Introduction of the Soft X-ray Imager (SXI) on board the Astro-H satellite

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on behalf of the SXI team
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Soft X-ray Imager (SXI)

- Requirements
  - Imaging capability for compensating the calorimeter (Soft X-ray Spectrometer; SXS)
  - Bridging the dynamic ranges of the SXS (0.3—10 keV) and of the Hard X-ray Imager (HXI; 5—80 keV)

  - Wide dynamic range: 0.2 – 20 keV
  - Low background: similar to the Suzaku X-ray CCD (XIS)
From XIS (Suzaku) to SXI (ASTRO-H)

**XIS**
- 4 cameras
  - 1 chip/camera
  - FOV 18 arcmin
- MIT/Lincoln chip
- Nch CCD
- FI and BI
- Temp -90°C
  - Peltier Cooler
- Optical Blocking Filter

**SXI**
- 1 camera
  - 4 chips/camera
  - FOV 38 arcmin
- HPK chip
- Pch CCD
- BI
- Temp -120°C
  - Stirling Cooler
- Optical Blocking Layer
X-ray CCD chip of SXI

Spec (manufacturer: Hamamatsu Photonics)
- Pch back-illuminated CCD (carrier = hole)
  - Depletion layer is > 200 μm
- 4 chip mosaic
  - 1 chip Pixel: 24 μm, 1280x1280, 30.72mm
  - FOV 38arcmin (Focal Length ~ 5.6m)
- Optical Blocking layer (Al - PI – Al) on the chip
- Chip gap (dead area): >0.6mm  We need off-set the bore-sight by 5x5mm.
- SCI technique (Charge injection) is employed.
CCD current status

Spectrum of 55Fe
FWHM 135+/- 4 eV @ 6 keV
Noise 5.6 +/- 0.1 e-
Overall view of the SXI camera
Optical Blocking Layer (OBL)

- Specification
  - Optical/UV light is blocked
  - Eliminate the thin plastic film (OB Filter) to avoid the vacuum system.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Thickness</th>
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<tbody>
<tr>
<td>Al 400 Å</td>
<td></td>
</tr>
<tr>
<td>Polyimide 1000~2000 Å</td>
<td></td>
</tr>
<tr>
<td>Al 1000 Å</td>
<td></td>
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<td>CCD</td>
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OBL
Efficiency and Effective Area

SXI (with OBL)

SXI + XRT
SXI System

**SXI-A**
- CCD
  - Drive clock
  - CCD Driver (DAC + Analog SW)
- Video ASIC
  - ΔΣ modulator & decimation filter

**SXI-S**
- Heater
- Temp monitor
- CCD

**SXI-FrontEnd**
- HeaterPow
- HK ADC

**SXI-E**
- Sequencer FPGA
  - Frame data
  - Dark level process
  - Event extraction
- DE/IF FPGA
- SpW FPGA
  - Command
  - Frame data event candidates

**SXI-DE**
- CPU
- SOI SOC
- SpW FPGA

**Space Card**
- Universal SpW Module x2

**SXI PSU**

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*Hardwares of DE I/F board and sequencer board are identical.*
Calibration plan

• Screening process will begin this fall.
  – Optimize parameters such as voltage etc.
  – OBL, noise, bad pixels etc..

• Calibrations of flight sensors will begin in spring, 2012.
  – At Osaka Univ. (soft-energy band) and Kyoto Univ. (hard-energy band)
  – QE, energy resolution
    • How to calibrate QE of BI sensor with OBL?