1. Introduction of ASTRO-H and the SXI

ASTRO-H will carry four types of detectors and cover the 0.3-600 keV band. It will achieve the soft X-ray spectroscopy with high energy resolution (7 eV) and hard X-ray imaging for the first time.

One of the mission instruments, Soft X-ray Imager (SXI), carries 2x2 CCD array and achieves the largest field of view among the X-ray CCD cameras flown in space. It takes images and spectroscopic data in the 0.4-12 keV band, simultaneously[2].

2. The breadboard model of SXI

The SXI team has developed a breadboard model (BBM), a prototype model of circuit boards[3], which corresponds to the green-lined boxes in the right figure. The grey boxes indicate digital components. The solid, the dotted, and the dashed arrows show analogue signals, LVDS, and LVTTL respectively.

DE I/F, configured on a Universal SpW Board developed by the Mitsubishi Heavy Industries Ltd., consists of two FPGAs; User FPGA and SpW FPGA. The logic of User FPGA includes the digital filter, which convolves the CCD bit stream to 12 bit. DE I/F is connected to a SpW network, and SpW FPGA takes care of the communication. We used a SpaceCube1 (by Shimatufi Electric Ltd.) as a GSE (ground support equipment), which is also connected to the POSIX OS computer through Ethernet. The pixel code contains the pixel-type information such as frame start, line start and so on.

3. Development of data acquisition system using SXI BBM

Using the digital part of the BBM, we developed the X-ray CCD data acquisition system as shown in the figure below. We used SpaceWire/RMAP Library[4] to implement the software with the SpaceWire communication. These software are written in C++.

![Diagram of data acquisition system using SXI BBM]

4. Demonstration of end-to-end data acquisition

With these technology, we drove the whole BBM components. We used a 512x618 n-type CCD chip cooled to -15°C in a vacuum chamber in order to reduce the dark current, and irradiated X-rays from $^{55}$Fe. One of the images obtained is shown in the left figure; we verified the BBM adequately works as an X-ray CCD camera system. An extracted energy spectrum is shown in the right figure; the emission lines of Kα and Kβ are clearly resolved.

5. Summary

- We developed the SpaceWire-based data acquisition system with SXI BBM.
- The data acquisition software is coded using the SpaceWire/RMAP Library.
- We demonstrated the successful acquisition of the CCD data.
- Future works and the improvement of energy resolution are given in [3].

Reference