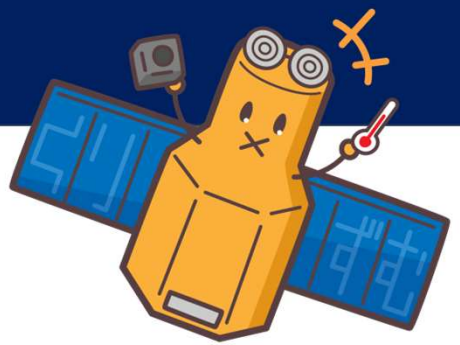
XRISM/Xtend calibration status: contamination, energy resolution, and pile-up

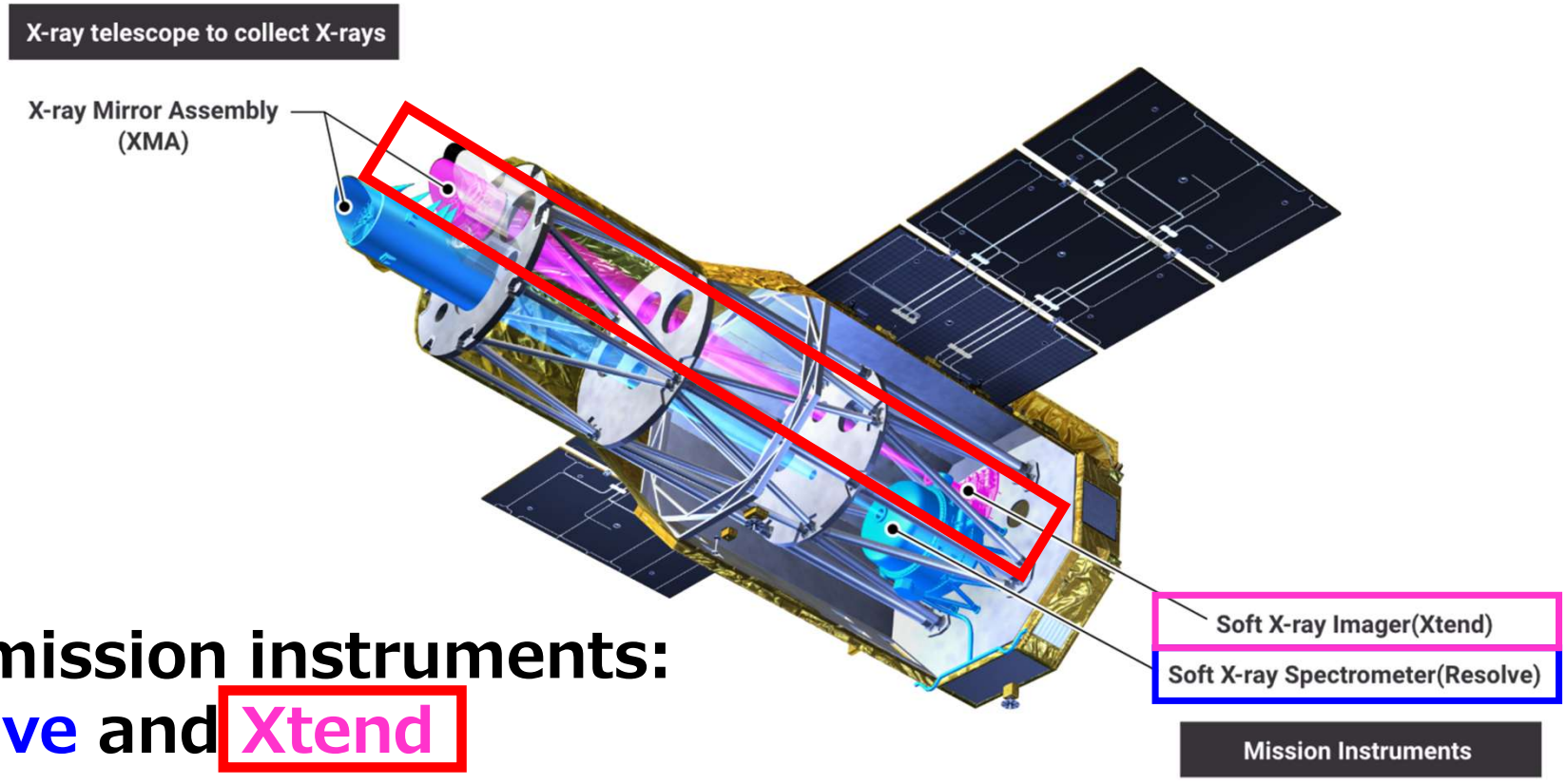
YONEYAMA Tomokage (ISAS/JAXA)
on behalf of the XRISM Xtend team



