

## Swift Observation of GRB 130216A

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### 1 Introduction

At 22:15:24 UT, the *Swift* Burst Alert Telescope (BAT) triggered and located GRB 130216A (Trigger = 548927; Melandri, *et al.*, *GCN Circ.* 14223). *Swift* did not slew because of the Moon observing constraint. The BAT on-board calculated location is RA, Dec = (67.898, +14.665) deg, which is

$$\text{RA(J2000)} = 04^{\text{h}} 31^{\text{m}} 36^{\text{s}}$$

$$\text{Dec(J2000)} = +14^{\circ} 39' 53''$$

with an uncertainty of 3 arcmin (radius, 90% containment, including systematic uncertainty). The BAT light curve shows a small precursor peak at  $T - 6$  s and then the main peak at  $T + 2$  s with a total duration of about 20 s. The peak count rate was  $\sim 10,000$  counts  $\text{s}^{-1}$  (15-350 keV), at  $\sim 2$  s after the trigger

Due to a Moon observing constraint, *Swift* could not observe the BAT position before 13:16 UT on 2013 February 20 and there were no XRT or UVOT data for this trigger before this time.

### 2 BAT Observation and Analysis

Using the data set from  $T - 240$  to  $T + 962$  s further analysis of BAT GRB 130216A has been performed by *Swift* team (Barthelmy, *et al.*, *GCN Circ.* 14229 Sakamoto & Barthelmy, *GCN Circ.* 14240). The BAT ground-calculated position is RA(J2000) = 67.901 deg ( $04^{\text{h}} 31^{\text{m}} 36.2^{\text{s}}$ ), Dec(J2000) = +14.670 deg ( $+14^{\circ} 40' 10.4''$ )  $\pm 1.0'$  (radius, sys+stat, 90% containment). The partial coding was 54%.

The mask-weighted light curve (Fig.1) shows two peaks. There is an initial small peak centered on  $\sim T - 6$  s with a duration of  $\sim 4$  s. The second peak starts at  $\sim T - 3$  s, peaks at  $\sim T + 2$  s, and ends at  $\sim T + 10$  s.  $T_{90}$  (15-350 keV) is  $6.5 \pm 1.1$  s (estimated error including systematics).

The time-averaged spectrum from  $T - 6.16$  to  $T + 4.31$  s is best fit by a power law with an exponential cutoff. This fit gives a photon index  $0.80 \pm 0.20$ , and  $E_{\text{peak}}$  of  $123.7 \pm 27.1$  keV ( $\chi_{\text{red}}^2 = 47.17$  for 56 d.o.f.). For this model the total fluence in the 15-150 keV band is  $3.0 \pm 0.1 \times 10^{-6}$  *ergs/cm*<sup>2</sup> and the 1-sec peak flux measured from T+1.11 sec in the 15-150 keV band is  $6.5 \pm 0.3$  *ph/cm*<sup>2</sup>/*sec*. A fit to a simple power law gives a photon index of  $1.35 \pm 0.04$  ( $\chi_{\text{red}}^2 = 72.98$  for 57 d.o.f.). All the quoted errors are at the 90% confidence level.

### 3 XRT Observation and Analysis

We have analysed 8 ks of XRT data for GRB 130216A (Melandri *et al.*, *GCN Circ.* 14223), from 317.7 ks to 347.4 ks after the BAT trigger. The data are all in Photon Counting (PC) mode. No X-ray afterglow is detected inside the refined BAT error circle (Sakamoto & Barthelmy, *GCN Circ.* 14240). The  $3\sigma$  upper limit is of  $4.7 \times 10^{-3} \text{ cts s}^{-1}$ .

This corresponds to an observed 0.3-10 keV flux of  $1.8 \times 10^{-13} \text{ erg cm}^{-2} \text{ s}^{-1}$  (assuming a typical GRB spectrum with photon spectral index of 2). If we consider the Galactic absorption in this direction ( $\sim 1.5 \times 10^{21} \text{ cm}^{-2}$ ; Kalberla *et al.* 2005) this corresponds to an unabsorbed flux of  $2.4 \times 10^{-13} \text{ erg cm}^{-2} \text{ s}^{-1}$ .

### 4 UVOT Observation and Analysis

The UVOT began settled observations of the field of GRB 130216A  $\sim 3.67$  days after the BAT trigger (Melandri, *et al.*, *GCN Circ.* 14254). The observations were delayed because of an observing constraint due to the Moon. No new source is seen inside the refined BAT error circle (Barthelmy, *et al.*, *GCN Circ.* 14229).

