Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY LETTERS

Mon. Not. R. Astron. Soc. **412,** L30–L34 (2011) doi:10.1111/j.1745-3933.2010.00999.x

Confirmation of the supergiant fast X-ray transient nature of AX J1841.0−0536 from *Swift* outburst observations

P. Romano,[1⋆] V. Mangano,[1] G. Cusumano,[1] P. Esposito,[2] P. A. Evans,[3] J. A. Kennea,[4] S. Vercellone,[1] V. La Parola,[1] H. A. Krimm,[5,6] D. N. Burrows[4] and N. Gehrels[6]

[1]*INAF, Istituto di Astrofisica Spaziale e Fisica Cosmica, Via U. La Malfa 153, I-90146 Palermo, Italy*
[2]*INAF, Osservatorio Astronomico di Cagliari, località Poggio dei Pini, strada 54, I-09012 Capoterra, Italy*
[3]*Department of Physics & Astronomy, University of Leicester, Leicester LE1 7RH*
[4]*Department of Astronomy and Astrophysics, Pennsylvania State University, University Park, PA 16802, USA*
[5]*NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA*
[6]*Universities Space Research Association, Columbia, MD 21044-3432, USA*

Accepted 2010 November 29. Received 2010 November 25; in original form 2010 November 11

ABSTRACT

Swift observed an outburst from the supergiant fast X-ray transient (SFXT) AX J1841.0−0536 on 2010 June 5, and followed it with X-ray Telescope (XRT) for 11 d. The X-ray light curve shows an initial flare followed by a decay and subsequent increase, as often seen in other SFXTs, and a dynamical range of ∼1600. Our observations allow us to analyse the simultaneous broad-band (0.3–100 keV) spectrum of this source, for the first time down to 0.3 keV, which can be fitted well with models usually adopted to describe the emission from accreting neutron stars in high-mass X-ray binaries, and is characterized by a high absorption ($N_{\rm H} \sim 2 \times 10^{22}$ cm^{-2}), a flat power law ($\Gamma \sim 0.2$) and a high-energy cut-off. All of these properties resemble those of the prototype of the class, IGR J17544−2619, which underwent an outburst on 2010 March 4, whose observations we also discuss. We show how well AX J1841.0−0536 fits in the SFXT class, based on its observed properties during the 2010 outburst, its large dynamical range in X-ray luminosity, the similarity of the light curve (length and shape) to those of the other SFXTs observed by *Swift* and the X-ray broad-band spectral properties.

Key words: X-rays: binaries – X-rays: individual: AX J1841.0−0536 – X-rays: individual: IGR J17544−2619.

1 INTRODUCTION

Supergiant fast X-ray transients (SFXTs) are a new class of high mass X-ray binaries (HMXBs) discovered by *INTEGRAL* (e.g. Sguera et al. 2005) that are associated with OB supergiant stars via optical spectroscopy. In the X-rays they display outbursts significantly shorter than those of typical Be/X-ray binaries characterized by bright flares with peak luminosities of 10^{36}–10^{37} erg s^{-1} which last a few hours (as observed by *INTEGRAL*; Sguera et al. 2005; Negueruela et al. 2006). As their quiescence is characterized by a luminosity of $\sim 10^{32}$ erg s^{-1} (e.g. in't Zand 2005; Bozzo et al. 2010), their dynamic range is of 3–5 orders of magnitude. While in outburst, their hard X-ray spectra resemble those of HMXBs hosting accreting neutron stars, with hard power laws below 10 keV combined with high-energy cut-offs at ∼15–30 keV, sometimes strongly absorbed at soft energies (Sidoli, Paizis & Mereghetti 2006; Walter et al. 2006). So, even if pulse periods have only been measured for a few SFXTs, it is tempting to assume that all SFXTs might host a neutron star. The mechanism producing the outbursts is still being debated, and it is probably related to either the properties of the wind from the supergiant companion (in't Zand 2005; Sidoli et al. 2007; Walter & Zurita Heras 2007; Negueruela et al. 2008) or to the presence of a centrifugal or magnetic barrier (Grebenev & Sunyaev 2007; Bozzo, Falanga & Stella 2008).

