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Swift Observation of GRB 130807A

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1 Introduction

At 10:25:43 UT, the *Swift* Burst Alert Telescope (BAT) triggered and located GRB 130807A (trigger=565651). *Swift* slewed immediately to the burst. The best *Swift* position is the X-ray position reported in Melandri *et al.*, *GCN Circ.* 15085.

2 BAT Observation and Analysis

Using the data set from $T-60$ to $T+243$ s from the recent telemetry downlink, further analysis of BAT GRB 130807A (Melandri *et al.*, *GCN Circ.* 15082) has been performed by the *Swift* team (Markwardt *et al.*, *GCN Circ.* 15083). The BAT ground-calculated position is RA(J2000) = 269.801 deg (17^h 59^m 12.4^s), Dec(J2000) = -27.616 deg (-27° $36'$ $56.7''$) $\pm$ 1.7 arcmin (radius, sys+stat, 90% containment). The partial coding was 92%.

The mask-weighted light curve (Fig. 1) shows an initial FRED-like peak starting at $T-10$ s, peaking at $\sim T=0$ s and decaying to background by $T+50$ s. This is followed by at least two more weaker peaks, one from roughly $T+90$ to $T+130$ s and the second beginning at $T+160$ s and continuing until the data are cut off at $T+243$ s. The two later peaks are coincident with flares seen in the XRT data. We note also that the *Swift* satellite slewed away from the source location at $\sim T+300$ s, while an XRT flare was still ongoing. T_{90} (15-350 keV) is 37.7 ± 4.6 s (estimated error including systematics).

The time-averaged spectrum from $T-12.18$ to $T+163.82$ s is best fit by a power law with an exponential cutoff. This fit gives a photon index 0.31 ± 0.89, and $E_{\rm peak}$ of 75.9 ± 35.2 keV ($\chi^2 = 56.96$ for 56 d.o.f.). For this model the total fluence in the 15-150 keV band is $(1.2 \pm 0.2) \times 10^{-6}$ $ergs/cm^2$ and the 1-sec peak flux measured from $T-4.68$ s in the 15-150 keV band is 0.4 ± 0.1 $ph/cm^2/sec$. A fit to a simple power law gives a photon index of 1.46 ± 0.17 ($\chi^2 = 63.40$ for 57 d.o.f.). All the quoted errors are at the 90% confidence level.

3 XRT Observation and Analysis

We have analysed the XRT data for GRB 130807A (Melandri *et al.*, *GCN Circ.* 15082), from 88 s to $\sim$ 40 ks after the BAT trigger. The XRT position for this burst is RA(J2000) = 269.801 deg (17^h 59^m 12.16^s), Dec(J2000) = -27.616 deg (-27° $36'$ $57.5''$) $\pm$ 3.6 arcsec (radius, 90% confidence).

In the first orbit (WT mode) the source is initially detected at a rate of $\sim$10 XRT *count* s^{-1}, rising to $\sim$100 *count* s^{-1} at the end of the first orbit (Fig. 2). During this period the spectrum can be fit by an absorbed power-law model with a photon index of 1.56 ± 0.08. The source showed an absorption column of $(8.6 \pm 1.0) \times 10^{21}$ cm^{-2}, slightly in excess with respect to the Galactic value of 6×10^{21} cm^{-2} (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 8.0×10^{-11} (1.2×10^{-10}) erg cm^{-2} $count^{-1}$.

In the second orbit (PC mode) the source had become much fainter ($\sim$ 0.03 *count* s^{-1}), and much softer, with a photon index of $2.3^{+0.5}_{-0.4}$. The source still showed an absorption column $(9.0 \pm 5.0) \times 10^{21}$ cm^{-2} consistent with the Galactic value. The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 5.0×10^{-11} (1.7×10^{-10}) erg cm^{-2} $count^{-1}$. Starting with the second orbit, the light curve rose from a count rate of $\sim$ 0.015 *count* s^{-1} after $\sim$ 4 ks to a

maximum of ~ 0.06 *count* s^{-1} at ~ 10 ks (with slope of -1.5 ± 0.1). After that it decayed with a slope of 0.9 ± 0.1, reaching the count rate of ~ 0.012 *count* s^{-1} at ~ 75 ks.