18th IACHEC Meeting
2026-04-21@Seeblick Pelham, Deutschland

About XRISM

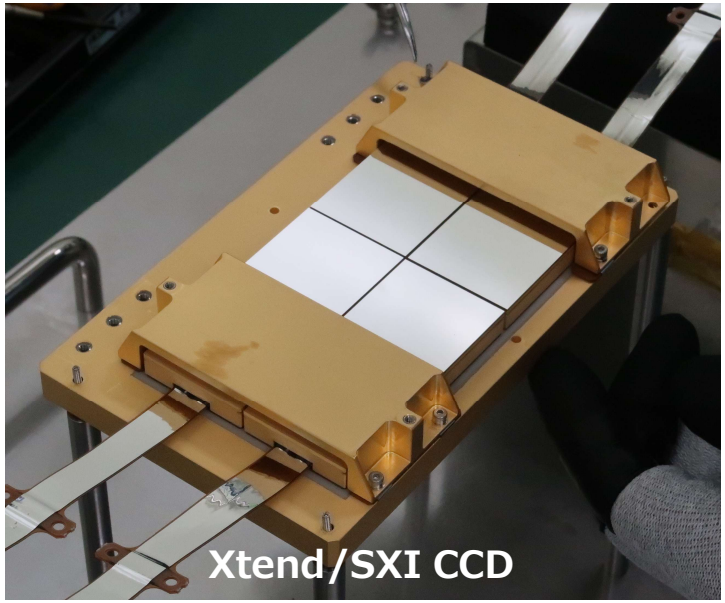
X-ray Imaging and Spectroscopy Mission

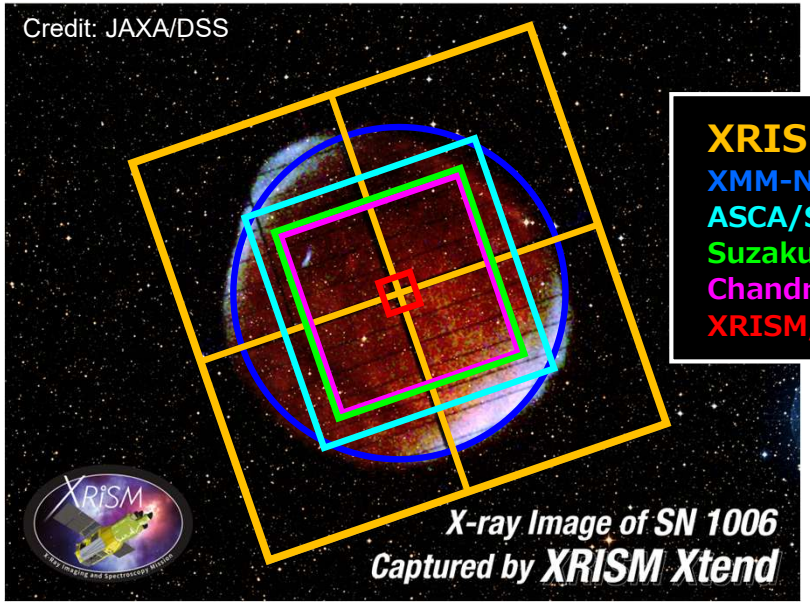


Two mission instruments:
Resolve and Xtend

Xtend, the Soft X-ray Imager

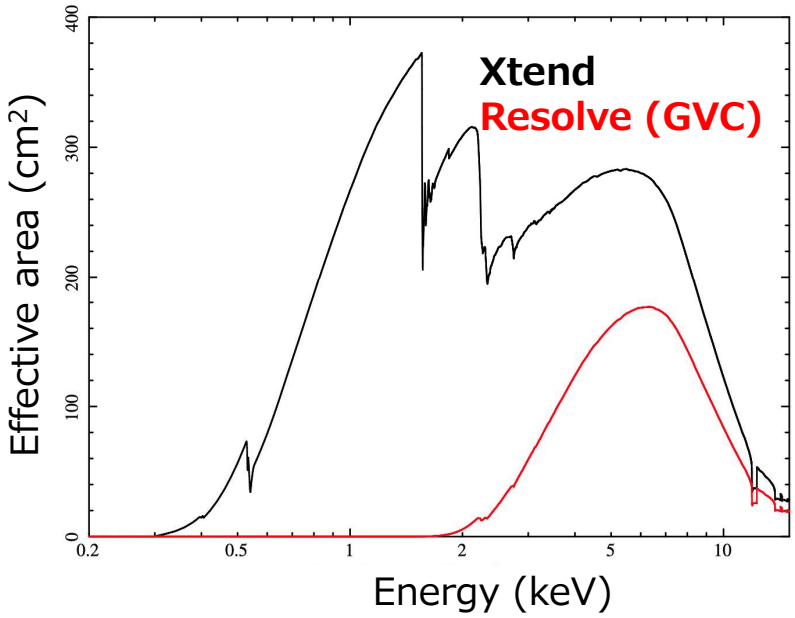
- X-ray telescope (XMA) + X-ray CCD array (SXI)
- Bandpass: 0.4 -- 13 keV
- Angular resolution: ~1.4' (HPD)
- Timing resolution: 4 s – 0.05 s
- FOV: 38.5' x 38.5'



