Swift Observations of GRB 100625A

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1 Introduction

BAT triggered on GRB 100625A on 2010 Jun 25 at 18:32:28 UT (Trigger 425647) (Holland et al. 2010). This was a short–hard burst with $T_{90} = 0.33$ s (Barthelmy et al. 2010). *Swift* slewed immediately to this burst and follow-up observations started with the XRT at 43 s and UVOT at 56 s. The best *Swift* position is the UVOT-enhanced XRT location, RA, Dec (J2000.0) = 15.°79574, −39.°08842, which corresponds to

$$\begin{aligned} \text{RA (J2000.0)} &= 01^{\rm h}03^{\rm m}10\overset{\rm s}{.}98 \\ \text{Dec (J2000.0)} &= -39°05'18\overset{''}{.}3 \end{aligned}$$

with an uncertainty of 1.″8 (radius, 90% containment, including systematics). No optical afterglow was detected by UVOT or by ground-based observatories. Gemini-South detected a source with $r \approx 23$ mag inside the XRT error circle (Levan & Tanvir 2010). They suggest that this may be the host galaxy of GRB 100625A. This source was also seen by Magellan (Berger et al. 2010) and GROND (Updike et al. 2010).

GRB 100625A was detected by *Konus–Wind* (Golenetskii et al. 2010). Their light curve had two main peaks with a total duration of approximately 0.35 s, and their spectrum was best fit with a power law with an exponential cutoff with $\alpha = -0.1^{+0.6}_{-0.5}$ and $E_{\rm peak}({\rm obs}) = 414^{+128}_{-78}$. It was also detected by *Fermi*/GBM (Bhat 2010). Their light curve showed two closely spaced narrow peaks with a duration of $T_{90} \approx 0.32$ s, and their spectrum was best fit by a power law with an exponential cutoff with a power law index of $-0.64^{+0.12}_{-0.11}$ and $E_{\rm peak} = 509.2^{+77.5}_{-61.5}$ keV. *INTEGRAL*/SPI-ACS detected GRB 100625A (Beckmann, priv. comm.).

2 BAT Observation and Analysis

The data set from $T - 239$ to $T + 500$ s was analysed to obtain the following information. The BAT ground-calculated position is RA, Dec (J2000.0) = 15.°796, −39.°091, which corresponds to

$$\begin{aligned} \text{RA (J2000.0)} &= 01^{\rm h}03^{\rm m}11\overset{\rm s}{.}1 \\ \text{Dec (J2000.0)} &= -39°05'29'' \end{aligned}$$

with an uncertainty of 1.′0, (radius, systematic + statistical errors, 90% containment). The partial coding was 100%.

The mask-weighted light curves (Figure 1) shows two overlapping peaks starting at $\approx T - 0.1$ s, peaking at $\approx T + 0.1$ s and $T + 0.2$ s, and ending at about $T + 0.3$ s. There is a weak, soft tail out to $\approx T + 30$ s. T_{90} (15–350 keV) is 0.33 ± 0.03 s (estimated error including systematics).

The time-averaged spectrum from $T - 0.1$ to $T + 0.3$ s is best fit by a simple power-law model. The power-law index of the time-averaged spectrum is 0.90 ± 0.10. The fluence in the 15–150 keV band is $(2.3 \pm 0.2) \times 10^{-7}$ erg cm^{-2}. The 1-s peak photon flux measured from $T - 0.37$ s in the 15–150 keV band is 2.6 ± 0.2 ph cm^{-2} s^{-1}. All the quoted errors are at the 90% confidence level.

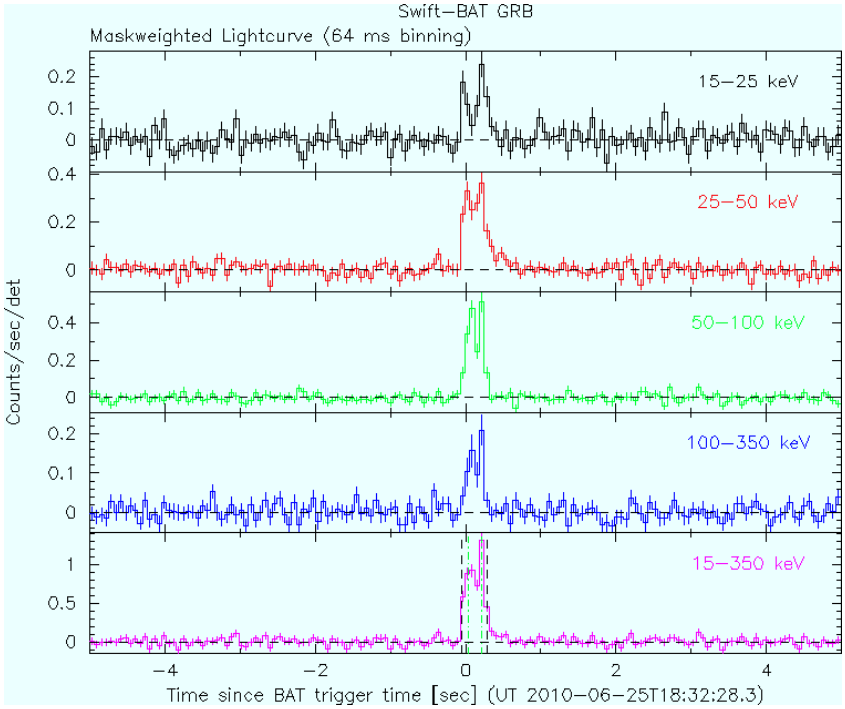

Figure 1: BAT light curves. The mask-weighted 64 ms light curves in the four individual plus total energy bands. The units are count s^{-1} illuminated-detector^{-1} and T_0 is 18:32:28.3 UT.