AX J1841.0−0536 was discovered during *ASCA* observations of the Scutum arm region performed on 1994 April 12 and 1999 October 3–4 as a flaring source which exhibited flux increases by a factor of 10 (up to $\sim 10^{-10}$ erg cm^{-2} s^{-1}) with rising times of the order of 1 hr (Bamba et al. 2001), a strong absorption $N_{\rm H} = 3 \times 10^{22}$ cm^{-2} and coherent pulsations with a period of 4.7394 ± 0.0008 s. A *Chandra* observation on 2004 May 12, which provided the coordinates refined to arcsecond accuracy [RA(J2000) = $18^{\rm h}41^{\rm m}0\overset{\rm s}{.}54$, Dec.(J2000) = $-5°35'46\overset{''}{.}8$; Halpern & Gotthelf (2004)], found the source at a much fainter level (4×10^{-12} erg cm^{-2} s^{-1}) and with a spectrum that was fitted with an absorbed power-law model [$\Gamma = 1.35 \pm 0.30$, $N_{\rm H} = (6.1 \pm 1.0) \times 10^{22}$ cm^{-2}]. A newly discovered source, IGR J18410−0535, was

⋆E-mail: romano@ifc.inaf.it

observed to flare by *INTEGRAL* on 2004 October 8 (Rodriguez et al. 2004), as it reached ≈70 mCrab in the 20–60 keV energy range (integrated over 1700 s) and 20 mCrab in the 60–200 keV range. The source was also detected in the 20–60 keV energy range in subsequent observations, at a flux roughly half that of the initial peak. Halpern & Gotthelf (2004) identified IGR J18410−0535 as AX J1841.0−0536. Halpern et al. (2004) established that the IR counterpart was 2MASS 18410043−0535465, a reddened star with a weak double-peaked Hα emission line, initially classified as a Be star, which Nespoli, Fabregat & Mennickent (2008) later reclassified as B1 Ib type star; this corroborated the evidence that AX J1841.0−0536 is a member of the SFXT class, as proposed by Negueruela et al. (2006). Sguera et al. (2009) presented the first broad-band spectrum of this source, obtained with *INTEGRAL* (IBIS+JEM-X), that they fitted with an absorbed power law with $\Gamma = 2.5 \pm 0.6, N_{\rm H} = 23^{+19}_{-14} \times 10^{22}\,{\rm cm}^{-2}$.

In 2007, *Swift* (Gehrels et al. 2004) observed the outburst of the periodic SFXT IGR J11215−5952 (Romano et al. 2007), which allowed us to discover that the accretion phase during the bright outbursts lasts much longer than a few hours, as seen by lower sensitivity instruments. This is contrary to what was initially thought at the time of the discovery of this new class of sources. Between 2007 October 26 and 2008 November 15, AX J1841.0−0536 was observed by *Swift* as part of a sample of four SFXTs which included IGR J16479−4514, XTE J1739−302 and IGR J17544−2619. The main aims were to characterize their long-term behaviour, to determine the properties of their quiescent state, to monitor the onset of the outbursts and to measure the outburst recurrence period and duration (Sidoli et al. 2008; Romano et al. 2009c, 2011). Approximately, two observations per week were collected with the X-ray Telescope (XRT; Burrows et al. 2005) and the UV/Optical Telescope (UVOT; Roming et al. 2005). During such an intense and sensitive monitoring, AX J1841.0−0536 was the only SFXT that did not go through a bright outburst, although several on-board Burst Alert Telescope (BAT; Barthelmy et al. 2005) detections have been recorded (Romano et al. 2009c).

In this Letter, we report on the observations of the first outburst of AX J1841.0−0536 observed by *Swift* on 2010 June 5 and we compare its properties with those of the prototype of the SFXT class, IGR J17544−2619, which went into a bright outburst on 2010 March 04.

2 OBSERVATIONS AND DATA REDUCTION

AX J1841.0−0536 triggered the *Swift*/BAT on 2010 June 5 at 17:23:30 UT (trigger 423958, de Pasquale et al. 2010; Romano et al. 2010b). This is the first outburst of AX J1841.0−0536 detected by the BAT for which *Swift* performed a slew, thus allowing broad-band data collection. The source was detected in a 1344 s BAT image trigger, during a pre-planned observation, and there is an indication that the source was already in outburst before this observation began and well after it ended. The XRT began observing the field rather late, at 17:51:50 UT ($T + 1708$ s), after the very long BAT image trigger. The automated target (AT; sequences 00423958000-001; Table S1) observations lasted for several orbits, until ∼59 ks after the trigger. Follow-up target of opportunity (ToO) observations for a total of 10.8 ks were obtained (sequences 00030988093–101). The data cover the first 11 d after the beginning of the outburst.

