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Swift follow-up observations of 13 INTEGRAL sources

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ABSTRACT

The various IBIS/ISGRI catalogs contain a large population of hard X-ray sources whose nature is still unknown. Even if > 20 keV positional uncertainty provided by ISGRI is unprecedented, it is still to large to pinpoint the counterpart at other wavelengths, which is the only secure way to obtain a source identification. We, here, continue the work of trying to reveal the nature of these hard X-ray sources, starting with the analysis of X-ray data collected via focusing X-ray telescopes, in order to obtain arcsec accurate X-ray positions. We can then identify counterparts at infrared and optical wavelengths and try to unveil the nature of the sources. We analysed data from observations of 13 *INTEGRAL* sources made with the *Swift* satellite. The X-ray images obtained by the X-Ray Telescope instrument allowed us to find possible counterparts to the IGR sources with positional accuracy of a few arcsec. We then browsed the online catalogs (e.g., NED, SIMBAD, 2MASS, 2MASX, USNO B1.0) to search for counterparts at other wavelengths. We also made use of the X-ray spectral parameters in trying to identify the nature of those objects. For the 13 objects, we found possible counterparts at X-ray energies and identified the IR/optical and/or UV counterparts as seen with *Swift*/UVOT. In each case, we also discuss the likelihood of association of the X-ray and *INTEGRAL* source. We confirm the previously proposed classification of IGR J02524−0829 (Sey 2 AGN), J08023−6954 (RS CVn star), and J11457−1827 (Sey 1 AGN). For 7 of these sources we give the first identification of their nature: IGR J02086−1742, J12060+3818, J12070+2535, J13042−1020, and J13412+3022 are AGN, and J14488−5942 is a probable X-ray Binary, and for J03184−0014, although we question the association of the IGR and *Swift* sources, we classify the latter as an AGN. We suggest that IGR J15283−4443 is a Galactic source, and we cannot further classify the source. Finally, we question the association of IGR J11457−1827 and J23130+8608 with the X-ray sources we have found, and further question the genuineness of the former IGR source.

Key words. Astrometry — binaries:close — Galaxies: Seyfert — X-rays: binaries — X-rays: galaxies—

1. Introduction

The most recent version of the IBIS catalog contains more than 700 hard X-ray sources (Bird et al. 2010). While a certain number were known as (hard) X-ray emitters prior to the launch of *INTEGRAL*, about half of them have been detected for the first time above 20 keV with IBIS/ISGRI (Lebrun et al. 2003). In the remainder of this paper we will refer to these sources as 'IGRs'[1]. Bodaghee et al. (2007) collected known parameters (e.g., the absorption column density, N_H, the pulse period for Galactic sources with X-ray pulsations, the redshift for AGN, etc.) of all sources detected by *INTEGRAL* during the first four years of activity. With this they could study the parameters spaces occupied by different families of sources and therefore could deduce important aspect concerning the physics of high energy sources. However, many of these IGRs are still unidentified, and therefore any attempt to study, understand and model populations of high energy sources will be incomplete. The determination of the nature of these object is therefore extremely important if one wants to have the most complete view of the content of our Galaxy and our Universe.

In this paper, we continue our work of identifying the unknown IGRs that we started soon after the discovery of the first IGRs. A first step is to provide an ∼arcsec position with soft X-ray telescopes such as *XMM-Newton* (Rodriguez et al. 2003, 2006; Bodaghee et al. 2006) *Chandra* (Tomsick et al. 2006, 2008, 2009), and also *Swift* (Rodriguez et al. 2008, 2009b,a). We then search for counterparts at a position consistent with the refined X-ray position of a given source. As in Rodriguez et al. (2008) and Rodriguez et al. (2009b) (paper 1 and paper 2 in the remainder of this article), we report here the analysis of *Swift* observations (XRT imaging and spectral analysis and UVOT imaging) of 13 IGRs that still lacked precise arcsec X-ray positions at the time of the writing of the paper. We also present the identification of IR and optical counterparts obtained from on-line catalogs such as SIMBAD, the United States Naval Observatory (USNO), the 2 Micron All Sky Survey point source and extended source catalogs[2] (2MASS and 2MASX, Skrutskie et al. (2006)), and the NASA/IPAC Extragalactic Database (NED[3]). Note that although the presence of a bright *Swift* source within a given *INTEGRAL* error circle usually renders likely the association between the two sources, there is a slight probability that the two sources are not associated, especially in the case of dim X-ray sources. This is, also, exemplified by the few cases where several *Swift* sources are found within the *INTEGRAL* error circle. Given the wide range of association probabilities from possible associations to nearly certain associations, no general statement can be given for the probability of associations. A low Galactic

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[1] An up-to-date on-line catalog of all IGRs can be found at http://irfu.cea.fr/Sap/IGR-Sources/ note the new address for the site

[2] http://www.ipac.caltech.edu/2mass/

[3] http://nedwww.ipac.caltech.edu/index.html

Table 1. Journal of the *Swift* observations analysed in this paper.

Source Id (IGR)	Id	Date Obs	Tstart (UTC)	Exposure (s)
J02086−1742	00038021001	2009-09-10	14:08:56	4938
J02524−0829	00036970001	2008-01-27	00:41:02	11117
	00036970002	2008-06-11	00:51:48	4310
J03184−0014	00030995001	2007-11-07	00:12:58	9192
	00036969001	2008-02-28	01:48:52	8378
	00036969002	2008-02-29	19:32:52	4711
	00036969003	2009-06-24	19:25:35	1030
J08023−6954	00036095001	2006-12-27	07:45:23	701
	00036095002	2006-12-30	08:04:22	5736
J11457−1827	00035645001	2006-07-27	00:05:11	10000
	00035645002	2006-07-29	00:19:43	3384
J12060+3818	00037838001	2008-10-13	00:31:19	5363
J12070+2535	00037837001	2008-10-27	18:03:14	2032
J12482-5828	00038349001	2008-12-19	00:43:32	3718
	00038349002	2009-05-08	01:06:36	1847
J13042-1020	00031153001	2008-03-03	15:34:26	2948
	00031153002	2008-03-05	14:11:09	816
	00031153003	2008-03-05	14:14:18	4889
	00031153004	2008-03-07	00:21:55	185
	00031153005	2008-03-07	00:22:18	6621
	00031153006	2008-03-09	11:45:39	2676
	00031153007	2008-03-13	13:44:13	3327
	00031153008	2008-03-16	11:00:24	3279
	00031153009	2008-04-23	05:01:41	3246
J13412+3022	00037380001	2008-08-24	00:42:39	2694
	00037835001	2008-08-25	15:17:06	3562
J14488-5942	00039094001	2009-09-25	19:25:22	16413
J15283-4443	00036114001	2007-01-06	07:36:11	5534
J23130+8608	00037078002	2007-07-09	01:33:08	7908
	00037078003	2007-07-11	00:03:00	11191

latitude source will have a higher chance of spurious association than a high latitude one. For all sources, we discuss the likelihood of association between the *INTEGRAL*, *Swift*, and counterparts at other wavelengths. Dubious cases (as, e.g., multiple possible counterparts) are discussed in more details.

