

# Swift Observations of the Fermi short GRB 081024B

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## 1 Introduction

The Fermi-LAT and Fermi-GBM detected GRB 081024B at 21:22:41 UT, (Trigger 246576161 / 081024.891). The location of the GRB reported by LAT data ground analysis is: RA(J2000) = 322.9 deg (21<sup>h</sup>31<sup>m</sup>36<sup>s</sup>), Dec(J2000) = +21.204 deg (+21<sup>d</sup>12<sup>'</sup>14.4<sup>"</sup>) with a statistical uncertainty of 0.16 deg (68% containment radius). The emission was seen up to 3 GeV, in the first 5 s after the trigger (Omodei *et al.*, *GCN Circ.* 8407).

The duration as seen with the Fermi-GBM was about 800 ms with 2 main peaks. The first peak lasted 200 ms and its spectrum is best fit using a power-law index with an exponential cutoff. The power-law index is  $-0.70 \pm 0.13$ , and the cutoff energy, parameterised as  $E_{\text{peak}}$ , is  $1583 \pm 520$  keV. The second peak lasted 600 ms and is best fit by a power-law spectrum with an index of  $-1.28 \pm 0.04$ . The 50–300 keV fluence is  $(3.4 \pm 0.1) \times 10^{-7}$  erg cm<sup>-2</sup>, with a peak flux measured over a 64 ms timescale of  $4.2 \pm 0.2$  ph cm<sup>-2</sup> s<sup>-1</sup>. The 15–150 keV 64 ms peak flux is  $7.4 \pm 0.4$  ph cm<sup>-2</sup> s<sup>-1</sup> (Connaughton *et al.*, *GCN Circ.* 8408).

GRB 081024B was also detected by the Suzaku-WAM covering the 50 keV–5 MeV energy range (Hanabata *et al.*, *GCN Circ.* 8444).

Swift-XRT began observing 70.3 ks after the burst and found initially three sources within the Fermi-LAT error circle (Guidorzi *et al.*, *GCN Circ.* 8410). Out of these, only source 2 seemed to show possible fading (Guidorzi *et al.*, *GCN Circ.* 8416, 8454). Source 1 and 2 were outside the Swift-UVOT field of view and no source was found at the position of source 3 (Schady & Guidorzi, *GCN Circ.* 8413). Optical ground-based observations performed with the P200 at a mid time of 30 hours post burst identified four optical sources within the XRT source 2 error circle, none of which showed evidence for variability (Cenko & Kasliwal, *GCN Circ.* 8417). Observations with TLS Tautenburg telescope (mid time of 0.88644 days) found evidence for variability of the optical source O2 out of the four previously identified (Kann *et al.*, *GCN Circ.* 8423). However, further observations with the 6-m telescope of the SAO RAS in Caucasus at 3.9 and 4.7 days after the burst did not find any evidence for fading for all of the four optical sources (Fatkhullin *et al.*, *GCN Circ.* 8456). Finally, Swift-XRT late-time observations between 13.1 and 15.1 days showed that no X-ray source previously identified had faded significantly, thus ruling them out as possibly associated with GRB 081024B (Guidorzi *GCN Circ.* 8513).

No radio source was found with the VLA observations at 4.1 days (Chandra *et al.*, *GCN Circ.* 8451).

## 2 BAT Observations and Analysis

No BAT data were taken for this burst.

## 3 XRT Observations and Analysis

The XRT began observing GRB 081024B in Photon Counting (PC) mode, 70.3 ks after the burst. In 9.9 ks net exposure data, we detected three uncatalogued sources within the Fermi-LAT error circle at the following positions: RA1(J2000) = 21<sup>h</sup>31<sup>m</sup>47.85<sup>s</sup>, Dec1(J2000) = +21<sup>d</sup>08<sup>'</sup>33.7<sup>"</sup>, RA2(J2000) = 21<sup>h</sup>31<sup>m</sup>37.22<sup>s</sup>, Dec2(J2000) = +21<sup>d</sup>16<sup>'</sup>32.1<sup>"</sup>, RA3(J2000) = 21<sup>h</sup>31<sup>m</sup>29.26<sup>s</sup>, Dec3(J2000) = +21<sup>d</sup>16<sup>'</sup>43.3<sup>"</sup>,

with uncertainties of 6.6, 5.4 and 5.5 arcsec (90% confidence) for source 1, 2 and 3, respectively (Guidorzi *et al.*, *GCN Circ.* 8410).

XRT observations went on until 6.9 days totalling 42 ks net exposure, during which all of the three sources showed no evidence for fading, except for source 2, for which we found a possible hint for fading. However, the probability that this source remained constant was estimated to be about 12% (Guidorzi *et al.*, *GCN Circ.* 8454).

