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IGR J16393−4643: a new heavily-obscured X-ray pulsar

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Abstract. An analysis of the high-energy emission from IGR J16393−4643 is presented using data from *INTEGRAL* and *XMM-Newton*. The source is persistent in the 20–40 keV band at an average flux of 5.1×10^{-11} ergs cm^{-2} s^{-1}, with variations in intensity by at least an order of magnitude. A pulse period of 912 ± 3 s was discovered in the *ISGRI* and *EPIC* light curves. The source spectrum is a strongly-absorbed ($N_{\rm H} = (2.5 \pm 0.2) \times 10^{23}$ cm^{-2}) power law that features a high-energy cutoff above 15 keV. Two iron emission lines at 6.4 and 7.1 keV, an iron absorption edge $\gtrsim$7.1 keV, and a soft excess emission of 7×10^{-15} ergs cm^{-2} s^{-1} between 0.5–2 keV, are detected in the *EPIC* spectrum. The shape of the spectrum does not change with the pulse. Its persistence, pulsation, and spectrum place IGR J16393−4643 among the class of heavily-absorbed HMXBs. The improved position from *EPIC* is R.A. (J2000)= $16^{\rm h}39^{\rm m}05.4^{\rm s}$ and Dec.= $-46^\circ 42' 12''$ ($4''$ uncertainty) which is compatible with that of 2MASS J16390535−4642137.

Keywords. X-rays: binaries, X-rays: individual: IGR J16393−4643=AX J163904−4642.

1. Observations & Analysis

The *INTEGRAL* data consist of roughly 1500 core program and public pointings between revolutions 30–260. Version 4.2 of the *INTEGRAL* OSA software was used to reduce raw data into images. Intensity, significance, variance, and exposure mosaic images in various energy bands between 20 and 60 keV were constructed. From these mosaics, we extracted a spectrum and a source location of R.A. (J2000)= $16^{\rm h}39^{\rm m}05^{\rm s}$ and Dec.= $-46^\circ 42.3'$ ($26''$ uncertainty) which agrees with the *ISGRI* position of Bird *et al.* (2004) while improving it. The mean flux (20–60 keV) of the source is 0.73 ± 0.02 counts per second, or 4.9 mCrab, at a significance of 36σ.

XMM-Newton observed IGR J16393−4643 on March 21, 2004, for an effective exposure time of ∼8 ks. We used the SAS v. 6.1.0 software to analyze the data and to extract the *EPIC* spectra. The refined X-ray position averaged from *MOS* and *PN* is R.A. (J2000)= $16^{\rm h}39^{\rm m}05.4^{\rm s}$ and Dec.= $-46^\circ 42' 12''$ ($4''$ uncertainty). This position does not coincide with the counterparts proposed by Combi *et al.* (2004), but is about 1' away from the infrared source 2MASS J16390535−4642137.

A pulsation of 912 ± 3 s was detected in both the *ISGRI* light curve of revolution 37 (an epoch during which the source was particularly bright) and in the *PN* data (Fig. 1).

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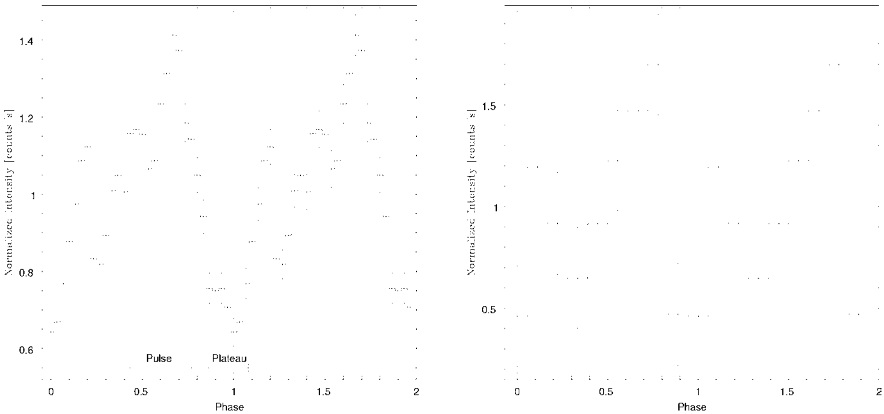

Figure 1. Light curves folded at 912 s for *PN* 2–10 keV (*left*) and *ISGRI* 15–40 keV (*right*).

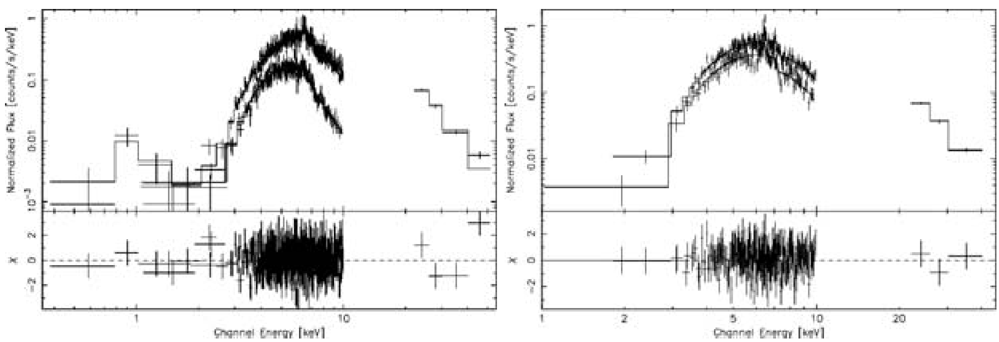

Figure 2. Average *PN*, *MOS*1–2, and *ISGRI* spectra (*left*), and the phase-resolved *PN* spectra constrained with the *ISGRI* spectrum (*right*).

The source spectrum can be fit with an absorbed power law plus an energy cutoff ($\Gamma_1 \sim 1, \Gamma_2 \sim 4, E_{\rm cut} > 15\,{\rm keV}, \chi^2_\nu = 0.96$) or with a Comptonized model ($kT_{\rm e} \sim 4.4\,{\rm keV}$, $\tau \sim 9$, $\chi^2_\nu = 0.95$, see Fig. 2 *left*). The spectrum features a large hydrogen column density of $N_{\rm H} \sim 25\,10^{22}\,{\rm cm}^{-2}$ which indicates that the absorption is intrinsic since it is an order of magnitude more than the galactic absorption. Iron lines at 6.4 keV (Fe Kα) and 7.1 keV (Fe Kβ) are detected, as is a soft excess emission of $7 \times 10^{-15}{\rm ergs\,cm}^{-2}\,{\rm s}^{-1}$ which requires a blackbody component in the model. The absorbed, integrated fluxes (in units of $10^{-11}{\rm ergs\,cm}^{-2}\,{\rm s}^{-1}$) are 4.4 in the 2–10 keV band, and 5.1 in the 20–60 keV band. The pulsation affects the normalizations but does not modify the shape of the spectra nor its parameters, specifically the $N_{\rm H}$, in any appreciable way (Fig. 2 *right*).

Details of the analysis can be found in Bodaghee *et al.*, 2005 (submitted to A&A).

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