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From hours to years: Swift's revolutionary view of SFXTs

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Abstract. Bright hard-X–ray flares of Supergiant Fast X–ray Transients (SFXTs) have triggered *Swift* since launch. We present the most recent results on *Swift* follow-ups of outburst from SFXTs as investigated within our *Swift* Supergiant Fast X–ray Transients Project.

Key words. X-rays: binaries – X-rays: individual: IGR J16418−4532, AX J1841.0−0536

1. Introduction

Supergiant Fast X–ray Transients (SFXTs) are high-mass X–ray binaries, associated with OB supergiant companions, known for their characteristic flaring behavior, with peak X–ray luminosities reaching 10^{36}–10^{37} erg s^{-1} lasting hours (Sguera et al. 2005), a power-law X–ray spectrum with an exponential cutoff and an X–ray dynamic range of 3–5 orders of magnitude. Such flares have triggered the *Swift*/BAT since launch. To ensure simultaneous narrow-field instrument data, the *Swift* team has enabled automatic rapid slews to these objects following a BAT detection of flares, as is done for GRBs. The *Swift* SFXT Project[1] takes advantage of *Swift*'s unique capabilities of automatic fast-slewing and broad-band energy coverage. Our strategy has tripled the available sets of broad-band data of SFXT outbursts. Furthermore, thanks to *Swift*'s flexible scheduling, we investigated the long term properties of SFXTs through monitoring campaigns (Romano et al. 2011, and references therein) while outside the outbursts, where the very high sensitivity of XRT can be best exploited.

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[1] http://www.ifc.inaf.it/sfxt/

2. The 2012 June 3 flare of IGR J16418−4532

The *Swift*/BAT triggered on IGR J16418−4532 on 2012 Jun 3 at 18:08:48 UT (320-s image trigger 523489, Romano et al. 2012b). *Swift* performed an immediate slew, so that XRT imaged the field at T+448 s (T is the trigger time). The BAT event-by-event mask-weighted light

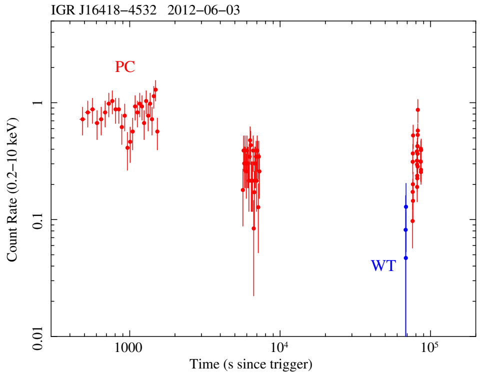

Fig. 1. Light curve of the 2012 June 3 outburst of IGR J16418−4532: WT (blue) and PC (red) data.

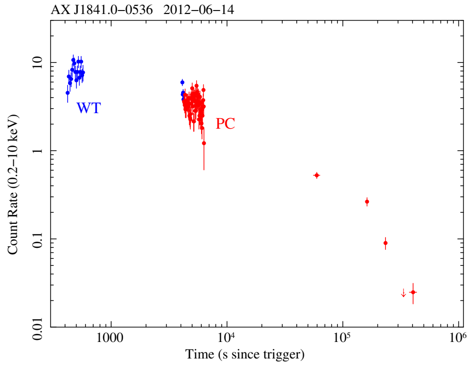

Fig. 2. Light curve of the 2012 June 14 outburst of AX J1841.0−0536: WT (blue) and PC (red) data.

curve (T−221 to T+963 s) of this rather faint flare starts at T−100 s, broadly peaks at 0.02 ph cm^{-2} s^{-1} and then mildly decreases after T+300 s. Emission is observed up to T+1500 s (when the DPH data stop). The BAT average spectrum (T+0 to T+320 s) is best fit by a simple power-law model with a photon index $\Gamma = 2.75 \pm 0.59$ (90% c.l.). The XRT light curve (Figure 1) shows an initial flare that reached about 2 counts s^{-1}, followed by a second and third orbits of data at $\sim$ 0.2 counts s^{-1}. The mean XRT/PC spectrum (T+466 to T+7318 s since the trigger) can be fit with an absorbed power law with a photon index of $\Gamma = 2.6^{+0.9}_{-0.8}$ and $N_{\rm H} = (37^{+9}_{-8}) \times 10^{22}$ cm^{-2}, in excess of the Galactic value (1.59×10^{22} cm^{-2}, Kalberla et al. 2005) and the values reported in (Romano et al. 2012c). The average 2–10 keV observed (unabsorbed) flux is 9×10^{-11} (5×10^{-10}) erg cm^{-2} s^{-1}.

3. The 2012 June 14 flare of AX J1841.0−0536

BAT triggered on AX J1841.0−0536 on 2012 Jun 14 at 19:11:51 UT (image trigger 524364, Romano et al. 2012a). The slew was immediate, so that XRT imaged the field at T+410 s. The BAT mask-weighted light curve starts at T−100 s, with the source already active. The flux then decreased and reached a minimum at T+80 s and a subsequent broad maximum between T+350 and 600 s. The mean BAT spectrum (T−91 to T+811 s) is best fit by a simple power-law model, with $\Gamma = 2.51 \pm 0.17$. Figure 2 shows the XRT light curve. The average XRT/WT (T+416 to T+4210 s, on-source exposure 257 s) and PC (T+4212 to T+6323 s, on-source exposure 2111 s) spectra can be fit simultaneously with a power law with $\Gamma = 0.7 \pm 0.1$, absorbed by a column of $N_{\rm H} = (1.8 \pm 0.3) \times 10^{22}$ cm^{-2} (consistent with the Galactic one, 1.59×10^{22} cm^{-2}), and a mean 2–10 keV observed (unabsorbed) fluxes of 5.8×10^{-10} (6.4×10^{-10}) erg cm^{-2} s^{-1} (WT) and 4.1×10^{-10} (4.4×10^{-10}) erg cm^{-2} s^{-1} (PC).

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