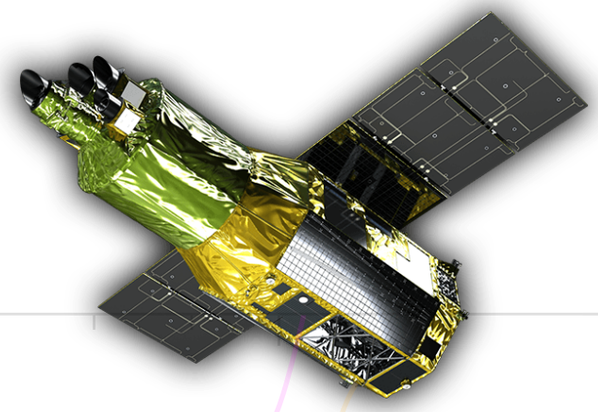
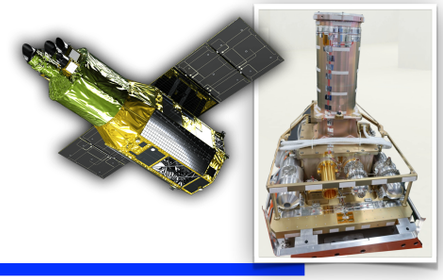
XRISM
X-Ray Imaging and Spectroscopy Mission



XRISM/Xtend calibration status: detector response and non-X-ray background

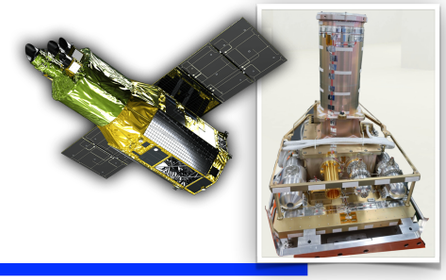
Hiromasa Suzuki (University of Miyazaki),
on behalf of the XRISM/Xtend team

Updates

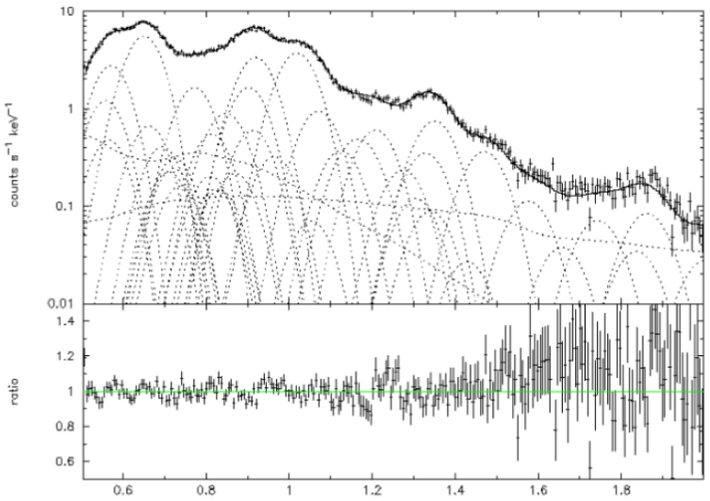


- **Detector response**
- **Consistency between full-win and 1/8-win data**
- Non X-ray background
- CCD behavior after a rebooting of electronics in 2024 Nov

