# Swift Observations of GRB 070419B

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## 1. INTRODUCTION

At 10:44:05 UT, on April 19, 2007, BAT triggered and located GRB 070419B (trigger=276212) (A. M. Parsons et al, GCN #6305). The initial BAT light curve showed a multiple peak structure with a duration of about 160 seconds and a peak count rate of ~2500 counts/sec (15-350 keV) observed at the time of the trigger.  Swift slewed immediately to the burst allowing for XRT and UVOT follow-up observations at T+ 81 and T + 89 seconds respectively.  The best Swift position is that determined from the XRT detection of the afterglow at RA (J2000) = 315.7065, deg, Dec (J2000) = -31.2638 deg; RA(J2000) = $21^h 02^m 49.57^s$, Dec(J2000) = $-31^h 15^m 49.7^s$ with an estimated error radius of 3.5 arcseconds (90% confidence) (Stratta., et al. GCN 6303). No afterglow candidate was found in the UVOT data.

Optical afterglow emission was detected in the VRI-bands by the following ground based telescopes: the 0.6m B&C telescope at the Mt. John Observatory on Lake Tekapo, New Zealand (Tristram, et al. GCN 6312, 6314 and de Ugarte Postigo, et al. GCN 6321) and the ANU 1m telescope + WFI at Siding Spring Observatory (Schmidt, et al. 6325). From the data from the Mt. John Observatory, de Ugarte Postigo, et al. GCN 6321 derived a complex lightcurve (preliminary analysis showed a steep decline up to T0 + 0.2 days and a plateau phase lasting until the end of their observations at T0 + 0.3 days with R ~ 21.0.

We note that this burst is distinct from GRB 070419A (trigger 276206) which occurred only 44:39 minutes earlier.

## 2) BAT OBSERVATION AND ANALYSIS

Using the data set from T- 239.9 to T+ 602.1 the BAT team reported further analysis of BAT GRB 070419B (Palmer, et al. GCN 6327). The BAT ground-calculated position is RA(J2000) =  315.709, deg, Dec(J2000) = -31.266 deg; RA(J2000) = $21^h 2^m 50.2^s$, Dec(J2000) = -31d 15' 58.3" with an uncertainty of 1 arcmin, (radius, sys+stat, 90% containment). The partial coding was 66%.

The mask-weighted light curve (Figure 1) shows 4 main peaks at ~T+0 s, T+25s, T+35s, and T+60s. The duration T90 (15-350 keV) is 236.5 +-12 sec (estimated error including systematics).

The time-averaged spectrum from -11.7 to 314.8 s is best fit by a simple power-law model.  The power law index of the time-averaged spectrum is 1.70 +- 0.05. The fluence in the 15-150 keV band is 7.5 +- 0.2 x 10^-6 erg/cm2. The 1-sec peak photon flux measured from T-0.28 sec in the 15-150 keV band is 1.4 +- 0.2 ph/cm2/sec. All the quoted errors are at the 90% confidence level.

## 3. XRT OBSERVATION AND ANALYSIS

We have analyzed the first 3 orbits of Swift-XRT data on GRB 070419B (Parsons et al. GCN 6305), with a total exposure of 276 s in Windowed Timing (WT) mode and of 4.5 ks in Photon Counting (PC) mode. This provides a refined XRT position at RA(J2000)= 315.7065 deg Dec(J2000)= -31.2638 deg RA(J2000)=$21^h 02^m 49.57^s$, Dec(J2000)=-31 15 49.7

with an estimated error radius of 3.5 arcseconds (90% confidence). This position is 32 arcseconds from the BAT position (Parsons et al. GCN 6305), 1.2 arcseconds from the initial XRT position (Parsons et al. GCN 6305) and 3.0 arcseconds from the optical candidate (Tristram et al. GCN 6314).

The 0.3-10 keV X-ray light curve presents a flaring behavior starting from 88 s up to about 350 s after the burst, with three flares. The second and third orbits data taken in PC mode show marginal evidence of a flat

decay between 3.8 ks and 6.0 ks after the trigger, followed by a fading decay behavior that can be fit with a power law model with decay index 1.3+/-0.1 (Figure 2).

The X-ray spectrum from the XRT/WT data from 88 s to about 350 s can be fit by an absorbed power law with a photon index of 1.88+/-0.03 and a total column density of NH=(0.22+/-0.01)e22 cm**-2. We note that the Galactic column density in the direction of the source is 6.7e20 cm**-2 (Dickey & Lockmann 1990).

## 4. UVOT OBSERVATION AND ANALYSIS

No afterglow was detected by UVOT. The 3 sigma upper limits on short (< 5 minutes) and long (<3 hours) time scales are

| Filter | Tstart(s) | Tstop(s) | Texp(s) | UpperLim |
|--------|-----------|----------|---------|----------|
| Wh | 89 | 189 | 98 | >20.0 |
| V | 195 | 390 | 191 | >18.5 |
| WH | 89 | 6176 | 475 | >21.0 |
| V | 195 | 11038 | 1273 | >19.9 |
| B | 4354 | 5987 | 393 | >20.2 |
| U | 4149 | 5782 | 393 | >19.9 |
| UVW1 | 3945 | 5578 | 393 | >20.1 |
| UVM2 | 3740 | 11600 | 647 | >20.4 |
| UVW2 | 4765 | 10427 | 1082 | >21.0 |

