# *SWIFT*, *INTEGRAL*, *RXTE*, AND *SPITZER* REVEAL IGR J16283–4838

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**ABSTRACT**

We present the first combined study of the recently discovered source IGR J16283–4838 with *Swift*, *INTEGRAL*, and *RXTE*. The source, discovered by *INTEGRAL* on April 7, 2005, shows a highly absorbed (variable $N_{\rm H} = 0.4 - 1.7 \times 10^{23}\,{\rm cm}^{-2}$) and flat ($\Gamma \sim 1$) spectrum in the *Swift*/XRT and *RXTE*/PCA data. No optical counterpart is detectable ($V > 20\,{\rm mag}$), but a possible infrared counterpart within the *Swift*/XRT error radius is detected in the *2MASS* and *Spitzer*/GLIMPSE survey. The observations suggest that IGR J16283–4838 is a high mass X-ray binary containing a neutron star embedded in Compton thick material. This makes IGR J16283–4838 a member of the class of highly absorbed HMXBs, discovered by *INTEGRAL*.

Key words: gamma rays: observations, X-rays: binaries, X-rays: individual (IGR J16283-4838), stars: neutron.

## 1. INTRODUCTION

Star formation in our Galaxy takes place mainly in the dense regions of the spiral arms. These regions host massive molecular clouds and also the majority of the single and binary neutron stars ($\sim 10^9$) and black holes ($\sim 10^8$) in the Milky Way. The dense molecular clouds lead to strong star formation activity, which also results in the formation of binary systems, and subsequently to X-ray binary systems. These objects show X-ray flares and outbursts because of accretion processes onto the compact object. At the same time, the gas and dust of the spiral arms absorb most of the emission in the optical to soft X-ray regime below 10 keV. In addition, dense absorbing atmospheres around the object make the detection of these sources even more difficult. The hard X-ray and soft gamma-ray mission *INTEGRAL* operates at energies above 20 keV. With the large field of view and its observing program focussed on the Galactic plane and center, *INTEGRAL* is a powerful tool to discover highly absorbed sources ($N_{\rm H} > 10^{23}\,{\rm cm}^{-2}$). So far a handful of those enigmatic objects has been found by *INTEGRAL*. Most, if not all, of these sources appear to be HMXBs, probably hosting a neutron star as the compact object and show variable absorption. Here we report the discovery and analysis of another highly absorbed source, IGR J16283–4838. This work makes the first use of the combined data of *INTEGRAL*, *Swift*, *RXTE*, and *Spitzer*.

## 2. OBSERVATIONS

IGR J16283–4838 was discovered (Soldi et al. 2005) during the observation of the Norma arm region by the imager IBIS/ISGRI on-board *INTEGRAL*. The observation lasted from April 7-9, 2005, with an effective ISGRI exposure time of 126 ksec. The source showed a flux of $f_X = (4.8 \pm 0.8) \times 10^{-11}\,{\rm erg\,cm^{-2}\,s^{-1}}$ in the 20 - 60 keV band. The analysis of the data prior to the discovery resulted in a $3\sigma$ upper limit of $f_{20-60\,{\rm keV}} = 1.7 \times 10^{-11}\,{\rm erg\,cm^{-2}\,s^{-1}}$. The source showed significant brightening during an *INTEGRAL* observation starting on April 10 (Paizis et al. 2005). After the discovery of IGR J16283–4838 two *Swift* follow-up observations took place 3 and 5 days after the last *INTEGRAL* observation. The first one started on April 13, 14:02 U.T. with an exposure time of 2.5 ksec, which resulted in an effective *Swift*/XRT exposure of 550 sec. A second observation was performed on April 15 with 2600 sec effective XRT exposure time. Applying a centroid algorithm to the data of April 15 gives a refined position for the source of $R.A. = 16^{\rm h}28'10.56''$, $DEC = -48°38'56.4''$ with an uncertainty of 6" radius. IGR J16283–4838 was then also observed twice by *RXTE*/PCA, and a counterpart was found in the 2MASS and *Spitzer*/GLIMPSE data bases. Another observation in the K-band was performed with the 6.5m Magellan-Baade telescope on April 21, 2005. This observation indicates that the source seen in the 2MASS is a blend of point sources, with the brightest showing $K = 14.1\,{\rm mag}$ (Steeghs et al. 2005). Therefore the identification with the *Spitzer* source is tentative.