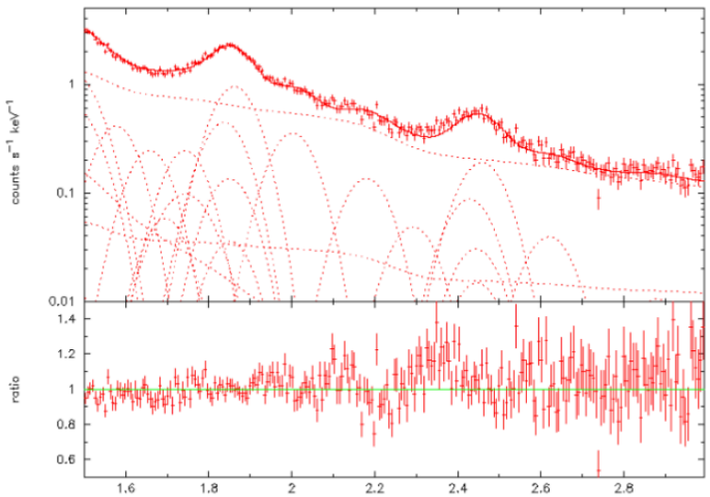
Detector response



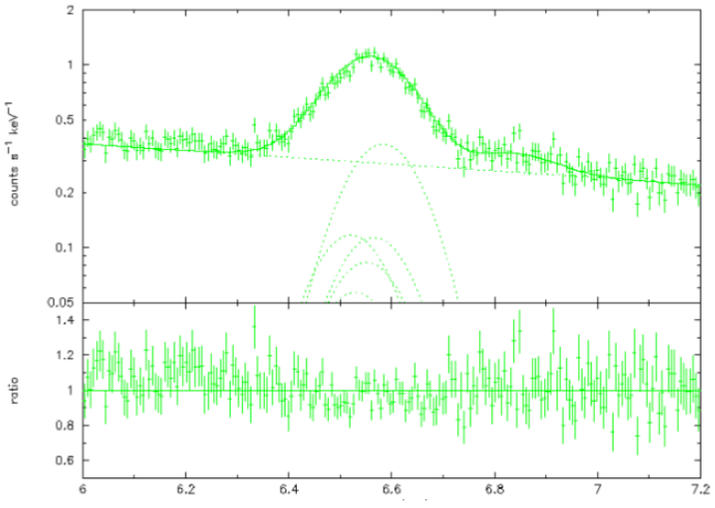
E0102 : 0.5 - 2.0 keV



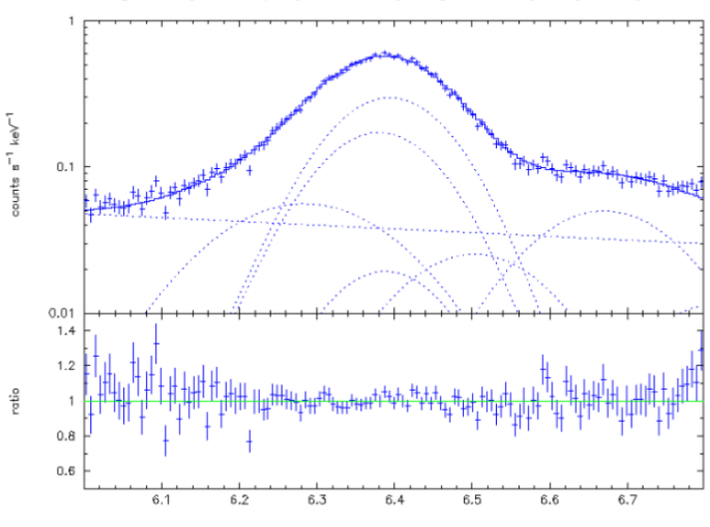
N132D : 1.5 - 3.0 keV



Perseus : 6.0 - 7.2 keV



