Swift Observations of the LAT burst GRB 131231A

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1. Introduction

Sonbas *et al.* (GCN Circ. 15640) reported the GRB detection. At 04:45:16.08 on Dec 31, 2013, Fermi LAT detected high energy emission from GRB 131231A, which was also detected by Fermi-GBM (trigger 410157919/131231198). **Table 1** contains the best reported positions from Swift.

Xu *et al.* (GCN Circ. 15641) reported the position from NOT for the optical afterglow of this GRB. Xu *et al.* (GCN Circ. 15645) determined a redshift of 0.642 from VLT, and Cucchiara (GCN Circ. 15652) determined a redshift of 0.6439 from Gemini. **Table 2** is a summary of GCN Circulars about this GRB from observatories other than Swift.

2. BAT Observations and Analysis

BAT did not observe this burst. A Swift ToO observation of the Fermi-LAT GRB field started 52.1 ks after the Fermi trigger.

3. XRT Observations and Analysis

We have analysed 23 ks of XRT data for the Fermi/LAT-detected burst: GRB 131231A, from 52.1 ks to 431.2 ks after the Fermi/LAT trigger. The data are entirely in Photon Counting (PC) mode. An X-ray source is detected within the Fermi/LAT error circle.

The light curve (**Figure 1**) can be modelled with a power-law decay with a decay index of $\alpha=1.47 \pm 0.06$.

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of 1.86 ± 0.13. The best-fitting absorption column is 1.4 (+0.7, -0.6) x 10^{21} cm^{-2}, at a redshift of 0.642, in addition to the Galactic value of 2.6 x 10^{20} cm^{-2} (Kalberla *et al.* 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 3.1 x 10^{-11} (3.7 x 10^{-11}) erg cm^{-2} $count^{-1}$.

A summary of the PC-mode spectrum is thus:
Galactic foreground: 2.6 x 10^{20} cm^{-2}
Intrinsic column: 1.4 (+0.7, -0.6) x 10^{21} cm^{-2} at z=0.642
Photon index: 1.86 ± 0.13

The results of the XRT team automatic analysis are available at http://www.swift.ac.uk/xrt_products/00020336.

4. UVOT Observations and Analysis

The Swift/UVOT began observations of the field of GRB 131231A 136.5 ks after the Fermi/LAT trigger (Sonbas *et al.*, 2013, GCN Circ. 15640 ; Holland and Mangano GCN Circ. 15673). The preliminary UVOT position is shown in **Table 1**. **Table 3** gives preliminary magnitudes using the UVOT photometric system (Breeveld *et al.* 2011, AIP Conf. Proc., 1358, 373). No correction has been made for the expected extinction in the Milky Way corresponding to a reddening of E_{B-V} of 0.02 mag. in the direction of the GRB (Schlafly *et al.* 2011, ApJS, 737, 103).