## 3. DISCUSSION

The position within the Galactic plane at only $+6.1$ arcmin makes a Galactic origin of the source likely, even though some AGN have been seen through the plane by *INTEGRAL*, like the Seyfert 1 galaxy GRS 1734-292. Strong variability as observed in IGR J16283–4838 has been seen in the X-ray spectra of Seyfert galaxies, but the X-ray spectrum is too flat ($\Gamma \simeq 1$) for a Seyfert galaxy. This would still leave the possibility of a blazar as counterpart. But the absorption by the Galaxy in the direction of the source ($N_{\rm H} = 2.2 \times 10^{22}\,{\rm cm^{-2}}$) is not high enough to explain the intrinsic absorption of $1.7 \times 10^{23}\,{\rm cm^{-2}}$, and thus intrinsic strong absorption in the blazar would be required, but this has not been seen so far in blazar spectra.

If we consider IGR J16283–4838 to be a Galactic source, mainly two types of bright and variable hard X-ray emitters are likely to be a counterpart: Low Mass and High Mass X-ray Binaries, LMXBs and HMXBs, respectively. The hard X-ray spectrum with strong absorption indicates the presence of a HMXB in which no pulsation have been detected so far. Also the bright infrared emission, if connected to the X-ray source, would indicate a massive star as the companion of the compact object. The luminosity of the object during the flare can be estimated by taking the brightest stage during the *RXTE* observation and assuming a distance to the object between 1 and 10 kpc. The unabsorbed flux is in this case only 20% larger than the absorbed one, because the significant part of the luminosity is emitted in the hard X-rays. The bolometric luminosity is then in the range $\log L_{\rm burst} = 34.0 - 36.5$ (where $L$ is in units of ${\rm erg\,s^{-1}}$). The quiescent luminosity of the system is at least a factor of $\sim 20$ lower with $\log L_{\rm q} < 33 - 35.2$. This range of values is consistent with measurements from known Be/X-ray binaries with a neutron star as the compact object (Negueruela 1998). In any case the luminosity is far below the Eddington luminosity of a neutron star of $1.4 M_{\odot}$ ($L = 1.8 \times 10^{38}\,{\rm erg\,s^{-1}}$).

The properties of IGR J16283–4838 are similar to those of a number of highly absorbed sources ($N_{\rm H} = 1 - 20 \times 10^{23}\,{\rm cm^{-2}}$) found in the Galactic plane, especially in the Norma arm region (Walter et al. 2004). Only one of the newly detected highly absorbed sources has been claimed so far not to be a HMXB (IGR J16358–4726; Patel et al. 2004). The fact that most of the absorbed sources so far have shown to be HMXBs (Kuulkers et al. 2005) containing neutron stars does not rule out significant contribution of HMXBs with a black hole as the compact object. It appears that variable absorption is a common feature in highly absorbed HMXBs. This could mean that the absorbing material is linked to the existence of a high mass donor in the binary system. In this case a strong and dense stellar wind ($10^{-7}$ to $10^{-5}\,M_{\odot}\,{\rm yr^{-1}}$) from the early-type stellar companion will probably cause the absorption in the system.

## 4. CONCLUSIONS

The newly discovered hard X-ray source IGR J16283–4838, located in the Norma arm region, is likely to be a HMXB containing a neutron star as the compact object (Beckmann et al. 2005). It is located in the Galactic Plane in the direction of star forming regions in the spiral arms and shows a large flare, which makes an extragalactic origin unlikely. The spectrum is hard ($\Gamma \sim 1$) and strongly absorbed during the flare, which indicates a HMXB rather than a LMXB. The luminosity is comparably low ($L < 10^{37}\,{\rm erg\,s^{-1}}$) which is typical for a neutron star HMXB. The strong and variable absorption ($N_{\rm H} = 0.4 - 1.7 \times 10^{23}\,{\rm cm^{-2}}$) indicates that IGR J16283–4838 belongs to the class of highly absorbed HMXBs discovered by *INTEGRAL* along the Galactic plane. Bright and absorbed sources like IGR J16283–4838 could contribute significantly to the Galactic hard X-ray background in the 10–200 keV band.

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