We start by introducing the *Swift* observations and we briefly present the data reduction techniques in Sec. 2. We then give the results of X-ray (Sec. 3) and IR/Optical/UV (Sec. 4) candidate counterparts identification. In Sec. 5 we describe the results for each source, including the results of the X-ray spectral analysis, and discuss their possible nature. We conclude the paper by summarising the results in Sec. 6.

2. Observations and data reduction

We searched the *Swift* archive for observations at less than 10′ of any IGR that has a position uncertainty greater than about 10′′. We excluded most of the new IGRs found in the Galactic centre by Bird et al. (2010) as too many possible X-ray counterparts can be found in the IBIS error. We also excluded sources for which a clear positional uncertainty is not given in Bird et al. (2010), as this may indicate source confusion in IBIS. We then only retained the pointings during which the XRT instrument was in photon counting mode as it is the only mode that provides a fine position. We report on the results of the 13 sources for which we found an X-ray source within the IBIS error box. The observing log for these is reported in Table 1.

We reduced the *Swift* data with the `HEASoft V6.7` software package and the calibration files issued on 2009-12-01 and 2009 October 7 for the UVOT and XRT instruments, respectively. The reduction procedure is identical to those presented in papers 1 and 2. For XRT, level 2 cleaned event files are obtained with `xrtpipeline` with standard parameters[4].

The XRT individual pointings of a given source were then co-added with `xselect`. We extracted spectra and light curves with `xselect` from a circular region with a radius of 20 pixels centred on the best position, while we obtained the background products from a source-free circular region with a radius of 40 pixels. Due to the presence of columns of dead pixels in the XRT, we produced “true” exposure maps with `xrtexpomap` that were given as input to `xrtmkarf` to produce corrected ancillary response files. We rebinned the spectra to have at least 20 counts per channel which allows for χ^2-minimization in the fitting with `XSPEC 12.5.1`. When this criterion was not achievable, the Cash statistic (hereafter C-statistic, Cash (1976)) was used instead.

When available, we analysed the UVOT level 2 data obtained from the *Swift* data archive. We first corrected the aspect for each individual UVOT exposure with the `uvotskycorr` tool, calculating the aspect correction via comparison to the USNO-B1.0 catalog[5](Monet et al. 2003). Then, we summed the aspect-corrected individual exposures and individual exposure maps with `uvotimsum`, and performed the UVOT astrometry using the summed images and exposure maps with the `uvotdetect` tool. The tool `uvotsource` was finally used to obtain the photometry of the sources. The UVOT magnitudes were estimated on a source region of 5′′ radius centred on the best source position obtained with `uvotdetect`, using a region of 20′′ radius free of sources as background. This tool corrects the source count rates for coincidence losses, makes an aperture correction, and converts the results to magnitudes following $m_{\rm source} = Z_{pt} - 2.5 \times log(CR)$ (Poole et al. 2008), where Z_{pt} is the photometric zero-point of the filter considered, and CR is the corrected source count rate. All corrections have been applied utilising the UVOT calibration files released on 2009-10-07. The complete description of the UVOT photometric calibration can be found in Poole et al. (2008).

3. X-ray astrometry with *Swift*/XRT

For each source we produced an image accumulating the maximum number of pc mode pointings available. We then searched for potential X-ray counterparts within the IBIS error box with `XIMAGE`. We retained only sources that had a signal to noise ratio (SNR) greater than 4σ and went down to 3σ when no significant excesses were found. We estimated the best source position and errors with `xrtcentroid`. The list of candidates counterpart, their number within the IBIS error box, X-ray position, and SNR are reported in Table 2.

4. Counterparts at other wavelengths

We searched the NED, 2MASS, 2MASX and the USNO-B1.0 on-line catalogs and UVOT images for the presence of infrared, optical and UV counterparts within the *Swift*/XRT error circle of each of the potential X-ray counterpart reported in Table 2. Infrared counterparts that are newly identified from this search are reported in Table 3. The typical positional accuracy for the 2MASS sources is 0.5′′ (Skrutskie et al. 2006), while that of the USNO-B1.0 sources is typically 0.2′′ (Monet et al. 2003). The magnitudes and UV positions of the optical and UV counterparts

[4] see http://heasarc.gsfc.nasa.gov/docs/swift/analysis/

[5] http://tdc-www.harvard.edu/software/catalogs/ub1.html

Table 2. List of sources for which X-ray counterparts have been found

Name (IGR J)	#	RA	Dec	error (″)	l	b	det. sig (σ)	90% IBIS confidence radius (′)	Offset from the IBIS position (′)
J02086−1742	1	02h 08m 34.8s	−17° 39′ 33.3″	3.3	188.9293°	−69.8490°	28	4.5	3.6
J02524−0829	1	02h 52m 23.4s	−08° 30′ 38.5″	3.6	185.5565°	−55.8849°	22	2–3	1.9
J03184−0014	1	03h 18m 17.4s	−00° 17′ 47.9″	5.2	181.8103°	−45.7089°	4.3	4	4.1
J08023−6954	1	08h 02m 41.8s	−69° 53′ 38.7″	6.3	282.6101°	−19.5480°	3.2	2–6	2.3
J11427+0854	1	11h 42m 27.1s	+08° 54′ 48.0″	5.6	257.8755°	65.5549°	3.4	3.9	3.2
J11457−1827†	1	11h 45m 40.5s	−18° 27′ 15.5″	3.5	281.8546°	41.7102°	100	3.4	0.3
J12060+3818	1	12h 06m 17.2s	+38° 12′ 37.0″	4.75	160.6109°	75.4265°	6.6	4.0‡	6.0
J12070+2535	1	12h 07m 05.3s	+25° 39′ 06.1″	4.5	218.8913°	79.9624°	8.3	3.4‡	4.2
J13042−1020	4	13h 04m 14.2s	−10° 20′ 20.7″	3.7	308.0957°	52.4043°	15	4.1	1.0
”		13h 04m 13.6s	−10° 21′ 21.9″	3.8	308.0894°	52.3875°	6.2	”	1.3
”		13h 04m 11.6s	−10° 19′ 52.3″	3.7	308.0793°	52.4130°	5.2	”	1.7
”		13h 04m 09.8s	−10° 19′ 44.4″	4.0	308.0676°	52.4158°	4.9	”	2.2
J13412+3022⋆	1	13h 41m 11.2s	+30° 22′ 40.9″	4.25	52.4662°	78.6298°	8.8	3.8	2.1
J14488−5942	2	14h 48m 43.3s	−59° 42′ 16.3″	3.7	317.2340°	−0.1298°	16	4.4	0.7
”		14h 49m 00.5s	−59° 45′ 03.9″	4.9	317.2462°	−0.1875°	3.8	”	3.3
J15283−4443	1	15h 28m 16.1s	−44° 43′ 41.7″	6.0	330.0392°	9.7322°	3.3	3	1.4
J23130+8608	1	23h 08m 55.3s	+86° 05′ 50.9″	4.8	121.0910°	23.5978°	3.8	4.8	4.7

† From Winter et al. (2009).
‡ IBIS error possibly underestimated (see text).
⋆ Wrong name (J13415+3033) given in Bird et al. (2010).

are reported in Table 4. The USNO-B1.0 photometric accuracy is typically 0.3 mag (Monet et al. 2003). The lower limits on the UVOT magnitudes are given at the 3σ level. The UVOT positional uncertainties are dominated by a 0.5″ systematic uncertainty (90% confidence) for each source.