The SFXT prototype IGR J17544−2619 triggered the BAT on 2010 March 04 at 23:13:54 UT (trigger 414875, Romano et al. 2010a). *Swift* executed an immediate slew, so that the narrow-field instruments (NFI) started observing it about 395 s after the trigger. The AT ran for ∼5 ks and was followed by one ToO observation (00035056149) for ∼0.8 ks until the source went into Moon constraint; Table S1.

The XRT data were processed with standard procedures (XRTPIPELINE v0.12.4), filtering and screening criteria by using FTOOLS in the HEASOFT package (v.6.9), as fully described in e.g. (Romano et al. 2011). We used the latest spectral redistribution matrices (20100930). The BAT data were analysed using the standard BAT analysis software within FTOOLS. Mask-tagged BAT light curves were created in several energy bands (see Romano et al. 2011, for further details). Survey data products, in the form of Detector Plane Histograms (DPH), are available, and were also analysed with the standard BATSURVEY software. All quoted uncertainties are given at 90 per cent confidence level for one interesting parameter unless otherwise stated.

3 RESULTS

3.1 Light curves

Fig. 1 (left-hand panel) shows the *Swift*/XRT 0.2–10 keV light curve of AX J1841.0−0536 throughout our 2008 monitoring programme (Romano et al. 2009c) background-subtracted and corrected for pile-up, PSF losses and vignetting. All data in one observation (1–2 ks, typically) were generally grouped as one point, except for the June 5 outburst, which shows up as a vertical line on the adopted scale (Fig. 1, right-hand panel). The observed dynamical range of this source in the XRT band is ≈1600, considering as the lowest point a 3σ upper limit obtained on MJD 54420 at 5×10^{-3} count s^{-1}, and the highest point the peak of the June 5 outburst. Fig. 2 shows the detailed light curves during the brightest part (first orbit) of the outburst in several energy bands. The BAT light curve is rather flat and weak, but significant signal is found at the lower energies (15–50 keV).

For the timing analysis, we converted the event arrival times to the Solar system barycentre with the task BARYCORR and the *Chandra* position (Halpern & Gotthelf 2004). We note that the XRT PC-mode read-out frequency slightly undersamples the source period of ∼4.7 s (Bamba et al. 2001) with respect to its Nyquist frequency, which would guarantee an unambiguous reconstruction of the signal. Timing searches were conducted in various time intervals and energy ranges around ∼4.7 s, employing two methods: a fast-folding algorithm and an unbinned Z_n^2 test (Buccheri et al. 1983). In both cases, the searches were inconclusive and we could

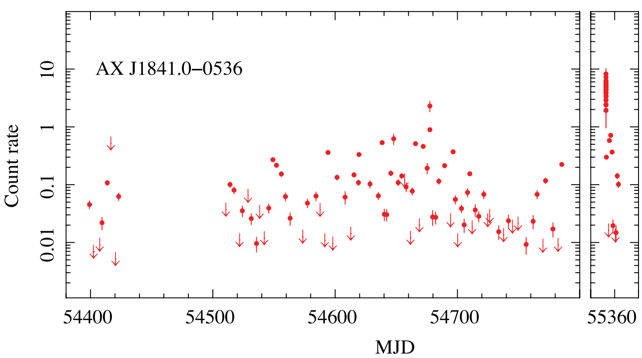

Figure 1. Left-hand panel: *Swift*/XRT (0.2–10 keV) light curve of the 2007–08 monitoring campaign (2007 October 26 to 2008 November 15; Romano et al. 2009c). Right-hand panel: light curve of the 2010 June 5 outburst in the same time-scale. The downward-pointing arrows are 3σ upper limits.

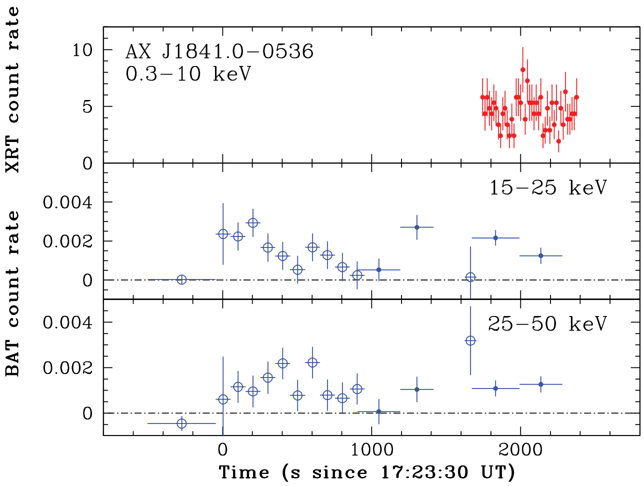

Figure 2. XRT and BAT light curves of the initial orbit of data of the 2010 June 5 outburst of AX J1841.0−0536 in units of count s^{-1} and count s^{-1} detector^{-1}, respectively. The empty circles correspond to BAT in event mode (S/N = 5), filled circles to BAT survey mode data.

