

Swift Observations of GRB 121128A

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1. Introduction

At 05:05:37 UT, the *Swift* Burst Alert Telescope (BAT) triggered and located GRB 121128A (trigger=539866). *Swift* slewed immediately to the burst and found uncatalogued X-ray and optical sources (Oates *et al.* GCN Circ. 14007). The best *Swift* position of this burst is the UVOT position. The best reported positions from the BAT, XRT and UVOT instruments can be found in **Table 1**. The latest XRT position can be viewed at http://www.swift.ac.uk/xrt_positions.

The GRB was also observed by Konus-Wind (Golenetskii *et al.*, GCN Circ. 14010), Fermi (McGlynn, GCN Circ. 14012), RAPTOR (Wren *et al.*, GCN Circ. 14013), Faulkes Telescope North (Japelj *et al.*, GCN Circ. 14008), Sayan observatory (Volnova *et al.*, GCN Circ. 14019, 14024), MITSuME (Yoshii *et al.*, GCN Circ. 14023), ARIES (Pandey *et al.*, GCN Circ. 14043), Westerbork Synthesis Radio Telescope (van der Horst, GCN Circ. 14018) and a spectroscopic redshift of 2.20 was reported by Gemini-N (Tanvir *et al.*, GCN Circ. 14009). A summary of the GCN Circulars about this GRB from observatories other than *Swift* can be found in **Table 2**.

Standard analysis products for this burst are available at:
http://gcn.gsfc.nasa.gov/swift_gnd_ana.html.

2. BAT Observations and Analysis

The analysis of the BAT data, using the data set from T-119 to T+195 sec, was reported by Palmer *et al.* (GCN Circ. 14011). The BAT ground-calculated position is RA, Dec = 300.589, 54.301 deg which is RA(J2000) = 20h 02m 21.3s Dec(J2000) = +54d 18' 02.6" with an uncertainty of 1.0 arcmin, (radius, sys+stat, 90% containment). The partial coding was 88%. The mask-weighted light curve shows a complex, multi-peaked structure. The burst began with a faint precursor at \sim T-4 s. The main emission started at \sim T+10 s, peaked at T+22 s and continued until just after T+40 s, with weak emission extending out to \sim T+70 s. $T_{90}(15-350 \text{ keV})$ is 23.44 ± 1.63 s (estimated error including systematics).

The time-averaged spectrum from T-0.00 to T+41.69 s is best fit by a power law with an exponential cutoff. This fit gives a photon index 1.32 ± 0.18 , and E_{peak} of 64.5 ± 6.8 keV (χ^2 33.43 for 56 d.o.f.). For this model the total fluence in the 15-150 keV band is $6.9 \pm 0.4 \times 10^{-6}$ erg cm⁻² and the 1-s peak flux measured from T+21.68 s in the 15-150 keV band is 12.9 ± 0.4 ph cm⁻² s⁻¹. A fit to a simple power law gives a photon index of 1.86 ± 0.04 (χ^2 62.32 for 57 d.o.f.). All the quoted errors are at the 90% confidence level.

The results of the batgrbproduct analysis are available at:
http://gcn.gsfc.nasa.gov/notices_s/539866/BA/.

3. XRT Observations and Analysis

The XRT began observing the field of GRB 121217A at 05:06:44 UT, 67 seconds after the BAT trigger. Analysis of the XRT data was reported by Stratta *et al.* (GCN Circ. 14016). The XRT obtained 33.9 ks of data for GRB 121128A, from 67 s to 197 ks after the BAT trigger. The data comprise 108 s in Windowed Timing (WT) mode (the first 9 s were taken while Swift was slewing) with the remainder in Photon Counting (PC) mode.

The best fit model, to the X-ray light curve (**Figure 2**) is a power law with two breaks. The decay index starts as 2.37 (+0.19, -0.17), a break is observed at 159 seconds, which gives way to an index of 0.56 (+/-0.06). The second break occurs at $(1.52 [+0.23, -0.15]) \times 10^3$ seconds, and the final decay index is 1.63 (+/-0.05).