5. X-ray spectral analysis and possible identifications of the thirteen IGRs

In this section we report the individual results for each source, and discuss their possible nature. We also include the results of the X-ray spectral analysis of the XRT data. In all cases, we started to fit the source spectra with a simple model of an absorbed power law. This provided an acceptable representation in the large majority of the cases. The absorption due to intervening material along the line of sight is obtained from the Leiden/Argentine/Bonn (LAB) surveys of Galactic H I in the Galaxy[6]. The LAB Survey is the most sensitive Milky Way H I survey to date, with the most extensive coverage both spatially and kinematically and an angular resolution of 0.6 degrees (Kalberla et al. 2005).

The spectral parameters we obtained are reported in Table 5. The errors on the X-ray spectral parameters (including upper limits) are given at the 90% confidence level. We also report in this table the extrapolated hard X-ray fluxes of these sources as measured by IBIS and obtained by extrapolating the best XRT spectrum in the same energy range. Note that while, in most cases, these fluxes are estimated over the 20–40 keV range, in some cases, they are obtained in different ranges to match published results on those sources. To estimate the luminosity of the candidate AGN we used H_0=75 km/s/Mpc to convert the redshift (of the suggested counterpart) to distance.

5.1. J02086−1742

This source is also one of the new IGRs reported in the most recent version of the IBIS catalog (Bird et al. 2010), for which inspection of the *Swift* archives shows the existence of an observation aimed at a *Swift* object. Although the coordinates of Swift J0208.5−1738 and that of the IGR sources indicate an offset of about 5′, both objects have error boxes that render their association likely. There is one single bright X-ray source with a position that is compatible with both the *Swift* and *INTEGRAL* ones indicating that the sources are the same (Table 2). The X-ray position is also at 22″ from the position of 1RXS J020835.8-173950. Given the 20″ error box given by *Rosat*, it is likely that the XRT source and the *Rosat* one are the same. The XRT error box contains NVSS J020834−173933 a ∼ 42 mJy 1.4 GHz radio source as reported in NED. The source is also clearly detected in the infra red, optical and UV bands (Tables 3, and 4).

The XRT spectrum is well represented by a hard power law model with very little absorption (χ^2_ν=1.05 for 41 dof) compatible with the value on the line of sight obtained from the LAB survey (Kalberla et al. 2005). The extrapolated 20–40 keV flux is compatible with the flux measured by IBIS (Bird et al. 2010) which further strengthens the associations of the X-ray source and the IBIS one. The high galactic latitude, the radio detection and the brightness in all IR/optical and UV bands as well as the detection at soft and hard X-ray energies argue in favour of the source being an AGN. The low value of the absorption would argue in favour of a type 1 AGN. We note that Masetti et al. (2010) further classify the source as a Sey 1.2 AGN through optical spectroscopy.

[6] http://www.astro.uni-bonn.de/∼webaiub/english/tools_labsearch.php

Table 3. List of newly identified infrared counterparts in the 2MASS and 2MASX catalogs.

Name (IGR)	Counterpart	Magnitudes J	H	K_s	Offset from the XRT position (″)
J02086−1742	2MASS J02083494−1739347	14.51 ± 0.04	13.61 ± 0.04	12.54 ± 0.03	2.6
J02524−0829	2MASX J02522337−080376	11.79 ± 0.02	10.99 ± 0.02	10.66 ± 0.04	0.9
J03184−0014⋆	2MASS J03181753−0017502	− − −	− − −	15.22 ± 0.15	3.1
J08023−6954	2MASS J08024164−6953377	12.25 ± 0.02	11.65 ± 0.02	11.52 ± 0.02	1.3
J11457−1827†	2MASX J11454045−1827149	12.87 ± 0.03	12.15 ± 0.04	11.65 ± 0.06	0.9
J12070+2535	2MASS J12070528+2539059	15.53 ± 0.06	14.71 ± 0.05	− − −	0.3
J13042−1020 #1	2MASX J13041438−1020225	9.62 ± 0.02	8.50 ± 0.02	8.68 ± 0.02	3.4
J13412−3022	2MASX J13411117+3022411	12.03 ± 0.02	11.33 ± 0.03	11.02 ± 0.04	0.4
J14488−5942#1	2MASS J14484322−5942137	15.46 ± 0.07	13.53 ± 0.04	12.43 ± 0.04	2.6
J15283−4443	2MASS J15281596−4443416	10.34 ± 0.02	10.03 ± 0.02	9.97 ± 0.02	1.5
J23130+8608	2MASS J23085980+8605526	12.98 ± 0.02	12.40 ± 0.03	12.22 ± 0.02	4.9

⋆ See also Paper 2.
† From Winter et al. (2009).

Table 4. Magnitudes and UVOT positions of the newly identified optical and UV counterparts in the USNO-B1.0 catalog (I, R and B bands) and *Swift*/UVOT detector (V, B, U, UVW1, UVM2, and UVW2 bands). The B magnitudes are those obtained from the UVOT detectors and when available. The long dashes indicate the absence of corresponding data.

