

# Result of regular observations by X-ray fluorescence spectrometer onboard HAYABUSA spacecraft

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X-ray spectrometer on HAYABUSA, XRS, has a regular observation for three hours per a week to detect the cosmic x-ray background (CXB) and fluorescent x-rays from the standard sample with HAYABUSA XRS. This report shows the latest results of the XRS status.

Between the launch of HAYABUSA on May 2003 and the software upload on the end of December 2003, XRS had been continued the regular observation. Each data set showed that the number of counts detected by XRS was larger than that of expected one. During a few weeks after the launch, it was considered that the influence of solar x-ray flares. But X-ray flux showed ten times higher counts than expected, even when the solar condition was quiet. Therefore, the FIFO status was almost FULL which means FIFO buffer overflow occurred and only a part of X-ray was obtained.

The FIFO buffer status depends on the balance of writing and reading. The FIFO buffer overflow means the readout speed is slower than the speed of data generation. The data generation due to X-ray incidence was expected to be too small to fill the FIFO buffer. The reason of high rate of data generation is now discussed. While the data generation is higher, the reason of slowness of data readout was found. The data readout of XRS was implemented by software, and the readout speed was slower in proportion to the second power of X-ray event due to the judgment routine of vertical splits. X-ray events over multi-pixels on X-ray CCD do not reflect the X-ray energies. Therefore the judgment of split events is required and the events are removed or summed if the events were divided into multi-pixels. For horizontal split-events, they are easily judged because the readout is horizontally performed. However, vertical split requires event storing and check all pairs of stored events.

The effect of vertical split was rechecked using the pre-flight data. It was found that the effect to X-ray spectrum is less than 1 %. XRS adopted the vertical binning, which factor is 16, and the counts of vertical splits were one-sixteenth of that of horizontal splits statistically. The software without this vertical split judgment, it was found that the vertical split routine was primary factor of readout slowness.

Between the end of December 2003 and the beginning of January 2004, there are a few days to stop HAYABUSA Ion engine. During this term, there were a few chances to update the software, and it was uploaded to HAYABUSA on 29 December 2003. Through the functional checks of the software, the FIFO status showed the decreasing counts of the FIFO FULL flags, and the increasing counts of the FIFO EMPTY flags. Previous software never showed the FIFO EMPTY signs, and the effect of removing the judgment of vertical split was clearly verified.

In addition, the X-ray flux monitoring function was implemented to the new software. The background to implement this function, XRS has the possibility to use as an instrument to monitor solar condition. By the observation two weeks after the launch of HAYABUSA, it was found that the X-ray flux from the standard sample has the strong correlation to the flux of the solar X-rays observed by GOES satellite. HAYABUSA is preparing the Earth swing-by, and approaching to the Earth. Then this function will be evaluated.

Astronomical X-ray satellites reported degradation of X-ray CCD. XRS has the possibility to meet the same situation. Between the end of October 2003 and the beginning of November 2003, the biggest flare had happened, and XRS observed the X-rays from the standard sample. The result of this observation, too noisy data was only obtained. During a few hours, the spectra had showed strangeness. But two weeks after the flare, the regular observation of XRS showed regular spectra. At present, the degradation of X-ray CCD is not found.

HAYABUSA XRS will continue the regular observation until HAYABUSA reached the asteroid 25143 Itokawa.