# Swift Observation of GRB 101204A

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## 1   Introduction

GRB 101204A was discovered during on the ground analysis of BAT data. The burst was detected at 23:53:29 UT (Trigger 439806) (J. R. Cummings, , *GCN Circ.* 11440). After the detection, Swift began a Target of Opportunity observation to locate the X-ray and optical afterglow of the burst. XRT and UVOT began observations at $T + 126\ ksec$. Our best position is the UVOT location RA($J2000$) = $167.53683deg$ ($11h10m08.84s$), Dec($J2000$) = $-20.42014deg$ ($-20d25'12.5''$) with an error of 0.6 arcsec (90% confidence, including boresight uncertainties).

## 2   BAT Observation and Analysis

At 23:53:29 UTC on December 4, 2010 Swift-BAT detected GRB 101204A (BAT trigger # 439806). No source was detected onboard. An automated script on the ground detected a source at RA($J2000$) = $167.548deg$ ($11h10m11.6s$), Dec($J2000$) = $-20.434deg$ ($-20d26'04''$); the source was 3.5% coded.

As seen by BAT, the burst was a single gradual pulse about 10 seconds long. In the 10-second interval for which we have detailed event data, which covers almost all of the burst, the spectrum is best fitted by a simple power law with a photon index of $1.3 \pm 0.2$. The fluence from 15 to 150 keV was $1.2 \pm 0.4 \times 10^{-6} ergs/cm^2$ . The spectrum may be slightly distorted by edge of FOV effects, tending to reduce the number of lower-energy photons detected relative to higher-energy photons. All the quoted errors are at the 90% confidence level.

## 3   XRT Observations and Analysis

Using $9.9ksec$ of XRT data of GRB 101204A in Photon Counting mode, and 4 UVOT images, we find an astrometrically corrected XRT position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue) RA($J2000$) = $167.53702deg$ ($11h10m08.88s$), Dec($J2000$) = $-20.41985deg$ ($-20d25'11.5''$) $\pm 1.6\ arcsec$ (90% confidence, including boresight uncertainties). This position is within $2.3\ arcsec$ of the initial XRT position, and $1.1\ arcsec$ from the optical afterglow candidate, reported by Sbarufatti *et al.*, *GCN Circ.* 11442.

The $0.3 - 10\ keV$ light curve (Fig.1) shows a simple powerlaw decay with by a slope of $1.3 \pm 0.1$.

The spectrum can be modeled with an absorbed power-law with spectral index of $2.1^{+0.3}_{-0.2}$. The NH column density is the same as galactic column density, $3.3 \times 10^{20} cm^{-2}$. The average observed (unabsorbed) flux over $0.3 - 10\ keV$ for this spectrum (spanning a time of 126195-163343 seconds after the trigger) is $10.0 \times 10^{-13}$ ($11.0 \times 10^{-13}$) $ergs/cm^2/sec$.

## 4   UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 101204A 126195 s after the initial BAT trigger (S. Oates *et al.*, *GCN Circ.* 11447). An uncatalogued source is found at the UVOT position RA($J2000$) = $167.53683deg$ ($11h10m08.84s$), Dec($J2000$) = $-20.42014deg$ ($-20d25'12.5''$) with an error of 0.6 arcsec (90% confidence) in the U and V bands.

| Filter | Start | Stop | Exposure | 3-Sigma UL |
|--------|-------|------|----------|------------|
| V | 126195 | 133279 | 2563 | 20.51±0.19 |
| V | 271960 | 336155 | 3553 | >21.62 |
| U | 127505 | 134378 | 2329 | 20.03±0.12 |
| U | 272471 | 336626 | 3273 | 21.27±0.26 |

