Swift Observations of GRB 100901A

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1 Introduction

At 13:34:10 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 100901A (trigger = 433065; GCN 11159). The BAT light curve showed two main peaks. The peak count rate was ~800 counts/sec (15-350 keV), at ~1 sec after T_0. (Fig. 1; GCN 11159).

The best Swift position of this burst is the XRT enhanced position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) RA, Dec = 27.26485, +22.75850 which is equivalent to

  RA (J2000): 01h 49m 3.56s
  Dec (J2000): +22d 45' 30.6"

with an uncertainty of 2.2 arcsec (radius, 90% confidence; GCN 11167).

A large number of ground-based optical/NIR follow-up observation reported on the fading afterglow that was detected up to T_0+6 days after the trigger. Spectroscopic observations with Gemini-N gave a redshift of $z = 1.408$ (GCN 11164). The burst was also detected at radio wavelengths with the WSRT (GCN 11256) and the Expanded VLA (GCN 11257).

2 BAT Observation and Analysis

Using the data from T_0-240 to T_0+663 sec, the BAT ground-calculated position is RA, Dec = 27.252, 22.751 deg, which is

  RA(J2000) = 01h 49m 00.5s
  Dec(J2000) = +22d 45' 02.9"

with an uncertainty of 3.5 arcmin, (radius, sys+stat, 90% containment). The partial coding was 40%.

The mask-weighted light curve shows two main peaks. The first peak starts at ~ T_0-5 sec, peaks at ~ T_0+5 sec, and ends at ~ T_0+10 sec. The second peak starts at ~ T_0+300 sec, peaks at ~ T_0+390, and ends at ~ T_0+490 sec. T_{90} (15-350 keV) is 439±33 sec (estimated error including systematics).

The time-averaged spectrum from T_0-2.4 to T_0+471.8 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.52±0.21. The fluence in the 15-150 keV band is 2.1±0.3 × 10^{-6} erg/cm^2. The 1-sec peak photon flux measured from T_0-1.81 sec in the 15-150 keV band is 0.8±0.2 ph/cm^2/sec. All the quoted errors are at the 90% confidence level.
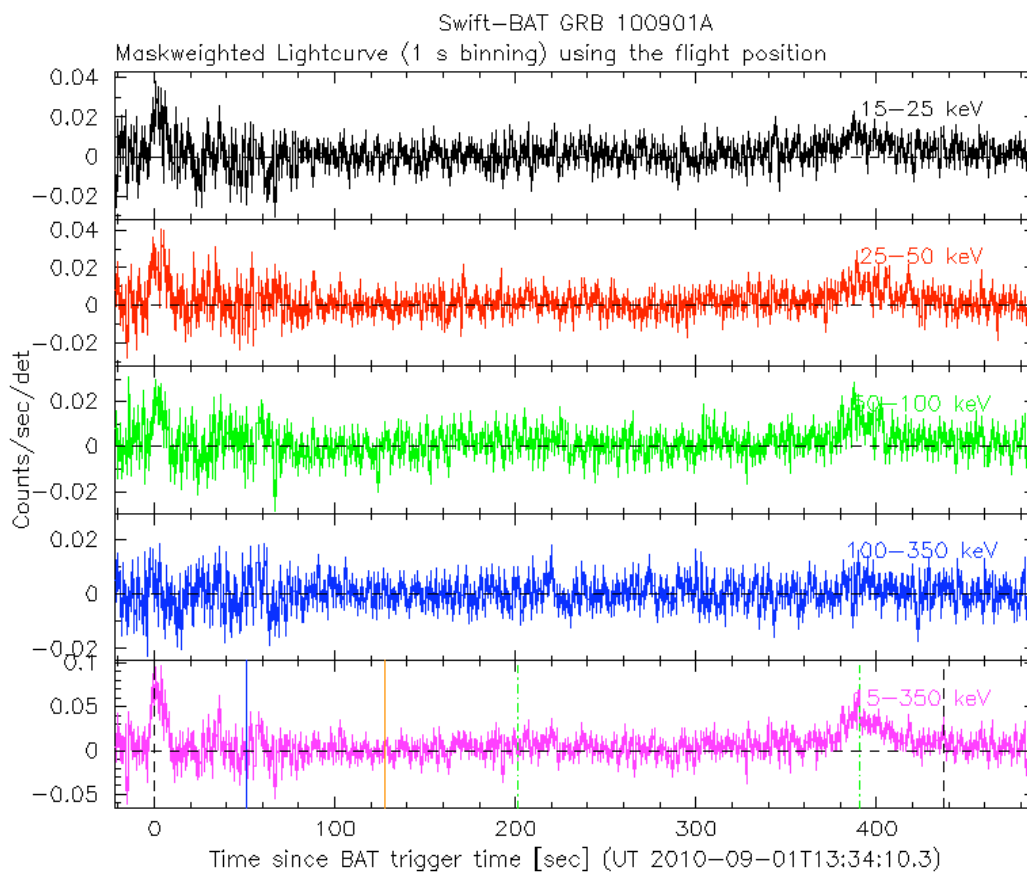
Figure 1: BAT light curves in four individual plus total energy bands.