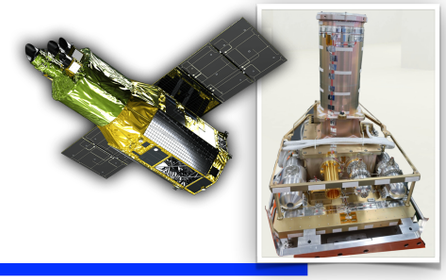
Circinus: : 6.0 – 6.8keV



- Keep improving RMF using several cal. targets
- on-axis results look good

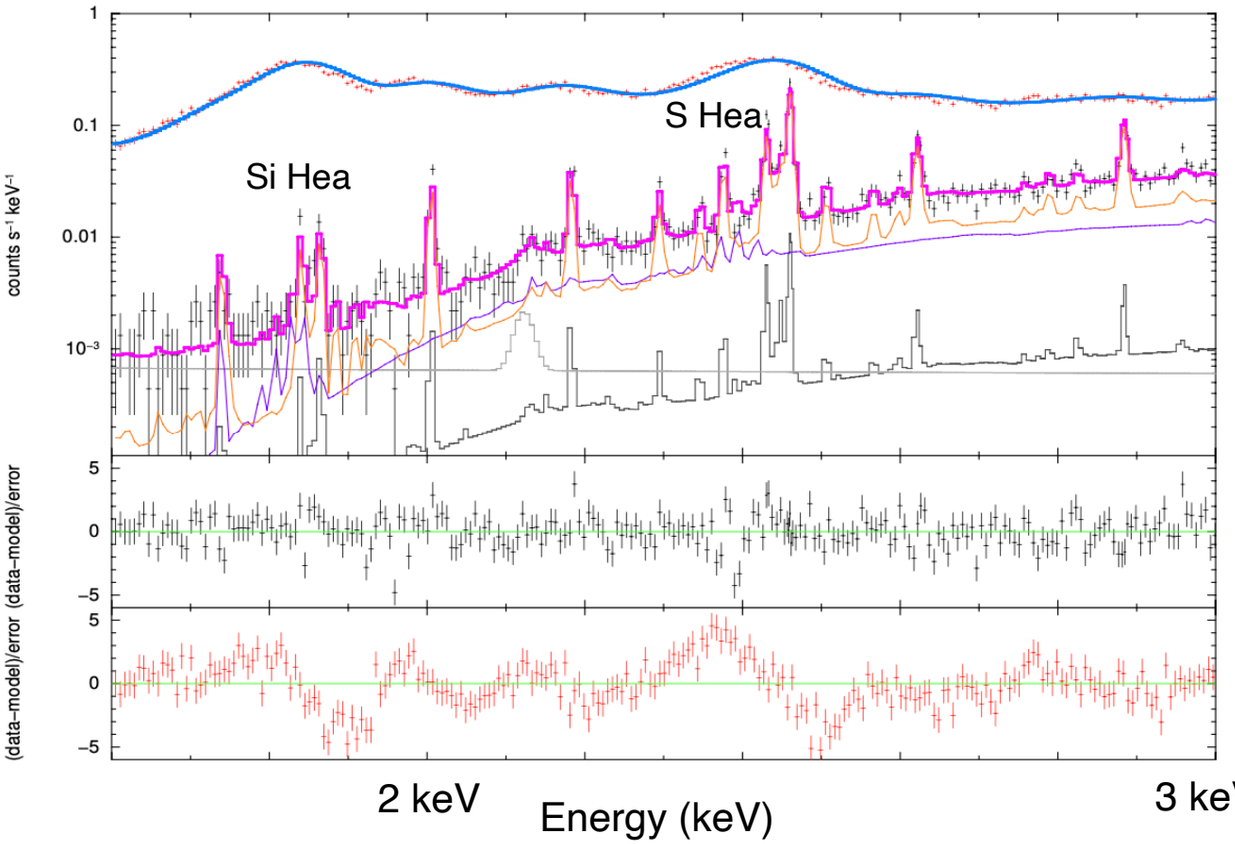
A. Nagao (Osaka U.)