The light curve behaviour (at late times) is unusual, but not unprecedented, for a GRB. The BAT and XRT spectral indices are similar to those observed for GRB 060124 (BAT spectrum $\Gamma = 1.89 \pm 0.19$, XRT-WT spectrum $\Gamma = 1.40 \pm 0.01$, XRT-PC spectrum $\Gamma = 2.1 \pm 0.1$; Romano et al., 2006, A&A, 456, 917) and for the transient supermassive black hole Swift J1644+57 (Burrows et al., 2011, Nature, 476, 421), but inconsistent with what generally observed for a Supergiant Fast X-ray Transient (SFXT). The dynamical range of GRB 130807A (~ 3300) is similar to what observed for GRB 060124 or for a typical SFXT, but very different from what was observed for Swift J1644+57.

The source was not detected in the BAT transient monitor (15-50 keV) before 3:03 UT, August 6, 2013, the most recent monitor epoch currently available. Events like Swift J1644+57 or SFXTs are usually detected in X-rays for several days before the trigger, Swift J1644+57 behaved similarly. It is therefore likely that BAT trigger 565651 was a somewhat unusual GRB rather than a Galactic or extragalactic transient, in spite of its proximity to the Galactic center.

4 UVOT Observation and Analysis

The UVOT began settled observations of the field of GRB 130807A ~ 145 s after the BAT trigger (Melandri, *et al.*, *GCN Circ.* 15082). No optical source consistent with the XRT position (Melandri *et al.*, *GCN Circ.* 15085) is detected in the UVOT exposures.

The 3-σ upper limits using the UVOT photometric system (Breeveld et al. 2011, AIP Conf. Proc. 1358, 373) for the first finding chart (FC) exposure and subsequent summed exposures are:

Filter	T_{start} (s)	T_{stop} (s)	Exp (s)	Mag
$white_{FC}$	3572	3722	147	>20.3
white	3572	5573	541	>21.1
v	4348	5984	393	>19.3
b	3732	5369	393	>20.3
u_{FC}	145	311	163	>19.7
u	145	5164	360	>19.9
w1	4759	4959	197	>19.6
m2	4552	6078	284	>19.7
w2	4143	5780	393	>20.2

Table 1: 3σ upper limits from UVOT observations (De Pasquale & Melandri, *GCN Circ.* 15086). The values quoted above are not corrected for the Galactic extinction due to the reddening of $E_{(B-V)} = 2.03$ in the direction of the burst (Schlegel et al. 1998).