3 XRT Observation and Analysis

The first XRT snapshot (data collected until ~620 s after the trigger) consists of a number of superimposed flares, with the main peak around ~410 s (GCN 11171); this peak was also seen in the BAT data (GCN 11169). The light curve shows a underlying decaying trend with $\alpha = 0.67\pm0.09$, until around 10.6 ks, after which there is a re-brightening which can be modelled with a power-law of $\alpha = -0.53$ +0.10/-0.11. Beyond $T_0+32.5$ ks, the light curve again decays, following $\alpha = 1.50\pm0.05$.

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of 1.68 ± 0.04. The best-fitting absorption column is 3.6 (+0.7, -0.6) $\times 10^{21}$ cm^{-2}, at a redshift of 1.408 (GCN 11164), in addition to the Galactic value of 7.1 x 10^{20} cm^{-2} (Kalberla et al. 2005). The PC mode spectrum has a photon index of 2.19 ± 0.07 and a best-fitting absorption column of $3.9\pm0.9 \times 10^{21}$ cm^{-2} (in addition to the Galactic value). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 3.5×10^{-11} (5.1×10^{-11}) erg cm^{-2} counts^{-1}.

GRB 100901A
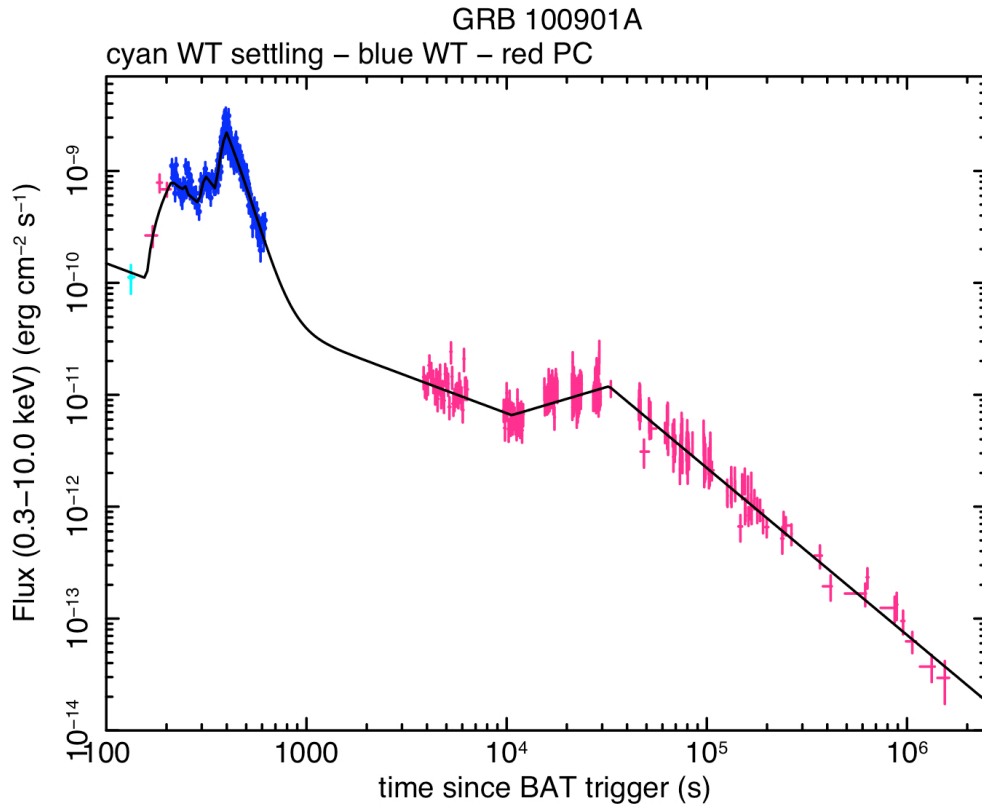### cyan WT settling – blue WT – red PC

Figure 2: XRT light curve of the fading X-ray source inside the BAT error circle in the 0.3–10 keV band.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 100901A 147 s after the BAT trigger (GCN 11176). We detect an object not present in the DSS in all filters within 0.1 arcsec of the Enhanced Swift-XRT position (GCN 11169).