Name	USNO B1.0	UVOT position[†]		Magnitudes[a]							
(IGR)		RA	DEC	I	R	V	B	U	UVW1	UVM2	UVW2
J02086−1742	0723-0034272	02h 08m 34.9s	−17° 39′ 34.8″	14.2	15.0	− − −	16.4	14.53 ± 0.03	− − −	− − −	− − −
J02524−0829[¶]	0814-0027101[⋆]	02h 52m 23.4s	−08° 30′ 37.8″	10.7	11.3	− − −	11.4	16.88 ± 0.03	− − −	18.93 ± 0.05	− − −
J08023−6954	0201-0188880	08h 02m 41.6s	−69° 53′ 38.0″	12.9	14.3	− − −	15.6	− − −	18.29 ± 0.08[‡]	20.75 ± 0.37	19.3 ± 0.15[‡]
J11427+0854	No counterpart	11h 42m 27.2s	8° 54′ 47.9″	− − −	− − −	− − −	− − −	− − −	18.86 ± 0.07[‡]	19.06 ± 0.06	− − −
J11457−1827	0715-0241351[⋆]	− − −	− − −	11.2	10.5	− − −	10.6	− − −	− − −	− − −	− − −
J12060+3818	1282-0243241	12h 06m 17.4s	38° 12′ 35.3″	18.4	18.9	18.7 ± 0.2	19.0 ± 0.1	18.47 ± 0.09	18.07 ± 0.07	17.97 ± 0.07	18.47 ± 0.06
J12070+2535[¶]	1156-0188536[⋆]	12h 07m 05.3s	25° 39′ 06.5″	16.4	16.1	17.5 ± 0.1	18.2 ± 0.1	17.9 ± 0.1	18.6 ± 0.1	18.9 ± 0.2	19.1 ± 0.1
J13042−1020 #1[‡,¶]	0796-0240939	13h 04m 14.3s	−10° 20′ 21.1″	6.7	11.2	14.35 ± 0.01	15.33 ± 0.01	15.66 ± 0.02	16.80 ± 0.02	17.55 ± 0.03	17.41 ± 0.02
J13412+3022[¶]	1203-0214236[⋆]	13h 41m 11.2s	30° 22′ 41.5″	9.2	9.7	14.96 ± 0.03	15.91 ± 0.03	16.15 ± 0.04	16.93 ± 0.07	17.29 ± 0.05	17.38 ± 0.05
J15283−4443	7847-00975-1	15h 28m 16.0s	−44° 43′ 42.0″	9.9	10.3		Detector saturated		12.58 ± 0.04	13.06 ± 0.04	13.25 ± 0.04
J23130+8608	1760-0040693	23h 08m 59.8s	86° 05′ 53.0″	12.8	14.4	− − −	16.3	17.51 ± 0.03	18.69 ± 0.16	21.15 ± 0.21	− − −

† The UVOT positional accuracy is dominated by a statistical uncertainty of 1.1″.
¶ The UVOT source is (possibly) extended, the UVOT magnitudes are not calculated over the entire extension of the source.
‡ UVOT magnitudes averaged over multiple pointings.
⋆ There are multiple USNO-B1.0 sources in the XRT error circle. This is the closest to the IR source.
a Magnitudes with no errors are obtained from the USNO B1.0 catalog and have a typical uncertainty of 0.3 mag.

5.2. J02524−0829

This object was first reported by (Krivonos et al. 2007) and associated to MCG-02-08-014 a z=0.016721 Sey 2 galaxy (Bikmaev et al. 2008). However no refined X-ray position was published for this object leaving the possibility of a chance association. We found one single X-ray source within the IBIS 3′ error box. The XRT position (Table 2 is at 1′′ from the position of the Sey 2 galaxy, which confirms the association of these sources. The X-ray position is also clearly compatible with the nucleus of a spiral galaxy seen in the UVOT images (not shown). The magnitudes measured in the U-filter show some slight variability between the two pointings (it has $m_U = 15.373 \pm 0.08$ during the second one).

The X-ray spectrum is well fitted with an absorbed power law (χ^2_ν=1.3 dof 27 dof). The absorption is significantly in excess to the value measured on the line of sight, which indicates the source is significantly absorbed, while the photon index, although quite poorly constrained, has a value typical of a type 2 AGN. All our results confirm that IGR J02524−0829 is associated with MCG-02-08-014, and hence is a Sey 2 AGN.

5.3. J03184−0014

This very poorly studied object was first reported in Bird et al. (2007), and a single *Swift* observation was analysed by us in Paper 2. We had found a single X-ray source, however, outside the IBIS error which had led us to dismiss it as the counterpart to the IGR source (Paper 2). Here we used 3 additional *Swift* observations which allowed us to obtain a total exposure on this region about 2.5 times longer than in Paper 2.

As previously reported, there is no X-ray source within the 4′ IBIS error box of this source. The most significant X-ray source in this field is 4.1′ from the best position and is consistent with the object mentioned in Paper 2, and the position we report here should be considered as the most accurate one. The IR counterpart, 2MASS J03181753−0017502 (see Paper 2) is classified as a quasar in SIMBAD. We, however, point out that this classification is based on the positional coincidence of a Quasar (dubbed SDSS J03184−0015) within the IBIS error box mentioned in Bird et al. (2007). This object is not associated to *Swift* and to the 2MASS source we report here either. Instead the X-ray error box contains SDSS J031817.53−001750.0 reported as an extended source and classified as a galaxy in NED. There is no source in the USNO B1.0 catalog within the XRT error box. There is no obvious UVOT counterpart in the two pointings during which the X-ray position in the UVOT field of view (fov). The source position is, however, close to a very bright source and confusion with this nearby object cannot be completely excluded.

The X-ray spectrum has a very low statistical quality. It is fitted with an absorbed power law (C=23 for 27 dof), but the parameters are poorly constrained (Table 5). The parameters are compatible with any X-ray emitting source, and the extrapolated 20–40 keV flux is not compatible with the 20–40 keV flux from Bird et al. (2007).

The X-ray position of the source may indicate that it is an active galaxy, although the low statistical quality of the data leads to some caution. In Paper 2 we did not favour an association of the *Swift* and IGR source. The finding of a Galaxy within the *Swift* error box may, however, question this conclusion. In any case we tentatively classify the *Swift* source as an active galaxy and suggest that it could be associated to the IGR. In this case, the source is not the quasar mentioned in SIMBAD. One should also keep in mind that the IGR object could be a spurious IBIS source since it is not reported in the last IBIS catalogs catalog of Bird et al. (2010) and Krivonos et al. (2007)[7].

5.4. J08023−6954

This source was discovered by Revnivtsev et al. (2006) who already suggested the source was an chromospherically active star (RS CVn type). Optical spectroscopy led Masetti et al. (2008) to further confirm the suspected type of this object. These authors, however, point out that this identification is only tentative since they had just a marginal possible X-ray counterpart. Reanalysis of the *Swift* data shows the presence of a 3.2σ source within the error box. The X-ray position is compatible with that of the counterpart analysed by Masetti et al. (2008). We remark that the XRT error box contains IR, optical and UV counterparts with positions that are compatible. This gives further strength to the reality of the X-ray source. We remark that the UVW1 magnitudes had compatible values between the two pointings. The average of these are reported in Table 4.