Detector response

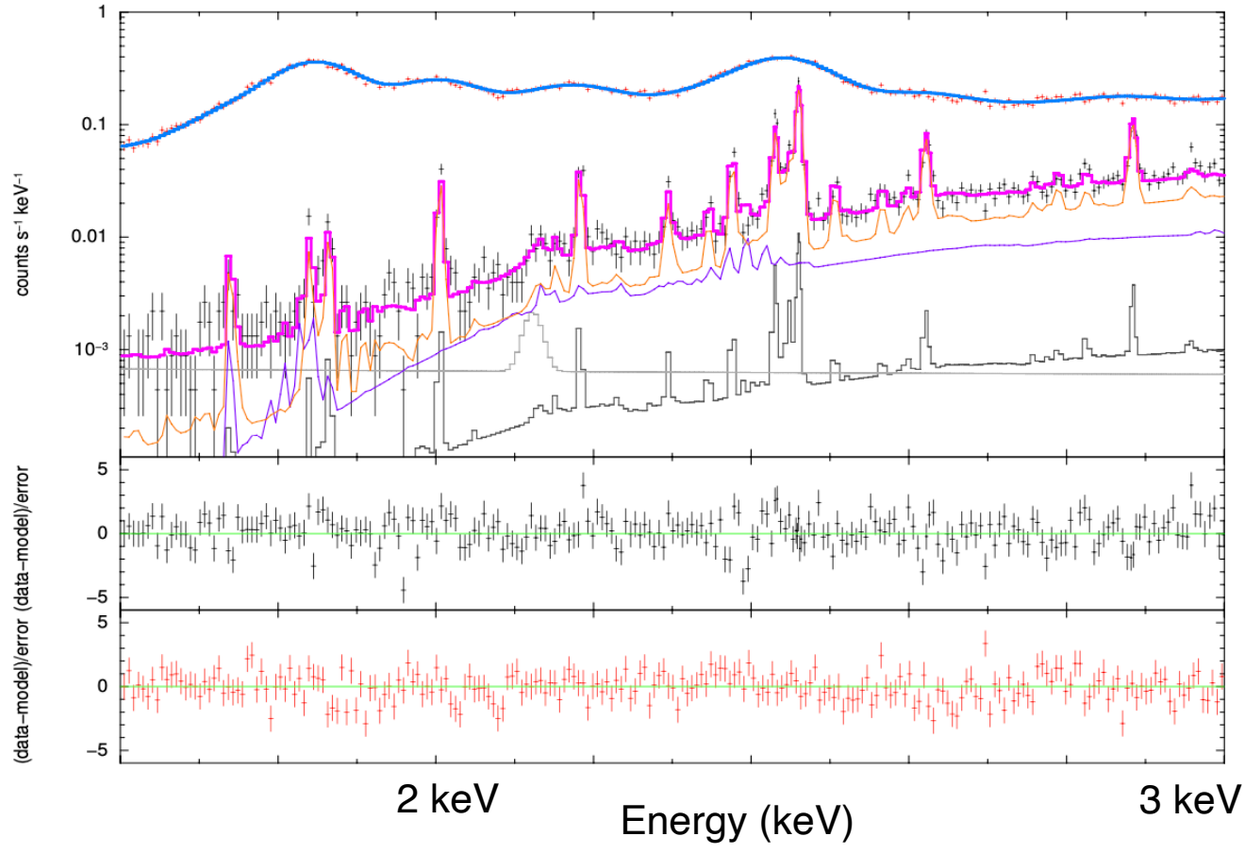


Data taken in 2025.03.05

CALDB **v20241115**



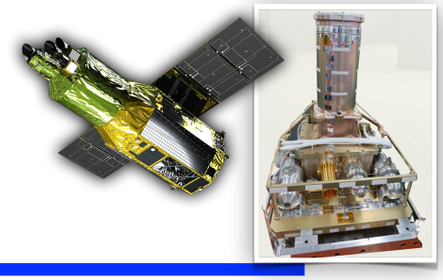
CALDB **v20260315**



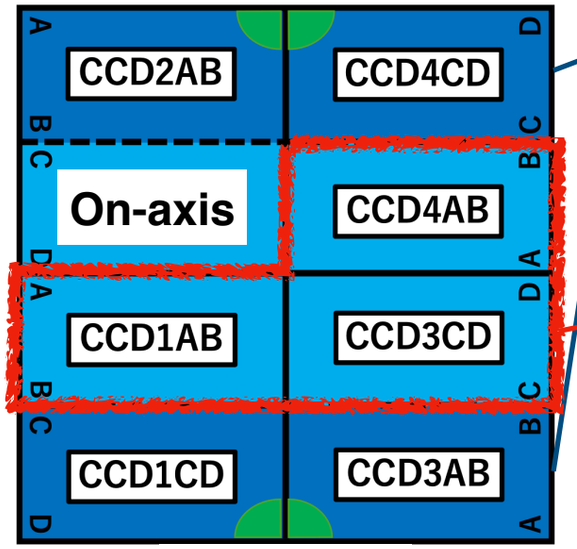
+ **Resolve data** — **Resolve model**
+ **Xtend data** — **Xtend model**

- Previous CALDB release did not consider time evolution of CTI, so not suitable for analysis of recent observations