The preliminary  $3\sigma$  upper limit using the UVOT photometric system (Breeveld *et al.* 2011, AIP Conf. Proc. 1358, 373) for the exposures are:

Filter	Start	Stop	Exposure	$3\sigma$ UL
w1	317224	346946	7959	> 22.2

Table 1:  $3\sigma$  upper limits from UVOT observations (Marshall & Melandri, *GCN Circ.* 14254). The values quoted above are not corrected for the Galactic extinction due to the reddening of  $E_{(B-V)} = 0.49$  in the direction of the burst (Schlegel *et al.* 1998).

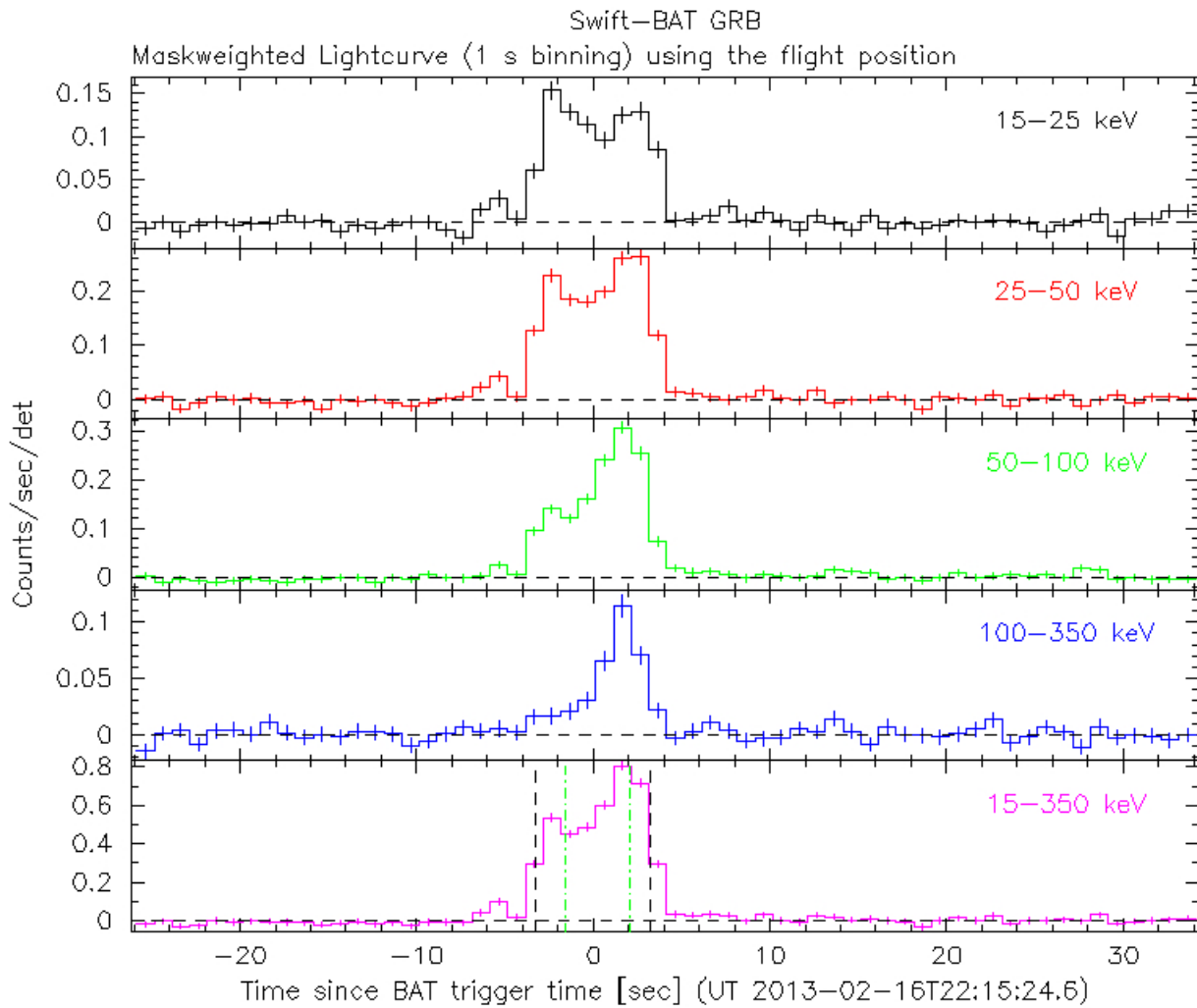


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands (15 - 25, 25 - 50, 50 - 100, 100 - 350 and 15 - 350 keV).