A Tale of Two Faint Bursts

University of Leicester

Kim Page (University of Leicester), on behalf of the *Swift*-XRT Team.

kpa@star.le.ac.uk

GRBs 050223 and 050911 were discovered by the *Swift*-BAT on 23rd Feb. and 11th Sept. 2005. The observation of GRB050223 showed a faint, fading X-ray source, which was identified as the afterglow; GRB050911, however, was not detected, making any X-ray afterglow extremely faint. The faintness of the afterglow of GRB050223 could be explained by a large opening or viewing angle, or by the burst being at high redshift. The complete non-detection of GRB050911 may indicate the burst occurred in a low-density environment, or, alternatively, was due to a compact object merger.

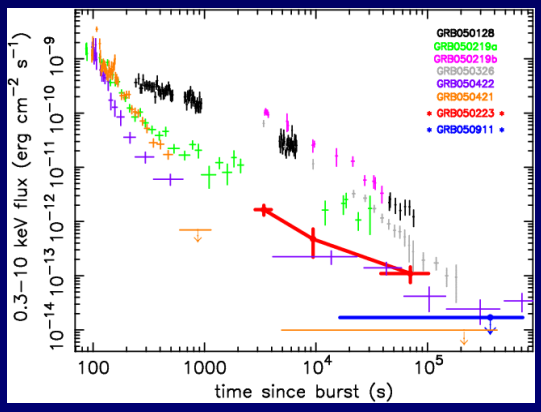

Figure 1: Flux light-curves for a selection of *Swift* GRBs, showing the faintness of the X-ray afterglows of GRB050223 (thick red line) and GRB050911 (blue 3σ upper limit). Adapted from Nousek et al. (2005).

The bursts are faint in both prompt and afterglow emission (see Table 1 and Figures 1 & 2). In the case of GRB050223, the X-ray flux at 11 hours was below all those detected by *BeppoSAX* (Piro 2004). The flux upper limit for GRB050911 shows that, at ~10^4 s, any X-ray afterglow emission was at least an order of magnitude fainter than all of the other long bursts detected by *Swift*, with the possible exception of GRB050421 (Godet et al. 2005).

Burst	GRB050223	GRB050911	Swift mean
T_{90} (s)	23	16	46
15-150 keV fluence (erg cm^{-2})	4.8 x 10^{-8}	3.0 x 10^{-7}	2.3 x 10^{-6}
0.3-10 keV unabs. flux (erg cm^{-2} s^{-1})	8.2 x 10^{-13}	UL: 1.7 x 10^{-14}	5.2 x 10^{-10}
[time range post-burst]	[2.8-4.0 ks]	[16-716 ks]	[large range]

Table 1: Burst parameters.

GRB050223 – a large opening/viewing angle or high redshift?

Using the standard GRB afterglow models (Zhang & Mészáros 2004), the data are inconsistent with post-jet-break evolution. A large opening angle could explain both a late jet-break and the faintness of the afterglow, as well as the BAT fluence being relatively low.

Alternatively, the low afterglow flux and prompt fluence could be caused by the burst being at high redshift; *Swift* GRBs are at a mean redshift of ~2.1, while pre-*Swift*, the mean was ~1.2.

See Page et al. (2005a) for more details.

GRB050911 – a "naked GRB" or a merger?

The complete non-detection of an X-ray afterglow is very unusual for *Swift* bursts. Before GRB050911, only 4 other *Swift* GRBs were undetected by the XRT, all of which were slewed to after longer intervals than for GRB050911. Thus, any afterglow must have faded very rapidly or been extremely faint. One possible explanation is the "naked GRB" model, whereby the burst occurs in a low density environment, with the lack of surrounding material leading to a weak, or non-existent, forward shock. This may be the explanation for GRB050421 (Godet et al. 2005).

Short bursts (T_{90} < 2 s; thought to be formed through compact object mergers) tend to show weak afterglows, fading below the XRT detection threshold rapidly. Although T_{90} > 2 s for GRB050911, there are 2 initial short (~0.5 s) spikes. Thus, GRB050911 is like many short bursts in showing an initial short peak followed by longer, softer faint high energy emission (Norris & Bonnell 2005). It could have been caused by a merger event: if one of the compact objects were a black hole, rather than a neutron star, the large mass ratio could lead to delayed accretion and, hence, later (after 2 s) emission (Davies, Levan & King 2005).

See Page et al. (2005b) for more details.

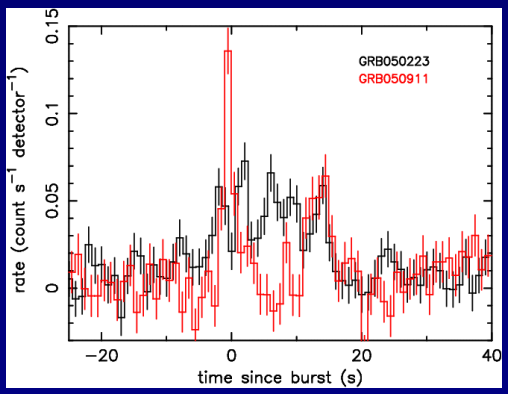

Figure 2: BAT light-curves (1-s bins) showing the count-rate per fully illuminated detector.

References

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Conclusions

The X-ray afterglows of both GRB050223 and GRB050911 are among the faintest at early times. Although *Swift* has the ability to measure faint X-ray emission out to many days after the burst, some afterglows are still too weak to be detected, indicating a difference in environment and/or formation method.