# Swift Observation of GRB 120722A

*A. Melandri (INAF-OAB), T. Sakamoto (GSFC/UMBC), T. A. Pritchard (PSU), S. D. Barthelmy (GSFC), D. N. Burrows (PSU), M. H. Siegel (PSU) and N. Gehrels (GSFC), for the Swift Team*

## 1  Introduction

At 12:53:26 UT, the *Swift* Burst Alert Telescope (BAT) triggered and located GRB 120722A (Trigger = 528195; Melandri, *et al.*, *GCN Circ.* 13499). *Swift* slewed immediately to the burst. The BAT on-board calculated location is RA, Dec = (230.491, +13.250) deg, which is

RA(J2000) = $15^h\ 21^m\ 58^s$
Dec(J2000) = $+13°\ 15'\ 01''$

with an uncertainty of 3 arcmin (radius, 90% containment, including systematic uncertainty). The BAT light curve shows a peak with a total duration of about 25 s. The peak count rate was $\sim$ 1300 counts s$^{-1}$ (15-350 keV), at $\sim$ 5 s after the trigger.

The XRT began observing the field at 12:55:59.4 UT, $T+153$ s after the BAT trigger. Using promptly downlinked data we find a bright, uncatalogued X-ray source located at RA, Dec = (230.496, 13.251) deg, which is equivalent to:

RA (J2000) = $15^h\ 21^m\ 59.20^s$
Dec (J2000) = $+13°\ 15'\ 04.0''$

with an uncertainty of 4.1$''$ (radius, 90% containment). This location is 20$''$ from the BAT onboard position, within the BAT error circle.

UVOT took a finding chart exposure of 150 s with the White filter starting $T+156$ s after the BAT trigger. No credible afterglow candidate has been found in the initial data products. The $2.7' \times 2.7'$ sub-image covers 100% of the XRT error circle. The typical $3\sigma$ upper limit has been about 19.6 mag. The $8' \times 8'$ region for the list of sources generated on-board covers 100% of the XRT error circle. The list of sources is typically complete to about 18 mag. No correction has been made for the expected extinction corresponding to E$_{(B-V)}$ of 0.05.

## 2  BAT Observation and Analysis

Using the data set from $T-60$ to $T+243$ s further analysis of BAT GRB 120722A has been performed by *Swift* team (Sakamoto, *et al.*, *GCN Circ.* 13503). The BAT ground-calculated position is RA(J2000) = 230.489 deg ($15^h\ 21^m\ 57.4^s$), Dec(J2000) = +13.249 deg ($+13°\ 14'\ 56.8''$) $\pm\ 3.4'$ (radius, sys+stat, 90% containment). The partial coding was 19%.

The mask-weighted light curve (Fig.1) shows a couple overlapping peaks starting at $\sim T-10$ s, peaking at $\sim T+23$ s, and ending at $\sim T+50$ s. $T_{90}$ (15-350 keV) is $42.4 \pm 10.5$ s (estimated error including systematics).

The time-averaged spectrum from $T-0.3$ to $T+47.5$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is $1.90 \pm 0.25$. The fluence in the 15-150 keV band is $1.2 \pm 0.2 \times 10^{-6}\ ergs/cm^2$ and the 1-sec peak photon flux measured from $T+24.02$ s in the 15-150 keV band is $1.0 \pm 0.3\ ph/cm^2/sec$. All the quoted errors are at the 90% confidence level.

## 3   XRT Observations and Analysis

We have analysed 11.3 ks of XRT data for GRB 120722A (Melandri, *et al.*, *GCN Circ.* 13499), from 161 s to 40.2 ks after the BAT trigger. The enhanced XRT position for this burst was given by Evans, *et al.*, *GCN Circ.* 13502. The astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is RA, Dec = 230.49656, +13.25109 which is equivalent to:

RA (J2000) = $15^h\ 21^m\ 59.17^s$
Dec (J2000) = $+13° \ 15'\ 03.9''$

with an uncertainty of $2.1''$ (radius, 90% containment) (Evans, *et al.*, *GCN Circ.* 13502).

The light curve (Fig.2) after $T + 500$ s can be modelled with a single power-law model with a decay index $\alpha = 0.52^{+0.15}_{-0.16}$. A flare is detected between $T + 161$ and $T + 500$ s.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of $2.79^{+0.84}_{-0.74}$. The best-fitting absorption column is $(5.7^{+2.0}_{-1.7}) \times 10^{22}\ cm^{-2}$, in excess of the Galactic value of $3.1 \times 10^{20}\ cm^{-2}$ (Kalberla et al. 2005). The counts to observed (unabsorbed) $0.3 - 10\ keV$ flux conversion factor deduced from this spectrum is $8.3 \times 10^{-11} (8.8 \times 10^{-11})\ erg\ cm^{-2}\ count^{-1}$.