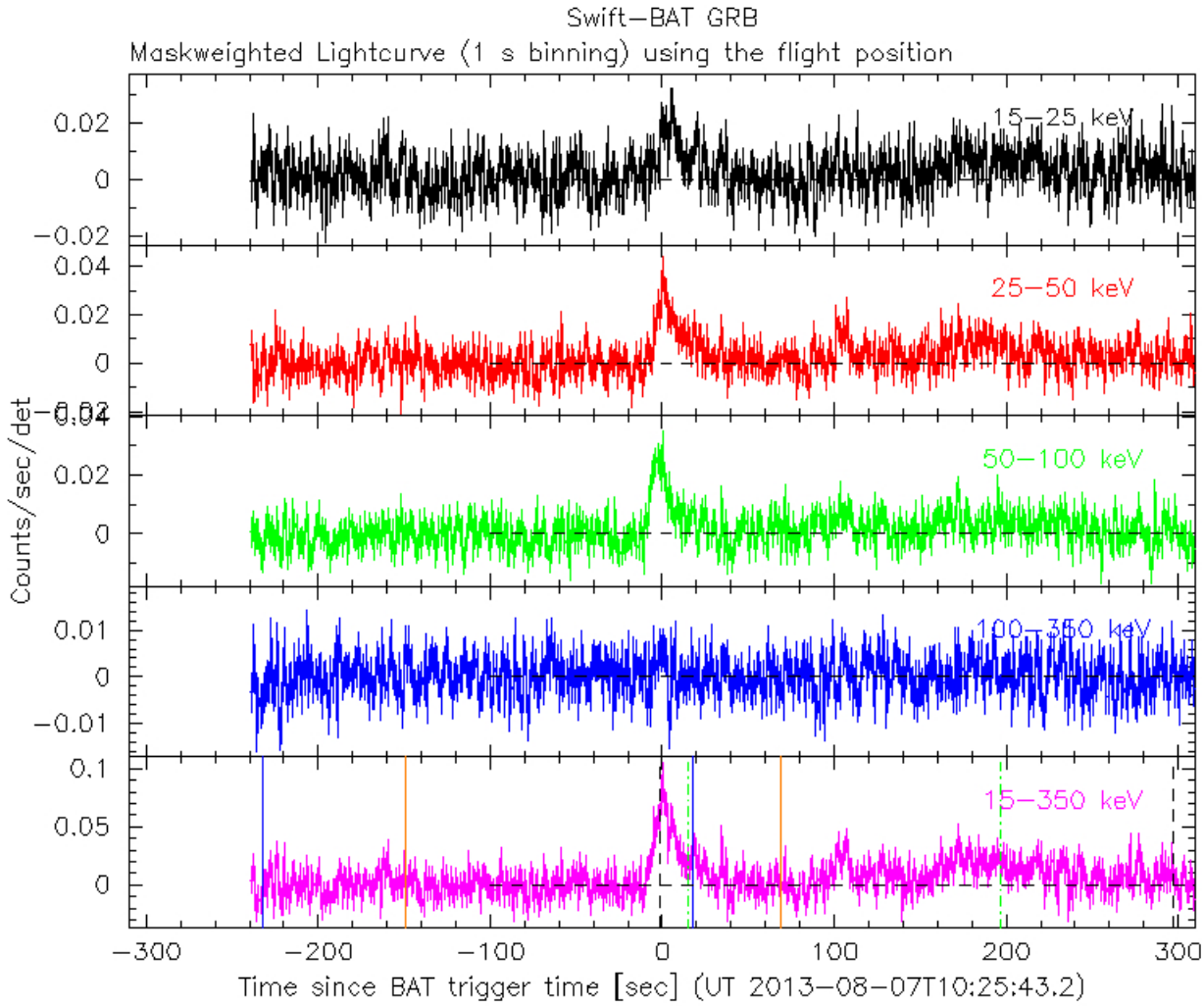

Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands (15 - 25, 25 - 50, 50 - 100, 100 - 350 and 15 - 350 keV).

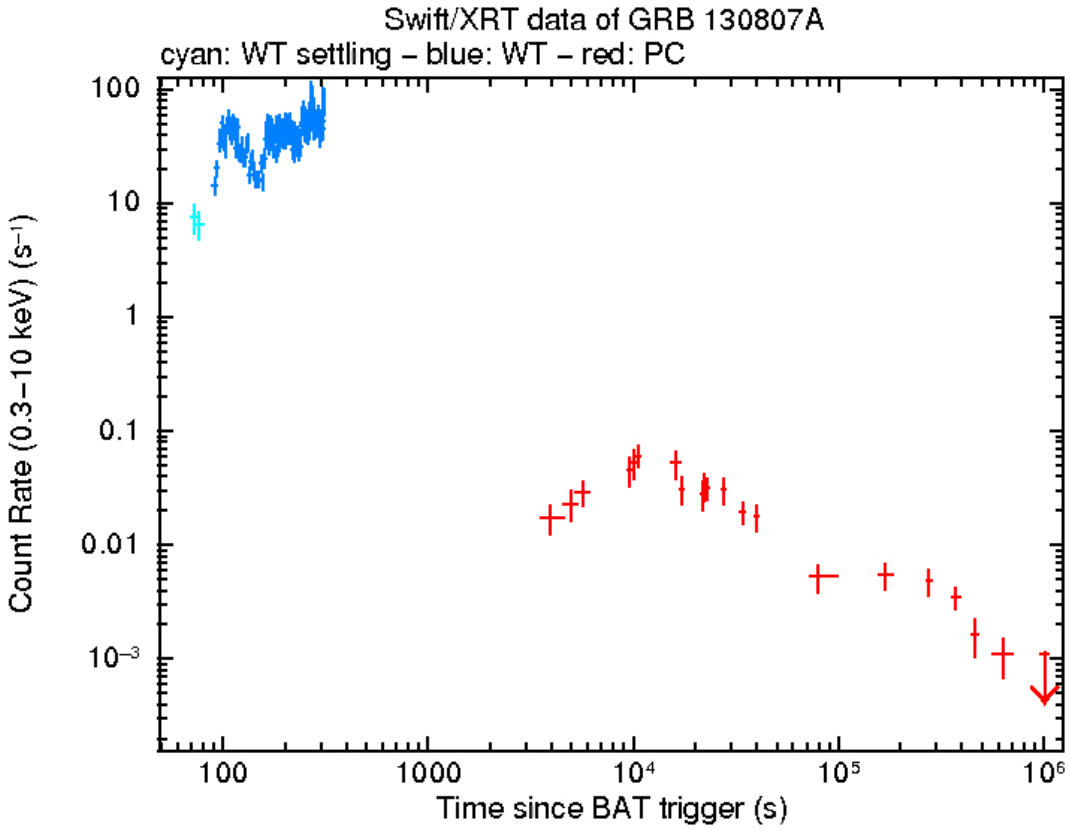

Figure 2: XRT data of GRB 130807A from the *Swift*-XRT light curve repository (Evans et al., 2009, MNRAS, 397, 1177).