These upper limits are consistent with R~20 mag reported by Tristam (GCN, 6314) at T = 7775s, especially given the red color (I=20.7, R=22.1 )reported at later times by Schmidt and Mackie (GCN, 6325). However, the UVOT results place useful constraints on the brightness of the early afterglow.
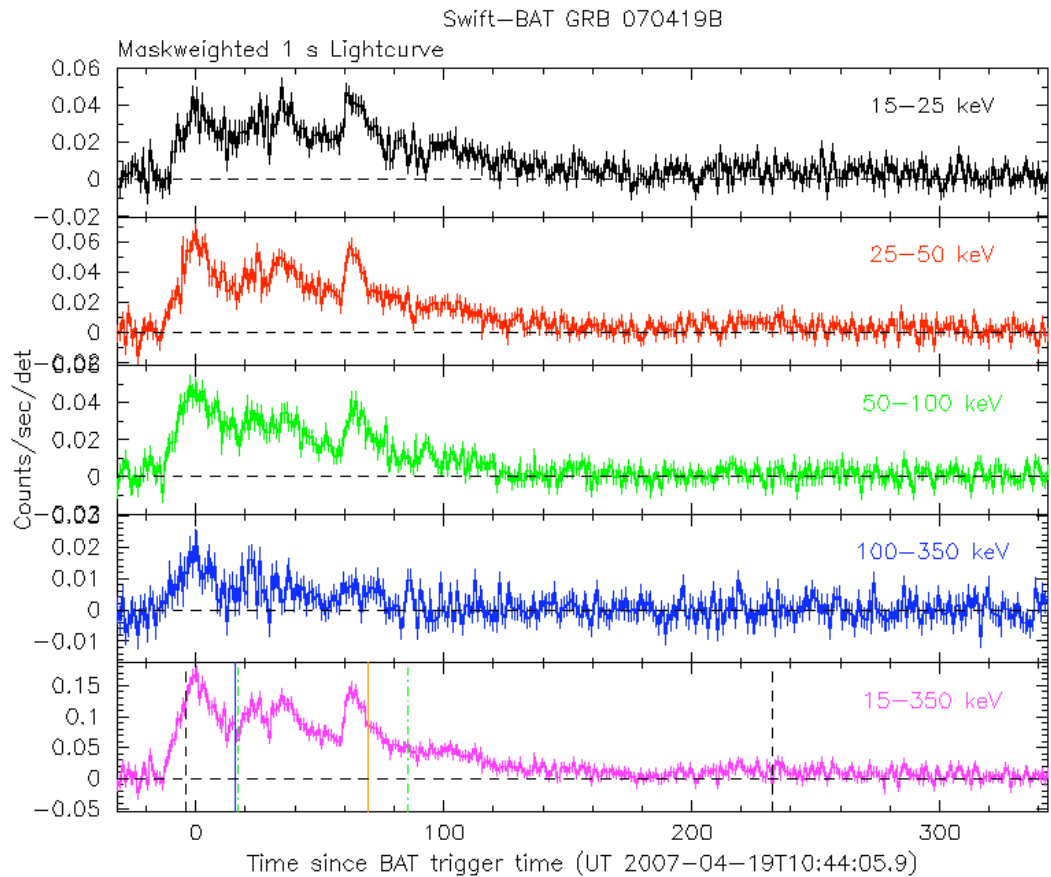
Fig.1: BAT Lightcurve.  The light curve in the 4 individual plus total energy bands.
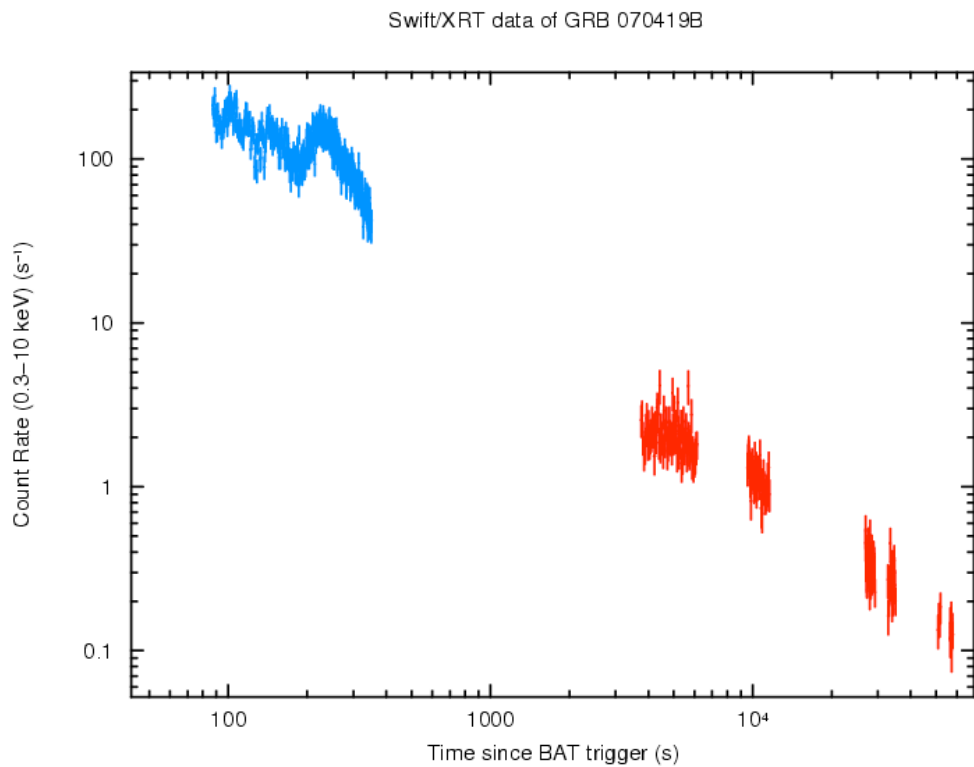
Fig. 2: XRT Lightcurve