

In-orbit monitoring of contamination on the XRISM SXI

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A reduction in detection efficiency due to contamination

 The Suzaku/XIS and Chandra/ACIS had buildups of contamination on the optical blocking filters of their CCD instrument, which reduced quantum efficiency especially in the soft energy band below 1 keV.



XRISM/SXI



- The Soft X-ray Imager (SXI) is the CCD camera for Xtend installed on XRISM.
- A large field of view of 38.5' × 38.5' is achieved by combining a 2 × 2 BI-CCD array with the XMA.
- The SXI system also has the 200 µm thick aluminum layer (OBL) on the CCD surface to block optical/IR lights.
- It covers an energy range of 0.4–13 keV.

Measures to avoid contamination on XRISM/SXI

• Contamination Blocking Filter (CBF) is equipped at top of the SXI.



Fig. 6. Schematic of XRISM/SXI

- The filter is 40/200/80 nm of Al/polyimide/Al.
- It blocks outgases from getting inside the SXI body and optical/IR lights.
- It is at 50 cm above the CCD chips and keeps at 25 °C by heater not to build up contamination on its surface.

The QE of SXI

- The quantum efficiency (QE) of the SXI = CBF Transmissivity × CCD QE
 - Both was measured from a ground experiment performed at the synchrotron facility in Japan (KEK photon factory).
 - > The results are implemented in the current QE CALDB.



It is necessary to monitor the reduction of QE due to on-orbit contamination.

Evaluation of On-Orbit Contamination on the XRISM/SXI

- Evaluation method
 - For the on-axis of SXI, we evaluated absolute contamination using SNR 1E0102.2-7219 spectrum, with constant brightness.
 - For the entire SXI, we analyzed the spatial distribution of contamination across 4 CCDs using from event data taken during Dayside earth observations.



of the SXI CCDs (Uchida et al 2025)

Fig.10. Xtend image of a SNR 1E0102.2-7219 Fig. 11. Xtend image of a Dayside earth

Data analysis and its results of SNR 1E0102.2-7219

- We used all observations data (full window and 1/8 window) obtained between November 2023 and April 2025.
- The contaminating point source (RXJ0103.6-7201) from the source region.

		EVDOSI DE TIME (kal	
	DATE-003	EAFUSURE TIME [KS]	DATAWODE
000105000	2023-11-01	5.5	full window
000105000	2023-11-01	28	1/8 window
000118000	2023-11-19	78	full window
000136000	2023-12-24	65	full window
100010010	2024-02-19	34	1/8 window
101005010	2024-10-10	16	full window
101005011	2024-10-11	18	full window
101006010	2024-10-11	32	1/8 window
101007010	2025-04-07	17	full window
101007011	2025-04-07	14	full window
101008010	2025-04-08	7.5	1/8 window
101008011	2025-04-08	23	1/8 window

Table. 2. SXI Observations of 1E0102.2-7219



Fig. 12. Extracted source image

Data analysis and its results of SNR 1E0102.2-7219

 Spectra fitting was performed on the 0.4-2.0 keV soft X-ray band using the hcnocol * IACHEC model from P.Plucinsky et al (2017) to evaluate on-axis carbon contamination.



Since no statistically significant amount of carbon deposition was detected, it was concluded that there is no evidence of the contamination on XRISM/SXI.

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Evaluation of the spatial distribution of contamination across the entire SXI

- The Day earth spectrum in soft-band is dominated by N-Kα (0.39 keV) and O-Kα (0.53 keV).
- The image was divided into 61 positions, and the line normalizations were calculated from the spectra of each position.



Fig. 15. Xtend spectrum of the dayside earth

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Evaluation of the spatial distribution of contamination across the entire SXI

• The N/O ratios were compared to the on-axis for evaluation of the relative amount of contamination.



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Summary

- We are monitoring in-orbit contamination on XRISM/SXI.
- Since the launch in September 2023, we analyzed the all observations of the SNR 1E0102.2– 7219 to estimate the on-axis contamination level (column density of carbon). As a result, no significant contamination was obtained; the upper limit was found to be 0.3×10^{18} cm⁻².
- For entire SXI, we used the dayside earth events and compared the N and O Kα line intensity ratios across the CCDs. As a result, the N/O values at any position agree with the on-axis value within 15%.
- We conclude that the contamination is negligible at entire SXI even 1 year after the launch.



Appendix

Comparison of the flux of 1E0102.2-7219 to the IACHEC model value



Comparison of the flux of 1E0102.2-7219 to the IACHEC model value

- The relative line normalizations compared to the IACHEC model.
- Free parameters: are the constant and the line normalizations of OVII, OVIII, NeIX, and NeX.

