

*Swift*/XRT observations of  
*INTEGRAL* sources

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# Introduction

In the following, we provide a short report on the remaining *Swift*/XRT observations performed on many unidentified *INTEGRAL*/IBIS sources. Results on individual objects are presented and briefly discussed. Only sources detected at a confidence level  $\geq 3\sigma$  are considered as likely counterparts. Simple spectral fitting have been performed on the data to obtain information on the source spectrum; quoted column densities are always in excess to the galactic value.

Out of 41 sources, 5 (IGR J17507–2856, IGR J17536–2339, IGR J17541–2252, IGR J18186–1703 and IGR J18249–3243) have yet to be observed, while 5 are still incomplete (IGR J05319–6601, IGR J09026–4812, XTE J1716–389, IGR J17407–2808 and IGR J18244–5622). In our first report we discussed 19 objects, while 17 are presented here. Most of the data reported here have been used in submitted papers or published in the form of Atels. Objects with no classification will be observed within our ongoing optical follow-up program as soon as possible.

## IGR J14298–6715

Two observations analyzed with exposure: 1) 3861 s (obscode: 00036109001), 2) 2609 s (obscode: 00036109002)

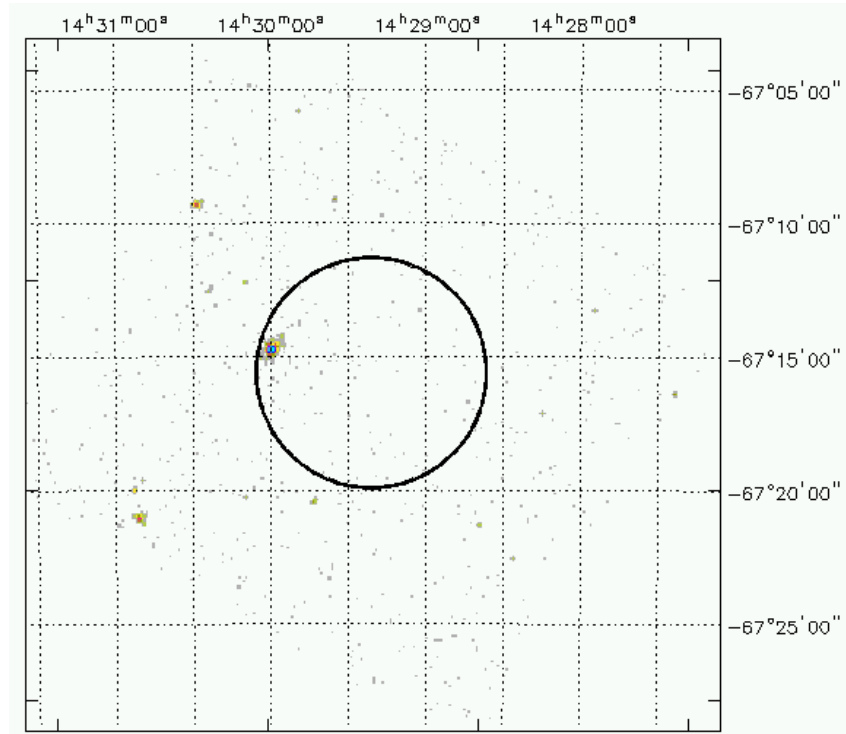


Figure 1: XRT image of the IGR J14298–6715 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

Within the IBIS error box of this source, we find a bright X-ray source at the following position:

$$\text{RA(J2000)} = 14^{\text{h}}29^{\text{m}}59^{\text{s}}.56$$

$$\text{Dec(J2000)} = -67^{\circ}14'43''.33$$

$$\text{error box} = 4''.00$$

This source coincides with a ROSAT Faint Survey source (1RXS J142959.9–671447). There are two USNO–B1.0 objects within the XRT uncertainty:

$$1) \text{ RA(J2000)} = 14^{\text{h}}29^{\text{m}}59^{\text{s}}.08 \quad \text{Dec(J2000)} = -67^{\circ}14'44''.8$$

(with magnitude  $R = 17.5 - 17.9$ )

$$2) \text{ RA(J2000)} = 14^{\text{h}}29^{\text{m}}59^{\text{s}}.82 \quad \text{Dec(J2000)} = -67^{\circ}14'45''.0$$

(with magnitude  $R = 16.3$ ).

Object # 2 is also coincident with a 2MASS source at RA(J2000) =  $14^{\text{h}}29^{\text{m}}59^{\text{s}}.81$ , Dec(J2000) =  $-67^{\circ}47'44''.8$  (with magnitudes  $J = 15.192$ ,  $H = 14.697$ ,  $K = 14.583$ ).

The X-ray data analysis provides as best-fit a thermal component (bremsstrahlung) with  $kT \sim 0.15$  keV plus a power law having photon index  $\Gamma \sim 0.8$ .

## IGR J14331–6112

Two observations analyzed with exposure: 1) 4404 s (obscode: 00036110001), 2) 751 s (obscode: 00036110002)

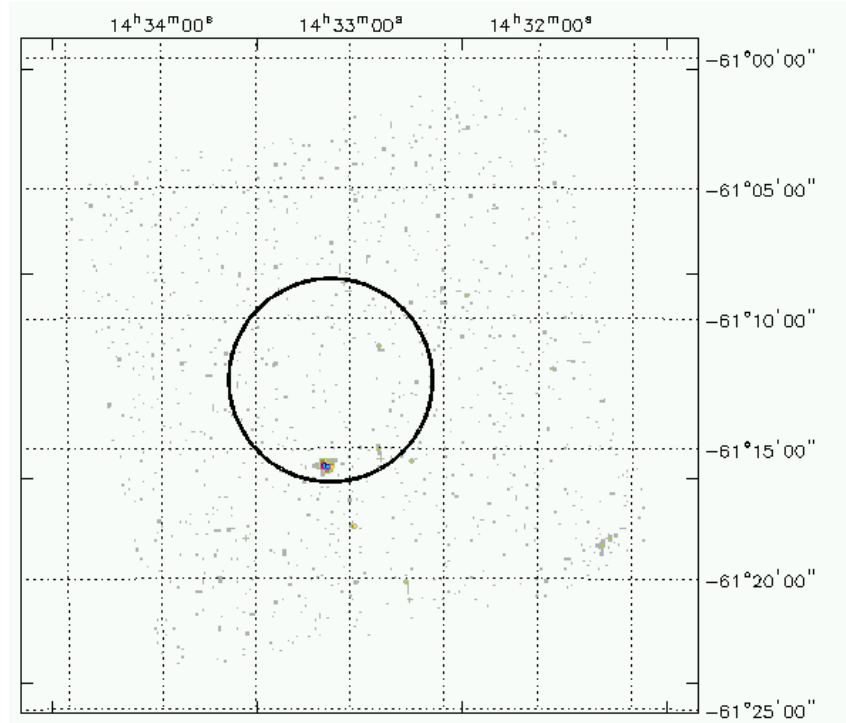


Figure 2: XRT image of the IGR J14331–6112 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