Finally, XRT re-observed the field of view from 13.1 to 15.1 days with a net exposure of 9.8 ks and still detected all of the three sources with rates compatible with the corresponding values of the first observation. In particular, an upper limit to the possible power-law decay index,  $F(t) \sim t^{-\alpha}$ , of source 2 was found to be:  $\alpha < 0.4$  (90%) throughout the entire XRT observations. Therefore, we concluded that none of these sources corresponds to the X-ray afterglow of GRB 081024B.

Figure 1, totalling 52 ks exposure and spanning from 70.3 ks to  $1.3 \times 10^6$  s, shows the XRT field of view centred on the Fermi-LAT error circle and the three X-ray sources detected. The average 0.3–10 keV rates are estimated to be:  $(1.90 \pm 0.25) \times 10^{-3}$  count  $s^{-1}$ ,  $(9.5 \pm 2.1) \times 10^{-4}$  count  $s^{-1}$ ,  $(1.33 \pm 0.22) \times 10^{-3}$  count  $s^{-1}$ , for source 1, 2 and 3, respectively.

## 4 UVOT Observations and Analysis

The UVOT observed the field of GRB 081024B starting at 70.3 ks after the burst. XRT Source 1 and Source 2 identified in *GCN Circ.* 8410 (Guidorzi *et al.*) are outside the UVOT field of view, and no new source is detected at the position of Source 3 down to the 3 sigma upper limits reported in Table 1 (Schady & Guidorzi, *GCN Circ.* 8413).

Filter	$T_{\text{mid}}$ (days)	Exposure (s)	Mag ( $3\text{-}\sigma$ )
v	1.215	885	>20.33
b	0.824	864	>21.26
u	0.814	2641	>21.42
uvw1	0.894	1531	>21.07
uvm2	0.883	2548	>21.36
uvw2	1.163	1201	>21.07

Table 1:  $3\text{-}\sigma$  upper limit values from UVOT observations.

The values quoted in Table 1 are on the UVOT Photometric System (Poole *et al.*, 2008, MNRAS 383,627). They are not corrected for the expected Galactic extinction corresponding to a reddening of  $E_{B-V} = 0.07$  mag in the direction of the burst (Schlegel *et al.*1998).

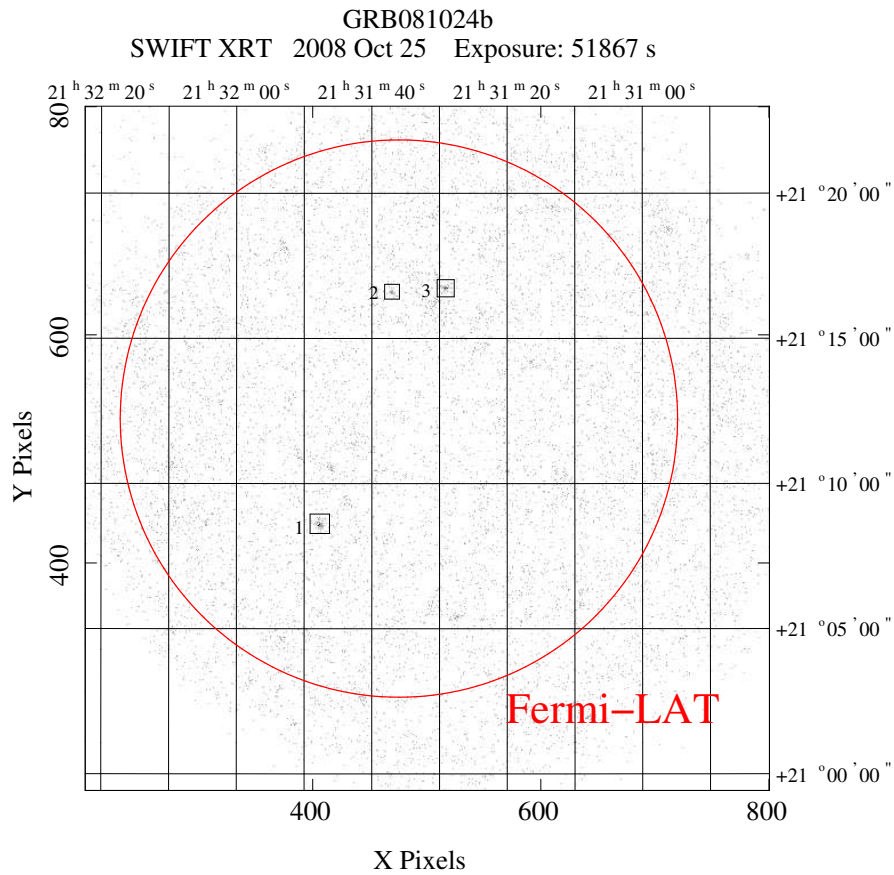


Figure 1: XRT image of the entire observation (52 ks exposure). The Fermi-LAT error circle is shown. Three X-ray sources were identified, none of which displayed significant variability throughout the entire XRT observations.