Swift Observations of GRB 130305A

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1 Introduction

At T = 11:39:16 UT on 2013 March 5, the *Swift* Burst Alert Telescope (BAT) triggered on GRB 130305A (trigger=550329), but no source was found onboard (Cummings & Palmer, GCN Circ. 14257). In ground analysis of the BAT scaled-map data, a significant source was found on the edge of the BAT FOV (2.25% coded). *Swift* was pointed to the GRB location starting 31 ks after the burst.

The best *Swift* localization of this burst is the *Swift*/XRT position (`http://www.swift.ac.uk/xrt_positions/`; see also Malesani et al., GCN Circ. 14263) which is RA(J2000) = $07^{\rm h}46^{\rm m}59\overset{\rm s}{.}45$, Dec(J2000) = $+52°02'00\overset{''}{.}2$, with an uncertainty of $3\overset{''}{.}7$.

The burst was detected by *Fermi*/LAT (Guiriec et al., GCN Circ. 14260), but only at energies below 75 MeV, as well as by several other detectors, namely *Fermi*/GBM (Yu & Xiong, GCN Circ. 14261), Konus/*Wind* (Golenetskii et al., GCN Circ. 14262), and INTEGRAL/SPI-ACS.

Despite several follow-up attempts, no optical counterpart was detected by either *Swift*/UVOT or ground-based observatories. Tables 1 and 2 summarize the reported limits.

2 BAT Observations and Analysis

Using 11 s of event data covering part of the burst (Cummings et al., GCN Circ. 14277), the best BAT position is RA(J2000) = 116.774°, Dec(J2000) = +52.037°, which corresponds to:

RA(J2000) = $07^{\rm h}47^{\rm m}05\overset{\rm s}{.}8$,
Dec(J2000) = $+52°02'11''$,

with an estimated uncertainty of $1\overset{'}{.}8$ (radius, 90% containment). This position is $1\overset{'}{.}0$ from the XRT afterglow position (Malesani et al., GCN Circ. 14263).

The BAT mask-weighted light curve does not show more detail than the raw light curve (Fig. 1) due to the extreme partial coding (2.5%). There is a single peak, approximately symmetrical, a total of about 20 s long. Note, however, the much longer duration seen at high energy by the Konus/*Wind* team (Golenetskii et al., GCN Circ. 14262).

The following spectral results appear to cover about 90% of the total flux of the burst, based on the raw light curve excess over constant background. Again, the partial coding makes the uncertainty of the fit parameters large. A fit to a simple power law function has a photon index of 0.78 ± 0.20. This is harder than most other BAT-detected long GRBs. The fluence in the 15–150 keV band was $(4.8 \pm 1.8) \times 10^{-6}$ erg cm^{-2}.

3 XRT Observations and Analysis

Swift/XRT began observing the field of GRB 130305A at 20:15:26 UT, 31 ks after the GRB. An X-ray source was detected within the *Swift*/BAT error circle (Malesani et al., GCN Circ. 14263), at coordinates (see `http://www.swift.ac.uk/xrt_positions/`) RA(J2000) = 116.7477°, Dec(J2000) = +52.03338°, which correspond to:

RA(J2000) = $07^{\rm h}46^{\rm m}59\overset{\rm s}{.}45$,
Dec(J2000) = $+52°02'0\overset{''}{.}2$,

with an uncertainty of $3\overset{''}{.}7$.

XRT collected 16 ks of data, from 31.0 to 210.2 ks after the GRB, entirely in photon counting (PC) mode. The light curve of the X-ray afterglow (Fig. 2) can be modeled using a power-law with a decay index of $\alpha = 2.4^{+0.5}_{-0.4}$ (Zhang et al., GCN Circ. 14276).

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of $1.9^{+0.6}_{-0.5}$. The best-fitting absorption column is $3.2^{+2.9}_{-2.1} \times 10^{21}$ cm^{-2}, in excess of the Galactic value of 4.8×10^{20} cm^{-2} (Kalberla et al. 2005, A&A, 440, 775). The counts to observed (unabsorbed) 0.3–10 keV flux conversion factor deduced from this spectrum is 5×10^{-11} (7×10^{-11}) erg cm^{-2} count^{-1}.

The results of the XRT-team automatic analysis are available at `http://www.swift.ac.uk/xrt_products/00020234`.