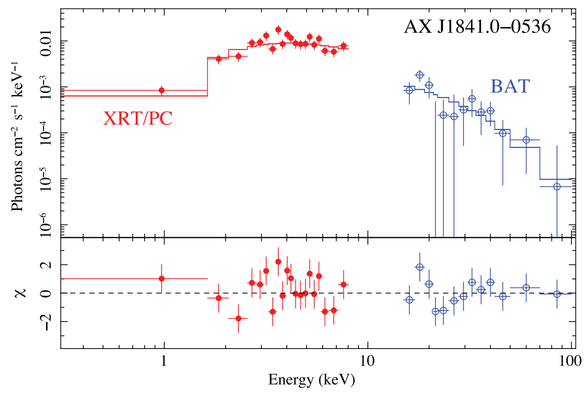

Figure 3. Spectroscopy of the 2010 June 5 outburst of AX J1841.0−0536. Top panel: simultaneous XRT/PC (filled red circles) and BAT (empty blue circles) data fit with the HIGHECUT model. Bottom panel: the residuals of the fit (in units of standard deviations).

not set meaningful upper limits on the pulsed fraction, because of the red noise and the scalloping due to the poor sampling.

3.2 Spectra

For the 2010 June 5 outburst of AX J1841.0−0536, we extracted the mean spectrum of the brightest X-ray emission (observation 00423958000, T+1708 to 2390 s) and performed a fit in the 0.3–10 keV band of the data, which were rebinned with a minimum of 20 count bin^{-1} to allow χ^2 fitting. An absorbed power-law model yielded a column of $N_{\rm H} = 2^{+2}_{-1} \times 10^{22}$ cm^{-2}, a photon index $\Gamma = 0.6^{+0.6}_{-0.5}$ [$\chi^2_\nu = 1.56$, 17 degrees of freedom (d.o.f.)] and a 2–10 keV unabsorbed flux of $F_{2-10\,\rm keV} = 6.3 \times 10^{-10}$ erg cm^{-2} s^{-1}. As there is no strict overlap between the BAT event data and the XRT data (see Fig. 2), we extracted one spectrum from the BAT event file of the whole observation 00423958000 (‘event’), and one from the XRT event file in the same observation. There are, however, BAT survey data available in the interval T + 1672–1992 s, and we extracted one (‘survey’) spectrum in this restricted interval. We performed joint fits in the 0.3–10 and 14–100 keV energy bands for XRT and BAT, respectively. A factor was included to allow for normalization uncertainties between the two spectra. The broad-band fits performed with the BAT ‘survey’ spectrum yield consistent results with the ones performed with the BAT ‘event’ spectrum, albeit with more unconstrained parameters due to the much more limited statistics. Therefore, in Table 1 we report the fits performed with the BAT ‘event’ spectrum. A simple absorbed power-law model is clearly an inadequate representation of the broad-band spectrum ($\chi^2_\nu = 1.6$ for 29 d.o.f.), so we also considered other models typically used to describe the X-ray emission from accreting pulsars in HMXBs, such as an absorbed power-law model with an exponential cut-off (CUTOFFPL in XSPEC) and an absorbed power-law model with a high-energy cut-off (HIGHECUT). The latter models provide a significantly more satisfactory fit of the broad-band emission, resulting in a hard power-law-like spectrum below 10 keV, with a roll over of the higher energies when simultaneous XRT and BAT data fits are performed. Fig. 3 shows the fits for the HIGHECUT model. Table 1 reports the average 2–10 keV luminosities. Two estimates of the distance are available from Nespoli et al. (2008; $3.2^{+2.0}_{-1.5}$ kpc) and Sguera et al. (2009; 6.9 ± 1.7 kpc), so we assumed 5 kpc, which is consistent with both.

3.3 IGR J17544−2619

Fig. 4 shows the first orbit of the XRT and BAT light curves of the 2010 March 04 outburst of IGR J17544−2619. The XRT count rate reaches a peak exceeding 25 count s^{-1}, then decreases to about 0.5 count s^{-1} and increases again up to about 20 count s^{-1} at the end of the first orbit of observations.

