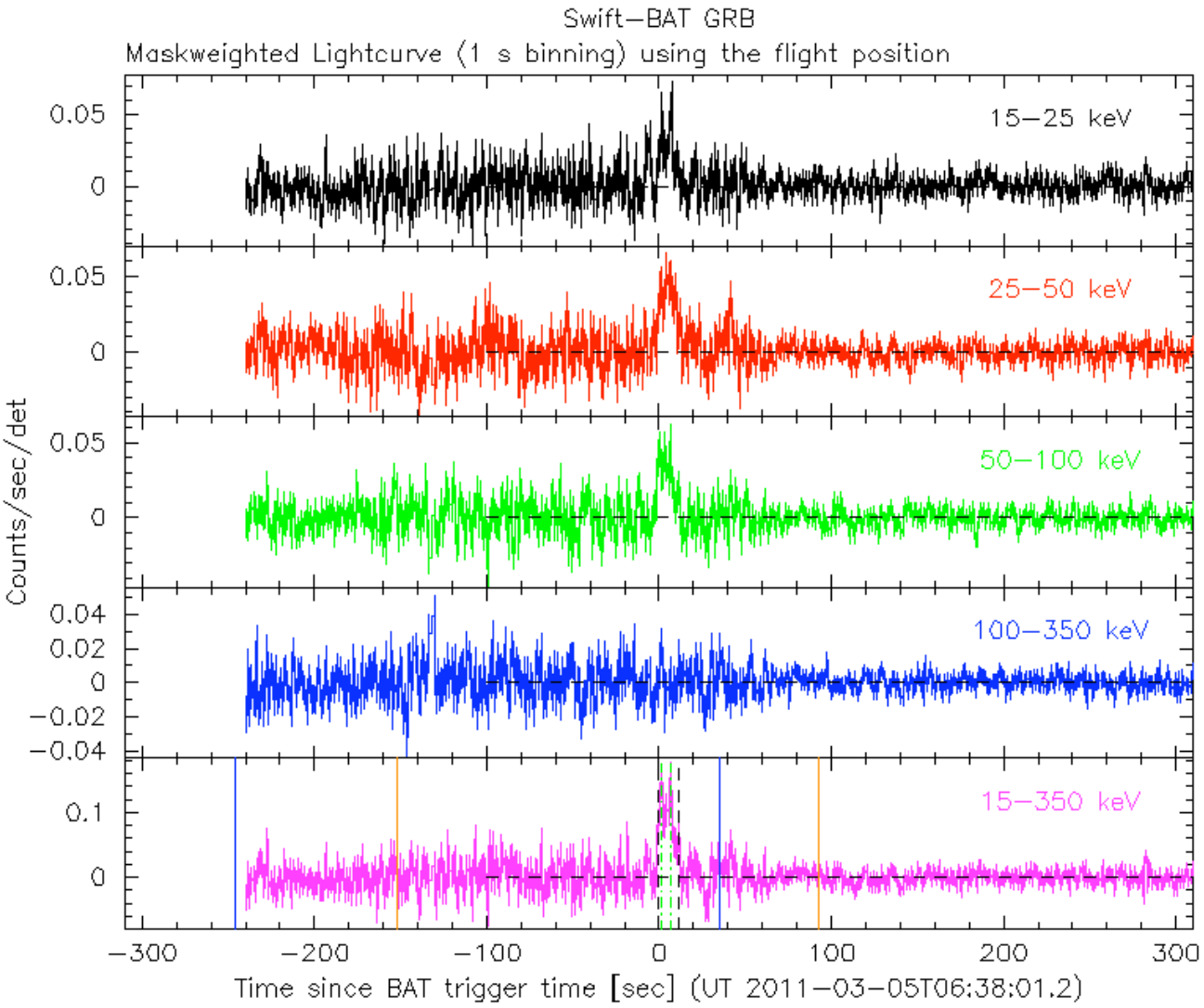

Figure 1: BAT Light curve of GRB 110305A.

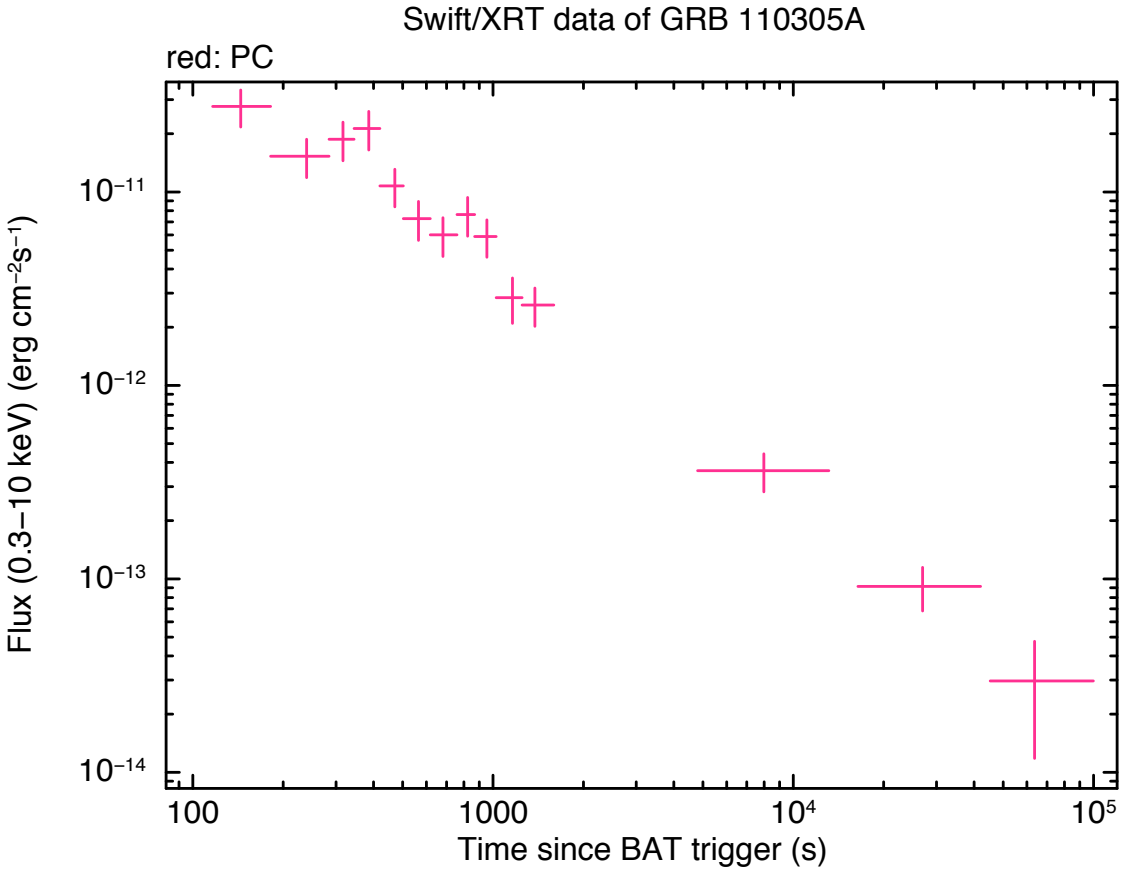

Figure 2: XRT flux light curve of GRB 110305A in the 0.3-10 keV band. The approximate conversion is 1 count $s^{-1} = \sim 4.9 \times 10^{-11}$ergs s^{-1} cm^{-2}.