Table 1: Afterglow magnitudes from UVOT observations

The values quoted above are not corrected for the Galactic extinction due to the reddening of E(B-V) = 0.03 in the direction of the burst (Schlegel et al. 1998). The U lightcurve decays with a slope 1.67 ± 0.16.
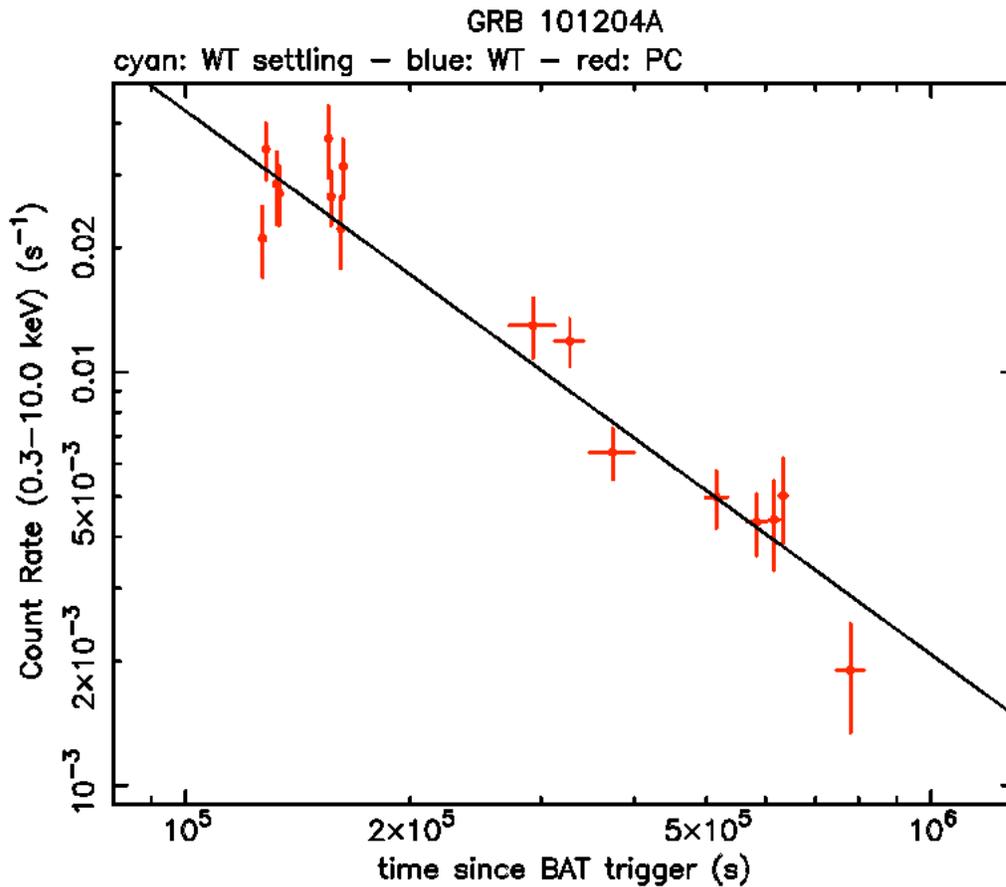


Figure 1: XRT Lightcurve. Counts/sec in the 0.3-10 keV band: Photon Counting mode (red). The approximate conversion is 1 count/sec = $\sim 3.4 \times 10^{-11}$ $ergs/cm^2/sec$.
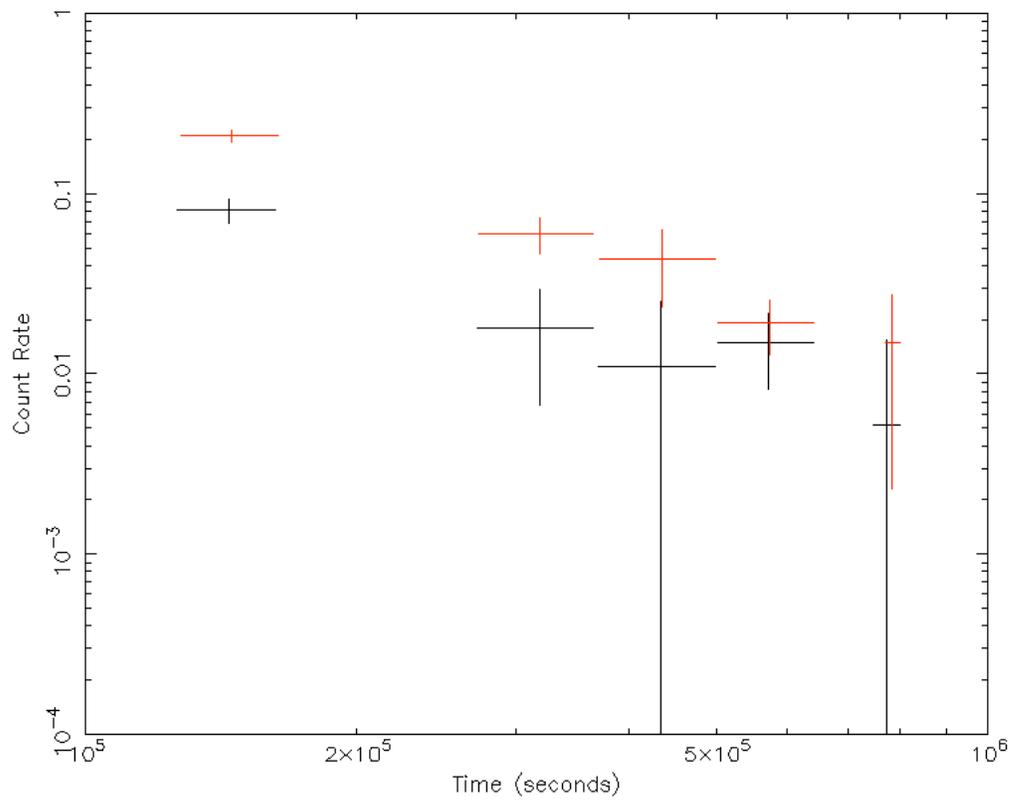
Figure 2: UVOT light curve: U band (red), V band (black)