The XRT/WT spectrum (T + 401–839 s), extracted with a grade 0 selection to mitigate residual calibration uncertainties at low energies, was fitted with an absorbed power law resulting in $\Gamma = 0.9^{+0.1}_{-0.1}$, $N_{\rm H} = (0.9^{+0.2}_{-0.1}) \times 10^{22}$ cm^{-2} ($\chi^2_\nu = 0.989$ for 125 d.o.f.) and $F_{2-10\,\rm keV} \sim 1.9 \times 10^{-9}$ erg cm^{-2} s^{-1} (unabsorbed). The XRT/PC spectrum (T + 840 to T + 2242 s) yields $N_{\rm H} = (1.8^{+0.7}_{-0.5}) \times 10^{22}$ cm^{-2}, $\Gamma = 1.5^{+0.4}_{-0.4}$ ($\chi^2_\nu = 748$, 17 d.o.f.) and $F_{2-10\,\rm keV} \sim 1.9 \times 10^{-10}$ erg cm^{-2} s^{-1} (unabsorbed). We extracted a BAT

Table 1. Spectral fits of XRT and BAT data of the outburst of AX J1841.0−0536 and IGR J17544−2619.

Model	$N_{\rm H}$	Γ	$E_{\rm c}$	$E_{\rm f}$	F	L	χ^2_ν/d.o.f.	$N_{\rm H}$	Γ	$E_{\rm c}$	$E_{\rm f}$	F	L	χ^2_ν/d.o.f.
AX J1841.0−0536								IGR J17544−2619						
POW[a]	$5.2^{+2.4}_{-2.2}$	$1.4^{+0.5}_{-0.6}$			0.5	2.0	1.6/29	$1.9^{+0.2}_{-0.2}$	$1.8^{+0.1}_{-0.1}$			1.3	2.4	1.9/135
CPL[b]	$2.2^{+1.9}_{-1.1}$	$0.2^{+0.7}_{-0.6}$	16^{+21}_{-5}		0.6	1.8	1.2/28	$0.7^{+0.2}_{-0.2}$	$0.4^{+0.2}_{-0.2}$	7^{+2}_{-1}		1.6	2.7	1.1/134
HCT[c]	$1.9^{+1.7}_{-1.0}$	$0.2^{+0.4}_{-0.5}$	4^{+12}_{-4}	16^{+10}_{-9}	0.6	1.8	1.2/27	$0.7^{+0.2}_{-0.2}$	$0.6^{+0.2}_{-0.2}$	3^{+1}_{-1}	8^{+2}_{-2}	1.6	2.6	1.0/133

$N_{\rm H}$ is absorbing column density ($\times 10^{22}$ cm^{-2}); F is 2–10 keV observed flux ($\times 10^{-9}$ erg cm^{-2} s^{-1}) and L is 2–10 keV luminosity ($\times 10^{36}$ erg s^{-1}).
[a]Absorbed power law.
[b]Cut-off power law, energy cut-off $E_{\rm c}$ (keV).
[c]Absorbed power law, high-energy cut-off $E_{\rm c}$ (keV), e-folding energy $E_{\rm f}$ (keV).

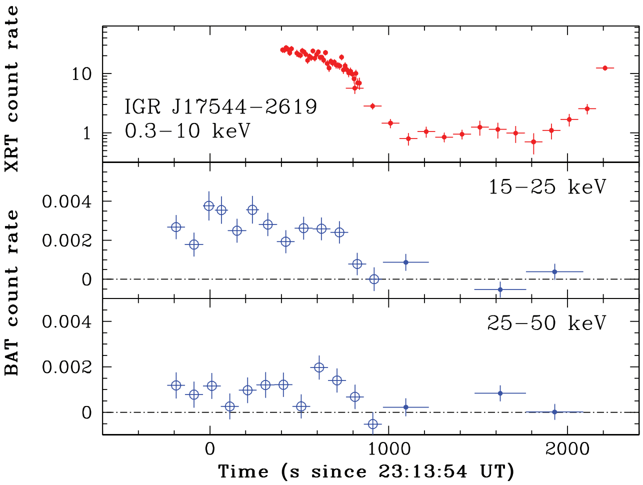

Figure 4. Same as Fig. 2 for the 2010 March 4 outburst of IGR J17544−2619.