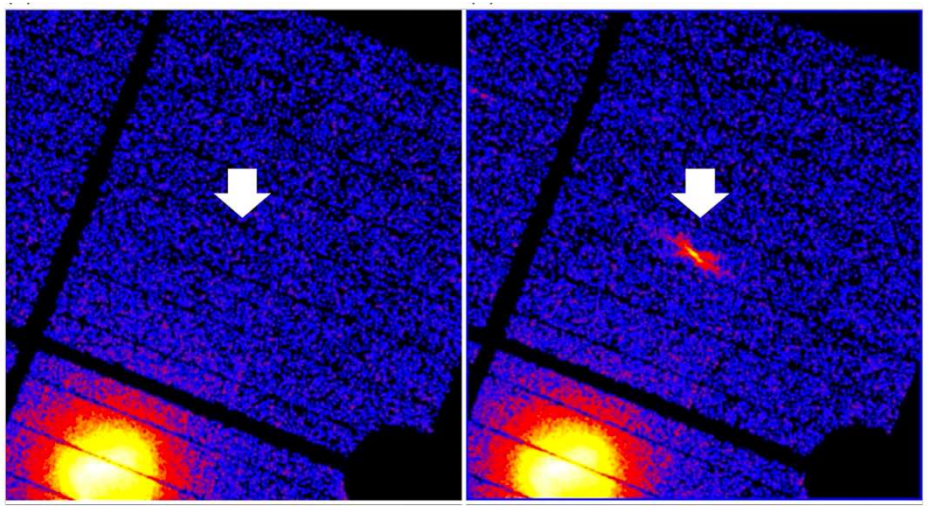


Xtend's Mission

- To observe diffuse sources (like SNRs, GCs) with the wide FOV
- To support Resolve's observation
  - by resolving point sources contaminating the target source
  - by determining the continuum with the wider bandpass
    - (due to closed gate valve of Resolve)
- To search for transient sources (Xtend Transient Search; XTS)



AX J1910.7+0917 (Atel #16607); Yoshimoto+ in prep.



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Xtend in 18th IACHEC meeting

- Cross Cal. of the Effective Area: **INOUE Shun** (done)
- Xtend Cal. Status (1): **TY** (we are here)
- Xtend Cal. Status (2): **SUZUKI Hiromasa**
  - Response, background
- Xtend Transient Search: **YOSHIMOTO Marina**

Current Status of Xtend

Going well.

Current Status of Xtend

- All CCDs are in operation
- Maintains the energy resolution of 170 – 180 eV
  - Degradation of the charge transfer inefficiency (CTI) is as expected from the ground experiment
  - Meets the requirement of 250 eV at EOL
- No degradation of the effective area/quantum efficiency
  - Contamination is very well suppressed

Current Calibration Status of Xtend

- Xtend CalDB ver. 12: 20250915
- Updates from CalDB 11 based on the in-flight cals:
  - Gain-related files
    - Charge trail
    - CTI
    - Gain
  - RMF parameters

XRISM CALIBRATION DATA			
GEN Index Summary	Current Version: 20241115	Release Notes	Download
Resolve Index Summary	Current Version: 20250915	Release Notes	Download
XTEND Index Summary	Current Version: 20250915	Release Notes	Download
General Index Summary	Current Version: 20240822	Release Notes	Download