Detector response



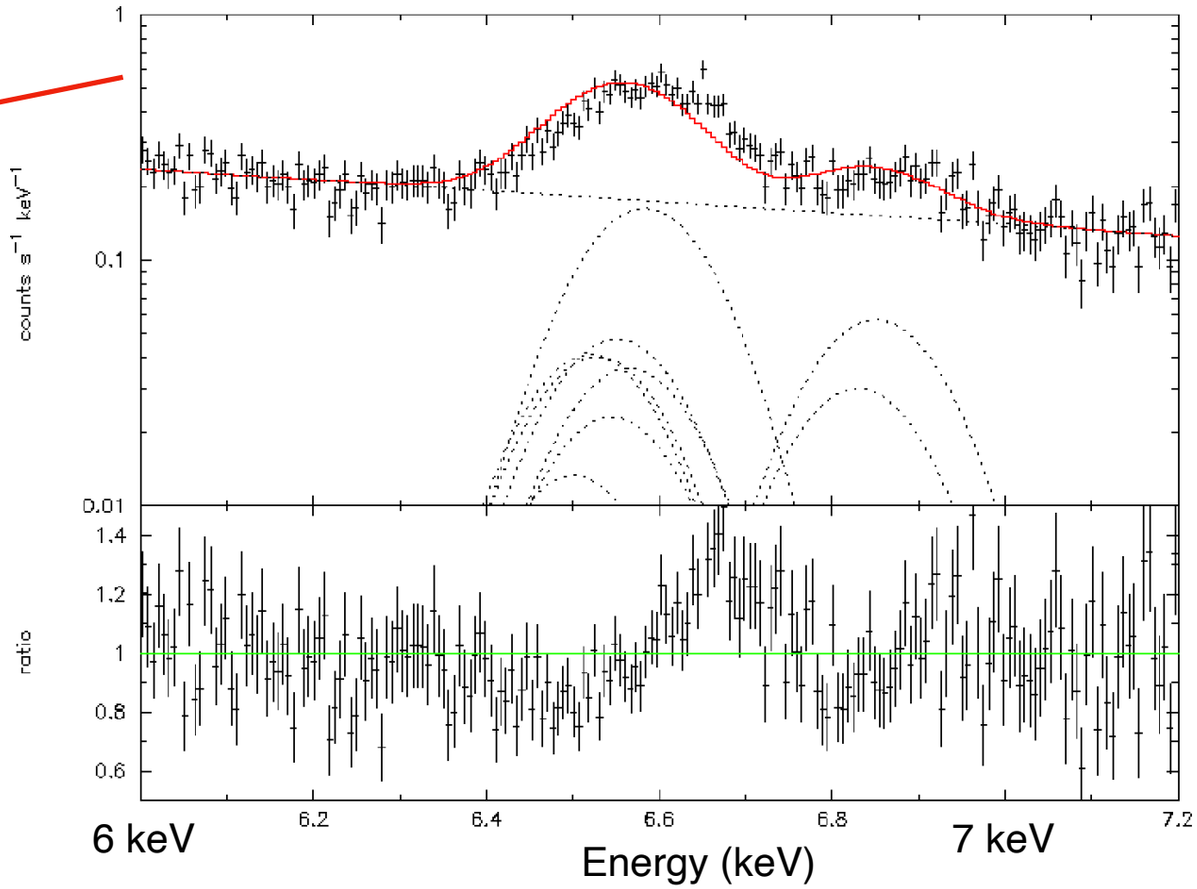
Xtend CCDs



Fe-55
cal source

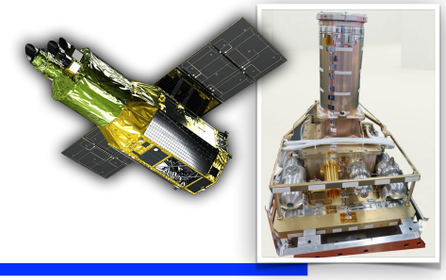
Irradiated by Fe-55 and hopefully well calibrated