Within the IBIS error box of this source, we find a bright X-ray source at the following position:

$$\text{RA(J2000)} = 14^{\text{h}}33^{\text{m}}07^{\text{s}}.89$$

$$\text{Dec(J2000)} = -61^{\circ}15'40''.45$$

$$\text{error box} = 4''.00$$

This source is associated to an USNO–B1.0 object located at  $\text{RA(J2000)} = 14^{\text{h}}33^{\text{m}}08^{\text{s}}.21$ ,  $\text{Dec(J2000)} = -61^{\circ}15'39''.1$  (with magnitude  $R = 17.5 - 17.7$ ), also listed in the 2MASS catalogue (with magnitudes  $J = 14.664$ ,  $H = 13.993$ ,  $K = 13.873$ ).

The X-ray spectroscopy indicates an unabsorbed flat ( $\Gamma \sim 0.7$ ) spectrum.

## IGR J14471–6319

Three observations analyzed with exposures: 1) 4546 s (obscode: 00036132001), 2) 3893 s (obscode: 00036132002), 3) 3570 s (obscode: 00036132003)

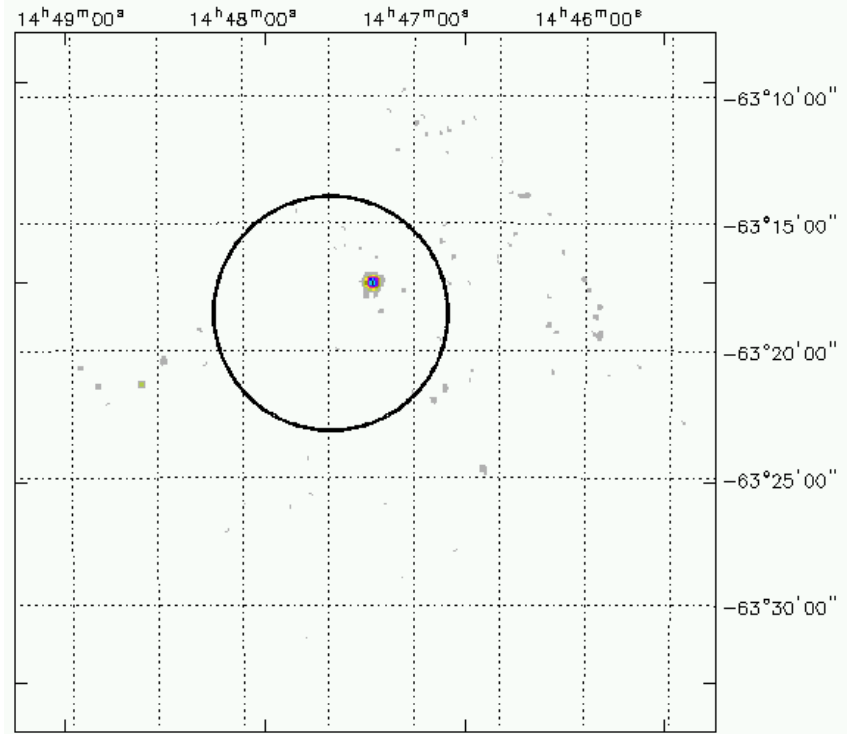


Figure 3: XRT image of the IGR J14471–6319 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

We find, within the IBIS error box, an X-ray source at the following position:

$$\begin{aligned} \text{RA(J2000)} &= 14^{\text{h}}47^{\text{m}}14^{\text{s}}.69 \\ \text{RA(J2000)} &= 14^{\text{h}}47^{\text{m}}14^{\text{s}}.69 \end{aligned}$$

$$\text{Dec(J2000)} = -63^{\circ}17'19''.56$$

$$\text{error box} = 4''.03$$

This object is associated with a ROSAT Faint Survey source (1RXS J144628.3–641627). Within the XRT uncertainty we found at least 4 USNO–B1.0 objects of which only one is listed in the 2MASS catalog (RA(J2000) = 14<sup>h</sup>47<sup>m</sup>14<sup>s</sup>.88, Dec(J2000) = –63°17'19".2, with magnitudes  $J = 14.02$ ,  $H = 12.91$ ,  $K = 12.00$ ).

The X-ray spectrum is well described by an absorbed ( $N_{\text{H}} \sim 2 \times 10^{22} \text{ cm}^{-2}$ ) power law having photon index  $\Gamma \sim 1.7$ .

## IGR J14471–6414

Two observations analyzed with exposure: 1) 117 s (obscode: 00036111001), 2) 5128 s (obscode: 00036111002)

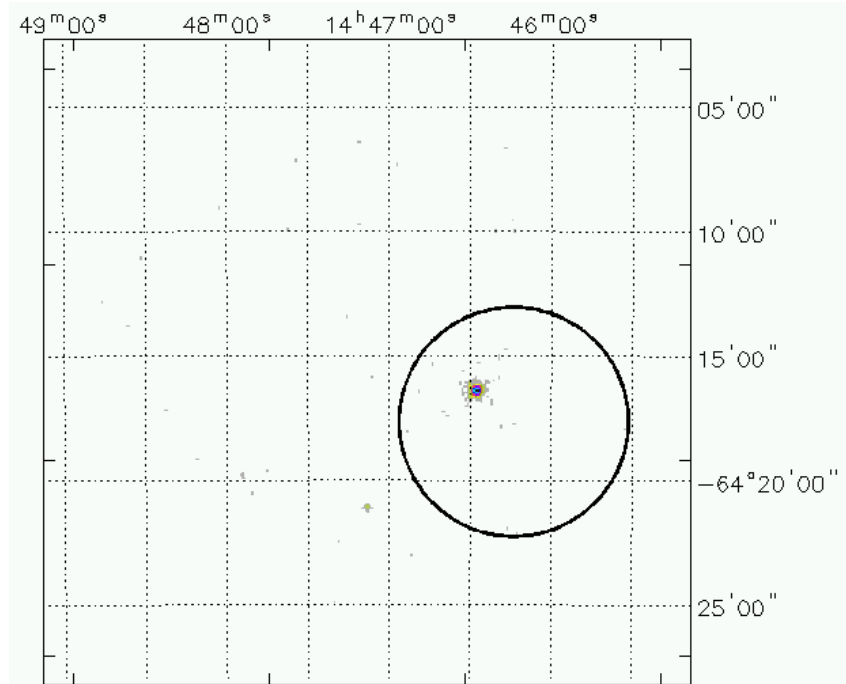


Figure 4: XRT image of the IGR J14471–6414 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

