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Modeling the Response Function for Soft X-ray Imager onbord ASTRO-H Satellite

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The ASTRO-H satellite is the 6th Japanese X-ray astronomical observatory to be launched in FY2015. The satellite carries four kinds of detectors, and one of them is an X-ray charge-coupled device (CCD) camera, the soft X-ray imager (SXI), installed on the focal plane of an X-ray telescope. The SXI contains four CCD chips, each with an imaging area of $31\ \mathrm{mm} \times 31\ \mathrm{mm}$, arrayed in mosaic, covering the whole field of view of $38' \times 38'$, the widest ever flown in orbit. The CCDs are a P-channel back-illuminated (BI) type with a depletion layer thickness of 200 um. We operate the CCDs in a photon counting mode in which the position and energy of each photon in the energy range of $0.4-12$ keV are measured. To evaluate the X-ray spectra obtained with the SXI, the accurate calibration of its response function is essential. For this purpose, we performed calibration experiments in Osaka University, Kyoto University, and the synchrotron facility at KEK, each with different X-ray sources with various X-ray energies. We fit the obtained spectra with 6 components; primary peak, secondary peak, constant tail, Si escape and Si fluorescence, and then model their energy dependence using physics based or empirical formulae. Since this is the first time for the P-channel BI type CCDs on the X-ray satellite, we need special care on the constant tail component which is originated in partial charge collection. We notice that we need to assume a trapping layer at the incident surface of the CCD and implemented in the response model. We also note that we have to consider detailed spectral features in the incident X-ray spectrum, even with conventional ^{55}Fe sources, to obtain accurate response functions.

Primary author: INOUE, Shota (Osaka university)

Co-authors: NAKAJIMA, Hiroshi (Osaka University); TSUNEMI, Hiroshi (Osaka University); UCHIDA, Hiroyuki (Kyoto University); HAYASHIDA, Kiyoshi (Osaka University); MORI, Koji (Miyazaki University); TAMASAWA, Koki (Tokyo University of Science); NOBUKAWA, Kumiko (Kyoto University); NOBUKAWA, Masayoshi (Kyoto University); ANABUKI, Naohisa (Osaka University); NAGINO, Ryo (Osaka University); TANNO, Shoma (Tokyo University of Science); KATADA, Shuhei (Osaka University); UEDA, Shutaro (ISAS/JAXA); TANAKA, Takaaki (Kyoto University); KONNO, Takahiro (Tokyo University of Science); KOHMURA, Takayoshi (Tokyo University of Science); TSURU, Takeshi (Kyoto University); YOSHINO, Yuma (Tokyo University of Science)

Presenter: INOUE, Shota (Osaka university)

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