Swift Observations of GRB 100805A

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1   Introduction

At 04:12:42 UT on 5 August 2010 BAT triggered on and located GRB 100805A (Hoversten, *et al.*, *GCN Circ.* 11047, Trigger #430957). Swift slewed to this burst immediately. XRT began follow up observations at $T+126$ s, and UVOT observations began at $T+130$ s. Our best position is the UVOT position at RA($J2000$) = 299.87713 deg ($19h59m30.51s$), Dec($J2000$) = +52.62783 deg ($+52d37'40.1''$) with an uncertainty of 0.4 arcsec (radius, 90% confidence statistical + systematic).

Ground-based observations of GRB 100805A were reported by numerous observatories. The robotic Palomar 60 inch telescope detected the afterglow at R=17.3 at 3 minutes after the burst (Cenko, *et al.*, *GCN Circ.* 11050) and at R=19.5 at 44 minutes after the burst, finding a power-law decay index of $\alpha \sim 0.8$ (Cenko, *et al.*, *GCN Circ.* 11051). Additionally the afterglow was detected in the optical by the 2 m Liverpool Telescope (Gomboc, *et al.*, *GCN Circ.* 11052), the 1.23 m CAHA Telescope (Gorosabel, *et al.*, *GCN Circ.* 11054), GRAS 002 (Nissinen & Hentunen, *GCN Circ.* 11056), IAC80 at the Observatory of Teide (Gorosabel, *et al.*, *GCN Circ.* 11060), ROTSE-IIIb (Pandey, *et al.*, *GCN Circ.* 11063), RAPTOR (Wren, *et al.*, *GCN Circ.* 11064), Xinglong TNT (Xin, *et al.*, *GCN Circ.* 11065), SAO RAS (Moskvitin, *et al.*, *GCN Circ.* 11071), and CrAO (Rumyantsev & Pozanenko, *GCN Circ.* 11077).

2   BAT Observation and Analysis

Using the data set from $T-239$ to $T+963$ s further analysis of GRB 100805A (trigger #430957) was performed by the Swift team (Barthelmy, *et al.*, *GCN Circ.* 11058). The BAT ground-calculated position is RA($J2000$) = 299.846 deg ($19h59m23.0s$), Dec($J2000$) = 52.618 deg ($+52d37'05.8$"), with an uncertainty of 2.0 arcmin, (radius, sys+stat, 90% containment). The partial coding was 39%.

The mask-weighted light curve shows a few overlapping weak peaks starting at about $T-1$ s, peaking at $T+2$ s, and ending at $T+20$ s. There is a possible 3-sigma peak near $T+60s$. T_{90} ($15-350keV$) is $15.0 \pm 3.0s$ (estimated error including systematics).

The time-averaged spectrum from $T-1.4$ to $T+17.1$ s is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.76 ± 0.23. The fluence in the 15-150 keV band is $5.1 \pm 0.8 \times 10^{-7} erg$ cm^{-2}. The 1-second peak photon flux measured from $T+1.97$ s in the 15-150 keV band is 0.7 ± 0.2 $photon$ cm^{-2} s^{-1}. All the quoted errors are at the 90% confidence level.

The BAT light curve is shown in Figure 1.

3   XRT Observations and Analysis

The UVOT-enhanced XRT position of GRB 100805A is RA($J2000$) = 299.87770 deg ($19h59m30.65s$), Dec($J2000$) = +52.62788 deg ($+52d37'40.4$") with an uncertainty of 1.8 arcsec (radius, 90% confidence, Goad, *et al.*, *GCN Circ.* 11053). This position is within 1.2 arcsec of the UVOT position.