A spectrum formed from the WT mode data can be fitted with an absorbed power-law with a photon spectral index of 2.43 ± 0.11 . The best-fitting absorption column is $1.2 \pm 0.4 \times 10^{22} \text{ cm}^{-2}$, at a redshift of 2.2, in addition to the Galactic value of $2.1 \times 10^{21} \text{ cm}^{-2}$ (Kalberla *et al.* 2005). The PC mode spectrum has a photon index of 1.99 (+0.10, -0.09) and a best-fitting absorption column of $1.1 (+0.5, -0.4) \times 10^{22} \text{ cm}^{-2}$. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 4.1×10^{-11} (6.4×10^{-11}) $\text{erg cm}^{-2} \text{ count}^{-1}$.

The results of the XRT team automatic analysis are available at http://www.swift.ac.uk/xrt_products/00539866.

4. UVOT Observations and Analysis

The Swift/UVOT began settled observations of the field of GRB 121128A 85 s after the BAT trigger. Analysis of the UVOT data was reported by Oates (GCN Circ. 14017). A source consistent with the XRT position (Osborne *et al.*, GCN Circ. 14015) is detected in the initial *white*, *v*, *b* and *u* exposures only. **Table 3** gives preliminary magnitudes using the UVOT photometric system (Breeveld *et al.* 2011, AIP Conf. Proc., 1358, 373). **Figure 3** displays the light curves for the *white*, *v*, *b* and *u* filters. No correction has been made for the expected extinction in the Milky Way corresponding to a reddening of E_{B-V} of 0.31 mag. in the direction of the GRB (Schlegel *et al.* 1998).

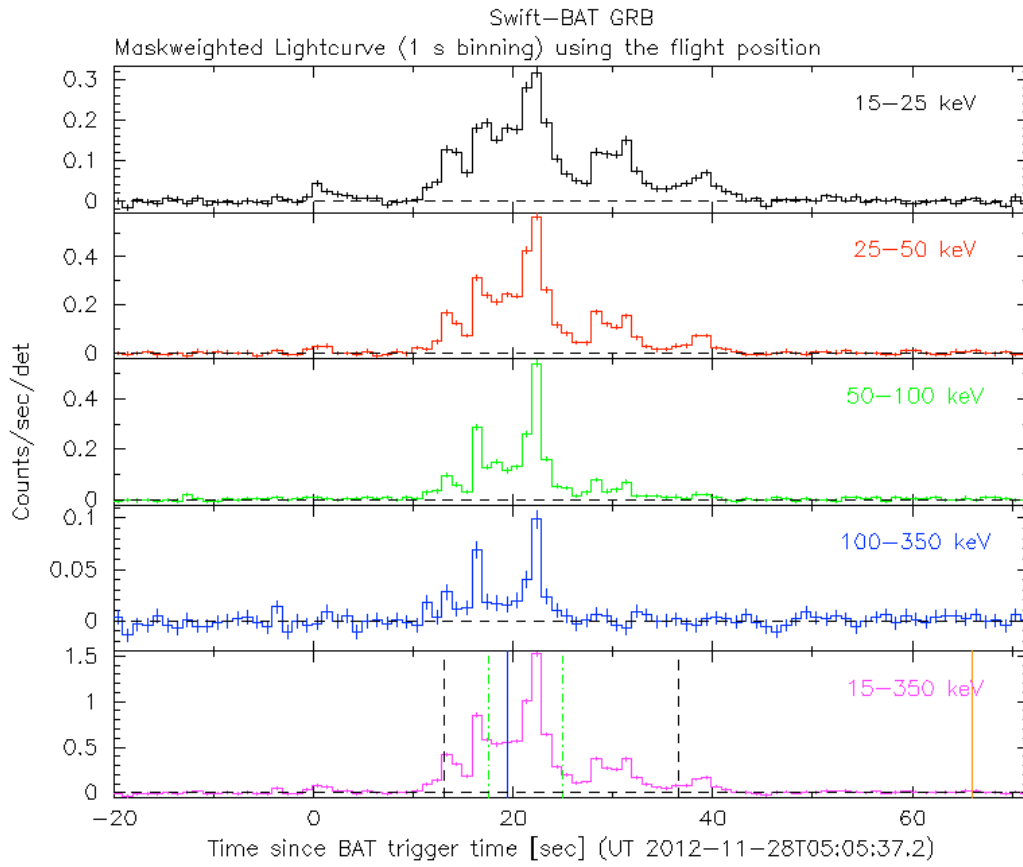


Figure 1. The BAT mask-weighted light curve in the four individual and total energy bands. The units are counts s^{-1} illuminated-detector $^{-1}$.