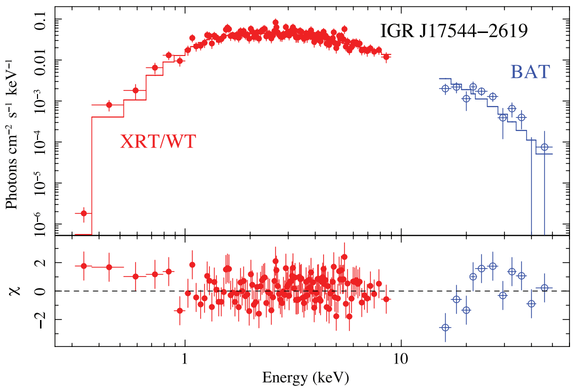

Figure 5. Same as Fig. 3 for the 2010 March 4 outburst of IGR J17544−2619.

spectrum strictly simultaneous with the XRT one and fitted them (0.3–10 keV, 14–50 keV) with the same models as adopted for AX J1841.0−0536. The results are in Table 1, while Fig. 5 shows the fits for the HIGHECUT model. For the luminosity calculation, we adopted a distance of 3.6 kpc (Rahoui et al. 2008).

4 DISCUSSION

In this Letter, we report our analysis of the 2010 June 5 outburst of AX J1841.0−0536 and the 2010 March 04 outburst of the SFXT prototype IGR J17544−2619. While in the first case, the image trigger was a very long one and NFI data could be collected only ∼1700 s after the trigger, when the source was relatively dim, in the second case, the slew occurred immediately after the trigger, while IGR J17544−2619 was still very bright.

Fig. 6 (panels e and g) shows the full light curves of the outbursts of AX J1841.0−0536 and IGR J17544−2619 as they were observed by *Swift* for 11 and 2 d, respectively, after the trigger. The AX J1841.0−0536 XRT light curve shows a decreasing trend from the initial bright flare from a maximum of ∼8 count s^{-1} down to ∼0.01 count s^{-1} during the first day, with several flares superimposed, hence yielding a dynamic range of approximately 900 during this outburst. Then, after 3 d, the source count rate rose again and reached ∼1 count s^{-1}. We estimate that the observed dynamical range of this source in the XRT band, considering the historical

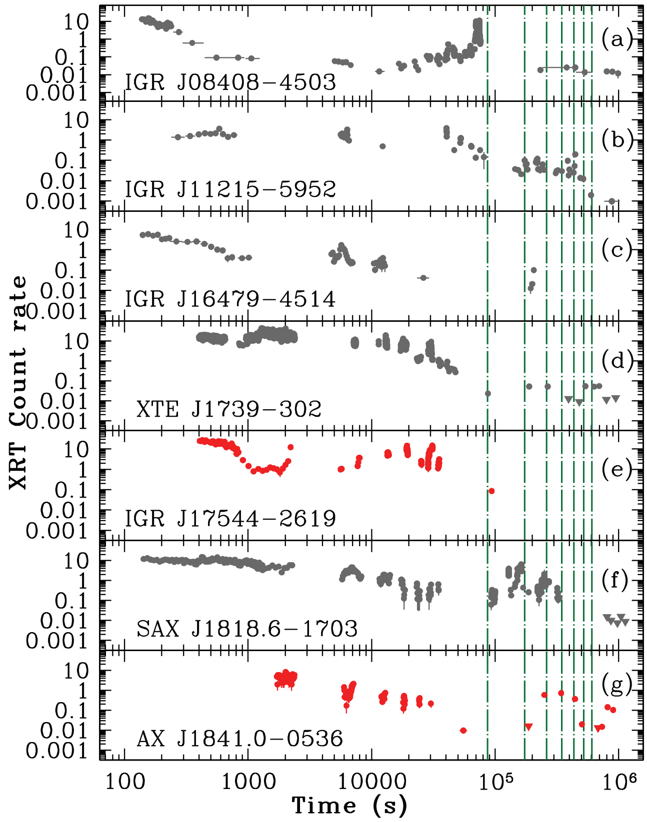

Figure 6. Light curves of the most representative outbursts of SFXTs followed by *Swift*/XRT referred to their respective BAT triggers (IGR J11215−5952 did not trigger the BAT, so it is referred to as MJD 54139.94). Points denote detections, triangles 3σ upper limits. Red data points (panels e and g) refer to observations presented here for the first time, while grey points to data presented elsewhere. Where no data are plotted, no *Swift* data were collected. Vertical dashed lines mark time intervals equal to 1 d, up to a week. References: IGR J08408–4503 (2008 July 5, Romano et al. 2009b; panel a); IGR J11215−5952 (2007 February 9, Romano et al. 2007; panel b); IGR J16479−4514 (2005 August 30, Sidoli et al. 2008; panel c); XTE J1739−302 (2008 August 13, Sidoli et al. 2009a; panel d); SAX J1818.6−1703 (2009 May 6, Sidoli et al. 2009b; panel f). Panels e and g report the 2010 March 4 outburst of IGR J17544−2619 and the 2010 June 5 outburst of AX J1841.0−0536, respectively (this work).