XRT observations began 126 seconds after the BAT trigger. Analysis of 3.3 ks of XRT data from 111 to 6700 s after the BAT trigger was performed (Stroh & Hoversten, *GCN Circ.* 11057). The data comprise 48 s in Windowed Timing (WT) mode (the first 8 s were taken while Swift was slewing)
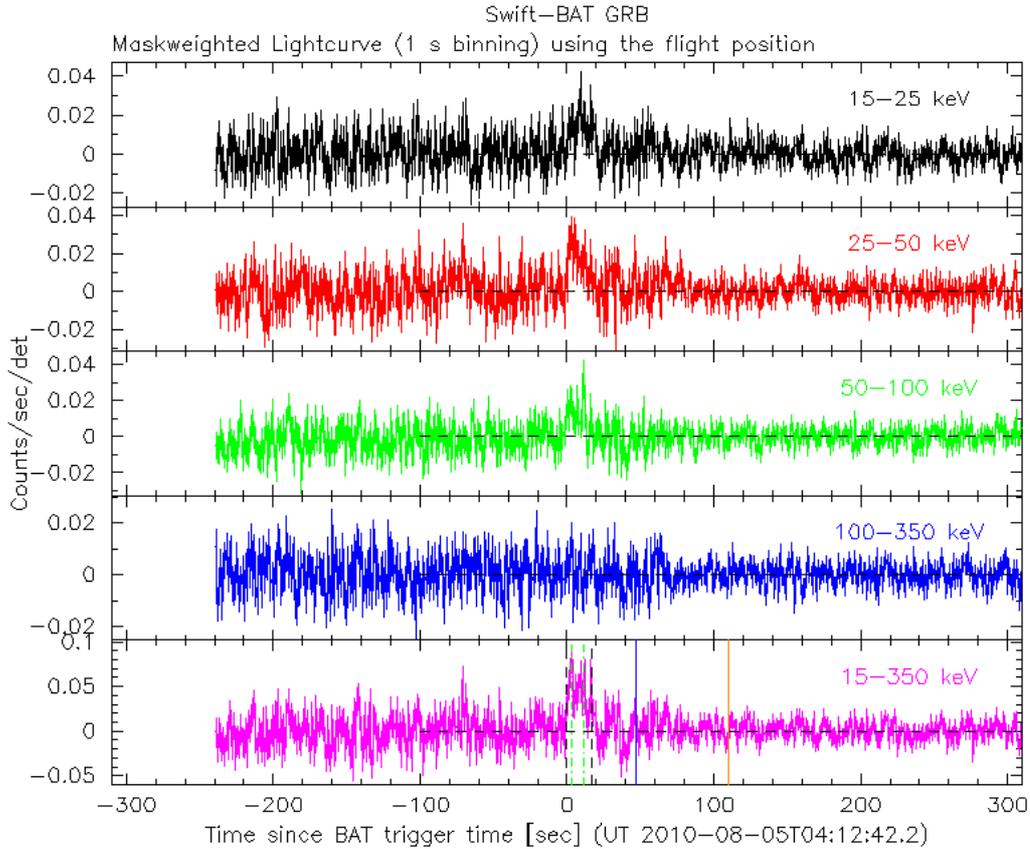
Figure 1: BAT Light curve. The mask-weighted light curve over all energy bands. The units are counts/s/illuminated-detector (note illum-det = 0.16 cm^2) and T_0 is 04:12:42.2 UT.

with the remainder in Photon Counting (PC) mode. The light curve can be modelled with an initial power-law decay with an index of $\alpha = 3.6^{+0.5}_{-0.4}$, followed by a break at $T + 294$ s to $\alpha = 0.45^{+0.12}_{-0.23}$, and a second break at $T + 16000$ s to $\alpha = 1.25 \pm 0.05$. A flare is also present in the light curve from $T + 600$ to $T + 1000$ s.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of $1.98^{+0.14}_{-0.12}$. The best-fitting absorption column is consistent with the Galactic value of 1.7×10^{21} cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is $4.1 \times 10^{-11} (5.8 \times 10^{-11})$ erg cm^{-2} $count^{-1}$.

The XRT light curve is shown in Figure 2.