Calibration/Health check operations for Xtend

Routine cal. observation

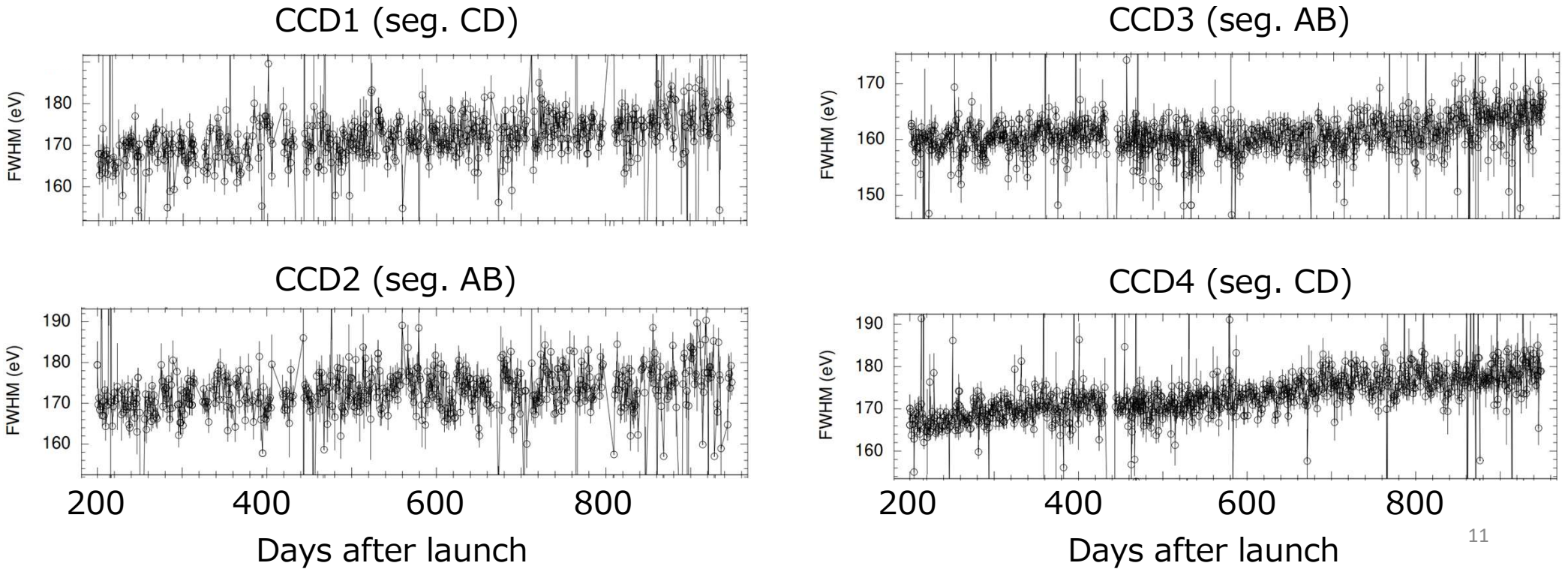
- 2 observations per year
- Perseus cluster, Cygnus loop
  - Energy (gain, response...)
- 1E0102.2-7219
  - Contamination

Rframe dump

- Twice per year
- To check noise and light leak
- Day Earth and Night Earth

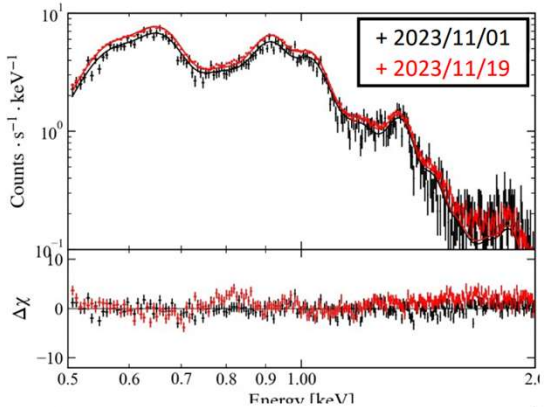
Energy Resolution (@5.9 keV; by ^{55}Fe Cal. Sources)

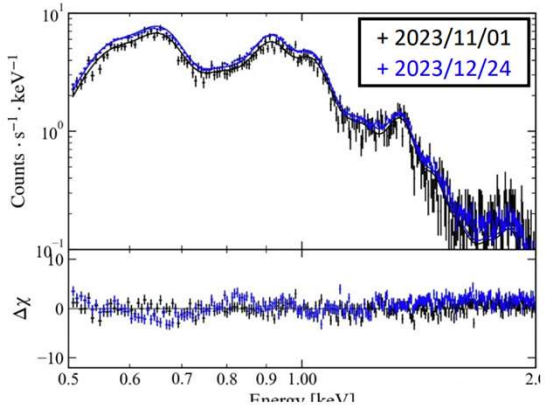
- Note: These plots are **BEFORE** applying corrections -> pessimistic case
- Gradually degrades by ~ 10 eV / 2 yr
- Slightly chip dependent
- 220 – 230 eV at 2033 (10 yr after launch)?