4 UVOT Observations and Analysis

Swift/UVOT began settled observations of the field of GRB 130305A 30,975 s after the BAT trigger (Breeveld et al., GCN Circ. 14268). No optical afterglow consistent with the XRT position is detected in any UVOT exposure. Table 1 reports the preliminary 3-σ upper limit using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc., 1358, 373), not corrected for the Galactic extinction in the direction of the burst $E(B-V) = 0.05$ mag (Schlafly & Finkbeiner 2011, ApJ, 737, 103).

Filter	$T_{\rm start}$ (s)	$T_{\rm stop}$ (s)	Exposure time (s)	Magnitude
u	30975	59030	3890	> 21.4

Table 1: *Swift*/UVOT observations of GRB 130305A. The start and stop times are relative to the BAT trigger time T.

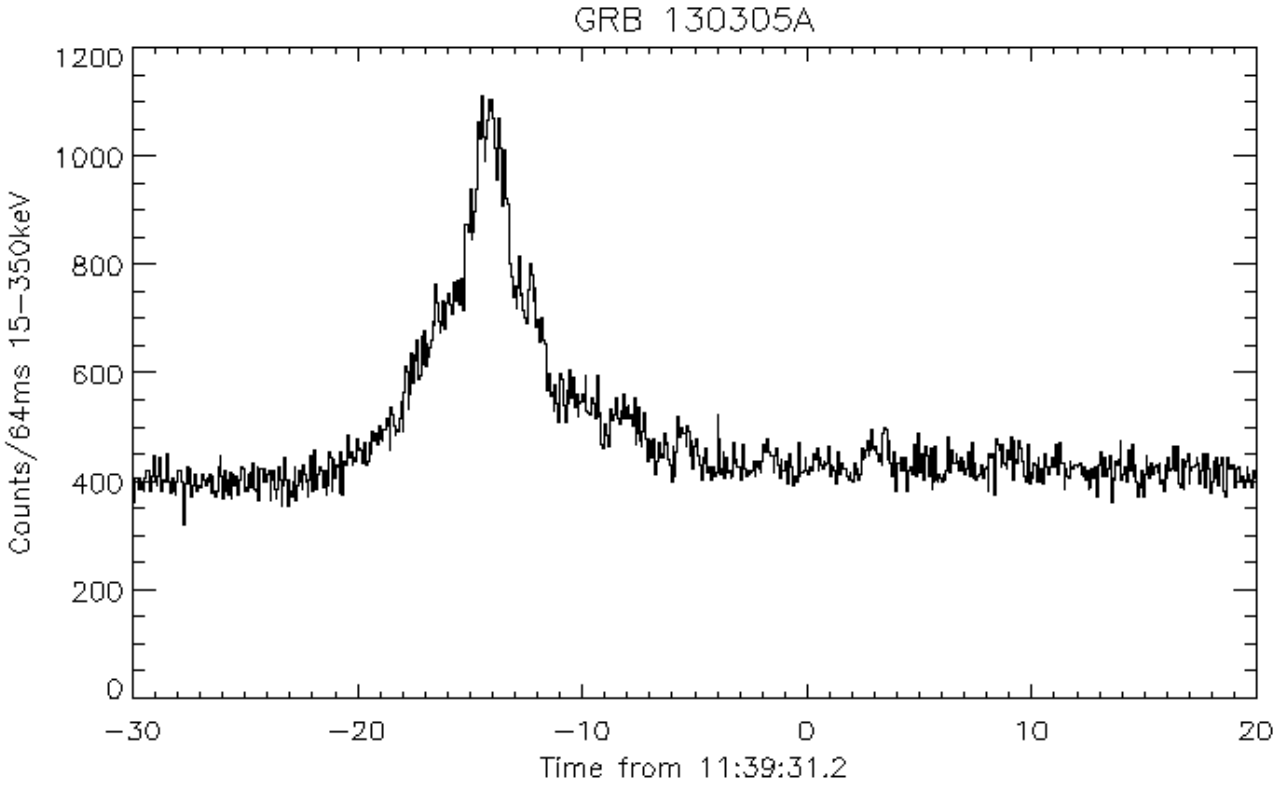

Figure 1: Unweighted BAT light curve of GRB 130515A in the 15–350 keV band. The unit for the time axis is seconds.

