Swift Observation of GRB 120305A

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1 Introduction

At 19:37:30 UT, the Swift Burst Alert Telescope (BAT) triggered and located the short GRB 120305A (trigger=516997, Stratta et al., GCN Circ. 13004). Swift slewed immediately, and the narrow field instruments were on target 69 seconds later. The X-ray telescope XRT detected a bright X-ray afterglow. The enhanced Swift/XRT position RA (J2000)= 03^h 10^m 8.73^s and Dec (J2000)= $+28^d$ $29'$ 30.9" with an uncertainty of 2.0 arcsec (radius, 90% confidence) was given by Beardmore *et al.* (GCN Circ. 13008).

The Swift/BAT light curve shows a single peak structure with a duration of about 200 msec.

The burst was observed also as a bright peak with the anti-coincidence system of INTEGRAL/SPI (SPI/ACS, $\sim$80 keV-$\sim$10 MeV) with same duration (V. Beckman on behalf of ISDC team, private communication).

Swift/UVOT began settled observations of the field 72 s after the BAT trigger. No optical afterglow is consistent with the enhanced XRT position.

No detection from ground-based facilities has been reported.

2 BAT Observation and Analysis

Using the data set from $T_0 - 60$ to $T_0 + 243$ sec from prompt telemetry downlinks, the BAT ground-calculated position is RA, Dec = 47.549, 28.495 deg which is RA(J2000) = 03^h 10^m 11.8^s and Dec(J2000) = $+28^d$ $29'$ 41.2" with an uncertainty of 1.0 arcmin (radius, sys+stat, 90% containment). The partial coding was 92%.

The mask-weighted light curve shows a single FRED-like spike starting at $\sim T_0 + 0.00$ sec, peaking at $T_0 + 0.02$ sec, and ending at $\sim T_0 + 0.20$ sec. At the $\sim$ 2-sigma level, there is possible emission out to $\sim T_0 + 20$ sec. $T_{90}(15 - 350$ keV) is 0.10 ± 0.02 sec (estimated error including systematics).

The time-averaged spectrum from T_0 to $T_0 + 0.136$ sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.00 ± 0.09. The fluence in the $15 - 150$ keV band is $2.0 \pm 0.1 \times 10^{-7}$ erg cm^{-2}. The 1-sec peak photon flux measured from $T_0 - 0.43$ sec in the $15 - 150$ keV band is 2.2 ± 0.2 ph cm^{-2} sec^{-1} (Palmer et al., GCN Circ. 13007).

Using 1-ms binned light curves, the spectral lag for the 15-25 keV to 50-100 keV bands is $2.0^{+0.6}_{-0.9}$ msec, and $-2.6^{+0.6}_{-0.4}$ msec for the 25-50 keV to 100-350 keV bands for both peaks combined. These lag values place this burst in the short burst category (Norris and Barthelmy, GCN Circ. 13015).

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/516997/BA/

3 XRT Observations and Analysis

The XRT data comprise 85 s in Windowed Timing (WT) mode with the remainder in Photon Counting (PC) mode. The light curve can be modelled with a broken power-law model with an initial plateau up to about $T_0 + 150$ sec followed by a power law decay with index $\alpha \sim -4.4$.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of 1.94 ± 0.20. The best-fitting absorption column is $4.7 \pm 1.0 \times 10^{21} \mathrm{cm}^{-2}$, in excess of the Galactic value of 1.1×10^{21} cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 4.5×10^{-11} (7.5×10^{-11}) erg cm^{-2} count^{-1} (Page et al., GCN Circ. 13009).

Detailed light curves in both count rate and flux units are available in both graphical and ASCII formats at http://www.swift.ac.uk/xrt_curves/00516997.

