

# Hitomi Observation of the Highly Obscured High-Mass X-ray Binary IGR J16318–4848

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## ABSTRACT

IGR J16318–4848 is a high-mass X-ray binary (HMXB) system with an extremely strong absorption. It was discovered by INTEGRAL (Courvoisier et al. 2003, IAUC, 8063) and the X-ray spectrum was found to be dominated with strong fluorescence lines of iron and nickel as well as the continuum emission (Matt & Guainazzi 2003, MNRAS, 341, L13). Long term light curves by RXTE-ASM, *Swift*-BAT and INTEGRAL-ISGRI suggest a possible orbital period of 80 d (Jain et al. 2009, RAA, 12, 1303). The fluorescence lines and the continuum vary on time scales of thousands of seconds, corresponding to an emitting region of about  $10^{13}$  cm (Walter et al. 2003, A&A., 411, L427). The optical/near-infrared (NIR) counterpart exhibits less absorption than that measured in the X-ray band, which implies that the absorbing material is concentrated around the compact object. The NIR spectrum also suggests the counter part is a supergiant B[e] star (Filliatre & Chaty 2004, ApJ, 616, 469) and hence the source is classified as a HMXB system. However, the nature of the compact source (neutron star or blackhole) is not yet confirmed.

Hitomi observation was performed just after the startup of the Soft X-ray Spectrometer (SXS), the Soft X-ray Imager (SXI), and one of the two Hard X-ray Imager (HXI). Because alignment matrices of the star trackers were not yet optimized, the source was outside of the field-of-view (FoV) of SXS for most of the exposure. On the other hand, larger FoVs of HXI and SXI enabled us to obtain a broad band spectrum and light curve. The effective exposure time of these two instruments are 42 ks and 143 ks for HXI and SXI respectively, although we use the data only when both of the two instruments were available in the current analyses.

SXT+SXI and HXT+HXI spectra show negligible contribution of the Compton shoulder as in the previous observations (Ibarra et al. 2007, A&A, 465, 501). The spectra are fitted with an absorbed cut-off power-law and three gaussians to account for the fluorescence lines. Comparing the spectral parameters with those obtained from Suzaku observation in 2006 (Barragan et al. 2009, A&A, 508, 1275), the flux of continuum and line components significantly decreased in this ten years while the equivalent widths increased. Unabsorbed luminosity in 2 to 10 keV is  $5.8 \times 10^{35}$  ergs/s, which is far below the Eddington limit of  $1.8 \times 10^{38}$  ergs/s for a neutron star of  $1.4 M_{\odot}$  and hence permits moderate accretion. The ratio of the continuum flux to the fluorescence line flux is positively correlated with the continuum flux. In other words, the continuum component varies more dynamically than the line component, or at least a part of the line emission is not affected by the continuum emission.

In spite of a severely limited number of source events, we successfully detected Fe  $K\alpha_1$  and Fe  $K\alpha_2$  lines from SXS spectrum thanks to its outstanding energy resolution. We put a constraint on the  $K\alpha_1$  centroid to be  $6404.8^{+1.7}_{-1.3}$  eV, which is tightest among the past observations. Combining the best-fit parameters obtained with SXI and HXI, neutral or slightly ionizing state of Fe is plausible, although the gain uncertainty of each instrument should be referred. Considering the line-of-sight velocity of the line-emitting matter, NIR spectrum is consistent with no systemic velocity of the sgB[e] star ( $c\Delta\lambda/\lambda=110\pm 130$  km/s). Assuming that the line-emitting matter follows the compact object that rotates around a companion with a mass of  $30 M_{\odot}$ , a distance of  $10^{13}$  cm, and an inclination angle of  $45^{\circ}$ , the maximum line-of-sight velocity will be 450 km/s (9 eV), which does not change our estimation.

Coherent pulsation search is performed both for SXI and HXI light curves from 1 s to one tenth of the exposure time of each instrument. We find a hint of periodicity at 46.9 s in the HXI light curve for the energy band from 5.5 to 80 keV.

KEY WORDS: Stars: individual: IGR J16318–4848 — binaries: spectroscopic — X-rays: binaries