data we collected during our monitoring campaign (Sidoli et al. 2008; Romano et al. 2009c; see Fig. 1), is ≈1600, hence placing it well in the customary range for SFXTs.

The outburst of IGR J17544−2619 has similar characteristics to the one observed on 2008 March 31, as the XRT light curve shows a peak at about 25 count s^{-1}, decreases to about 0.5 count s^{-1} and then increases again up to about 20 count s^{-1} at the end of the first orbit (Fig. 4). This behaviour was previously observed in IGR J17544−2619 and, most notably, in IGR J08408−4503 (Romano et al. 2009b) and SAX J1818.6−1703 (Sidoli et al. 2009b), so that this multiple-peak structure of the light curve could be considered a defining characteristic of the SFXT class and it is likely due to inhomogeneities within the accretion flow (e.g. in't Zand 2005).

Fig. 6 compares the light curves of AX J1841.0−0536 and IGR J17544−2619 with the outbursts of SFXTs as observed during our monitoring campaigns with *Swift*. The most complete set of X-ray observations of an outburst of a SFXT is the one of the periodic SFXT IGR J11215−5952 (Romano et al. 2007; Sidoli et al. 2007; Romano et al. 2009a), which was surprisingly long. We now know that such a length of the outburst (hence the length of the accretion phase) is a common characteristic of the whole sample of SFXTs followed by *Swift*, and in this respect AX J1841.0−0536 fits right in, as its outburst lasted several days.

We have presented the broad-band (0.3–100 keV) simultaneous spectroscopy of AX J1841.0−0536. This allows us to make a comparison with the findings on the other SFXTs that were observed in the same fashion. The soft X-ray spectral properties observed during this flare are generally consistent with those observed with *ASCA* during the 1999 flare Bamba et al. (2001; $N_{\rm H} = 3 \times 10^{22}$ cm^{-2}, $\Gamma = 1$). As AX J1841.0−0536 was observed relatively late after the trigger, no meaningful information can be derived on variability of the soft spectral parameters during the outburst, such as the absorbing column density. However, we note that the value of Γ in outburst follows the same trend of 'harder when brighter' as reported in table 4 of (Romano et al. 2009c), which was based on out-of-outburst emission.

For the joint BAT+XRT spectrum during the 2010 June 5 outburst, an absorbed power-law model is an inadequate description, and more curvy models are required. We considered an absorbed power-law model with an exponential cut-off and an absorbed power-law model with a high-energy cut-off, models typically used to describe the X-ray emission from accreting neutron stars in HMXBs. We obtained a good fit of the 0.3–100 keV spectrum, characterized by high absorption $N_{\rm H} \sim 2 \times 10^{22}$ cm^{-2}, a hard power law below 10 keV and a high-energy cut-off. These properties of AX J1841.0−0536 are reminiscent of those of the prototypes of the SFXT class, IGR J17544−2619 (whose data we have presented here and in Sidoli et al. 2009c,a; Romano et al. 2011) and XTE J1739−302 (Sidoli et al. 2009c,a).

Although no statistically significant pulsations were found in the present data, AX J1841.0−0536 is one of the four SFXTs with known pulse period (Bamba et al. 2001), $P_{\rm spin} = 4.7394 \pm 0.0008$ s, the others being IGR J11215−5952 (186.78 ± 0.3 s; Swank, Smith & Markwardt 2007), IGR J16465−4507 (228 ± 6 s; Lutovinov et al. 2005) and IGR J18483−0311 (21.0526 ± 0.0005 s; Sguera et al. 2007). While lacking the detection of cyclotron lines, which would yield a direct measurement of the magnetic field B of the neutron star, an indirect estimate can be obtained by considering the HIGHECUT fit to the broad-band spectrum of AX J1841.0−0536 in outburst. Our value of the high-energy cut-off $E_{\rm c} < 16$ keV, although loosely constrained, yields a $B \lesssim 3 \times 10^{12}$ G (Coburn et al. 2002). This value for B, which is indeed similar to the one derived for the prototype of the SFXT class IGR J17544−2619, is inconsistent with a magnetar nature of AX J1841.0−0536.