4   UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 120305A starting 72 s after the BAT trigger (Marshall & Stratta, GCN Circ. 13011). No optical afterglow consistent with the enhanced XRT position (Beardmore et al., GCN Circular 13008) is detected in the initial UVOT exposures. Preliminary 3-sigma upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc. 1358, 373) for the initial finding chart (FC) exposures and subsequent exposures are reported in Table 1. The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight corresponding to a reddening of $E_{B-V} = 0.43$ mag (Schlegel, et al., 1998, ApJS, 500, 525).
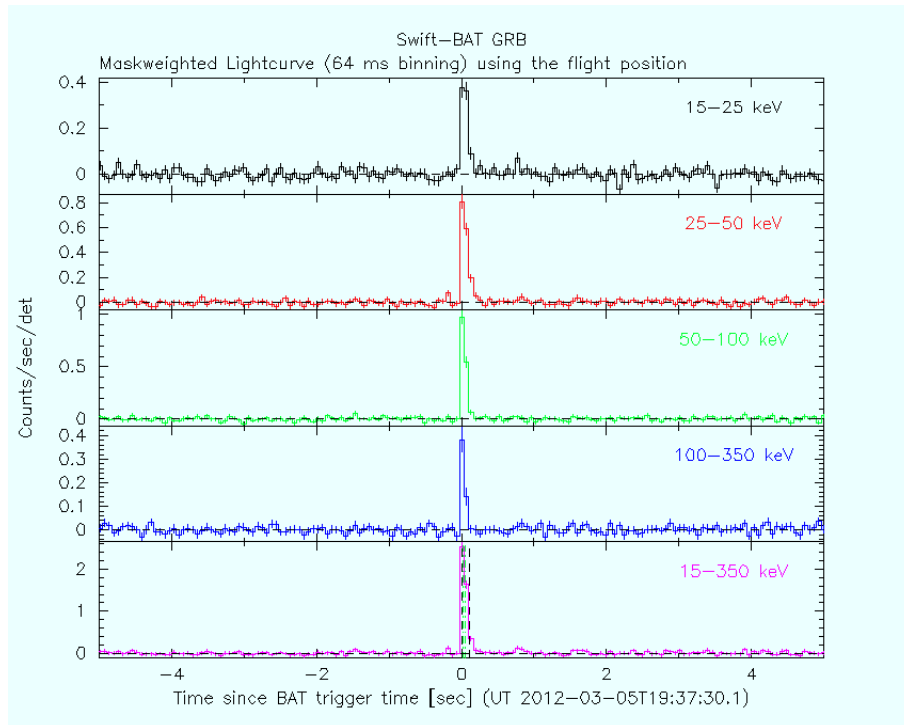

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts s^{-1} illuminated-detector^{-1} (note illum-det = 0.16 cm^2). The green dotted lines are T50 interval, the black dotted lines indicates the T90 interval.

Swift/XRT data of GRB 120305A
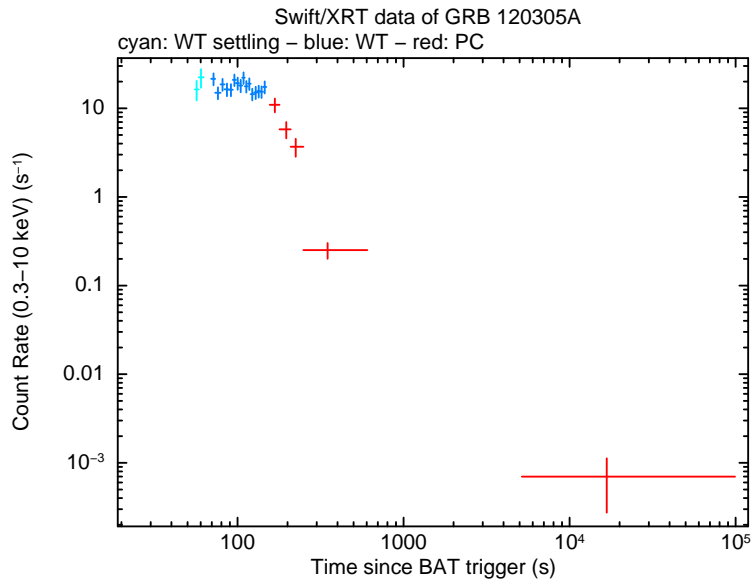cyan: WT settling – blue: WT – red: PC

Figure 2: XRT Lightcurve. Counts s^{-1} in the 0.3-10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion to observed (unabsorbed) flux is 1 count s^{-1} $\sim 4.5(7.5) \times 10^{-11}$ erg cm^{-2} s^{-1}.

Filter	T_start (s)	T_stop (s)	Exp (s)	3-sigma UL mag
white(FC)	72	221	147	> 20.1
u(FC)	284	534	246	> 20.4
white	72	6382	363	> 21.1
v	5158	11729	1082	> 19.7
b	540	18740	428	> 20.4
u	284	24898	1918	> 21.2
w1	5567	24288	1968	> 20.7
m2	11734	23381	1740	> 21.0
w2	6388	6584	193	> 20.4

Table 1: Magnitude limits from UVOT observations.