## 4   UVOT Observation and Analysis

The *Swift*/UVOT began settled observations of the field of GRB 120722A $T + 157$ s after the BAT trigger (Melandri, *et al.*, *GCN Circ.* 13499). No optical afterglow consistent with the enhanced XRT position (Evans, *et al.*, *GCN Circ.* 13502) 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:

| Filter | Start | Stop | Exposure | $3\sigma$ UL |
|---|---|---|---|---|
| white$_{FC}$ | 157 | 307 | 147 | > 20.9 |
| u$_{FC}$ | 315 | 565 | 246 | > 20.2 |
| white | 157 | 7159 | 685 | > 21.7 |
| v | 646 | 11696 | 1356 | > 20.5 |
| b | 570 | 18708 | 758 | > 21.4 |
| u | 315 | 18411 | 1583 | > 21.6 |
| w1 | 696 | 16188 | 820 | > 21.3 |
| m2 | 4785 | 12602 | 1279 | > 21.1 |
| w2 | 1028 | 6012 | 216 | > 20.2 |

Table 1: $3\sigma$ upper limits from UVOT observations. The values quoted above are not corrected for the Galactic extinction due to the reddening of $E_{(B-V)} = 0.05$ in the direction of the burst (Schlegel et al. 1998)
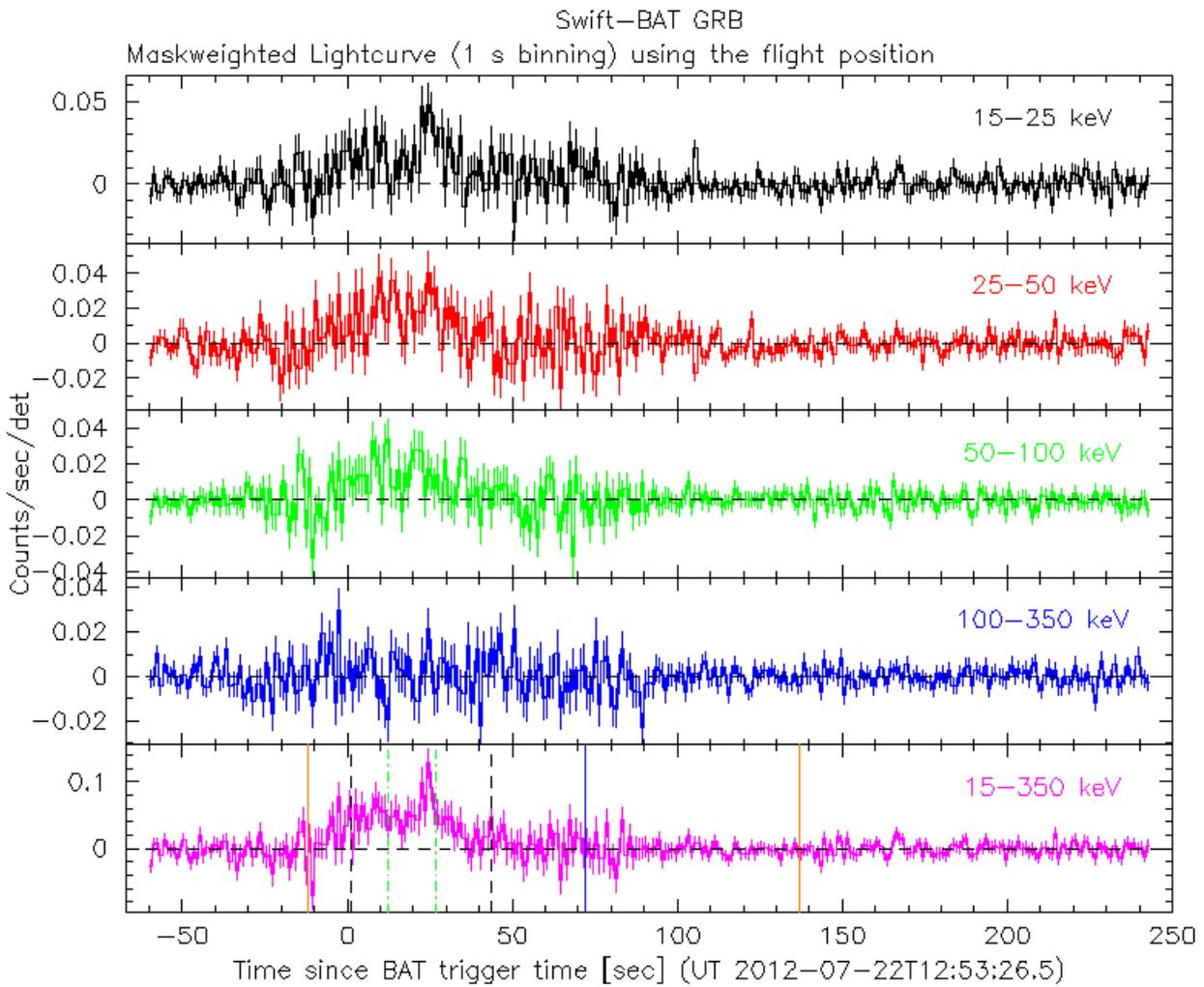
Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands (15 - 25, 25 - 50, 50 - 100, 100 - 350 and 15 - 350 keV).
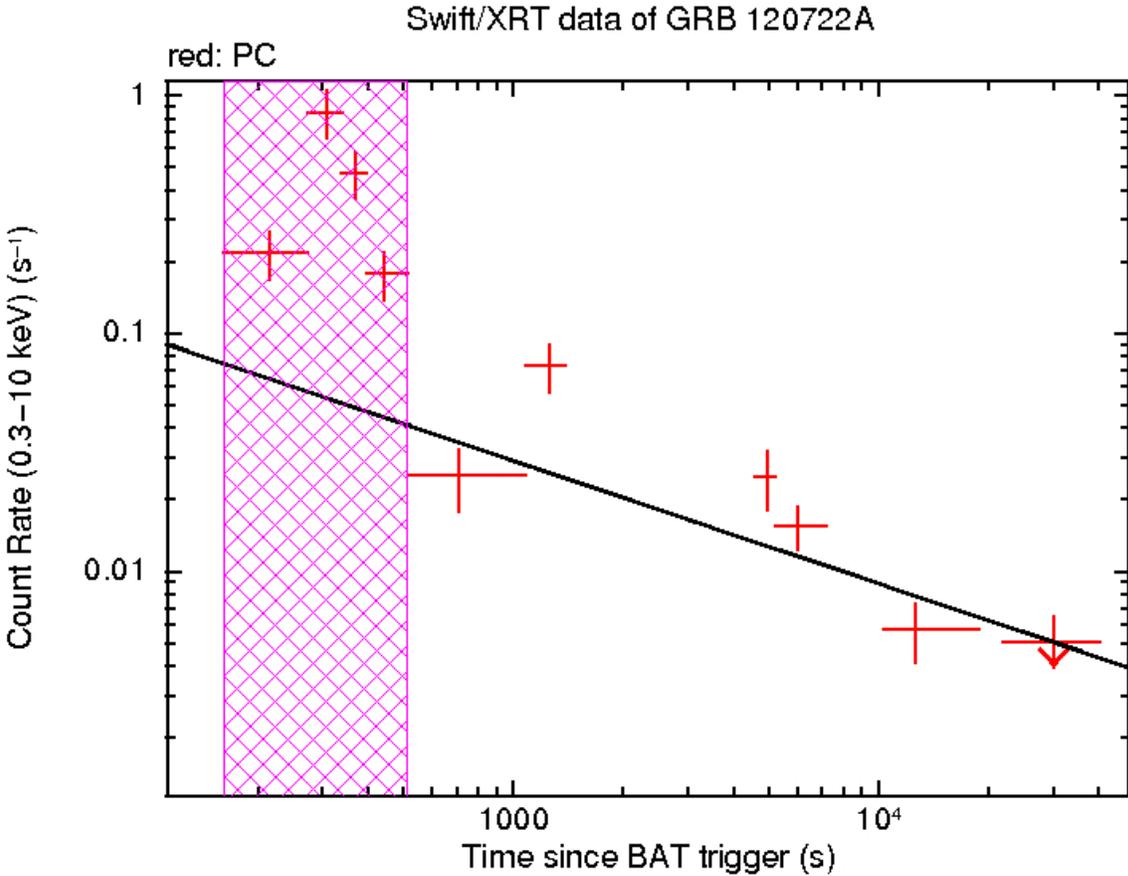
Figure 2: XRT Lightcurve. It can be modelled by a single power-law with an early flare (shaded region).