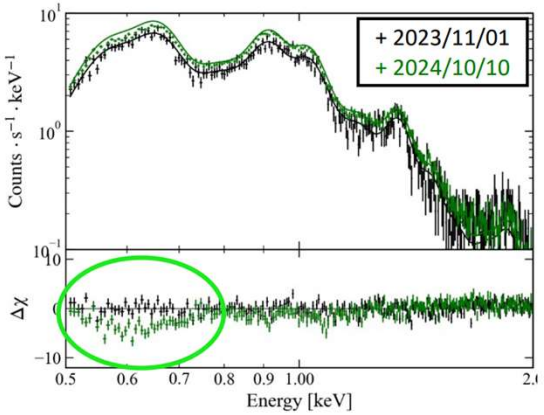


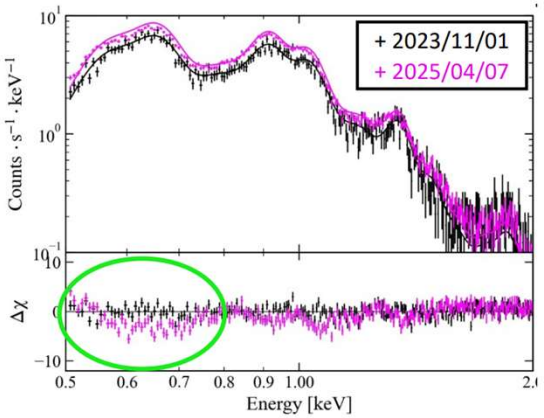
Contamination

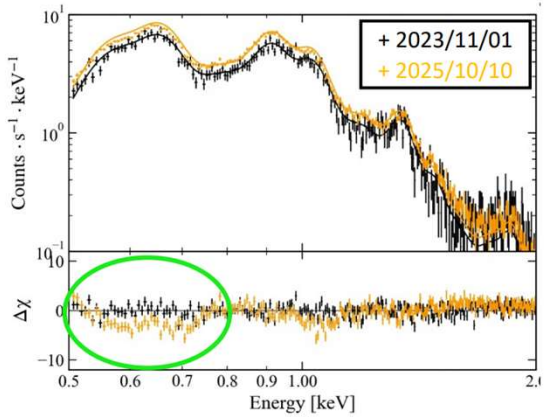
- Have been evaluated with E0102 fitted by the IACHEC model
- Model fitting method was improved; slight extra absorption appeared after 2024







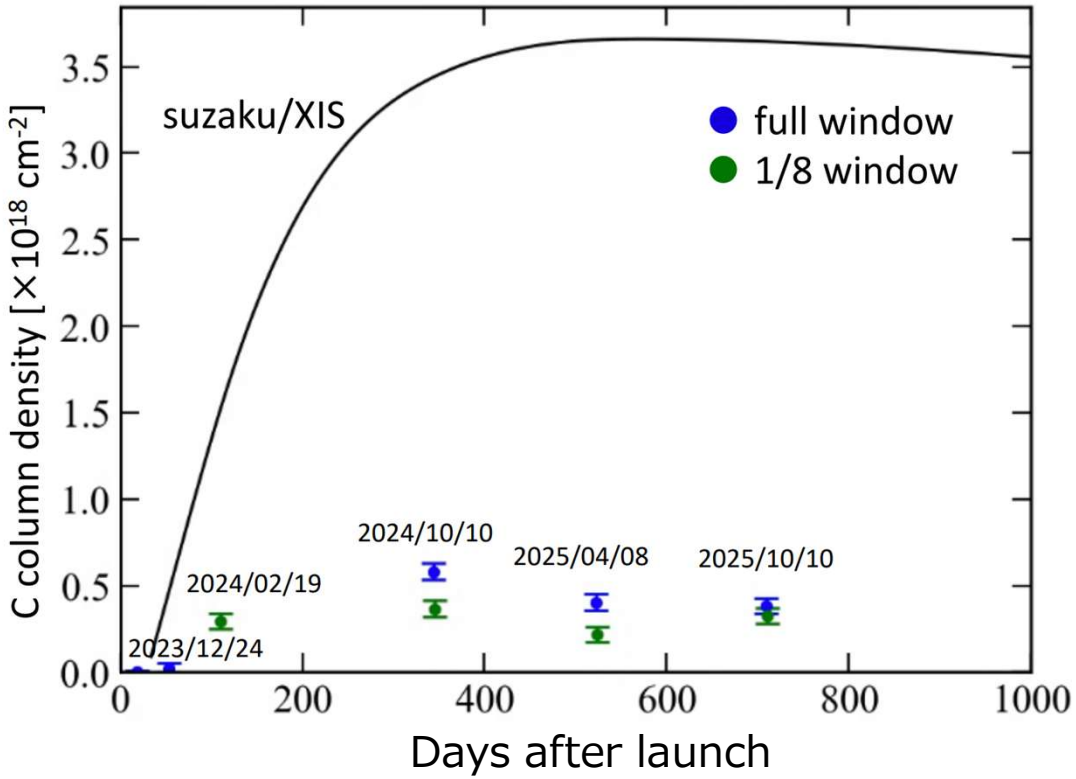




Full-window obs. of E0102
by M. Higuchi (TUS; graduated)

Contamination

- Improved method results in smaller error bars
- Conclusion not deviated; **contamination is low enough even in 2025**
- Cross-check with other sources is now in progress (at TUS)