Within the *INTEGRAL* error box again, we notice that a source is detected at the following position:

$$\text{RA(J2000)} = 14^{\text{h}}46^{\text{m}}27^{\text{s}}.79$$

$$\text{Dec(J2000)} = -64^{\circ}16'23''.46$$

$$\text{error box} = 3''.67$$

This source is likely associated to a ROSAT Faint Survey source (1RXS J144628.3–641627). There is one USNO–B1.0 source within the XRT error box at  $\text{RA(J2000)} = 14^{\text{h}}46^{\text{m}}26^{\text{s}}.94$ ,  $\text{Dec(J2000)} = -64^{\circ}16'24''.7$  (with magnitude  $R = 14.3 - 14.4$ ); this source is not listed in the 2MASS catalog.

The X-ray spectrum is well described by an unabsorbed power law having photon index  $\Gamma \sim 1.6$ .



## IGR J15539–6142

Two observations analyzed with exposures: 1) 4927 s (obscode: 00036115001), 2) 4882 s (obscode: 00036115002)

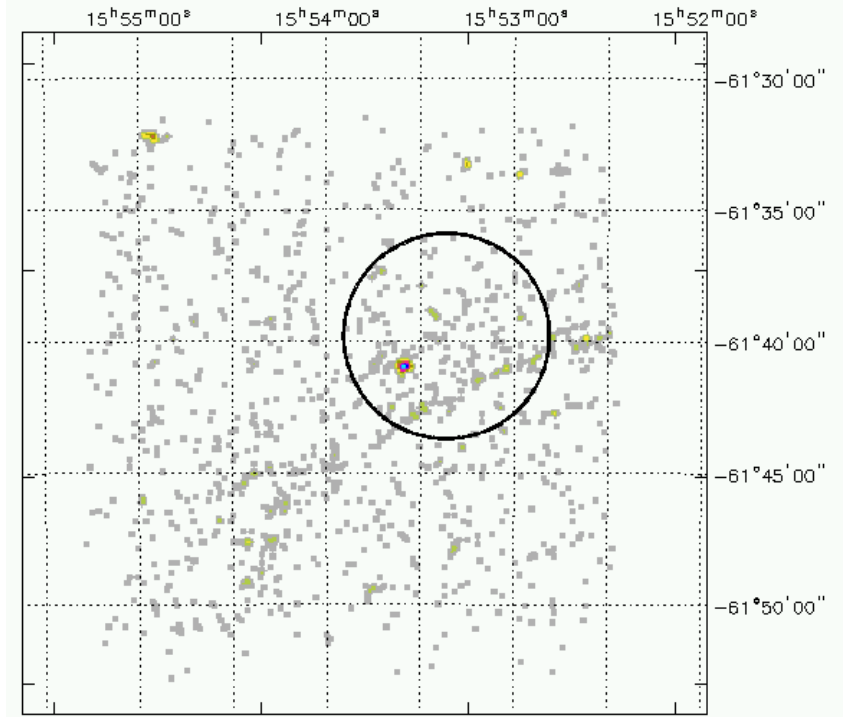


Figure 5: XRT image of the IGR J15539–6142 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

This source, first reported in the Circinus region by Keek et al. (2006), is now included in the third *INTEGRAL* catalogue. It was first associated to ESO 136–6, a galaxy behind the Milky way but afterwards Masetti et al. (2006a) noticed that an emission-line early-type star, HD 141689 (classified as B2/B3ne) is also present in the IBIS error box. The XRT data are now able to discriminate between the two sources; in fact the position of the detected excess is:

$$\text{RA(J2000)} = 15^{\text{h}}53^{\text{m}}35^{\text{s}}.22$$

$$\text{Dec(J2000)} = -61^{\circ}40'55''.40$$

$$\text{error box} = 4''.71$$

This is fully compatible with the position of the galaxy ESO 136–6.

The X-ray indicates an absorbed ( $N_{\text{H}} \sim 2 \times 10^{23} \text{ cm}^{-2}$ ) power law spectrum ( $\Gamma = 1.8$  frozen) (see Malizia et al. 2007), typical of a Seyfert 2 galaxy (Masetti et al. 2007b).

## IGR J16194–2810

Two observations analyzed with exposure: 1) 5202 s (obscode: 00036116001), 2) 2672 s (obscode: 00036116002)

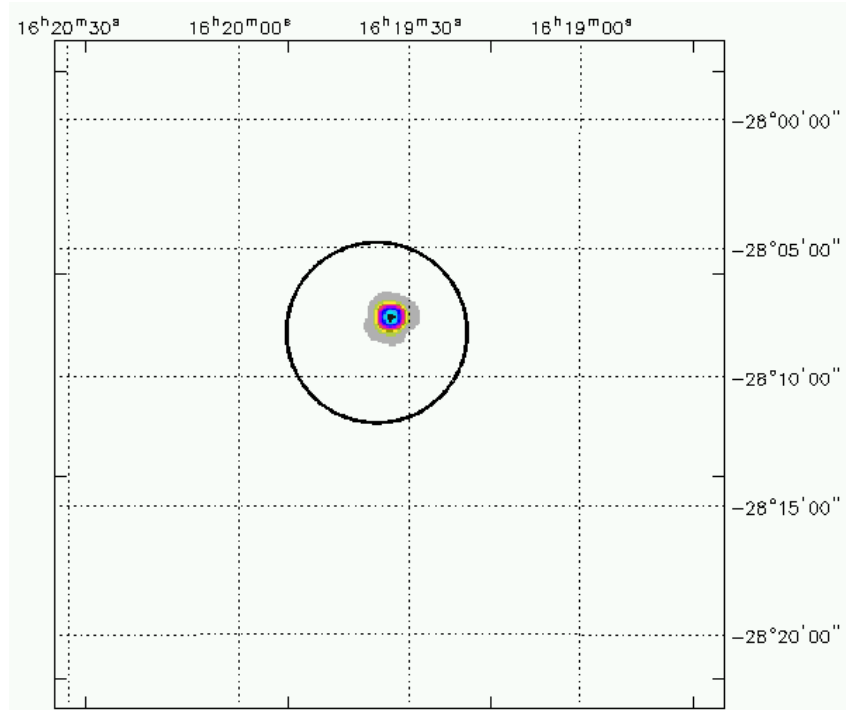


Figure 6: XRT image of the IGR J16194–2810 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