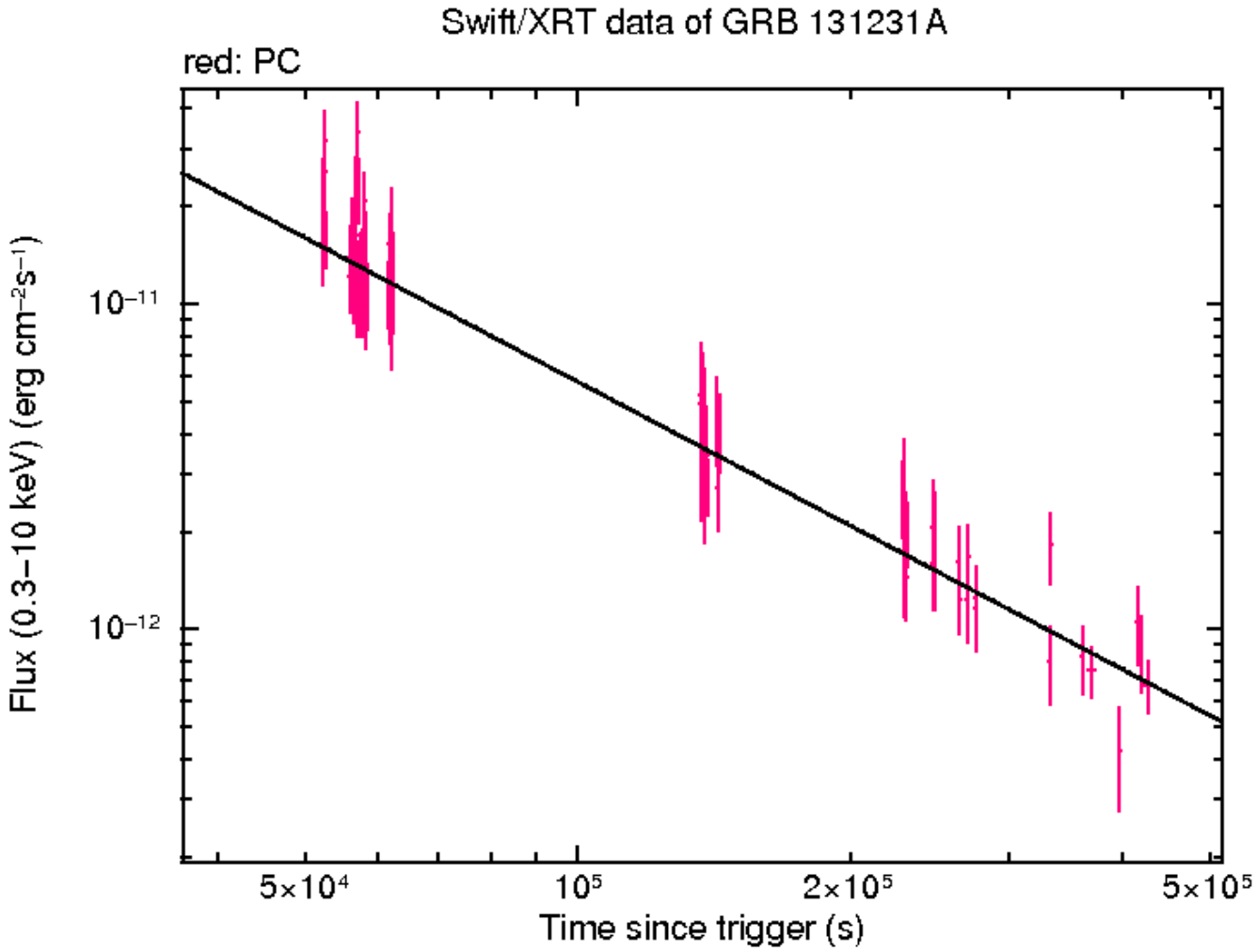

Figure 1. The XRT light curve.

RA (J2000)	Dec (J2000)	Error	Note	Reference
$00^h42^m21.66^s$	-01°39'10.6"	0.43"	UVOT-refined	Holland and Mangano GCN Circ. 15673
$00^h42^m21.70^s$	-01°39'06.7"	3.5"	XRT-final	UKSSDC
$00^h42^m21.70^s$	-01°39'06.7"	3.5"	XRT	Mangano *et al.* GCN Circ. 15648

Table 1. Positions from the Swift instruments.

Band	Authors	GCN Circ.	Subject	Observatory	Notes

Optical	Xu *et al.*	15641	Nanshan afterglow candidate	Xinjiang Astro.Obs.	detection
Optical	Malesani *et al.*	15642	afterglow confirmation from the NOT	NOT	detection
Optical	Singer *et al.*	15643	iPTF optical afterglow candidate coincident with Nanshan detection	iPTF	detection
Optical	Xu *et al.*	15645	VLT/X-shooter redshift	VLT	redshift
Optical	Halpern	15646	MDM afterglow observation	MDM	
Optical	Xin *et al.*	15647	xinglong TNT optical observation	TNT	
Optical	Perley	15650	P60 observations	Palomar 60-inch	detection
Optical	Cucchiara	15652	Gemini-South Redshift	Gemini	redshift
Optical	Pandey *et al.*	15676	Optical Observations	Nainital	detection
Optical	Huang and Urata	15681	Lulin Optical Observations	Lulin	
Optical	Volnova *et al.*	15711	AAO optical observations	Abastumani	detection
Radio	Perley	15680	CARMA 3mm detection	CARMA	detection
Gamma-ray	Sonbas *et al.*	15640	Fermi-LAT detection of a burst	Fermi LAT	detection
Gamma-ray	Jenke and Xiong	15644	Fermi GBM detection	Fermi GBM	E_{peak} = 146 ± 3 keV
Gamma-ray	Golenetskii *et al.*	15670	Konus-Wind observation	Konus-Wind	E_{peak} = 163 ± 6 keV
Gamma-ray	Jenke	15672	Fermi GBM correction to GCN Circ. 15644	Fermi GBM	

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

Filter	T_{start}	T_{stop}	Exposure	Mag	Err
u	246,875	248,554	1652	19.57	0.10
white	136,762	138,942	1650	19.37	0.05
white	228,985	231,172	1639	20.07	0.07

Table 3. UVOT observations reported by Holland and Mangano (GCN Circ. 15673). The start and stop times of the exposures are given in seconds since the Fermi trigger. No correction has been made for extinction in the Milky Way.