Pile-up

- The inevitable fate of CCDs when observing a bright source
- A simulation-based study has been performed for Xtend (TY+25 JATIS)
- Spectral distortion and grade migration were reproduced

Simulated Crab spectra

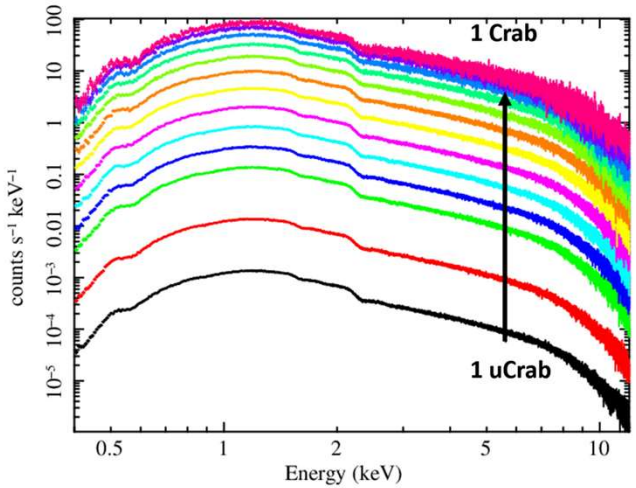
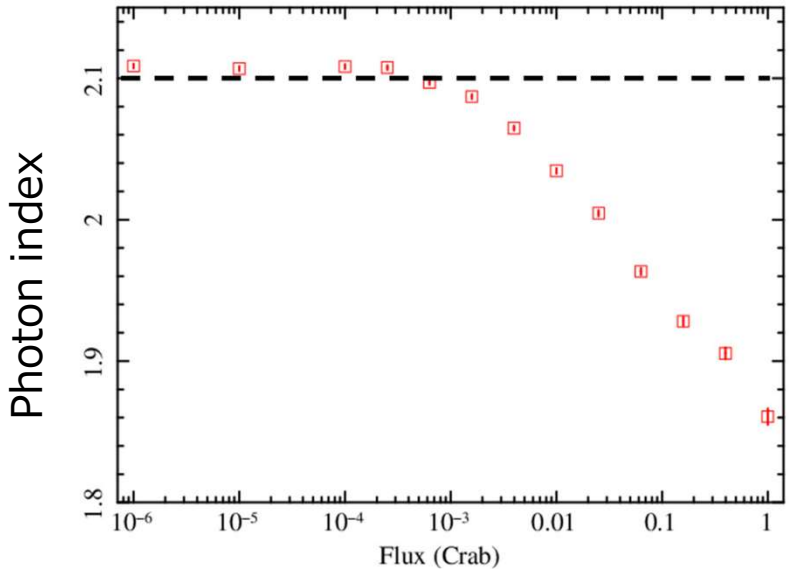


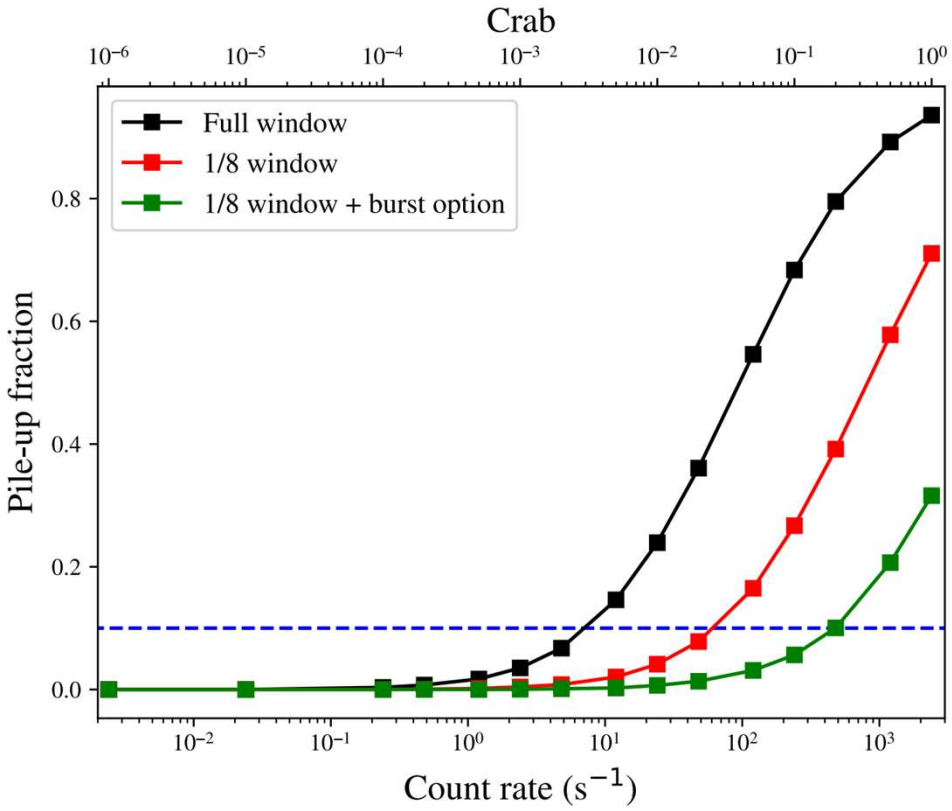
Fig. 1 Simulated spectra by the pile-up simulator by assuming a point source with the Crab spectrum with fluxes of 10^{-6} – 1 Crab. The full window mode is simulated in this figure. High input fluxes result in the high pile-up effect, by which fractions of photons are lost in the simulated spectra (see Fig. 2 for the quantitative evaluation of the pile-up).