Within the IBIS error box of this source, we find a bright X-ray source at the following position:

$$\text{RA(J2000)} = 16^{\text{h}}19^{\text{m}}33^{\text{s}}.28$$

$$\text{Dec(J2000)} = -28^{\circ}07'40''.65$$

$$\text{error box} = 3''.53$$

Optical follow-up observations revealed that this object is a new symbiotic X-ray binary.

The multiwavelength study of this source is reported in a paper by Masetti et al. (2007a), recently accepted for publication on A&A.

## IGR J16351–5806

Two observations analyzed with exposures: 1) 3376 s (obscode: 00036117001), 2) 2916 s (obscode: 00036117002)

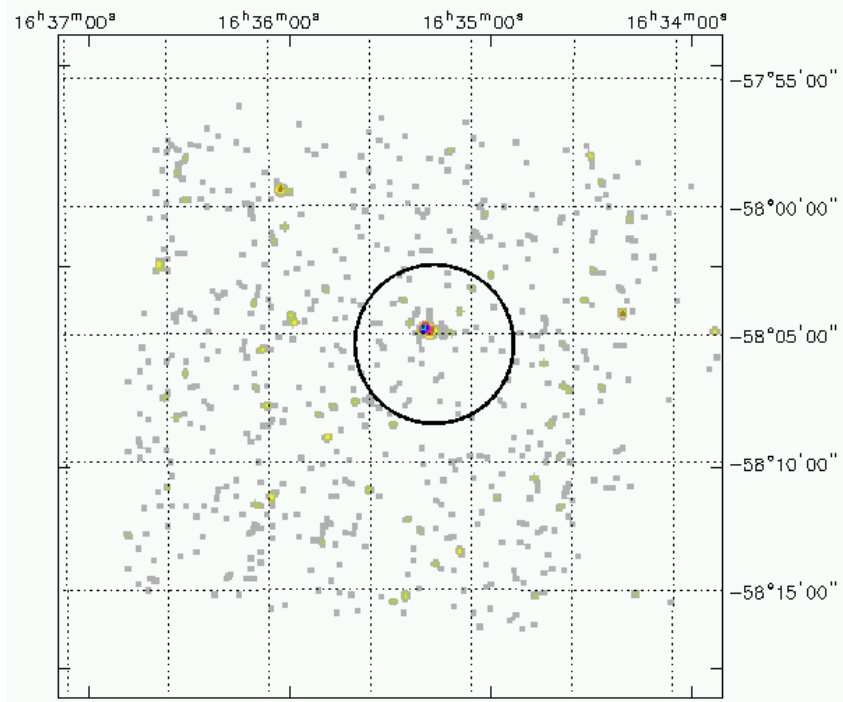


Figure 7: XRT image of the IGR J16351–5806 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

Within the IBIS error box of this source, we find an X-ray source at the following position:

$$\text{RA(J2000)} = 16^{\text{h}}35^{\text{m}}13^{\text{s}}.42$$

$$\text{Dec(J2000)} = -58^{\circ}04'49''.69$$

$$\text{error box} = 5''.08$$

The XRT position confirms the association with the Seyfert 2 galaxy ESO 137–34 (Landi et al. 2007).

The X-ray spectrum of this source is a power law ( $\Gamma = 1.6$ ) with no absorption; it is likely that this is a new Compton thick AGN (Malizia et al. 2007).

## IGR J16500–3307

One observation analyzed with exposure: 1) 4714 s (obscode: 00036118001)

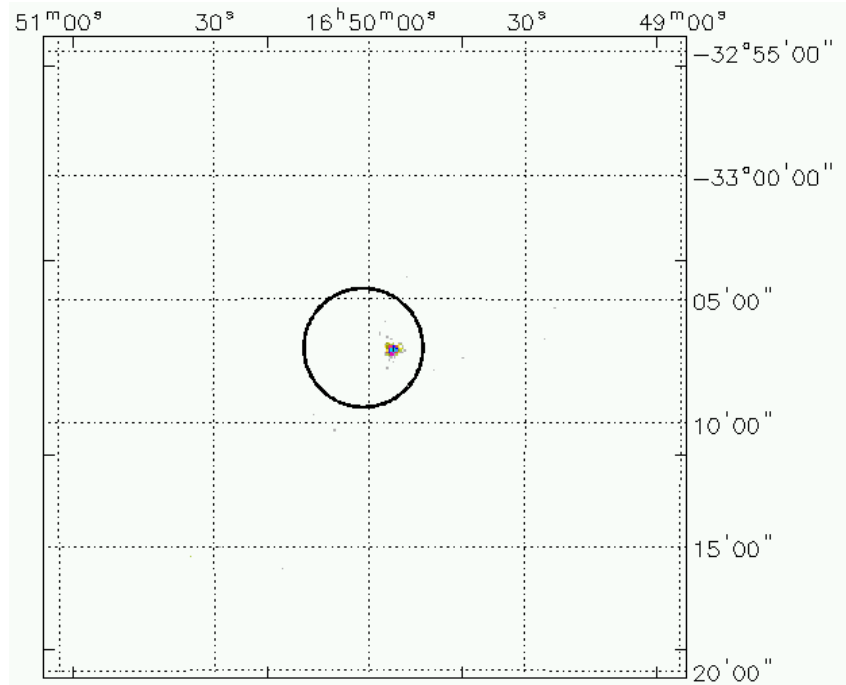


Figure 8: XRT image of the IGR J16500–3307 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

Within the IBIS error box, we find an X-ray source located at:

$$\text{RA(J2000)} = 16^{\text{h}}49^{\text{m}}55^{\text{s}}.50$$

$$\text{Dec(J2000)} = -33^{\circ}07'02''.78$$

$$\text{error box} = 3''.63$$

Optical follow-up are reported by Masetti et al. (2007b), being the source a Cataclysmic Variable or a low mass X-ray binary. The X-ray data are well modeled with a power law having a flat spectrum ( $\Gamma \sim 0.8$ ).