The spectrum has an extremely low statistical quality (it has 13 net counts only), and has basically no count above 2 keV, which prevents any sound spectral analysis. The fact that all source counts are below 2 keV indicates that this source is not highly absorbed. This and the detection of the source in the UV and optical domains, may indicate a nearby source. A tentative fit of the 0.2–2 keV spectrum shows that a simple power law with $\Gamma = 2.4^{+0.8}_{-0.7}$ provides a good representation (C=7.2 for 13 dof). The 2–10 keV flux is 2.6×10^{-14} erg cm^{-2} s^{-1}. The extrapolated 20–40 keV flux is at least a factor of 3400 lower than the flux reported by Revnivtsev et al. (2006). Note that this source is mentioned in the online version of the Krivonos' catalog, but not in Bird et al. (2007) and Bird et al. (2010). This may indicate a variable source which is compatible with the proposed RS CVn classification as these sources are known to be variable. We also note that RS CVn are know X-ray emitters (e.g. Osten et al. 2007), and can sometimes be detected at hard X-rays, as exemplified by the *Swift*/BAT detection of the RS CVn star II Peg (Barbier et al. 2005; Osten et al. 2007) during a flare. Note that the detection of the latter is a short lived event and the comparison with the *INTEGRAL* source may be questioned. Osten et al. (2007) report the analysis of the full flare of II Peg as seen with *Swift*. Hard X-ray detection of II Peg by the BAT telescope is visible over more than 8 ks, and less than 12 ks. Over this period the 10-200 keV flux is found around 1.2×10^{-9} erg cm^{-2} s^{-1} (Osten et al. 2007), which is easily detectable by *INTEGRAL* in a short exposure. While such a flare would be missed in a total 2 Ms observation as the one reported by Revnivtsev et al. (2006), one should note that IGR J08023−6954 lies close to a border of the field covered. Using Fig. 1 of Revnivtsev et al. (2006), and assuming they reached a 0.16 mCrab sensitivity for the full 2 Ms exposure, one can roughly estimate an effective exposure of $\sim$ 140 ks at the position of the IGR source. A II Peg-like flare (assuming a constant flux during 10 ks) would be detected by *INTEGRAL* during this accumulation time. It is therefore not totally excluded that Revnivtsev et al. (2006) caught the source while during an outburst. The non-detection of this source in the long term IBIS catalogs is also compatible with the source being highly variable and showing short lived hard X-ray activity. Although we do not bring any definite proof, the source could especially be a fake detection by the IBIS telescope, if true, we suggest that the IGR source and the *Swift* one could possibly

[7] see also http://hea.iki.rssi.ru/rsdc/catalog/index.php for an updated version of the Krivonos et al. (2007) catalog

be associated, which, then, would confirm that the hard X-ray source is a RS CVn.

5.5. J11427+0854

This source is first reported in Paltani et al. (2008) who, however, give a low probability of genuineness. They tentatively identify it with a 2MASX source. We found one single faint X-ray source within the IBIS error box even when extending the error box to the $\sim 5'$ value expected for a 5σ source (Gros et al. 2003). There are no 2MASS or USNO B1.0 source within the *Swift*/XRT error box of this potential counterpart, and it lies is at more than $4'$ from the 2MASX source mentioned in Paltani et al. (2008). Therefore an association of the two is ruled out. The XRT error box contains SDSS J114227.17+085448.2 that is classified as a point source in NED. We find a UV counterpart in the UVW1 and UVM2 UVOT filters which may indicate that this object emits mostly at short wavelengths.

The X-ray spectrum has only 15 counts and is consistent with no counts above 2 keV, which could indicate a very soft source. Given the low statistical quality a fit cannot be performed. The low probability of reality for the *INTEGRAL* source, and the faintness of the *Swift* one renders the question of the association dubious, although we cannot further conclude on the nature or reality of this source.

5.6. J11457–1827

This source is first reported in Paltani et al. (2008) who, based on the location of 1H 1142−178 within the IBIS error box suggest an association of both objects, and that, therefore, the *INTEGRAL* source is a Sey 1 AGN. A *Swift* refined position of the source is given by Winter et al. (2009) who associate the source to 2MASX J11454045−1827149 reported as a z=0.0329 ± 0.0001 galaxy in NED. We also found a possible counterpart in the USNO B1.0 catalog (Table 4).

Although the source is quite bright it seems that only the inner 5 pixels may be affected by pile up. We therefore extracted the spectrum from an annulus of 5 pixel inner radius and 30 pixel outer radius. The spectrum is well fitted with an absorbed power law (χ^2_ν=0.99 for 154 dof) with parameters that are well constrained. We note that the value of N_H is lower than that obtained through the LAB survey (Kalberla et al. 2005). The latter value is measured from a pointing that is $\sim 17'$ from the best position of the source, and spatial variations of the Galactic N_H could result in this apparent discrepancy. In a second run we, however, froze N_H to the best value returned by the LAB survey. We obtain a good fit (χ^2_ν=1.07 for 155 dof) and $\Gamma = 2.04 \pm 0.04$ slightly softer than when leaving N_H free to vary. The parameters are clearly compatible with those of a Sey 1 AGN.

5.7. J12060+3818

This object was first reported in Paltani et al. (2008) who give a probability of only 59% that the IGR source is real. There is no X-ray source within the IBIS error, but we remark a rather significant (6.6σ) source (Swift J120617.2+381837) at $\sim 6'$ from the centre of the IBIS error. First, one should note that Paltani et al. (2008) give an error of $\sim 3.96'$ which is a bit underestimated compared to the expected $4.72'$ error of a 5.26σ source as obtained from Gros et al. (2003). In this latter case the *Swift* source is within the 97% (i.e. $< 3-\sigma$) IBIS confidence radius. Now given that only $1 > 3-\sigma$ source is detected over the whole detector, the mean number of source within a $6'$ radius from the IBIS position is ~ 0.26. Assuming a Poisson distribution we can estimate a probability of 19% to find a source by chance in this area. Although chance association is non-negligible, we study here the possibility that the sources are related. IGR J12060+3818 has been associated to 2MASX J12055104+3819308 by Paltani et al. (2008). Since this IR source is not the IR counterpart to Swift J120617.2+381837, if the IGR and Swift sources are the same, then the former source is wrongly identified with the IR source in Paltani et al. (2008). The error box of XRT contains two quasars, SDSS J120617.35+381234.9 at $z = 0.8379 \pm 0.0011$ and B2 1203+38 at z=0.8380. We consider as very likely the possibility that those two objects are the same. A possible optical and UV counterpart is detected in all filters (Table 4), indicating that the source is not absorbed.

The X-ray spectrum is well represented by an absorbed power law (C=36.6 for 42 dof). As the parameters are poorly constrained, and since the value of the absorption (and the detection of the source at UV wavelengths) is compatible with very little absorption in direction of this source, we froze N_H to the value returned by the LAB survey in a second run. The photon index tends to a harder value ($\Gamma = 1.8 \pm 0.4$) a value more compatible with those usually found in AGN. The extrapolated 20–60 keV flux is much below the value found by Paltani et al. (2008), which could indicate that the *Swift* and *INTEGRAL* sources are not related. If they are related, then this source could be significantly variable. Our results lead us to tentatively classify Swift J120617.2+381837 as an AGN most probably of type 1. While we cannot completely rule out a chance association of the IGR and *Swift* sources, the fact that AGN are known hard X-ray emitters and the 81% probability of true association between the 2 sources also make us conclude that the sources are likely the same.

5.8. J12070+2535

As for the previous object while there is no X-ray object in the error IBIS box given by Paltani et al. (2008), we note a possible underestimation of this positional uncertainty. According to Gros et al. (2003) the IBIS error for a 5.37σ source is $4.64'$. In that latter case, a 8.3σ source, Swift J120705.3+253906, is found within the error. The XRT error box contains one 2MASS object, at a position compatible with a USNO B1.0 source, itself detected at UV wavelengths with UVOT (Tables 3, 4). The XRT position is also compatible with two objects reported in NED, SDSS J120705.29+253906.0 and MAPS-NGP O_377_0077115 that are very probably an unique object (their separation is $1''$). Both these objects are extended and classified as galaxies. Our refined X-ray position rules out the association of the IGR source with IRAS 12046+2554 (also identified as LEDA 38453 in SIMBAD) suggested by Paltani et al. (2008).

