Mem. S.A.It. Vol. 84, 604

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IGR J08408−4503 in outburst observed by *Swift*

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Abstract. Supergiant Fast X-ray Transients (SFXTs) are accreting HMXBs with OB supergiant companions showing outbursts in the soft/hard X–rays with an increase of 3−5 orders of magnitudes in the luminosity for a few hours followed by smaller amplitude flaring activity. We report on the analysis of the 2011 outburst of IGR J08408−4503 caught by *Swift*/BAT (15−150 keV) and followed up at softer energies (0.2−10 keV) with *Swift*/XRT. The spacecraft automatic slew and BAT/XRT simultaneous observations allowed us for the first time resolved broadband spectral analysis of the outburst emission for this source. We searched for spectral evolution and compare our results with those of IGR J16479−4514 time resolved spectral analysis.

Key words. X-rays: binaries – X-rays: individual: IGR J08408−4503, IGR J164794514

1. Introduction

Supergiant Fast X-ray transients (SFXTs) are Galactic hard X–ray transients showing hour-long outbursts with spectra resembling those of accreting neutron stars (NS) and peak luminosities of $10^{36} - 10^{37}$ erg s^{-1}. They differ from persistent HMXBs because *(i)* they have blue OB supergiant companion stars, *(ii)* they show very high dynamical range in outbursts (3−5 orders of magnitude). IGR J08408−4503 is an SFXT discovered in 2006 (Götz et al. 2007). Romano et al. (2009) reported on the analysis of two outbursts caught by *Swift*/BAT and followed-up at softer energies with *Swift*/XRT, on 2006 October 4 (Kennea and Campana 2006) and 2008 July 5 (Mangano et al. 2008). IGR J08408−4503 triggered the BAT again on 2009 August 28 (Barthelmy et al. 2009), 2010 March 28 (Romano et al. 2010) and 2011 August 25 (Mangano et al. 2011), but only in the latter case the XRT follow-up was quick enough to allow for broad band (0.3−100 keV) time resolved spectral analysis (see the BAT and XRT light curves shown in Fig. 1).

We present results of the fits of simultaneous BAT and XRT spectra obtained from *Swift* observations of the 2011 August 25 outburst of IGR J08408−4503 and compare them with what obtained in the time resolved spectral analysis of the outburst of 2008 March 19 of the prototype SFXT IGR J16479−4514 already published in Romano et al. (2008).

2. Analysis

The *Swift*-BAT and XRT data have been reduced with the `heasoft6.11` suite. Accurate investigation of the BAT and XRT data in Fig. 1 allowed us to select four time intervals where both BAT and XRT spectra showed

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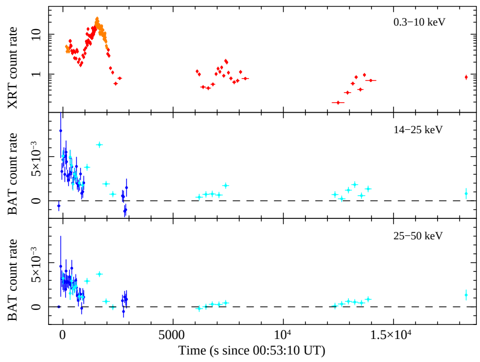

Fig. 1. XRT and BAT light curves of the 2011 August 25 outbursts of IGR J08408−4503. Red points refer to XRT data in Photon Counting (PC) mode; orange points refer to XRT data in Windowed Timing (WT) mode; blue points are form BAT event data and cyan points are from BAT survey data. The zero reference time is the BAT trigger time.

Table 1. Best fit parameter values for the spectra A, B, C, and D obtained with the models `wabs*cutoffpl` and `wabs*compTT`, labelled as MP and MC, respectively. N_H is the neutral hydrogen column density (in units of 10^{22} cm^{-2}), Γ is the power law photon index, E_c is the cut-off energy (in keV), T_0 is the temperature of the Comptonized seed photons (in keV), T_e and τ are the temperature (in keV) and the optical depth of the Comptonizing electron plasma (in spherical geometry).

MP	N_H	Γ	E_c (keV)		χ^2_ν (dof)
A	$7.7^{-2.7}_{+4.0}$	$0.04^{-0.43}_{+0.46}$	$10.8^{-2.4}_{+3.9}$	...	0.894(37)
B	$7.4^{-0.9}_{+1.1}$	$0.71^{-0.26}_{+0.26}$	$13.5^{-2.0}_{+4.3}$	...	1.32(143)
C	$5.9^{-1.5}_{+1.9}$	$0.25^{-0.30}_{+0.45}$	$6.7^{-2.5}_{+0.9}$	...	1.002(57)
D	$10.9^{-3.6}_{+5.9}$	$0.08^{-1.01}_{+1.11}$	$9.5^{-4.4}_{21.3}$	...	1.235(20)
MC	**N_H**	**T_0 (keV)**	**T_e (keV)**	**τ**	**χ^2_ν (dof)**
A	$4.5^{-1.9}_{+3.4}$	$2.08^{-0.69}_{+0.67}$	$7.9^{-1.4}_{+4.0}$	$9.4^{-4.2}_{+4.1}$	0.836(36)
B	$4.3^{-0.7}_{+0.8}$	$1.44^{-0.18}_{+0.16}$	$9.8^{-2.9}_{+10.1}$	$6.5^{-3.2}_{+6.2}$	1.25(142)
C	$3.6^{-1.1}_{+1.4}$	$1.46^{-0.36}_{+0.31}$	$7.1^{-2.9}_{+213.1}$	$7.0^{-6.7}_{+6.2}$	0.963(56)
D	$8.1^{-4.0}_{+9.5}$	$1.70^{-0.68}_{+1.07}$	$7.4^{-3.1}_{+247.7}$	$9.1^{-5.5}_{+11.4}$	1.259(19)

enough statistics for broad band spectral analysis. If we use the BAT trigger time *T* as zero reference time, the selected time intervals are the following: A: from T+292.47 to T+963.08 s, B: from T+1515 to T+1815 s, C: from T+1815 to T+2115 s, D: from T+6629.08 to T+7905.48 s. We fit all these spectra in the 0.3−100 keV band with an absorbed power-law model with high energy cut-off (`wabs*cutoffpl`) and an absorbed comptonized model (`wabs*compTT`). Both models have already been successfully used to describe *Swift* broad band spectra of SFXT outbursts for this and other sources(Romano et al. 2008, 2009). The the best fit parameters obtained are listed in Table 1.

3. Conclusions

In the IGR J16479−4514 outburst of 2008 March 19 we have been able to analyze three broad band spectra in the 0.3−100 keV band extracted during the rising of the explosive event. In the IGR J08408−4503 outburst of 2011 August 25 we could extract four broad band spectra, one before the peak of the emission, one at the peak and two during the decay phase of the event. Though the latter source is an order of magnitude less luminous, the spectral parameters of the two sources are similar and, in both cases, roughly constant in time. The spectra are always highly absorbed and well modeled by a power-law with high energy cut-off or a Comptonization model.

Acknowledgements. PR and VM acknowledge financial contribution from the agreement ASI-INAF I/009/10/0.

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