4   UVOT Observation and Analysis

The Swift UVOT began settled observations of the field of GRB 100805A starting 130 s after the BAT trigger (Holland & Hoversten, *GCN Circ.* 11062). An optical afterglow is detected in all filters except uvw2. The refined UVOT position is RA(J2000) = 299.87713 deg (19h59m30.51s), Dec(J2000) = +52.62783 deg (+52d37'40.1") with an uncertainty of 0.43 arcsec (radius, 90% confidence statistical + systematic). This is 1.2 arcsec west of the UVOT-enhanced XRT position (Goad, *et al.*, *GCN Circ.* 11053).
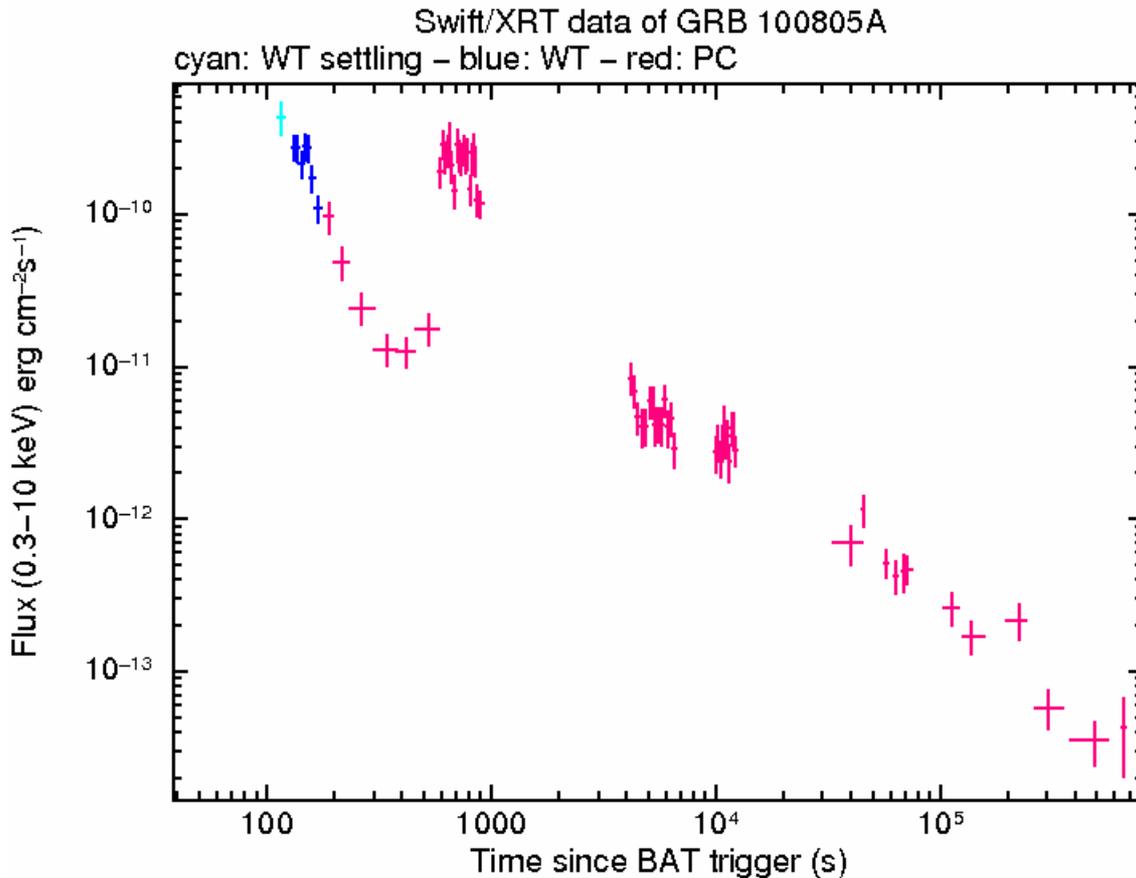
Figure 2: XRT Light curve. Flux in the 0.3-10 keV band: settling exposure (cyan), Window Timing Mode (blue), and Photon Counting mode (red). The approximate conversion is 1 count $s^{-1} \simeq 4.1 \times 10^{-11}\ ergs\ cm^{-2}\ s^{-1}$.

Preliminary magnitudes, and 3-sigma upper limits for detecting a source in the finding charts and in the co-added images are summarized in Table 1. The magnitudes reported in the table are on the UVOT Photometric System (Poole et al., 2008). They are not corrected for Galactic extinction which is $E(B-V) = 0.19$ along the line of sight to the burst (Schlegel, Finkbeiner, & Davis, 1998).

Figure 3 shows the light curve of the afterglow in the UVOT filters. The light curve suggests that the afterglow may have brightened in the UVOT white band between approximately 1 day and 6 days after the BAT trigger (Holland & Hoversten, *GCN Circ.* 11081). This may indicate the presence of a supernova component in the light curve. However the analysis is complicated by the presence of several bright stars near the optical afterglow.