GCN	Author(s)	Telescope	Time since GRB (hr)	Band	Magnitude
14274	Kumar & Pandey	ARIES	6.8	R	> 21
14309	Stecklum et al.	Tautenburg	7.0	R	> 23.2
14324	Volnova et al.	AZT-33IK	9.9	R	> 21.4
14265	Cenko	P60	15.1	g'	> 22.8
14265	Cenko	P60	15.1	r'	> 22.2
14265	Cenko	P60	15.1	i'	> 21.7
14267	Butler et al.	RATIR	15.1	r'	> 23.4
14267	Butler et al.	RATIR	15.1	i'	> 23.1
14313	Singer et al.	P48 Oschin	17.6	R	> 20.8
14313	Singer et al.	P48 Oschin	18.3	R	> 20.8
14272	Cucchiara et al.	Gemini-N	40.8	r'	> 26.1

Table 2: Ground-based optical observations of GRB 130305A. The time refers to the BAT trigger T.

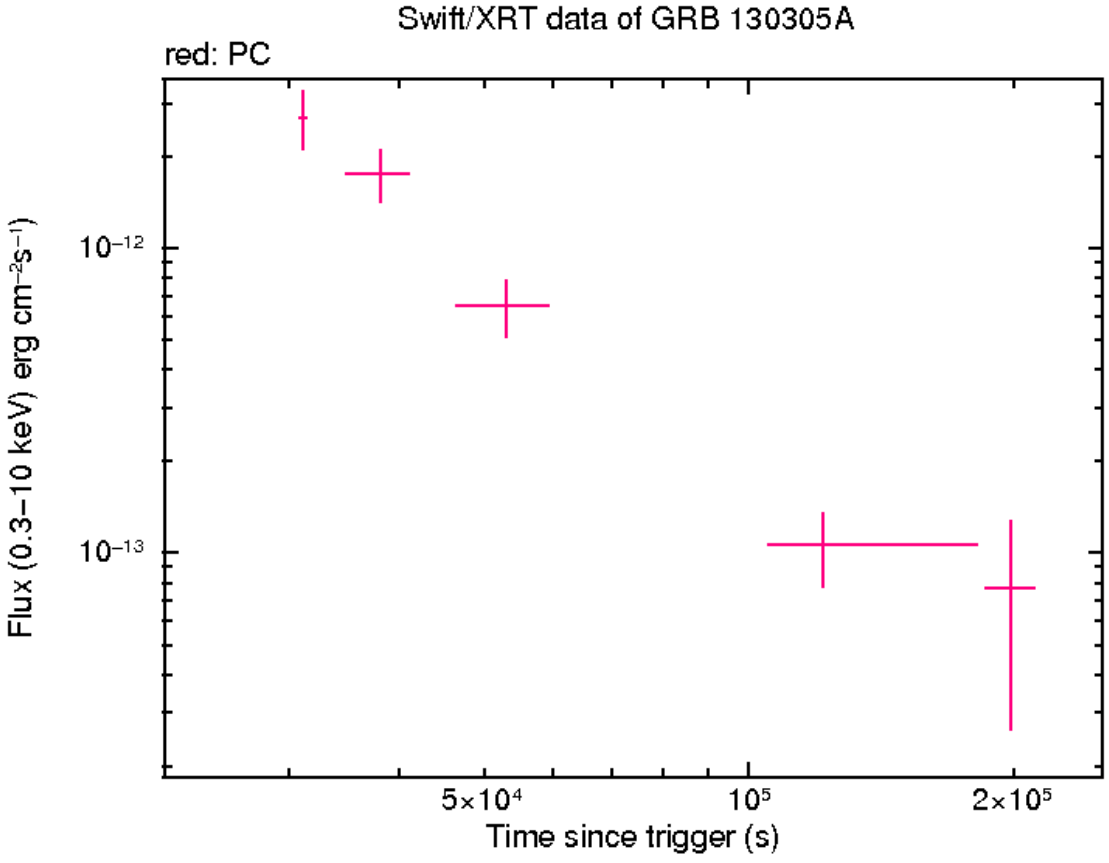

Figure 2: *Swift*/XRT flux light curve of the GRB 130305A afterglow in the 0.3–10 keV band.