The XRT spectrum of this source is well fitted with an absorbed power law (C=56 for 47dof). The spectral analysis shows some absorption in excess to the value of the line of sight, however its level remains low, and this object is clearly not a member of the heavily obscured sources. The extrapolated 20–60 keV flux is quite lower than that reported in Paltani et al. (2008), which, again, may indicate that the sources are either not related, or that we are observing a variable X-ray source. Here again we cannot conclude further on the association of the two sources. We nevertheless tentatively classify Swift J120705.3+253906 as an AGN most probably of type 1.

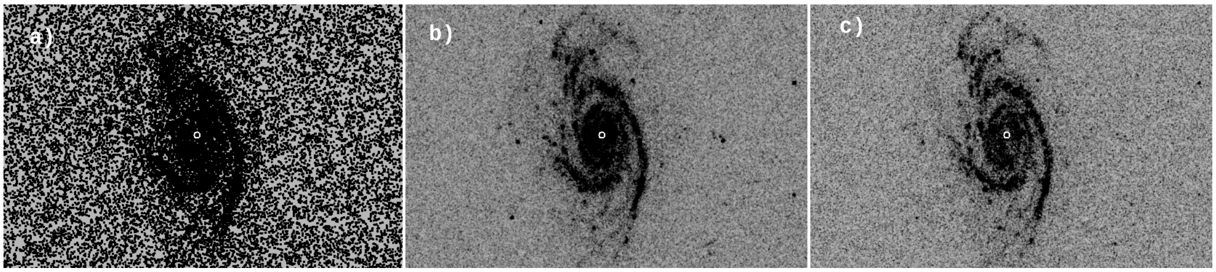

Fig. 1. 9.6′×6.0′a): UVM2 b): UVW1 c): UVW2 UVOT images around IGR J13042−1020. The white circle shows the best XRT position for Src #1, identifying it with the centre of the face-on spiral galaxy NGC 4939.

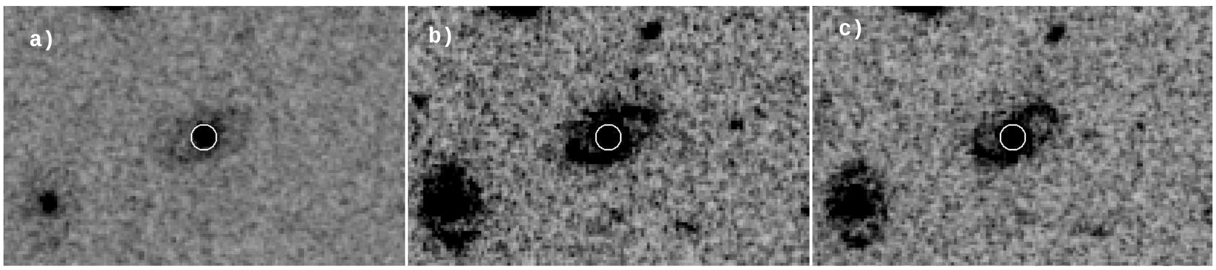

Fig. 2. 2.3′×1.5′a): UVM2 b): UVW1 c): UVW2 UVOT images around IGR J13412+3022. The white circle shows the best XRT position, identifying it with the centre of the spiral galaxy Mrk 268.

5.9. J13042–1020

The first mention of this object can be found in Bird et al. (2010). There are four $> 4\sigma$ XRT sources within the IBIS error box. Two of these (Src #2 and Src #4 in Table 2) are coincident with HII regions related to the galaxy NGC 4939 according to NED. We do not discuss them further here as it seems quite unlikely that they are at the origin of the hard X-ray source. Src #3 has 2MASS J13040977−1019414 in its error box. It is detected in the optical filters of UVOT but not at UV wavelengths. Src #1 on the other hands is positionally compatible with an extended 2 MASS source, reported as being NGC 4939 a z=0.010374 Sey 2. The X-ray position falls right on the centre of a face-on spiral Galaxy as can be seen in Fig. 1. We consider this object as the most promising counterpart. Note that this source is also reported in the 2nd XMM catalog (Watson et al. 2009) as 2XMM J130414.3−102021 at a position consistent with the *Swift* one.

In order to avoid contamination by Src #2 and #4, the region of extraction of the X-ray spectrum was slightly shifted. The X-ray spectrum has a shape typical of an absorbed source showing a soft excess, and, indeed, a simple absorbed power law does not provide an acceptable fit. The origin of soft excesses in AGN is subject to debate (see e.g. Porquet et al. 2004). Amongst other possibilities it could, for example, be the signature of partial absorption of the inner flow, or the high energy tail of thermal emission from the accretion disc. A spectral fit with a partial covering absorber and a power law leads to a rather good fit (χ^2_ν=0.95 for 9 dof). The value of the absorption is clearly in excess to the value of the line of sight N_H (Table 5). The covering fraction is 97 ± 1%, and the photon index is typical of an AGN (Table 5). The extrapolated 20–40 keV flux is about 4 times lower than the value obtained with IBIS (Bird et al. 2010). While this is not a definite proof against the partial covering model (this could simply indicate that the source is variable), and since thermal emission is also a commonly suggested hypothesis for the origin of soft excesses (Pounds et al. 2001; Porquet et al. 2004), we also fitted the spectrum with an absorbed power law and a black body only absorbed by the intervening material on the line of sight (i.e. N_H is frozen to $= 0.033 \times 10^{22}$ cm^{-2}). A good fit is also achieved (χ^2_ν=0.79 for 8 dof) with this model. The parameters are poorly constrained, but seem to, however, indicate a rather hard spectrum ($\Gamma = 0.1^{+1.2}_{-0.8}$) and some intrinsic absorption (N_H= $10^{+7}_{-9} \times 10^{22}$ cm^{-2}). Note that the extrapolated 20–40 keV flux is 2.2×10^{-11} erg cm^{-2} s^{-1}, which is a factor of $\gtrsim 6$ higher than that found with IBIS. The black body has a temperature $kT_{bb} = 0.24^{+0.05}_{-0.04}$ keV and luminosity $L_{bb} = 2.2 \pm 0.4 \times 10^{40}$ erg/s at z=0.0104. The black body temperature is compatible with those reported by Porquet et al. (2004), and the luminosity is compatible with an AGN nature for this source. In both cases (partial covering and black body), our results tend to further confirm the association of the XRT source with the IGR, and the high absorption would argue in favour of a Sey 2.