3 XRT Observation and Analysis

The *Swift*/XRT began observing GRB 100625A at 18:33:16.7, 48.3 s after the BAT trigger. Using 646 s of Photon Counting (PC) mode data and one UVOT image the astrometrically corrected X-ray position (using the XRT–UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) is RA, Dec (J2000.0) = 15.°79574, −39.°08842, which corresponds to

$$\begin{aligned} \text{RA (J2000.0)} &= \quad 01^{\rm h}03^{\rm m}10\overset{\rm s}{.}98 \\ \text{Dec (J2000.0)} &= -39^\circ05'18\overset{''}{.}3 \end{aligned}$$

with an uncertainty of $1\overset{''}{.}8$, (radius, 90% containment).

The X-ray light curve (Figure 2) can be modelled using a power-law decay with $\alpha = 1.34^{+0.44}_{-0.26}$ with a small flare at approximately $T + 200$ s.

A spectrum formed from the PC mode data can be fit with an absorbed power-law with a photon spectral index of $2.34^{+0.31}_{-0.23}$. The best-fitting absorption column is consistent with the Galactic value of 2.1×10^{20} cm^{-2} (Kalberla et al. 2005).

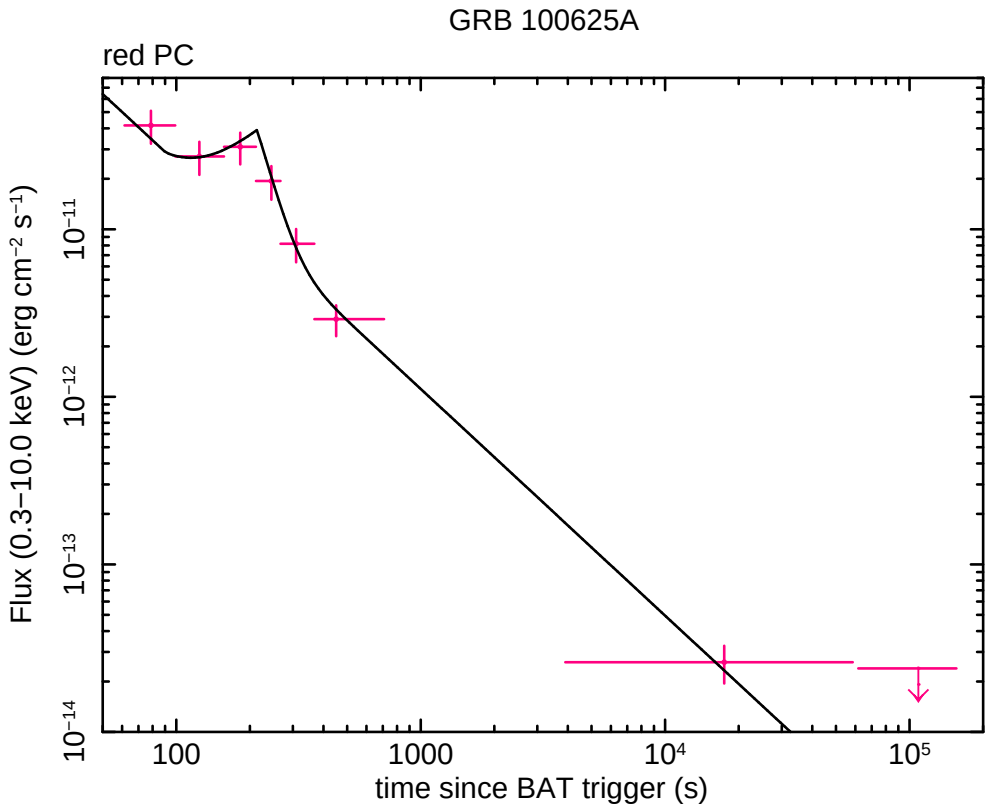

Figure 2: XRT flux light curves in erg cm^{-2} s^{-1} in the 0.3–10 keV band: Photon Counting mode (red). The conversion factor to observed (unabsorbed) flux is 3.2×10^{-11} (3.6×10^{-11}) erg cm^{-2} count^{-1}.

4 UVOT Observation and Analysis

The *Swift*/UVOT began settled observations of the field of GRB 100625A at $T + 56$ s. No optical afterglow consistent with the UVOT-enhanced (Goad et al. 2008) XRT position (Page et al. 2010), or the Gemini-South candidate host galaxy (Levan & Tanvir 2010), is detected in the initial UVOT exposures. Preliminary 3-σ upper limits using the UVOT photometric system (Poole et al. 2008) for the first finding chart (FC) exposures and subsequent exposures are given in Table 1.

The values quoted above are not corrected for the Galactic extinction due to the reddening of $E_{B-V} = 0.01$ mag in the direction of the burst (Schlegel et al. 1998).

Filter	$T_{\rm start}$	$T_{\rm stop}$	Exp(s)	Mag	
white$_{\rm FC}$	87	206	147	> 21.2	3-σ UL
$u_{\rm FC}$	269	519	246	> 20.2	3-σ UL
white	87	11 552	785	> 22.6	3-σ UL
v	598	5951	412	> 20.3	3-σ UL
b	524	10 640	1117	> 21.9	3-σ UL
u	269	6522	614	> 20.5	3-σ UL
uvw1	4725	6362	393	> 20.6	3-σ UL
uvm2	4520	6157	393	> 20.5	3-σ UL
uvw2	4111	12 302	1125	> 21.5	3-σ UL

Table 1: UVOT 3-σ upper limits for GRB 100625A. $T_{\rm start}$ and $T_{\rm stop}$ are the times, in seconds since the BAT trigger, of the start and stop of the observations. Exp is the total exposure time during the observation.

References

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