## AX J1700.2–4220

One observation analyzed with exposure: 1) 5879 s (obscode: 00036119001)

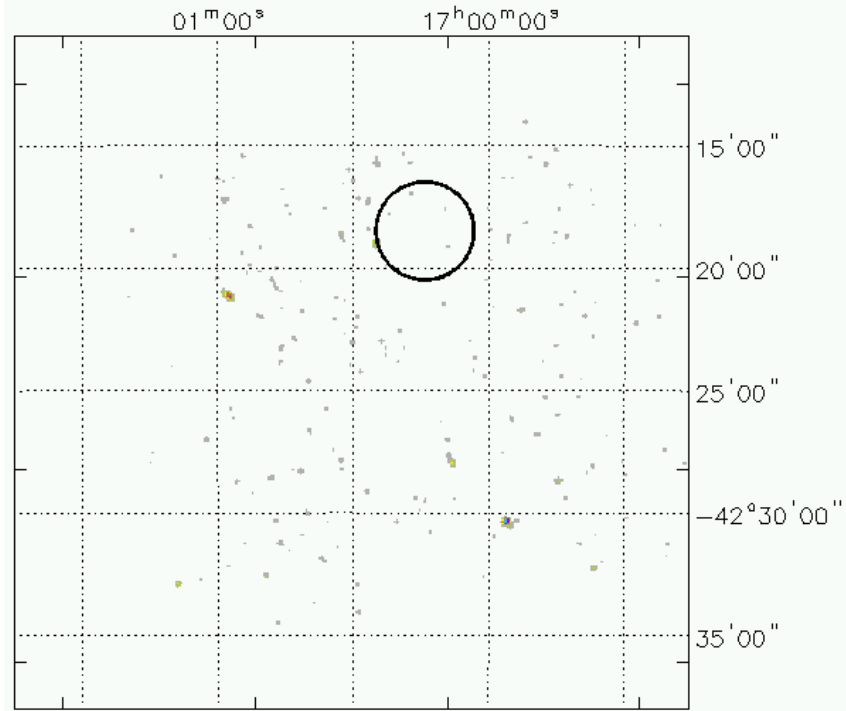


Figure 9: XRT image of the AX J1700.2–4220 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

While our own analysis did not detect any source within the *INTEGRAL* error box of this XRT observation, we notice that a source is detected at  $2.2\sigma$  in the ASDC archive, just at the border of the IBIS error box, at the following position:

$$\text{RA(J2000)} = 17^{\text{h}}00^{\text{m}}24^{\text{s}}.80$$

$$\text{Dec(J2000)} = -42^{\circ}19'00''.8$$

$$\text{error box} = 6''.00$$

If this excess is confirmed, the likely counterpart is the star HD153295 (Masetti et al. 2006b).

## XTE J1716–389

One observation analyzed with exposures: 1) 1380 s (obscode: 00036120001)

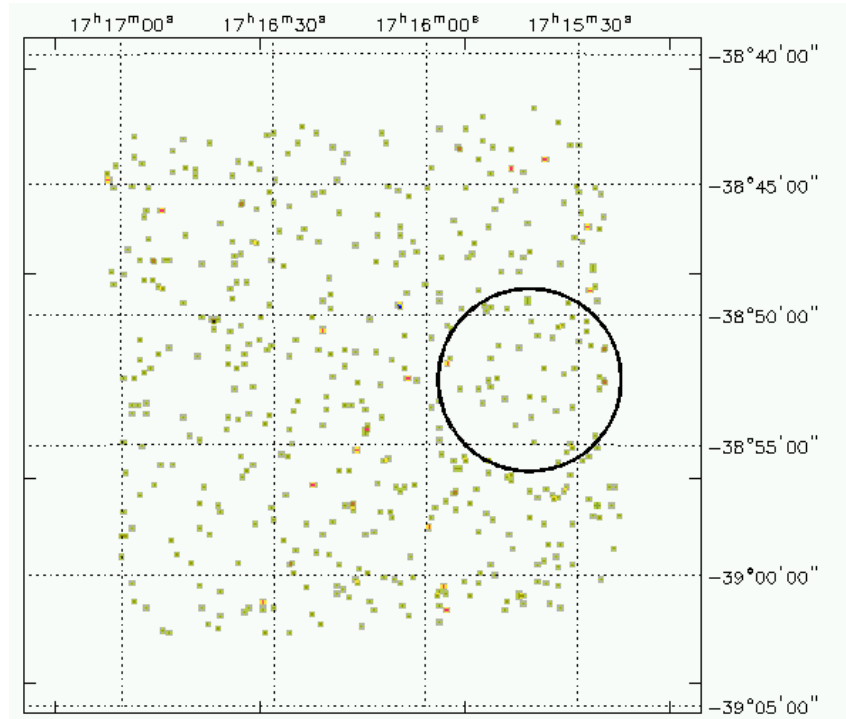


Figure 10: XRT image of the XTE J1716–389 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

No source is detected in the *INTEGRAL* error box in this XRT observation, but this is may be due to the too short observation available so far.

## IGR J17285–2922

Two observations analyzed with exposures: 1) 2630 s (obscode: 00035097001), 2) 6456 s (obscode: 00035097002)