5.10. J13412+3022

The first mention of this object can be found in Bird et al. (2010). The authors, however, gave the source a wrong name (IGR J13415+3033) when considering the source coordinates obtained by IBIS. We therefore propose to rename the source IGR J13412+3022. Note that the source is also referred to as IGR J13415+3023 in SIMBAD. There is one single bright XRT source within the IBIS error box. There are two objects in the XRT error box according to SIMBAD. One is Mrk 268, a Sey 2 galaxy at z=0.03986 ± 0.00004 according to NED, the other is SN1994o a SN Ia. We disregard the second object as a possible counterpart to the IGR source, and suggest that Mrk 268 is the true counterpart. Note that this object is reported in the IBIS catalog of Krivonos et al. (2007), but the position they obtained has a 6.5′ offset compared to the XRT one. We remark two possible IR counterparts within the XRT error box. The first is the one reported in Table 3. It is an extended source and is clearly the IR counterpart to the Sey 2. The second one is 2MASS J13411114+3022410 a point source at 0.8″ from the centre of the *Swift* position. We favor the first as the infrared counterpart to the high energy source. The source is also clearly detected in the USNO B1.0 catalog and in all UVOT filters (Table 4, Fig. 2).

Table 5. Results of the X-ray spectral analysis. Errors and upper limits are all given at the 90% level.

Name (IGR)	Net number of counts	Galactic N_H † $\times10^{22}$ cm^{-2}	N_H $\times10^{22}$ cm^{-2}	Γ	2–10 keV flux‡ erg cm^{-2} s^{-1}	20–40 keV flux erg cm^{-2} s^{-1}	
						Extrapolated	IBIS source
J02086−1742	931	0.01	< 0.017	$1.55^{+0.1}_{-0.08}$	6.4×10^{-12}	6.3×10^{-12}	6.8×10^{-12}
J02524−0829⋆	617	0.04	12 ± 3	2.4 ± 0.6	1.2×10^{-11}	4.7×10^{-12}	3.1×10^{-11}
J03184−0014	22	0.05	< 1.1	$1.4^{+1.5}_{-0.9}$	1.5×10^{-13}	2.0×10^{-13}	2.9×10^{-11}
J11457−1827¶	4020	0.03	$1.298^{+0.01}_{-0.003}$	$1.91^{+0.08}_{-0.04}$	1.4×10^{-11}	1.1×10^{-11}	3.3×10^{-11}
J12060+3818¶	48	0.016	< 0.13	$2.4^{+1.2}_{-0.9}$	1.5×10^{-13}	5.6×10^{-14}	3.1×10^{-11}
J12070+2535¶	74	0.016	0.3 ± 0.2	$1.9^{+0.6}_{-0.5}$	1.4×10^{-12}	1.1×10^{-12}	1.4×10^{-11}
J13042−1020[a]	268	0.033	29^{+8}_{-6}	2 ± 0.2	4.0×10^{-12}	1.7×10^{-12}	7.5×10^{-12}
J13412+3022[a]	90	0.014	30^{+11}_{-8}	$1.4^{+0.2}_{-0.6}$	8.0×10^{-12}	9.5×10^{-12}	9.1×10^{-12}
J14488−5942#1	344	1.8	13^{+6}_{-4}	$2.8^{+1.1}_{-0.9}$	7.9×10^{-12}	7.1×10^{-13}	3.8×10^{-12}
” #2	22	”	< 2.4	$2.2^{+2.2}_{-1.6}$	4.7×10^{-14}	7.9×10^{-15}	”
J23130+8608	20	0.052	− − −	$1.4^{+0.7}_{-0.9}$	7.0×10^{-14}	9.4×10^{-14}	1.4×10^{-11}

† Value obtained from the LAB survey (Kalberla et al. 2005).
‡ Flux corrected for the absorption.
⋆ Hard fluxes are estimated over the 17–60 keV ranges.
¶ Hard fluxes are estimated over the 20–60 keV ranges.
[a] Spectra fitted with a partial covering absorber and a power law.

Note the appearance of spiral arm-like structures clear at shorter UV wavelengths, compatible with the classification of the host galaxy as a SBb as reported in NED.

As for the previous IGR source, the spectrum, although of poor quality, may show two well separated broad structures. An absorbed power low does not provide an acceptable fit, and large residuals are seen at very soft X-rays. Similarly to the previous source, a fit with a partial covering absorbed an a power law provides an improvement over the simple absorbed power law (C=81 for 45 dof). The source shows intrinsic absorption with a large covering fraction (98^{+2}_{-6}%), and a rather hard photon index (Table 5). With this model the extrapolated 20–40 keV flux is erg cm^{-2} s^{-1} a value clearly compatible with the IBIS flux (Table 5). Adding a black body (only absorbed by the intervening material on the line of sight) to a fully absorbed power law also lead to a good representation of the spectrum (C=71 for 44 dof). The black body has a temperature $kT_{bb} = 0.31^{+0.15}_{-0.09}$ keV and a luminosity $L_{bb} = 2.9^{+1.7}_{-1.0}\times10^{41}$ erg/s at z=0.04, compatible with the values obtained for other AGN (e.g. Porquet et al. 2004). The power law slope is, however, very poorly constrained, and very soft ($\Gamma = 4.3^{+3.9}_{-2.4}$) for an AGN, but this model also indicates a high level of intrinsic absorption. In this case the extrapolated 20–40 keV flux is incompatible with the IBIS flux reported in Bird et al. (2010). However, freezing the photon index to a more common value of 1.8 lead to a 20–40 keV flux just slightly below that reported in the 4^{th} IBIS catalog. These results are clearly consistent with the source being a Sey 2 AGN. We therefore conclude that IGR J13412+3022 is the hard X-ray counterpart to Mrk 268, and therefore a Sey 2.

5.11. J14488−5942

This source is first mentioned in Bird et al. (2010) as a transient. There are two X-ray sources within the IBIS error box. Src #1 (Swift J144843.3−594216) has the highest significance. Its X-ray error box contains a 2MASS but no USNO B1.0 source. It is not detected by the UVOT telescope with lower limits (based on the faintest object detected in the images) $m_U > 22.1$ and $m_{UVW1} > 21.6$. This is not so unexpected given that the object is in the Galactic plane, and tends to suggest that it lies at a rather large distance in our Galaxy.

Src #2 (Swift J144900.5−594503) has a rather low significance (Table 2). It has no counterpart in any of the on-line catalogs, although it is about 3′ from G 317.3-0.2-41.5, a molecular cloud, and that an association of the two cannot be dismissed. It is not detected in the UVOT filters.

An absorbed power law gives a marginally acceptable fit (χ^2_ν=1.8 for 14 dof) to the spectrum of source #1. The fit indicates that significant intrinsic absorption shields the intrinsic emission of the source. Note that an absorbed black body provides a good description of the spectrum well with a temperature $kT = 1.2^{+0.3}_{-0.2}$ keV and a luminosity of 6×10^{34} erg/s/((d/10kpc)^2). The extrapolated 20–40 keV flux obtained with the absorbed power law model is a factor of $\gtrsim 5$ below the IBIS flux (Table 5). Flux difference would not be surprising surprising if the *Swift* and IGR sources were associated, as the IGR is reported as a transient and is therefore a variable source. In this case, the fact that the spectrum is quite soft, and the black body fit may indicate that we are seeing a neutron star binary in quiescence.