In conclusion, we have shown how AX J1841.0−0536 nicely fits in the SFXT class, based on the observed properties of AX J1841.0−0536 during the 2010 June 5 outburst: a large dynamical range in X-ray luminosity, the similarity of the light-curve length and shape to those of the prototype of the class IGR J17544−2619 and the X-ray broad-band spectrum, which we show here for the first time down to 0.3 keV, thus constraining both the absorption and the cut-off energy.

ACKNOWLEDGMENTS

We thank the *Swift* team duty scientists and science planners and the remainder of the *Swift* XRT and BAT teams, S. Barthelmy in particular, for their invaluable help and support. This work was supported in Italy by contract ASI-INAF I/009/10/0, at PSU by NASA contract NAS5-00136. PE acknowledges financial support from the Autonomous Region of Sardinia through a research grant under the programme PO Sardegna FSE 2007–2013, L.R. 7/2007 'Promoting scientific research and innovation technology in Sardinia'.

REFERENCES

Bamba A. et al., 2001, PASJ, 53, 1179
Barthelmy S. D. et al., 2005, Space Sci. Rev., 120, 143
Bozzo E., Falanga M., Stella L., 2008, ApJ, 683, 1031
Bozzo E. et al., 2010, A&A, 519, A6
Buccheri R. et al., 1983, A&A, 128, 245
Burrows D. N. et al., 2005, Space Sci. Rev., 120, 165
Coburn W. et al., 2002, ApJ, 580, 394
de Pasquale M. et al., 2010, Astron. Telegram, 2661
Gehrels N. et al., 2004, ApJ, 611, 1005
Grebenev S. A., Sunyaev R. A., 2007, Astron. Lett., 33, 149
Halpern J. P., Gotthelf E. V., 2004, Astron. Telegram, 341
Halpern J. P. et al., 2004, Astron. Telegram, 289
in't Zand J. J. M., 2005, A&A, 441, L1
Lutovinov A. et al., 2005, A&A, 444, 821
Negueruela I. et al., 2006, in Wilson A., ed., ESA SP-604, The X-ray Universe 2005. ESA, Noordwijk, p. 165
Negueruela I. et al., 2008, in Bandyopadhyay R. M., Wachter S., Gelino D., Gelino C. R., eds, AIP Conf. Proc. Vol. 1010, Supergiant Fast X-ray Transients and Other Wind Accretors. Am. Inst. Phys., New York, p. 252
Nespoli E., Fabregat J., Mennickent R. E., 2008, A&A, 486, 911
Rahoui F., Chaty S., Lagage P.-O., Pantin E., 2008, A&A, 484, 801
Rodriguez J. et al., 2004, Astron. Telegram, 340
Romano P. et al., 2007, A&A, 469, L5
Romano P. et al., 2009a, ApJ, 696, 2068
Romano P. et al., 2009b, MNRAS, 392, 45
Romano P. et al., 2009c, MNRAS, 399, 2021
Romano P. et al., 2010a, Astron. Telegram, 2463
Romano P. et al., 2010b, Astron. Telegram, 2662
Romano P. et al., 2011, MNRAS, 410, 1825
Roming P. W. A. et al., 2005, Space Sci. Rev., 120, 95
Sguera V. et al., 2005, A&A, 444, 221
Sguera V. et al., 2007, A&A, 467, 249
Sguera V. et al., 2009, ApJ, 697, 1194
Sidoli L., Paizis A., Mereghetti S., 2006, A&A, 450, L9
Sidoli L. et al., 2007, A&A, 476, 1307
Sidoli L. et al., 2008, ApJ, 687, 1230
Sidoli L. et al., 2009a, MNRAS, 397, 1528
Sidoli L. et al., 2009b, MNRAS, 400, 258
Sidoli L. et al., 2009c, ApJ, 690, 120
Swank J. H., Smith D. M., Markwardt C. B., 2007, Astron. Telegram, 999
Walter R., Zurita Heras J., 2007, A&A, 476, 335
Walter R. et al., 2006, A&A, 453, 133

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Table S1. Summary of the *Swift* observations.

Please note: Wiley-Blackwell are not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

This paper has been typeset from a TEX/LATEX file prepared by the author.