Spectral distortion by pile-up



Pile-up

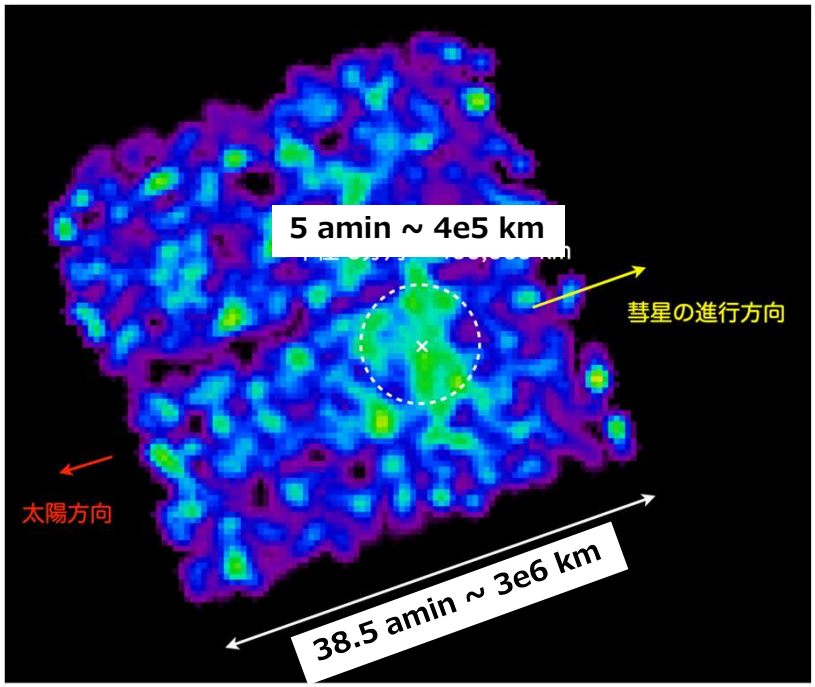
- Simple suggestion:
  Use 1/8 win (+ burst) for > 8 (66) cps for a point source

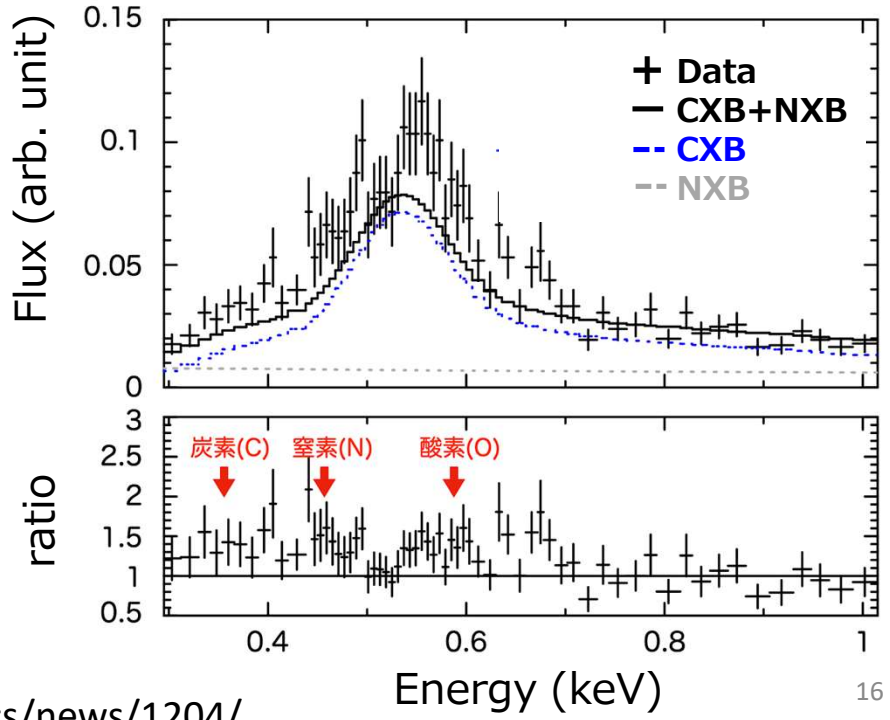


※Diffuse source is also evaluated in the paper

Xtend Observation of the Interstellar Object 3I ATLAS

- Performed at the end of Nov. 2025 (2025-11-26 – 11-28)
- First X-ray detection from an interstellar object
- CNO charge exchange lines...?
- Further analysis in progress



