

Swift Observation of the short GRB100117A

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1 Introduction

BAT triggered on the short GRB 100117A at 21:06:19 UT (Trigger 382941) (De Pasquale et al., *GCN Circ.* 10336). Swift slewed to this burst immediately, and XRT and UVOT began follow-up observations at $T + 80.1$ s. Our best position is the XRT location $RA(J2000) = 11.2690$ deg ($00h45m4.56s$), $Dec(J2000) = -01.5949$ deg ($-01d35'41.7'' \pm 2.4$ arcsec (90% confidence)).

2 BAT Observation and Analysis

Using the data set from $T - 239$ to $T + 484$ s, further analysis of BAT GRB 100117A has been performed by Swift team (Markwardt, et al., *GCN Circ.* 10338). The BAT ground-calculated position is $RA(J2000) = 11.280$ deg ($00h45m07.1s$), $Dec(J2000) = -1.586$ deg ($-01d35'11.1'' \pm 1.7$ arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 66%.

The masked-weighted light curve (Fig.1) starts at trigger time $\sim T + 0$ s with a single peak (possibly two) and returns to background at about $T + 0.4$ s. $T_{90} = 0.30 \pm 0.05$ (estimated error including systematics). The time-averaged spectrum from $T - 0.0$ to $T + 0.3$ sec is best fit by a simple power-law model, with a power law index $\Gamma = 0.88 \pm 0.22$ ($\chi^2 = 66.4 / 56$ d.o.f.). The fluence in the 15-150 keV band is $(9.3 \pm 1.3) \times 10^{-8}$ ergs cm^{-2} . The 1-s peak photon flux measured from $T - 0.35$ sec in the 15-150 keV band is 2.9 ± 0.4 ph $cm^{-2} s^{-1}$. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The XRT data indicate the presence of an unknown X-ray source inside the BAT error circle; its UVOT-enhanced position is $RA(J2000) = 11.2690$ deg ($00h45m4.56s$), $Dec(J2000) = -01.5949$ deg ($-01d35'41.7'' \pm 2.4$ arcsec (90% confidence)). This is 50.8 arcsec of the initial BAT ground position and inside the error circle. During the first 180s, data were taken in WT mode, then in PC mode.

The 0.3 – 10 keV light curve (Fig.2) shows an initial flaring activity lasting ~ 200 seconds, followed by a steep decay, with a decay rate of $\alpha = 3.5 \pm 0.2$. Between ~ 4 and ~ 150 ks after the trigger, the X-ray afterglow is marginally detected at 2.4 ± 1.2 counts/s, above the count rate predicted by the initial steep decay rate. This could indicate that the afterglow was in the shallow decline phase. The WT spectrum, fitted with a powerlaw plus absorber (at redshift $z=0$), provides the following best fit parameters: photon index $\Gamma = 1.70 \pm 0.14$, absorption $N_H = 1.2 \pm 0.4 \times 10^{21}$, in excess of the Galactic value of 2.7×10^{20} (Kalberla et al. 2005). The observed (unabsorbed) 0.3-10 keV flux is $F = 4.14(4.84) \times 10^{-10}$ ergs $cm^{-2} s^{-1}$. The same analysis, performed for the PC spectrum, yields $\Gamma = 3.31_{-0.67}^{+0.91}$, absorption $N_H = 2.6_{-1.3}^{+1.8}$, $F = 2.8(1.2) \times 10^{-13}$. The X-ray lightcurve is shown in Fig.2.

4 UVOT Observations and Analysis

The Swift/UVOT began settled observations of the field of GRB 100117A 89s after the BAT trigger (De Pasquale et al., *GCN Circ.* 10336) with a finding chart in the white band. No source was detected in this exposure in the UVOT-enhanced XRT error circle (Sbarufatti et al., *GCN Circ.* 10342), nor in the other filters, either in single or summed up exposures.

5 Ground based observations

The field of the short GRB100117A was observed by NOT (Xu et al., *GCN Circ.* 10337), Gemini South (Cenko et al., *GCN Circ.* 10339), Magellan (Chornock et al., *GCN Circ.* 10340), Gemini North (two epochs: Cucchiara et al., *GCN Circ.* 10341; Levan et al., *GCN Circ.* 10349), Tautenburg (Kann et al., *GCN Circ.* 10343). In the pre-burst observations, 1 source is present inside the enhanced XRT error circle. This source is extended, and it may be the host galaxy of the burst. According to Levan et al., this source faded by 0.23 ± 0.06 magnitudes in the r band between the first and second observation, which took place 7.9 and 33 hours after the trigger respectively. The higher flux in the first observation might have been due to the optical afterglow of GRB100117A.