The spectrum of source #2 has a very low significance. An absorbed power law provides a reasonable fit (C=24.5 for 20 dof), but the parameters are very poorly constrained (Table 5). Note that an absorbed black body also provides a good fit (C=25.5 for 20 dof). In this case, we obtain $N_H < 1.8\times10^{22}$ cm^{-2} (therefore at maximum consistent with the value of Galactic absorption on the line of sight), $kT = 0.5^{+0.5}_{-0.2}$ keV and a luminosity $< 6.3\times10^{33}$ erg/s/((d/10kpc)^2). Bird et al. (2010) classify this source as a transient since it was detected only during Rev 520. The analysis of both possible X-ray counterparts indicate that they are likely to be Galactic sources (which is strenghens by their low galactic latitude), and, in that case most probably X-ray binaries. While it is not possible to further confirm which (if any) of the 2 X-ray source is the true counterpart to the IGR, source #1 is intrinsically absorbed which is reminiscent of many of the IGR X-ray binaries. We also note that the amplitude of the variations of the 20–40 keV flux between the extrapolated value obtained from our fit, and the maximum reported in Bird et al. (2010) is of $\sim 3\times10^4$ for source #2. Again while this is not definite proofs that object #2 is not the IGR, all those points, and the fact that source #1 is the closest in position to the IGR, make us slightly prefer source #1 as the counterpart to the IGR source. In any case, we conclude that IGR J14488−5942 has a Galactic origin, and that, if it is indeed associated to source #1, it could be a member of the absorbed X-ray binaries.

5.12. J15283–4443

This source was discovered by Paizis et al. (2006), and apart from its detection in a single *INTEGRAL* pointing, nothing is known about it. We detect a single faint X-ray source at a position compatible with that of IBIS. There is one IR, optical and UV counterpart within the XRT error box (Tables 3, 4). The source is know as TYC 7847-975-1 and classified as a star. It is very bright in the UVOT filters and saturates the V, B and U filters. The magnitudes in these filters should then be taken with caution.

The spectrum has too few counts (9 net cts) to be exploitable. However, to compare the possible flux from the *Swift* source in the *INTEGRAL* range, we have assumed a power law spectrum whose photon index was frozen to different values, and let normalization free to vary. The highest extrapolated 17–40 keV flux is obtained with $\Gamma = 0.2$. It is however still a factor of ~ 1000 lower than the flux obtained with IBIS by Paizis et al. (2006). We therefore can only conclude of the Galactic nature of this source if the IGR source is associated to TYC 7847-975-1. The TYC source has a high proper motion which indicates a probable nearby object.

5.13. J23130+8608

This source is first reported in Bird et al. (2007), but is absent in the last version of the IBIS catalog. We found one faint X-ray source within the IBIS error box. The positional uncertainties of the XRT and the 2MASS catalog render marginally compatible the IR and X-ray sources (Table 2, 3). Note that the IR position is also compatible with that obtained at UV wavelengths with UVOT. The optical counterpart mentioned in Table 4 is more than 2″ away from the position of the IR (and UV) source which indicates that these sources are probably not related.

The X-ray spectrum has a very low statistical quality, and contains no count above 3 keV. As the parameters are very poorly constrained, and given the probable detection of the source at UV wavelengths, it has probably a very low intrinsic absorption. This point is further confirmed by the low value taken by N_H when fitted with an absorbed power law. A simple power law provides an adequate fit (C=7 for 14 dof). A simple black body also provides a good fit (C=6.3 for 14 dof), with kT= $0.3^{+0.2}_{-0.1}$ keV and L= $4 \pm 2 \times 10^{32}$ erg/s/((10kpc)^2). With the results in hands we cannot conclude further on the nature of the source, although the high Galactic latitude would tend to dismiss a Galactic compact object such as an X-ray binary. We do not exclude that the *Swift* and *INTEGRAL* sources are unrelated.

6. Summary and conclusions

In this paper, we reported the *Swift* X-ray analysis of the field of thirteen IGRs who still lacked an arcsec accurate position. The refined X-ray positions provided by the *Swift* observations (Table 2) allowed us to pinpoint the possible IR, optical and UV counterparts in most of the cases. We also analysed the X-ray spectra of the sources and used these results as additional arguments to confirm or refute the association of the *Swift* source with the *INTEGRAL* one. This also helped us to tentatively give a possible classification for the X-ray source. Table 6 reports the conclusions of our analysis

Table 6. Summary of the possible type for each counterpart of the thirteen sources, obtained through the analysis presented in this paper.

Name (IGR)	Type & Comment
J02086−1742	AGN, possibly Sey 1
J02524−0829	Sey 2 AGN at z=0.016721
J03184−0014	possible AGN, *Swift* and IGR associated?
J08023−6954	RS CVn
J11427+0854	?, possible spurious IGR
J11457−1827	Sey 1 AGN at z=0.0329
J12060+3818	QSO, possibly Sey 1, *Swift* and IGR associated?
J12070+2535	AGN, possibly Sey 1, *Swift* and IGR associated?
J13042−1020#1	AGN, possibly Sey 2
J13412+3022	Sey 2 AGN at z=0.03986
J14488−5942#1	probable XRB
J15283−4443	Galactic source, *Swift* and IGR associated?
J23130+8608	? , *Swift* and IGR associated?

We can summarise our results as follows:

– We identify IGR J02086−1742, IGR J12060+3818, IGR J12070+2535, IGR J13042−1020, and IGR J13412+3022 as AGN. We, however question the associations of IGR J12060+3818, IGR J12070+2535 with the X-ray counteparts we found. We suggest that IGR J02086−1742 is a possible Sey 1, and that IGR J13042−1020 is a possible Sey 2. Our analysis permits us to clearly identify IGR J13412+3022 as a Sey 2.
– We confirm the previously proposed associations of IGR J02524−0829, IGR J08023−6954, IGR J11457−1827. These objects are respectively classified as a Sey 2 AGN, a RS CVn star, and a Sey 1 AGN.
– We classify IGR J14488−5942 as a probable XRB,
– Apart from classifying IGR J15283−4443 as a Galacric source, we cannot further conclude on the nature of this source .
– We provide new data for IGR J03184−0014. We confirm the presence of a source found in Paper 2, but we rediscuss its possible association with the IGR source. We provide a new SDSS identification for the counterpart, which is classified as a galaxy. The X-ray source is therefore an AGN, which leads us to tentatively associate it with the IBIS source, although we remark that the latter could be spurious.
– We are not able to give a classification for IGR J11427+0854 and IGR J23130+8608. In both cases the association of the X-ray and the IGR can be questioned. We further question the genuineness of the former IGR source.

Caution should be expressed with these proposed identifications, as definitive conclusions will only come from optical/IR spectroscopy. We however are confident with the objects proposed as AGN as these comes from the identification of extended counterparts within the XRT error box. Note that IGR J13412+3022 is also a known Sey 2 object.

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