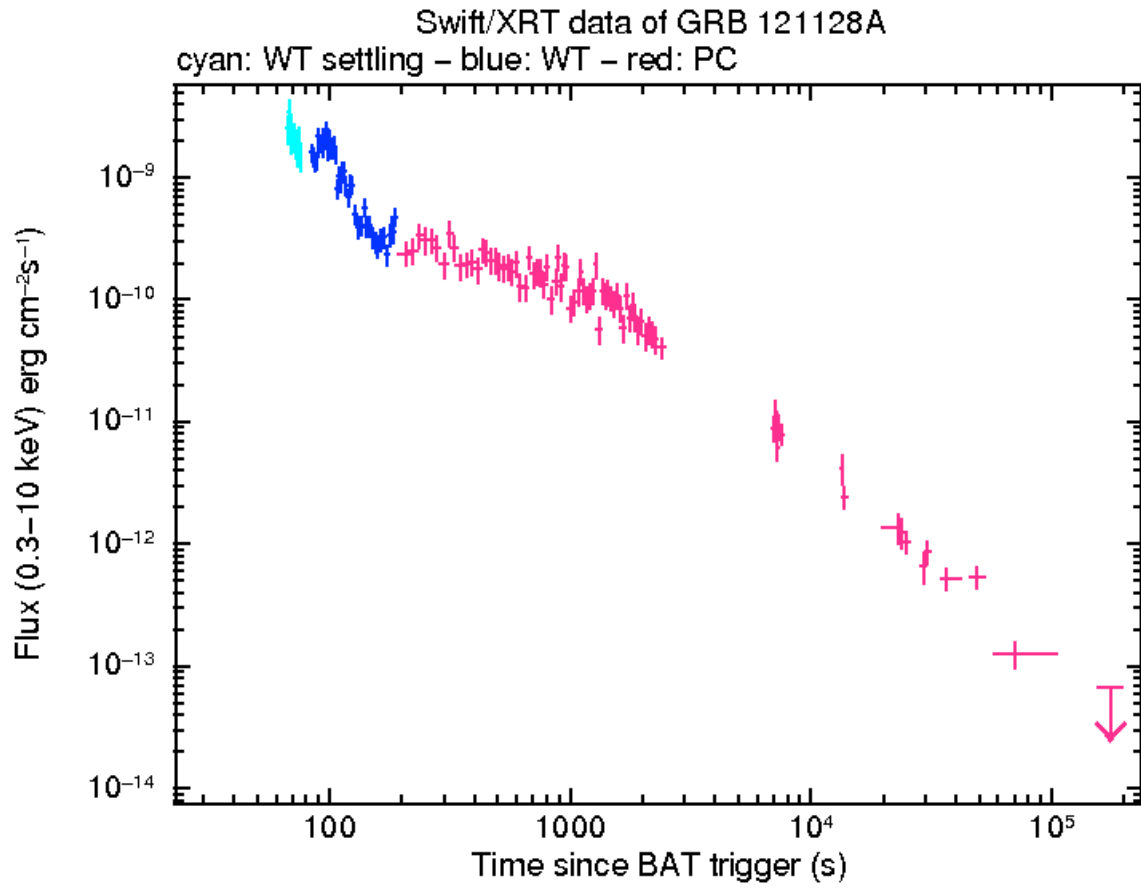
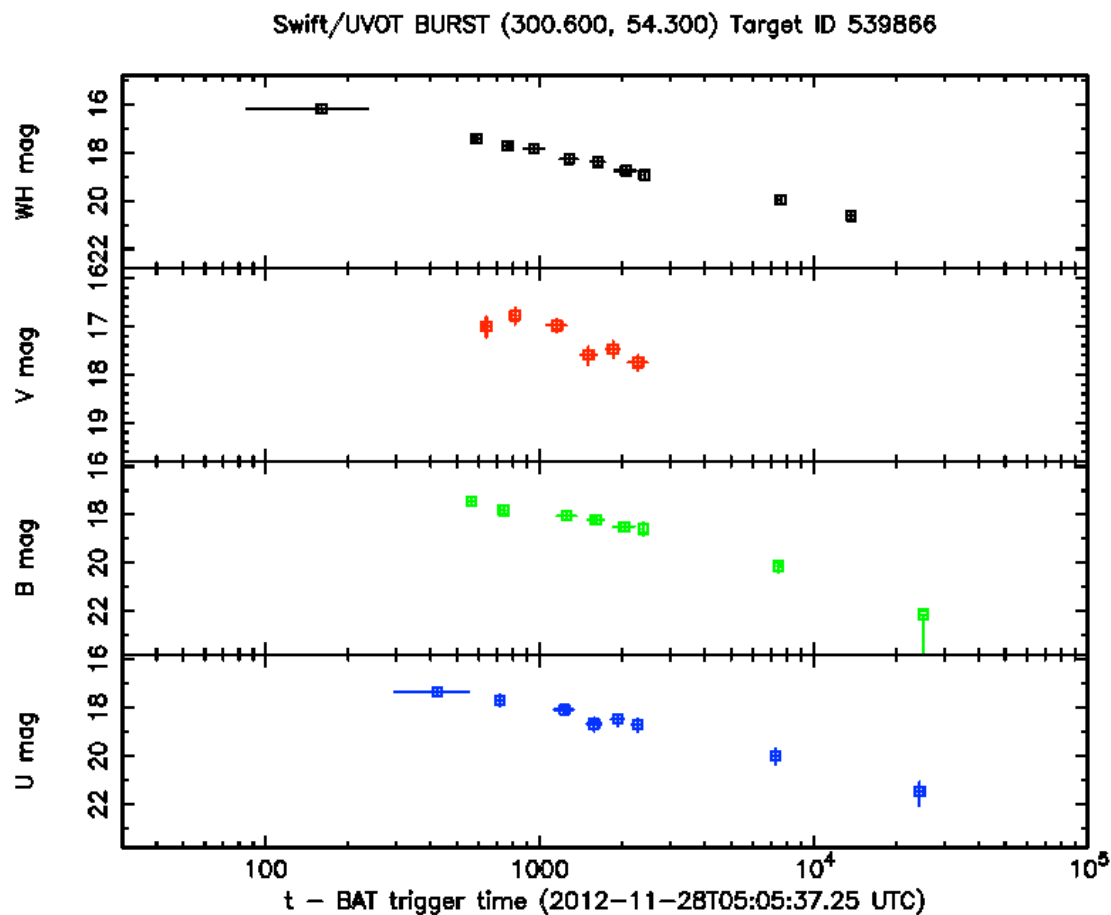