6 Fermi observations

GRB100117A was detected (Pecias et al., *GCN Circ.* 10345) by Fermi Gamma-Ray Burst Monitor (GBM). The GBM detected a single pulse of duration $T_{90} \simeq 0.4$. The time-averaged spectrum from $T - 0.128$ s to $T + 0.256$ s is adequately fitted by a power law function with an exponential high energy cutoff. The power law index is $\Gamma = 0.86^{+0.33}_{-0.27}$ and the cutoff energy, parameterized as E_{peak} , is 287^{+74}_{-50} keV (CSTAT 548 for 484 d.o.f.). The event fluence (8-1000 keV) in this time interval is $4.1 \pm 0.5 \times 10^{-7}$ ergs cm^{-2} . The 0.256-s peak photon flux measured starting from $T - 0.1284$ s in the 8-1000 keV band is 6.1 ± 0.4 ph $\text{cm}^{-2} \text{s}^{-1}$.

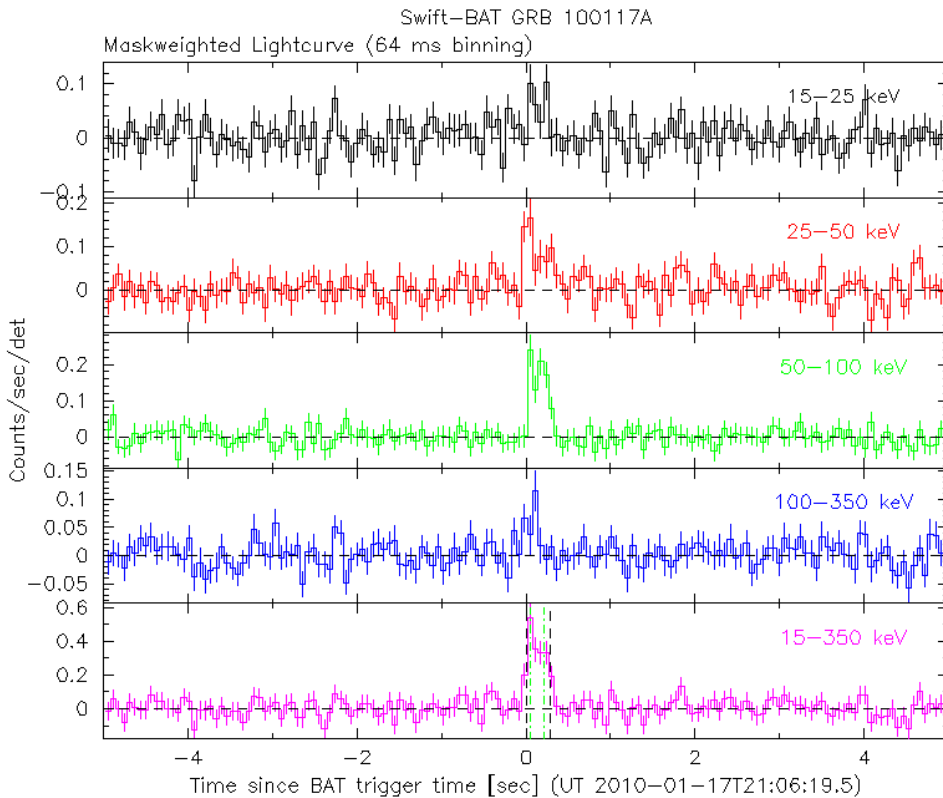


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands.

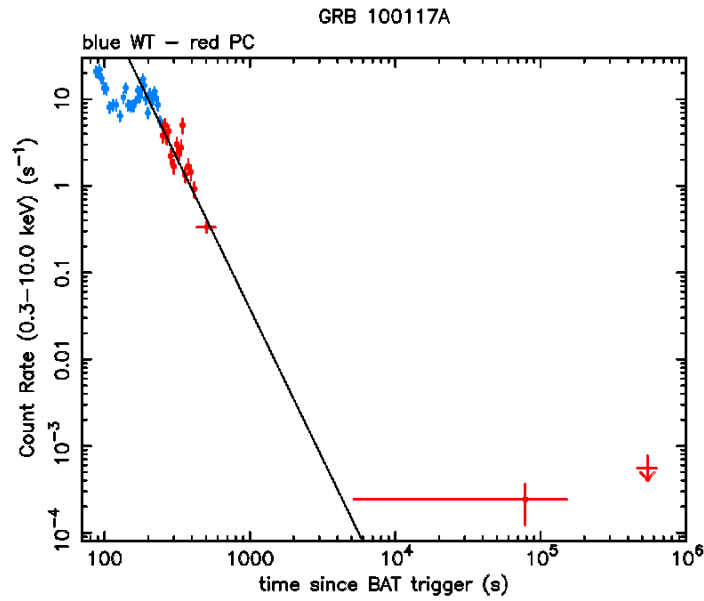


Figure 2: XRT Lightcurve. Counts/sec in the 0.3 – 10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion of the absorbed flux in WT and PC mode is 1 count/s = 4.2×10^{-11} ergs cm⁻² s⁻¹ and 2.8×10^{-11} ergs cm⁻² s⁻¹ respectively.

Filter	Start	Stop	Exposure	3-Sigma UL
white (finding chart)	89	238	147	20.4
white	89	11957	1228	21.4
v	5589	11747	1082	19.8
b	557	6607	216	19.9
u	302	6402	442	19.9
uw1	5999	18941	474	20.1
um2	5793	18652	1082	20.8
uw2	5384	12757	978	20.9

Table 1: Magnitude limits from UVOT observations