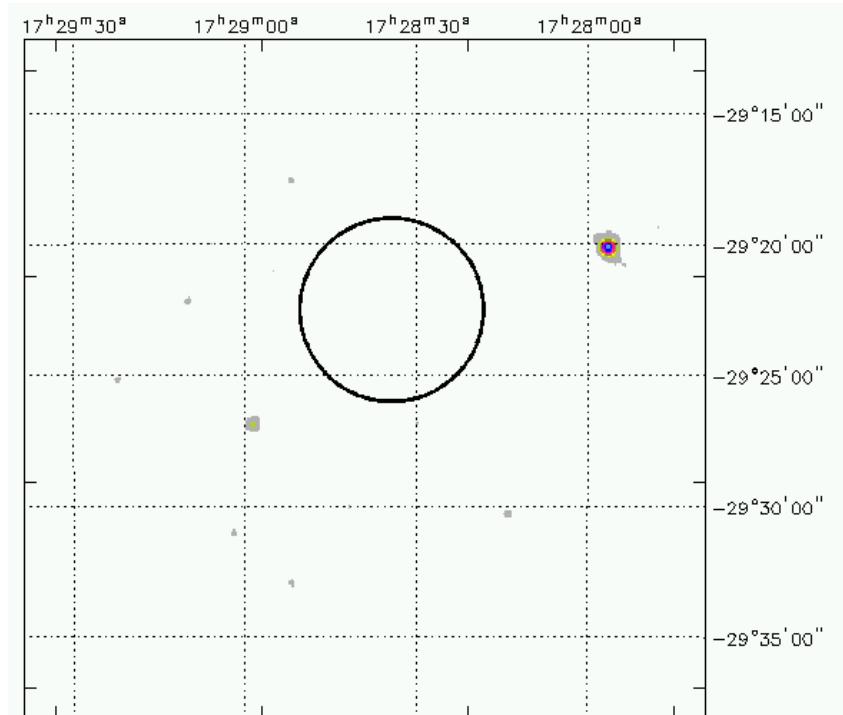


Figure 11: XRT image of the IGR J17285–2922 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

No source is detected in the *INTEGRAL* error box in these XRT observations, which is compatible with the transient nature of the source only detected in one *INTEGRAL* revolution (Bird et al. 2007).

## IGR J17331–2406

One observation analyzed with exposures: 1) 6210 s (obscode: 00036121001)

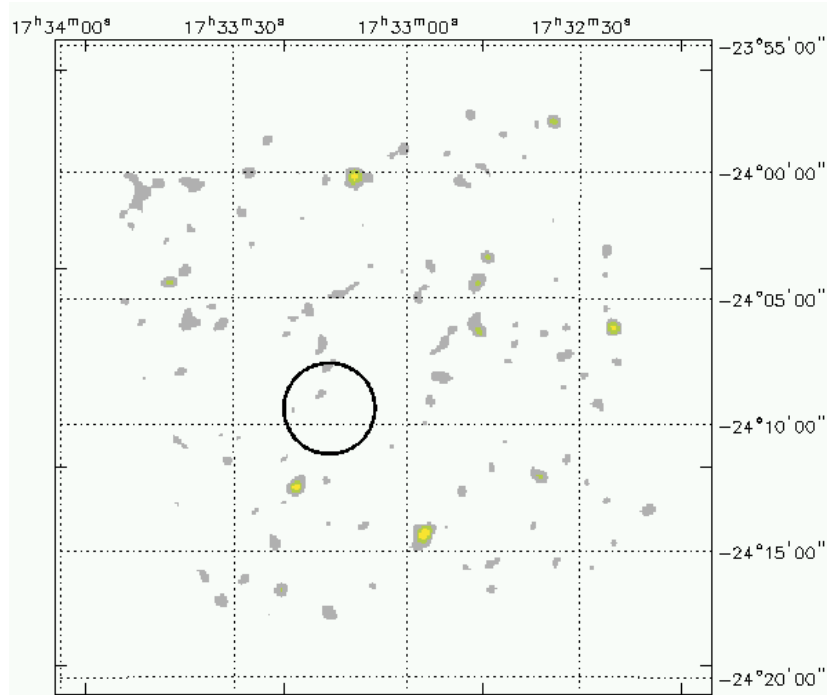


Figure 12: XRT image of the IGR J17331–2406 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

No source is detected in the *INTEGRAL* error box in this XRT observation, which is compatible with the transient nature of the source detected only in one *INTEGRAL* revolution (Bird et al. 2007).



## IGR J17407–2808

One observation analyzed with exposures: 1) 1051 s (obscode: 00030807001)

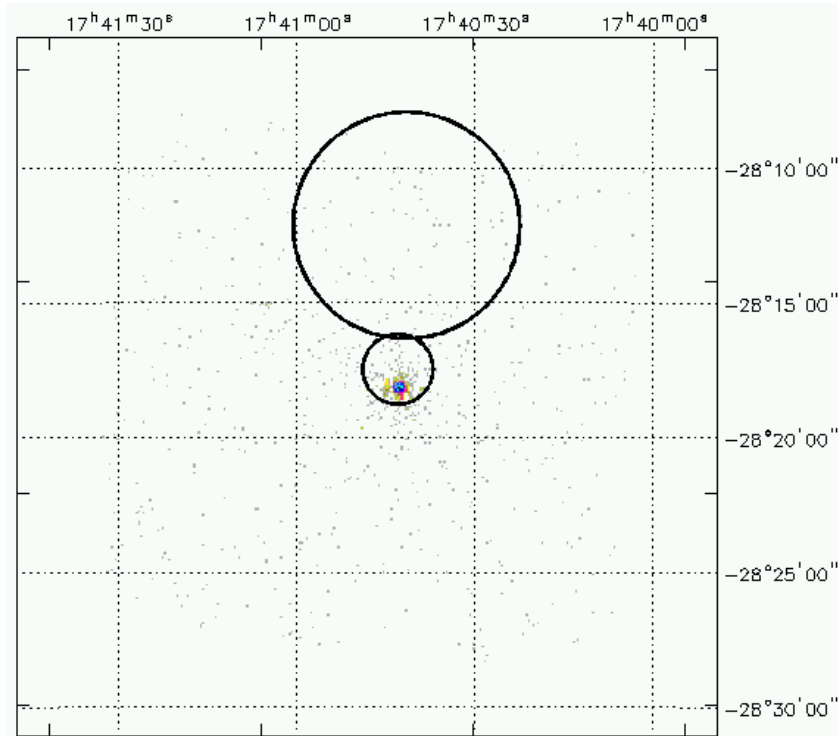


Figure 13: XRT image of the IGR J17407–2808 field. The two black circles represent the *INTEGRAL* error boxes of IGR J17407–2808 (bigger circle) and SLX 1737–282 (smaller circle), respectively (Bird et al. 2007).

During XRT observation no source is detected in the *INTEGRAL* error box of IGR J17407–2808. This is compatible with the transient nature of the source detected only in one *INTEGRAL* revolution (Bird et al. 2007). The source south of IGR J17407–2808 is the persistent source SLX 1737–282, also reported in the third, as well as in previous, *INTEGRAL*/IBIS surveys.

