

Swift Observations of GRB 120514A

V. Mangano (INAF IASF Pa), A. Maselli (INAF IASF Pa), H.A. Krimm (CRESST/GSFC/USRA), E.A. Hoversten (PSU), S.D. Barthelmy (GSFC), D.N. Burrows (PSU), M.H. Siegel (PSU), N. Gehrels (NASA/GSFC) for the Swift Team

1 Introduction

BAT triggered on GRB 120514A at 01:12:49 UT, (trigger 522197, Mangano *et al.*, *GCN Circ.* 13289). This was a rate-trigger on a long burst with $T_{90} = 164.4 \pm 5.8$ s. Swift slewed immediately to the burst and found an X-ray counterpart to the burst in XRT. XRT began follow up observations at $T + 101.3$ s, and UVOT observations began at $T + 110$ s.

Our best position is the enhanced XRT position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA($J2000$) = 283.00078 *deg* ($18^h 52^m 0.19^s$) Dec($J2000$) = -4.26359 *deg* ($-04^d 15' 48.9''$) with an uncertainty of 1.8 arcsec (radius, 90% confidence, Evans *et al.*, *GCN Circ.* 13292).

The field of GRB 120514A has been observed by some ground based telescopes: the TAROT robotic telescope (D=25 cm) located at the Calern observatory (France), observed 534 s after the GRB trigger in the R filter (Klotz *et al.*, *GCN Circ.* 13290); the LABOCA/APEX at Chajnantor (Chile) observed 3.7 hr after the burst in the 870 micrometer band (de Ugarte Postigo *et al.*, *GCN Circ.* 13293); the United Kingdom Infrared Telescope (UKIRT) on Mauna Kea, observed with a midpoint approximately 12 hours after the initial burst detection (Levan *et al.*, *GCN Circ.* 13296); the GROND mounted at the 2.2 m MPG/ESO telescope at La Silla Observatory observed in g'r'i'z/JHK, 2.4 h after the trigger (Nicuesa Guelbenzu *et al.*, *GCN Circ.* 13298). All of these telescopes measured only 3 sigma upper limits.

GRB 120514A has also been detected by the Suzaku WAM at 01:12:43.252 UT on 14 May 2012 (Akiyama *et al.*, *GCN Circ.* 13301).

2 BAT Observation and Analysis

Using the data set from T-239 to T+963 s from telemetry downlink, the refined analysis of BAT GRB 120514A was performed by the Swift team and reported in Baumgartner *et al.*, *GCN Circ.* 13291.

The BAT ground-calculated position is RA($J2000$) = 283.002 *deg* ($18^h 52^m 00.4^s$) Dec($J2000$) = -4.258 *deg* ($-04^d 15^m 28.6^s$) with an uncertainty of 1.1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 61%.

The mask-weighted light curve (Fig.1) shows 3 main peaks. The first starts at $\sim T-40$ s, and peaks at $\sim T+1$ s. The second overlaps the tail of the first, peaks at $\sim T+52$ and ends at $\sim T+115$ s. The third peak starts at $\sim T+120$ s, peaks at $\sim T+150$ s and ends at $\sim T+200$ s. At the 2-sigma level, there is possible precursor emission from $\sim T-160$ to $T-80$ s, and a possible fourth peak from $\sim T+260$ to $\sim T+420$ s. T_{90} (15–350 keV) is 164.4 ± 5.8 s (estimated error including systematics).

The time-averaged spectrum from T-8.75 to T+165.55 s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.62 ± 0.10 . The fluence in the 15–150 keV band is $(2.8 \pm 0.2) \times 10^{-6}$ erg cm $^{-2}$. The 1-s peak photon flux measured from T+0.22 s in the 15–150 keV band is 1.9 ± 0.2 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/522197/BA/

3 XRT Observations and Analysis

The whole Swift-XRT dataset for GRB 120514A (trigger 522197, Mangano *et al.*, *GCN Circ.* 13289), consists of 33.8 ks of data from 90 s to 254.8 ks after the BAT trigger. The data comprise 9 s in Windowed Timing (WT) mode taken while Swift was slewing (from T+90 to T+99 s), 97 s in Windowed Timing (WT) mode (from T+107.5 to T+204.5 s), with the remainder in Photon Counting (PC) mode (from T+101 s). Using the initial 932 s of PC mode data and 2 UVOT images, we find an enhanced XRT position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA($J2000$) , Dec($J2000$) = 283.00078, -4.26359 which is equivalent to RA($J2000$) = $18^h 52^m 0.19^s$ Dec($J2000$) = $-04^d 15' 48.9''$ with an uncertainty of 1.8 arcsec (radius, 90% confidence, Evans *et al.*, *GCN Circ.* 13292).

Refined analysis has been reported in Stratta *et al.*, *GCN Circ.* 13294. The 0.3–10 keV XRT light curve (Fig.2) after the initial 2 ks showing flares, can be modeled with a single power-law with decay slope: $\alpha_1 = 1.42_{-0.13}^{+0.16}$.

The spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of $1.9_{-0.11}^{+0.12}$ and best-fitting intrinsic absorption column of $1.07_{-0.14}^{+0.15} \times 10^{22} \text{ cm}^{-2}$ in excess of the Galactic value of $6.1 \times 10^{21} \text{ cm}^{-2}$ (Kalberla *et al.*, 2005). A spectrum formed from the initial 9.6 ks of PC mode data (from T+107 s to T+ 53.09 ks) can be fitted with an absorbed power-law with a photon spectral index of $2.17_{-0.32}^{+0.34}$ and best-fitting intrinsic absorption column of $1.66_{-0.43}^{+0.48} \times 10^{22} \text{ cm}^{-2}$.

The counts to observed (unabsorbed) 0.3–10 keV flux conversion factors deduced from these spectra are 6.8×10^{-11} (1.5×10^{-10}) $\text{erg cm}^{-2} \text{ s}^{-1}$ for WT and 6.9×10^{-11} (2.1×10^{-10}) $\text{erg cm}^{-2} \text{ s}^{-1}$ for PC.

The results of the XRT-team automatic analysis are available at http://www.swift.ac.uk/xrt_curves/00522197.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 120514A approximately 110 s after the BAT detection (Mangano *et al.*, *GCN Circ.* 13289). No optical afterglow consistent with the enhanced XRT position (Evans *et al.*, *GCN Circ.* 13292) 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 first finding chart (FC) exposure and subsequent exposures are given in the following Table 1 where T_{start} and T_{stop} are the start and stop time of the observation (Hoversten *et al.*, *GCN Circ.* 13297).

Filter	T_{start} (s)	T_{stop} (s)	Exp(s)	Upper Limit
white (FC)	110	260	147	>20.6
u (FC)	324	574	246	>20.5
white	110	1029	295	>20.9
u	324	574	246	>20.5

Table 1: 3-sigma upper limits from UVOT observations. (FC) stands for Finding Chart.

The magnitudes in the table are not corrected for the Galactic extinction corresponding to a reddening of $E(B-V) = 1.63$ in the direction of the burst (Schlegel et al., 1998, ApJS, 500, 525).