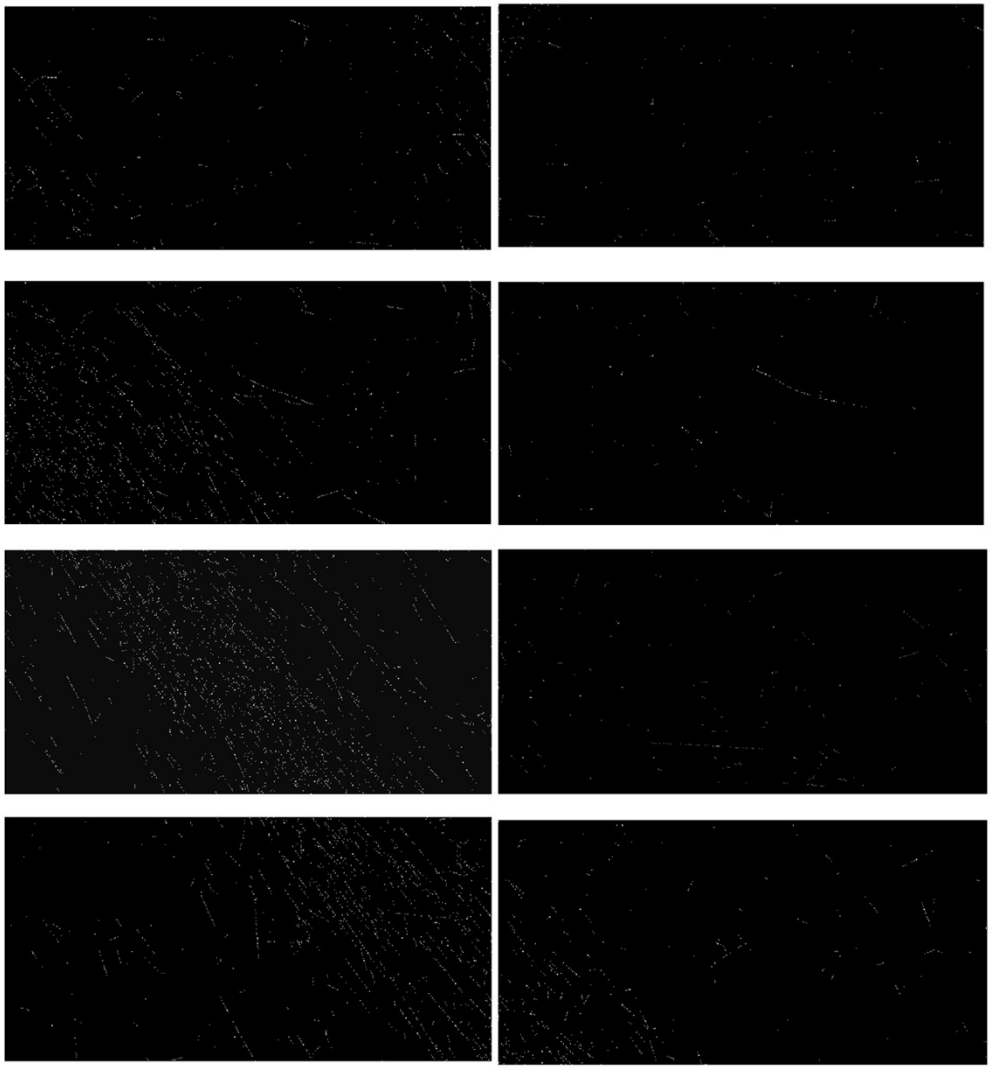


https://www.xrism.jaxa.jp/topics/news/1204/

Particle Event in 2026-03-29

- A prominent event occurred at 03/29 15:57:13
- Trajectory of an energetic particle was recorded as > 6000 events at a single exposure frame
- Impressive image just for share
- Any science...?

Note:
- Extracted from QL events (not final products)
- CCDs got no damage from this event



Summary

- **Xtend is going well**
- Calibration activity is being continued
- Energy resolution is degraded as expected from the ground experiments
- Contamination is well suppressed, while a new method is applied to estimate
- Pile-up is evaluated with a simulation
- Xtend worked as a cloud chamber