## 1RXS J174607.8–213333

One observation analyzed with exposure: 1) 5644 s (obscode: 00036123001)

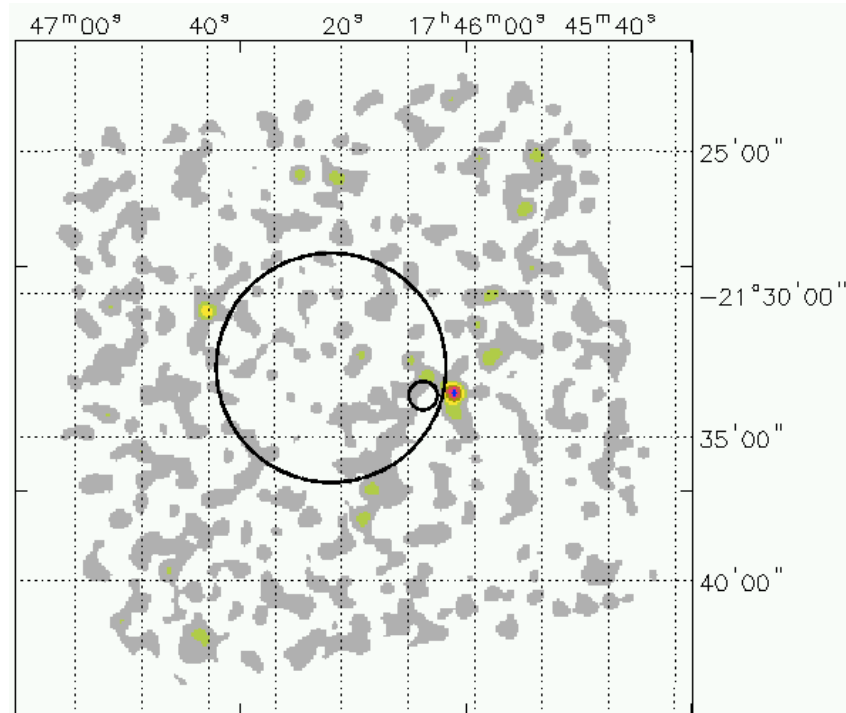


Figure 14: XRT image of the 1RXS J174607.8–213333 field. The big black circle represents the *INTEGRAL* error box (Revnivtsev et al. 2004), while the smaller black circle shows the ROSAT Faint Survey source.

No source is detected in the *INTEGRAL* error box of this XRT observation. Just outside of the IBIS error box, we find an X-ray source (detected at  $\sim 4.4\sigma$ ) located at:

$$\text{RA(J2000)} = 17^{\text{h}}46^{\text{m}}03^{\text{s}}.07$$

$$\text{Dec(J2000)} = -21^{\circ}33'26''.48$$

$$\text{error box} = 5''.02$$

Given that no other X-ray source is visible in the image, it is likely that this *Swift*/XRT excess coincides with the ROSAT Faint Survey source (see Figure 14).

Within the XRT error box we find two USNO–B1.0 objects at:

$$1) \text{ RA(J2000)} = 17^{\text{h}}46^{\text{m}}03^{\text{s}}.19 \quad \text{Dec(J2000)} = -21^{\circ}33'25''.00$$

(with magnitude  $B = 15.68$ )

and a 2MASS object at:

$$\text{RA(J2000)} = 17^{\text{h}}46^{\text{m}}03^{\text{s}}.16 \quad \text{Dec(J2000)} = -21^{\circ}33'27''.10$$

(with magnitudes  $J = 11.120$ ,  $H = 10.478$ ,  $K = 10.243$ ).

### AX J1749.1–2733

Two observations analyzed with exposure: 1) 4702 s (obscode: 00030911001), 2) 1318 s (obscode: 00036124001)

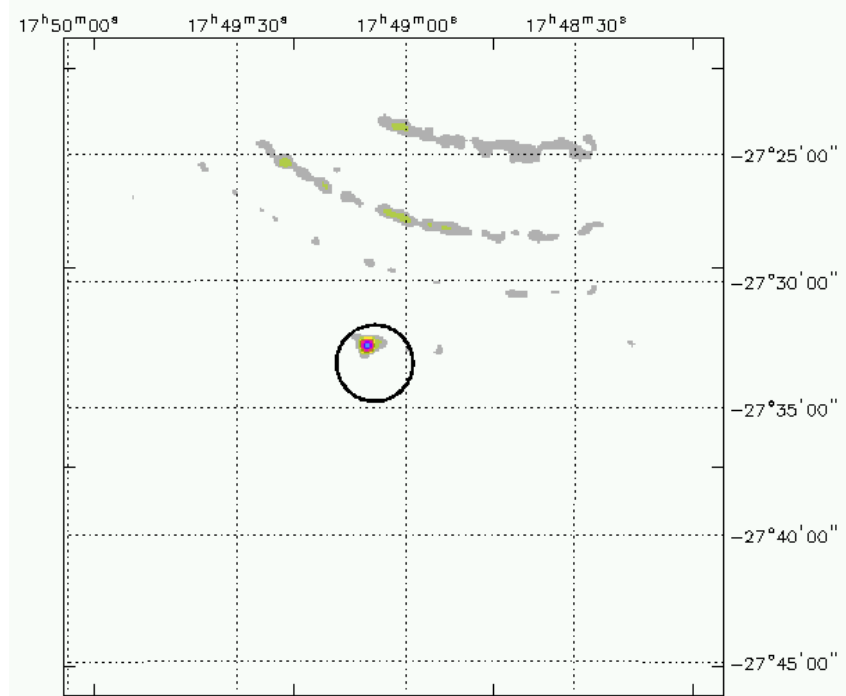


Figure 15: XRT image of the AX J1749.1–2733 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

We find a bright X-ray source within the IBIS error box located at:

$$\text{RA(J2000)} = 17^{\text{h}}49^{\text{m}}06^{\text{s}}.80$$

$$\text{Dec(J2000)} = -27^{\circ}32'32''.58$$

$$\text{error box} = 4''.08$$

Within the XRT error box we do not find any counterpart (but see Romano et al. 2007).

The X-ray spectrum is well described by an absorbed ( $N_{\text{H}} \sim 2 \times 10^{23} \text{ cm}^{-2}$ ) steep ( $\Gamma \sim 2.4$ ) power law.