Magnitudes and 3-sigma upper limits using the UVOT photometric system (Poole et al. 2008, MNRAS, 383, 627) for the first finding chart (FC) exposure and subsequent exposures are:

Filter	$T_{start}(s)$	$T_{stop}(s)$	Exp(s)	Mag/3σ UL
white (FC)	147	297	147	19.55 ± 0.19
u (FC)	305	555	246	17.52 ± 0.10
white	585	605	20	18.58 ± 0.32
white	4849	5051	198	18.66 ± 0.07
b	561	581	19	17.85 ± 0.30
b	4644	4844	197	18.69 ± 0.11
u	305	555	246	17.52 ± 0.10
u	4439	4639	197	18.08 ± 0.10
v	129	139	10	>17.21
v	3824	4024	197	18.50 ± 0.21
w1	4234	4434	197	18.53 ± 0.16
m2	4029	4229	197	19.22 ± 0.32
w2	611	626	15	>17.6
w2	5055	5255	197	>20.04
w2	9620	10520	885	20.73 ± 0.32

The values quoted above are not corrected for the Galactic extinction due to the reddening of E(B-V) = 0.10 in the direction of the burst (Schlegel et al. 1998).
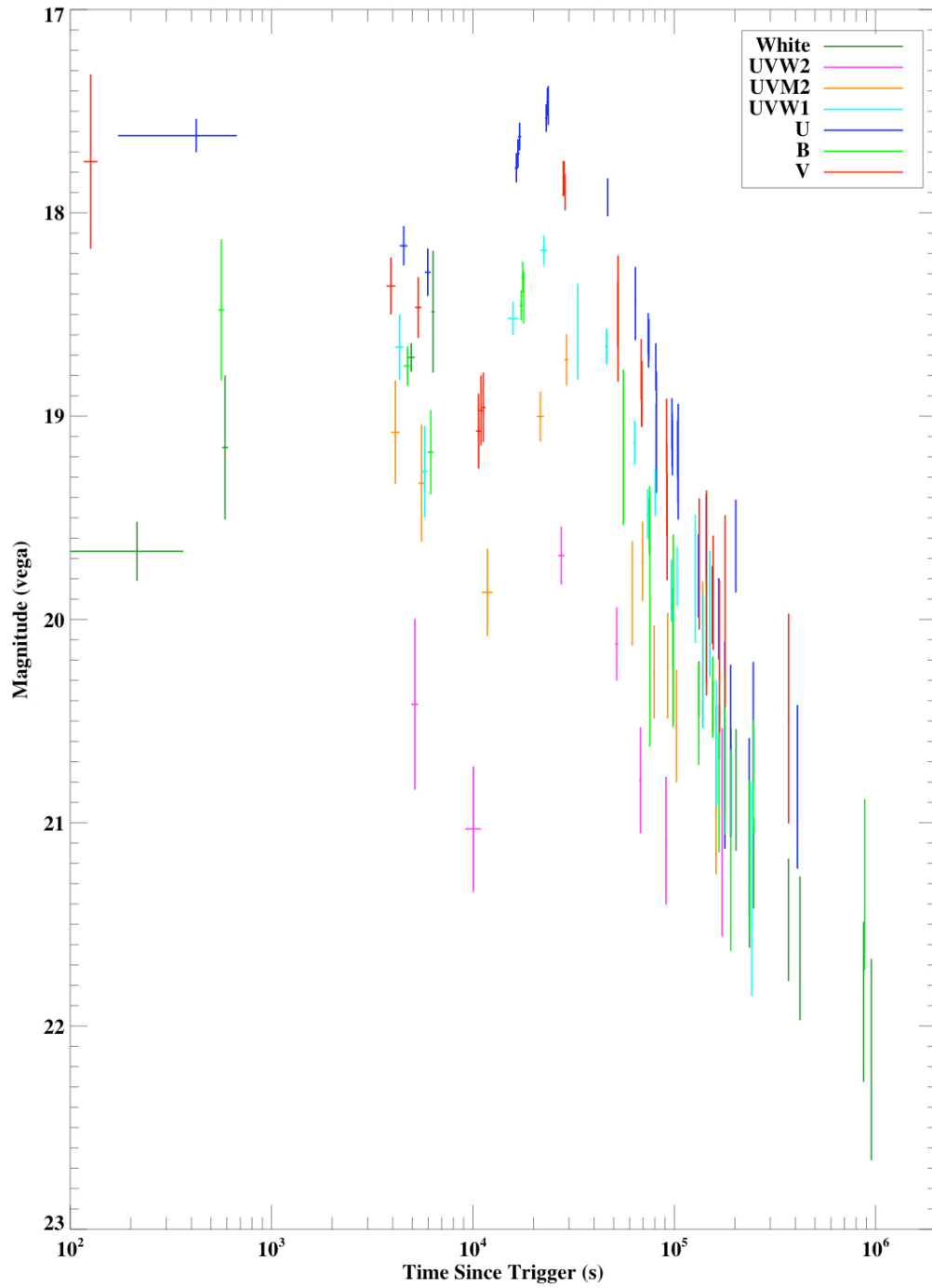
Figure 3: UVOT light curve of the optical afterglow.