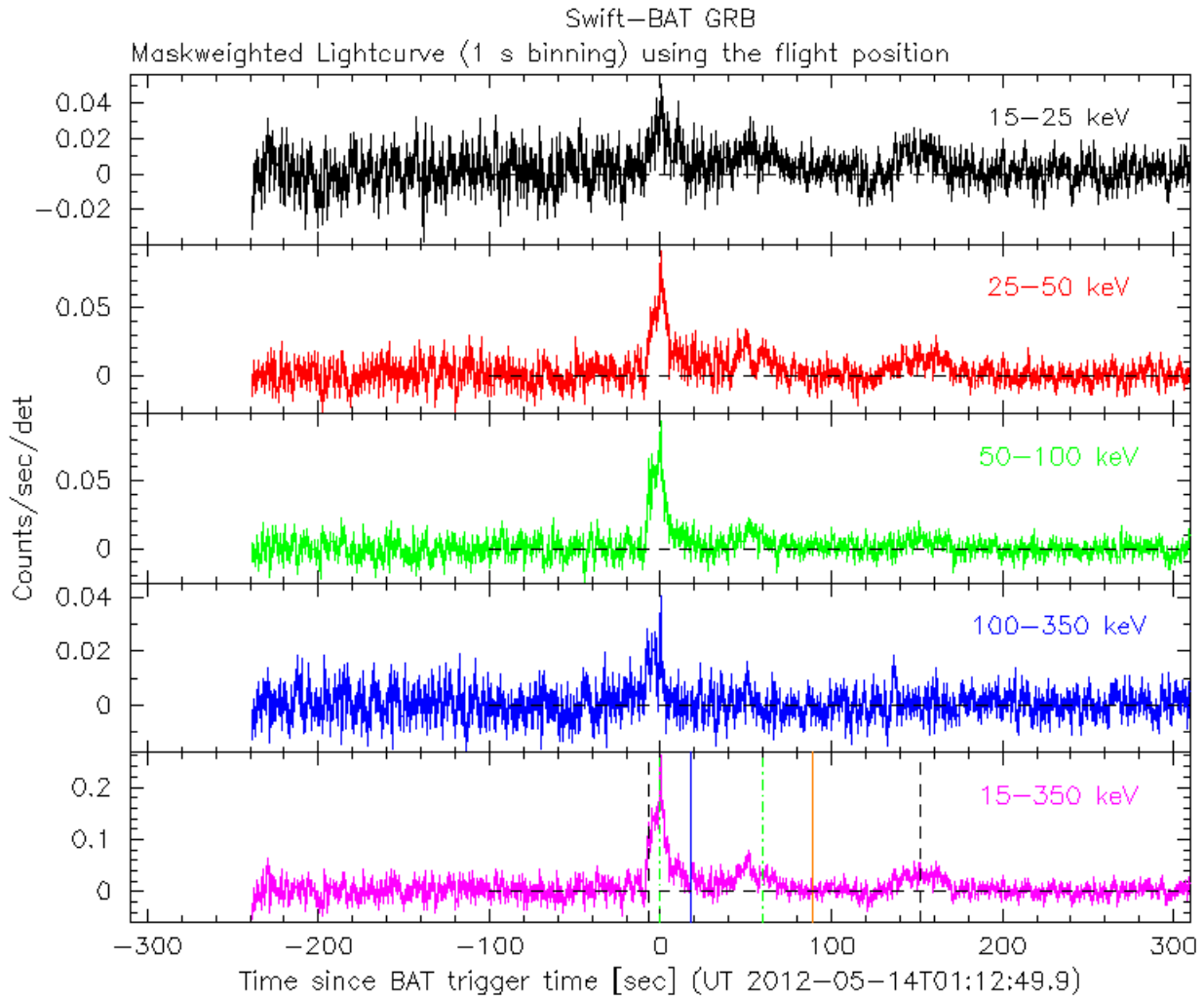


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are $\text{counts s}^{-1} \text{ illuminated-detector}^{-1}$ (note illum-det = 0.16 cm^2) and T_0 is 2012 May 14 01:12:49 UT.

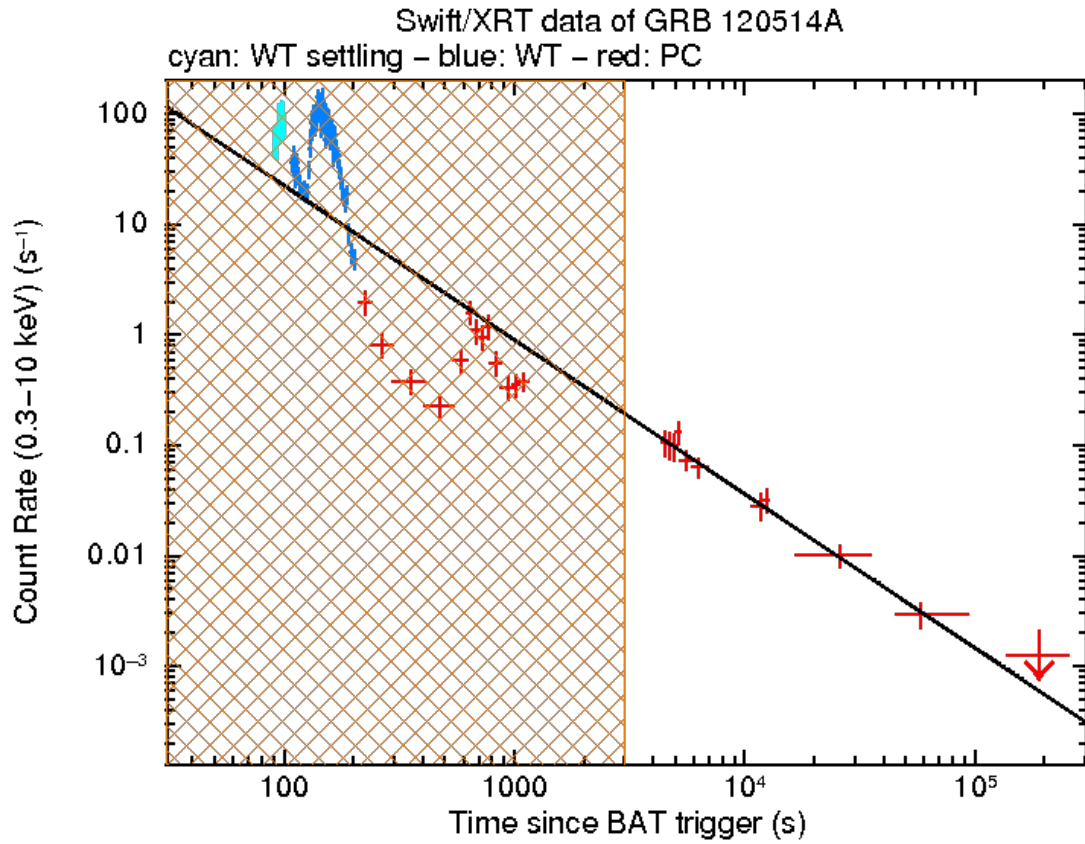


Figure 2: XRT Light curve. Counts/s in the 0.3–10 keV band: Windowed Timing mode (cyan for settling and blue for settled observation), and Photon Counting mode (red). The approximate conversion to unabsorbed flux is 1 count/s = $\sim 1.5 \times 10^{-10}$ erg cm⁻² s⁻¹. The vertical dashed region is the time interval excluded from the fit because of flaring activity.