## IGR J18256–1035

One observation analyzed with exposure: 1) 4816 s (obscode: 00036131001)

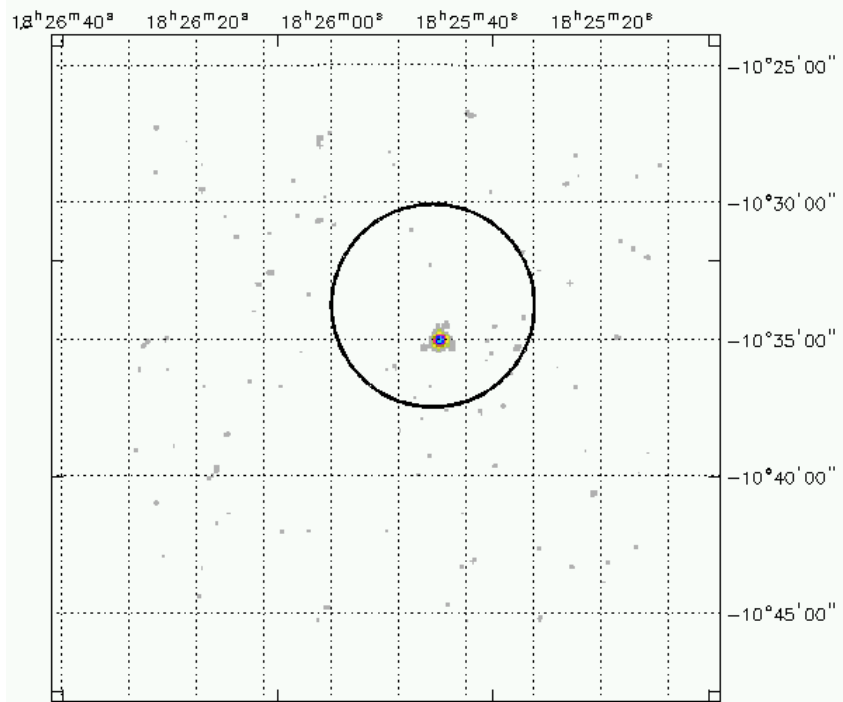


Figure 16: XRT image of the IGR J18256–1035 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

We find a bright X-ray source within the IBIS error box located at:

$$\text{RA(J2000)} = 18^{\text{h}}25^{\text{m}}43^{\text{s}}.85$$

$$\text{Dec(J2000)} = -10^{\circ}35'02''.41$$

$$\text{error box} = 4''.08$$

This source is associated to an USNO–B1.0 source located at  $\text{RA(J2000)} = 18^{\text{h}}25^{\text{m}}43^{\text{s}}.74$ ,  $\text{Dec(J2000)} = -10^{\circ}35'04''.4$ , with magnitude  $R \simeq 17$ ; no counterpart is listed in the 2MASS catalog.

The X-ray spectrum can be fitted with a an unabsorbed flat ( $\Gamma \sim 1$ ) power law.

## IGR J18259–0706

One observation analyzed with exposure: 1) 4546 s (obscode: 00036132001)

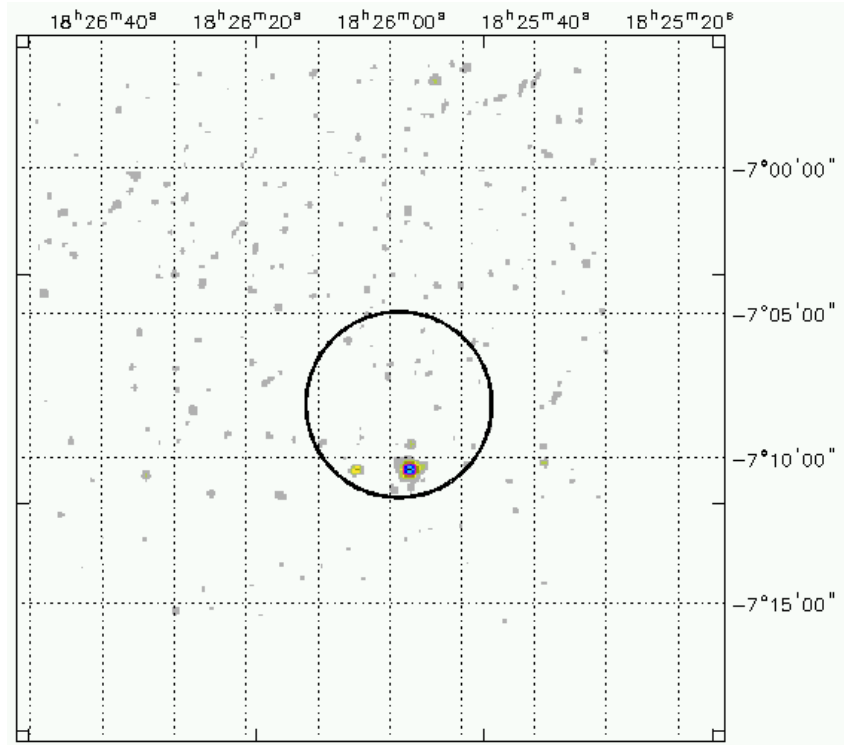


Figure 17: XRT image of the IGR J18259–0706 field. The black circle represents the *INTEGRAL* error box (Bird et al. 2007).

Within the IBIS error box of this source, we find a bright X-ray source at the following position:

$$\text{RA(J2000)} = 18^{\text{h}}25^{\text{m}}57^{\text{s}}.25$$

$$\text{Dec(J2000)} = -07^{\circ}10'24''.54$$

$$\text{error box} = 3''.71$$

Within the XRT uncertainty we find a USNO–B1.0 object at  $\text{RA(J2000)} = 18^{\text{h}}25^{\text{m}}57^{\text{s}}.07$ ,  $\text{Dec(J2000)} = -07^{\circ}10'22''.9$  (with magnitude  $R \simeq 15.2$ ), also listed in the 2MASS catalogue (with magnitudes  $J = 10.359$ ,  $H = 9.102$ ,  $K = 8.635$ ).

The X-ray spectrum is well fitted with a slightly absorbed ( $N_{\text{H}} \sim 0.6 \times 10^{22} \text{ cm}^{-2}$ ) power law having a photon index of  $\sim 1.4$  (Malizia et al. 2007).

## References

Bird et al., 2007, ApJ Supp. in press, astro-ph(0611493)

Landi et al., 2006, Atel 945

Landi et a., 2007, Atel 990

Keek et al. 2006, Atel 810  
Malizia et al. 2007, ApJ submitted Masetti et al., 2007a, A&A in press, astro-ph(07043682)  
Masetti et al., 2007b, Atel 1034  
Masetti et al., 2006a, Atel 815  
Masetti et al., 2006b, Atel 783  
Revnivtsev et al., 2004, Astron. Lett., 30, 382  
Romano et al., 2007, Atel 1040