The INTEGRAL/IBIS view of IGR J16318-4848. Possible detection of its spin period

Miralles-Caballero D.1, Blay P.2, Martinez-Nuñez S.3, Reig P.1, Camero-Arranz A.2 & Reglero V.2

1 Department of Molecular & Infrared Astrophysics - IEM – CSIC, Madrid, Spain
2 GACE-IPL-ICMUV, University of Valencia, Valencia, Spain
3 Dpto. Fisica Ingenieria de Sistemas y Teoria de la Senal, University of Alicante, Alicante, Spain
4 Physics Department, University of Hiraklio, Hiraklio, Greece

ABSTRACT

IGR J16318-4848 is the archetype of the new class of intrinsically obscured high-energy sources revealed by INTEGRAL. Many campaigns and multi-wavelength studies have been performed in order to understand its nature. This system still poses many uncertainties as the knowledge of some of its orbital parameters, besides, its scenario is still not clear, although some suggestions have been made so far. In this poster we report on a continuum spectral and a detailed timing analysis carried out with INTEGRAL/IBIS, from GPS and public observations up to date. Our goal is to characterize the source in the 20-300 keV regime. The main result of the study is the discovery of persistent modulations of around 9000 s throughout the light curve in the 20-40 keV energy range, which could constitute the spin period of this source. We also show the hard x-ray spectra of this source, which seems to have different behavior during flares.

1. INTRODUCTION

Courvoisier et al. 2003 performed the first source discovery with INTEGRAL (INtegral Gamma-Ray Astrophysics Laboratory, Winkler et al. 2003). Soon after, the extreme obscure nature of IGR J16318-4848 was revealed (Schartel et al. 2003, Matt & Guainazzi 2003), with a column density $N_H$ ~ 2 x 10$^{21}$ cm$^{-2}$. Fillietre & Chaty (2004) found its optical counterpart, proposed the source to be a High Mass X-Ray Binary system at 1-6 kpc with a B Supergiant emitting prohibited lines (SpBHe), and showed a significant NIR excess in their photometric and spectral study. They suggested that the material absorbing in the X-rays was around the compact object, whereas the whole system was enveloped in the material absorbing in the optical/NIR. Succeeding studies have shown that this source also exhibits MIR excess, likely to be of warm dust around the system (Kaplan et al. 2006, Rahlou et al. 2008).

IGR J16318-4848 represents a new class of obscured HMXRB for which multi-wavelength studies become necessary in order to understand the whole picture of its nature. On this poster we present the results obtained from a hard x-ray spectral and timing study performed on this source with the INTEGRAL/IBIS on board INTEGRAL. Persistent modulations around 9000 s have been found, which are likely to be the spin period of the system.

2. SPECTRAL ANALYSIS

The data analysed correspond to the first 5 years of INTEGRAL and have been reduced with the Off-line Science Analysis (OSA) Software. The x-ray pointings with off-axis angle below 5° were considered.

We first carried out a spectral analysis with XSPEC considering three flux ranges, in order to look for variability between bright and quiet regimes. We extracted three spectra from pointings whose 20-100 keV lies below 20 counts/s (A), between 20 and 30 c/s (B) and above 30 c/s (C). The spectra can be represented by a broken power law with $\Gamma = 1.5 \pm 0.1$ and $\epsilon_c = 35 \pm 5$ keV. According to these results, shown in table 1, the brightest states (B and C) are likely to be hard, unlike the case for the other source, as it can be inferred from the values of $\Gamma$. In figure 1 (top), all three spectra can be seen.

Table 1. Best-fit spectral parameters for the three intervals and the average.

We also analysed the average spectrum up to 300 keV, in order to have enough statistics to fit the data with analytical models such as the componization model.

The XSPEC spectral parameters are shown in figure 1 (bottom). As it can be seen, the source spectrum it is well explained by a componization model with temperature KT ~ 8.8 keV, similar parameter values to those obtained in Walter et al. 2004. It can also be fitted with a powerlaw with two breaks.

Figure 2. Top: Extract of the light curve rebinned to 300 s corresponding to the interval analysed. Middle: Power Spectrum of the previous light curve. Bottom: Result of the search period for the previous light curve.

3. TIMING ANALYSIS

Using the same pointings as before, we obtained the 20-40 keV light curve with a time binning of 16 s. We can see that the source is very variable, exhibiting many flares with duration between few hours up to a few days. A search for any modulation was carried out. In figure 2 (top) an extract of the light curve rebinned to 300 s, between MJD 53229 and 53292, is shown. A modulation around 10$^4$ s has been found. Actual, similar modulations are observed throughout the light curve. We obtained the power spectrum (figure 2 middle) of the extracted light curve, which shows a peak at around 0.11 mHz (~ 10$^4$ s). We then found a possible period using the FTOOL rsearch, at around 9320 s. The wide peak shown in figure 2 (bottom) was fitted with a Lorentzian, giving a FWHM of ~ 1800 s, which implies that the modulation is quite badly determined. This is likely due to large error bars in data and that our extracted light curve only covers 3-4 periods.

We interpret this modulation as the possible spin period of IGR J16318-4848 because:

- *Similar variability has been found at different intervals of the light curve (MJD 53229-53292, 53312-53412, 53417-53447).*
- *If we fold the extracted and the overall light curve, as displayed on figure 3, the result is about the power spectrum curve (instead of random). This is what would be expected if the spin period of the system were roughly 9300 s.*
- Future telescopes and studies with better resolution and time integration will be the clue to confirm or reject this discovery.

REFERENCES