Figure 2. The XRT light curve.

Figure 3. The UVOT, *white*, *v*, *b* and *u* band light curves.

RA	Dec	Er- ror	Note	Reference
20 ^h 02 ^m 24.00 ^s	+54 ^o 17' 59.1"	0.50"	UVOT-refined	Oates GCN Circ. 14017
20 ^h 02 ^m 24.00 ^s	+54 ^o 17' 58.9"	1.7"	XRT-enhanced	Osborne <i>et al.</i> GCN Circ. 14015
20 ^h 02 ^m 21.3 ^s	+54 ^o 18' 02.6"	1.0'	BAT-refined	Palmer <i>et al.</i> GCN Circ. 14011

Table 1. Positions from the Swift instruments.

Band	Authors	GCN Circ.	Observatory	Notes
Optical	Japelj <i>et al.</i>	14008	FTN	detection
Optical	Tanvir <i>et al.</i>	14009	Gemini	redshift
Optical	Wren <i>et al.</i>	14013	RAPTOR	detection
Optical	Volnova <i>et al.</i>	14019	Mondy	detection
Optical	Yoshii <i>et al.</i>	14023	MITSuME Akeno	detection
Optical	Volnova <i>et al.</i>	14024	Mondy	upper limit
Optical	Pandey and Kumar	14043	Nainital	detection
Radio	van der Horst	14018	WSRT	upper limit
Gamma-ray	Golenetskii <i>et al.</i>	14010	Konus-Wind	detection
Gamma-ray	McGlynn	14012	Fermi GBM	detection

Table 2. Summary of GCN Circulars from other observatories sorted by band and then circular number.

Filter	T_start(s)	T_stop(s)	Exp(s)	Mag
<i>white</i>	85	235	147	16.19 ± 0.03
<i>v</i>	629	649	19	17.00 ± 0.23
<i>b</i>	554	573	20	17.51 ± 0.17
<i>u</i>	298	547	246	17.33 ± 0.06
<i>w1</i>	679	2173	175	>19.6
<i>m2</i>	654	2496	214	>19.6
<i>w2</i>	605	2447	214	>20.0

Table 3. UVOT Observations. The start and stop times of the exposures are given in seconds since the BAT trigger. The preliminary detections and 3- σ upper limits are given. No correction has been made for extinction in the Milky Way.

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