References

[1] Barthelmy, S. D., et al. 2010, *GCN Circ.* 11058

[2] Cenko, S. B., et al. 2010, *GCN Circ.* 11050

[3] Cenko, S. B., et al. 2010, *GCN Circ.* 11051

[4] Goad, M. R., et al. 2010, *GCN Circ.* 11053
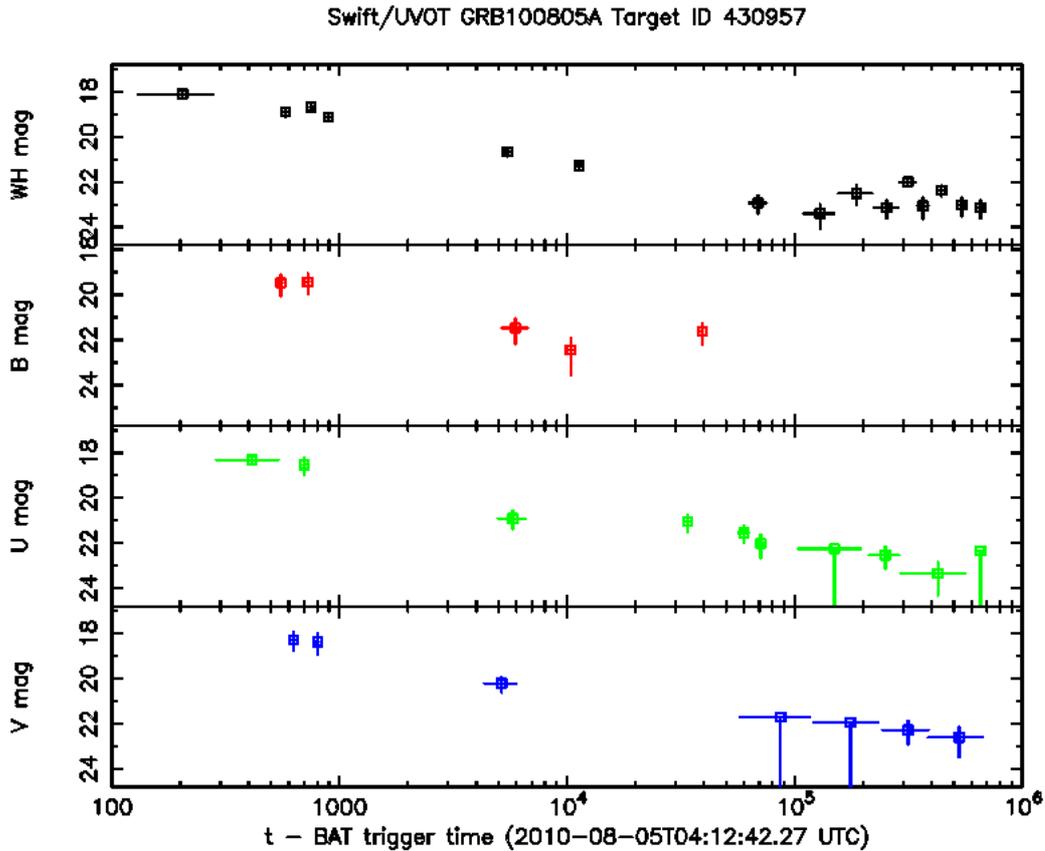
[5] Gomboc, A., et al. 2010, *GCN Circ.* 11052

Swift/UVOT GRB100805A Target ID 430957

Figure 3: UVOT Lightcurve. Magnitudes are shown for the white (black points), v (red points), b (green points), and u (blue points) band observations.

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 [7] Gorosabel, J., et al. 2010, *GCN Circ.* 11060

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[20] Xin, L. P., et al. 2010, *GCN Circ.* 11065

Filter	Start	Stop	Exposure	Magnitude
white (fc)	130	280	147	18.10 ± 0.08
u (fc)	288	538	246	18.32 ± 0.11
v	619	5984	432	19.80 ± 0.23
b	544	10,831	1213	21.22 ± 0.20
u	288	6600	659	18.55 ± 0.09
uvw1	668	6395	432	20.78 ± 0.39
uvm2	643	6189	432	20.68 ± 0.45
uvw2	594	12,479	1149	$> 21.6\ 3\sigma$ UL
white	130	11,744	1319	19.42 ± 0.07

Table 1: UVOT observations