SWIFT-XRT OBSERVATION OF THE AFTERGLOW OF GRB050319 AND XRF050416A

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ABSTRACT

We report on the analysis of the X-ray afterglow of GRB050319 and XRF050416A, detected with Swift-BAT and observed with the Swift narrow field instruments 225s and 80s after the burst onset, respectively. The afterglow emission was monitored by the XRT up to 2 months after the burst. The light curves show three different phases characterized by distinct slopes, with a flattening between the two break times. The extrapolation of the BAT light curve to the XRT band suggests that the initial phase of the afterglow may be the low energy tail of the prompt emission, while the next two phases are suggestive of refreshed shocks followed by a standard fireball evolution.

Key words: Gamma rays: burst; X-rays, individual: GRB050319, XRF050416A.

1. THE TWO BURSTS

GRB0950319 was a 150 sec long GRB, with a redshift z=3.24 (Fynbo et al. , 2005). The burst showed a multi-peak structure, with a fluence 1.6×10^{-6} erg cm^{-2} in the 15-350 keV band. The afterglow emission was monitored from 225 sec up to 28 days after the burst. The afterglow shows a very steep initial decay, followed by a flat phase and a further slow decay (see Table 1 and Figure 1). It also shows spectral evolution between the first two phases, as reported in Table 2. A detailed analysis of the afterglow of GRB050319 is reported in Cusumano et al. (2005).

The prompt emission of XRF050416A lasted 2.4 sec, with two distinct peaks and a fluence 3.8×10^{-7} erg cm^{-2} in the 15-350 keV band (Sakamoto et al., 2005). This event is classified as an X-ray flash, as the fluence in the 15.-30. keV band is larger than that in the 30-400 keV band. Cenko & Fox (2005b) report a redshift z=0.65. The afterglow emission was monitored from 76 sec up to 74 days after the burst. It shows a moderately steep initial decay, followed by a flat phase and by a very slow fading (see Table 1 and Figure 1). The spectrum, that shows significant absorption in excess to the Galactic line of sight value, is variable, going from a softer phase, consistent with the BAT slope, to a harder phase (see Table 2 and Figure 2). A detailed analysis of this event is presented in Mangano et al. (2005).

Table 1. Light curve best fit parameters

	GRB050319	XRF050416A
Slope A	5.53 ± 0.67	2.6 ± 0.7
T_{break1}	384 ± 22	170 ± 40
Slope B	0.54 ± 0.04	0.44 ± 0.13
T_{break2}	$(2.6 \pm 0.7) \times 10^4$	1450 ± 20
Slope C	1.14 ± 0.2	0.87 ± 0.2

2. DISCUSSION

The two events show a very similar behaviour, with a light curve characterized by three distinct phases, in agreement with the standard model of the Swift afterglows, presented in Zhang et al. (2005) (see also Nousek et al., 2005; Chincarini et al. , 2005). In both cases, the very good agreement of the XRT phase A data points with the extrapolation at low energy of the BAT fluxes suggests that this phase is the low energy tail of the prompt emission. This seems to be confirmed by the spectral analysis, where the X-ray spectrum evolves from

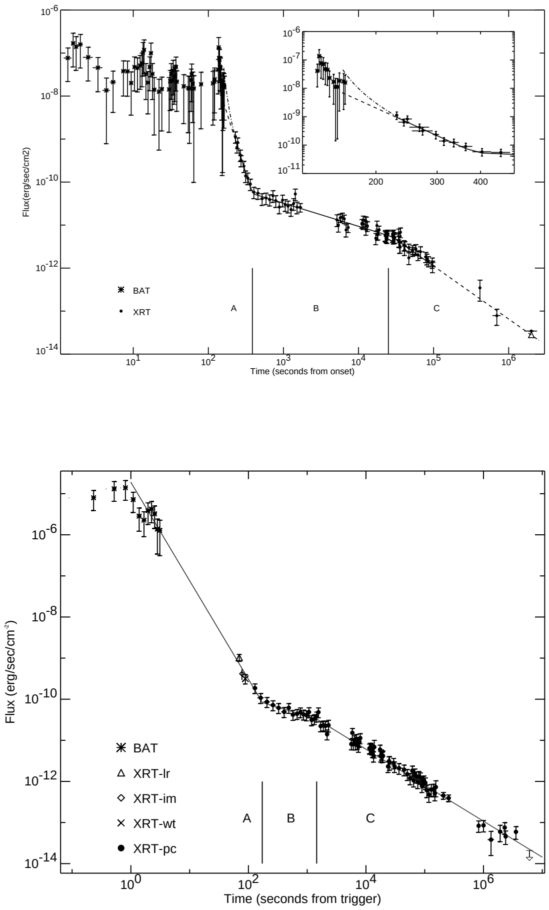

Figure 1. Top panel: GRB050319 light curve in the 0.2-10 keV band. The inset shows the good matching between the XRT and BAT light curves. Bottom panel: XRF050416A light curve in the 0.2-10 keV band. In both cases the BAT data are extrapolated into the XRT band using the best fit parameters derived from the spectral analysis

a steeper phase, with spectral index consistent with the BAT values, to a flatter phase. In this scenario, the flattening after the first break could be interpreted as the injection of additional energy from the central engine (refreshed shock). The last phase is consistent with a standard fireball evolution. The observed phenomenology suggests that XRFs and GRBs may share the same physical origin.

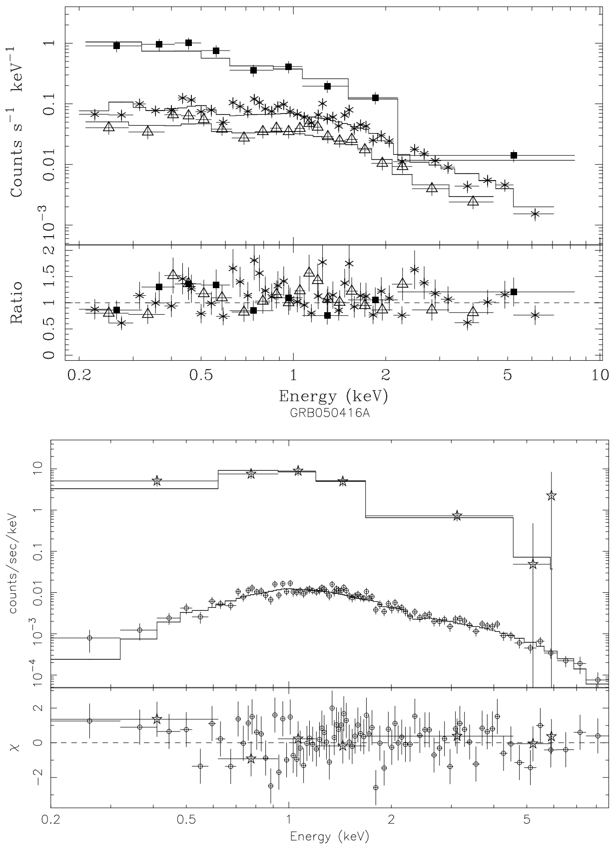

Figure 2. Top panel: GRB050319 XRT spectra and residuals of phases A (squares), B (stars) and C (triangles). Bottom panel: XRF050416A XRT spectra and residuals of phase A (stars) and B+C (circles)

Table 2. Spectrum best fit parameters

		GRB050319		XRF050416A
N_H(Gal.)		1.13×10^{20}		0.21×10^{21}
N_H(Intr.)		...		$(6.8 \pm 1.1) \times 10^{21}$
Γ_{BAT}		2.1 ± 0.2		2.9 ± 0.2
Γ_{XRT}	A	2.60 ± 0.22	A	3.0 ± 0.4
	B	1.69 ± 0.06	B+C	2.04 ± 0.11
	C	1.8 ± 0.08		

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