A. Nagao (Osaka U.)

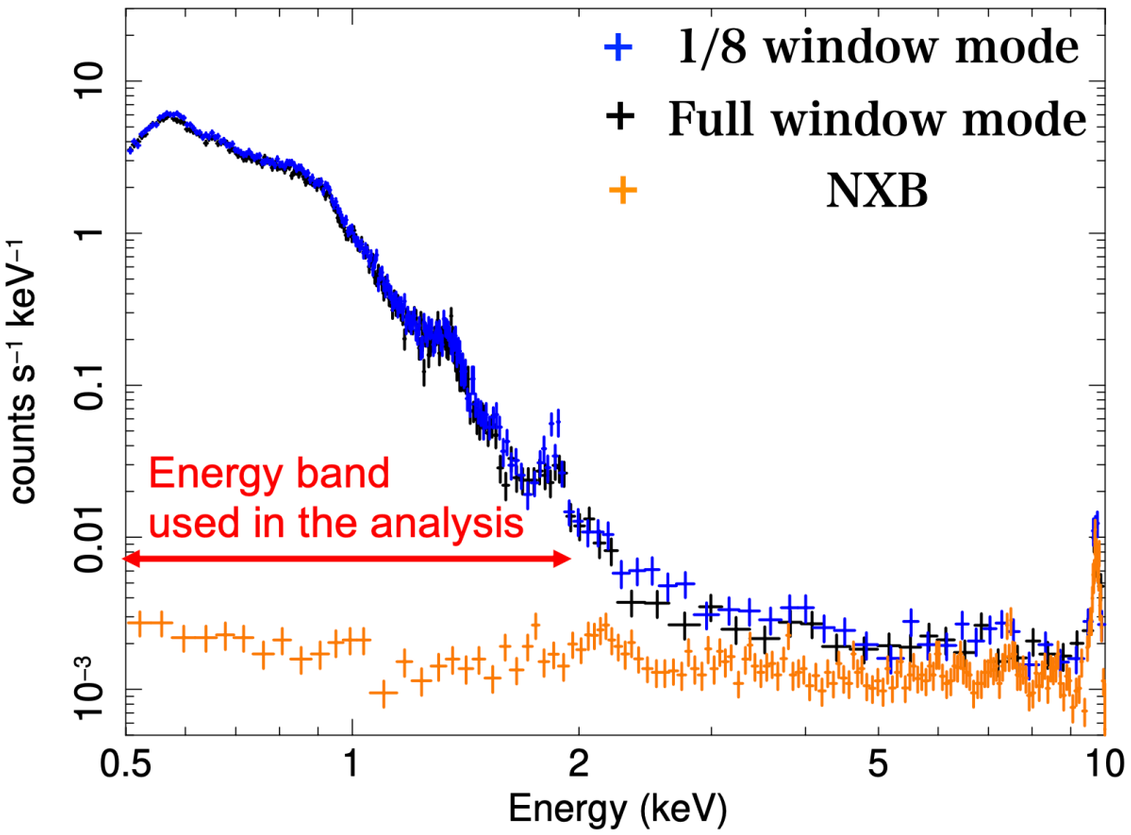


- Three CCD segments (not on-axis, not irradiated by Fe-55) seem to require updates on gain or CTI correction
- Work in progress!

Full-win vs. 1/8-win spectra



Cygnus loop



0.5–2 keV	**Observed** Full window (cts/s)	**True** Full window (cts/s)
Cyg. Loop	1.752±0.002	1.739±0.002
N132D	1.825±0.004	1.822±0.004

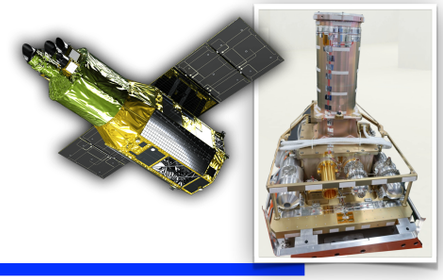
Observed 1/8 window (cts/s)	**Expected** 1/8 window (cts/s)	**Observed vs. expected** (%)
1.843±0.006	1.847±0.006	0.24±0.5%
1.882±0.005	1.850±0.005	-1.7±0.4%

K. Takayama (Kindai U.)

- 1/8-win count rates are higher than full-win by a few %
- This difference is explained by different dead times and out-of-time events
- ~1.7% inconsistency in N132D may be due to pile-up

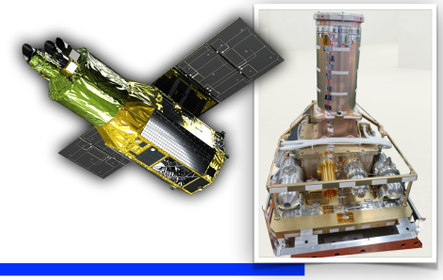
XRISM
X-Ray Imaging and Spectroscopy Mission

Updates

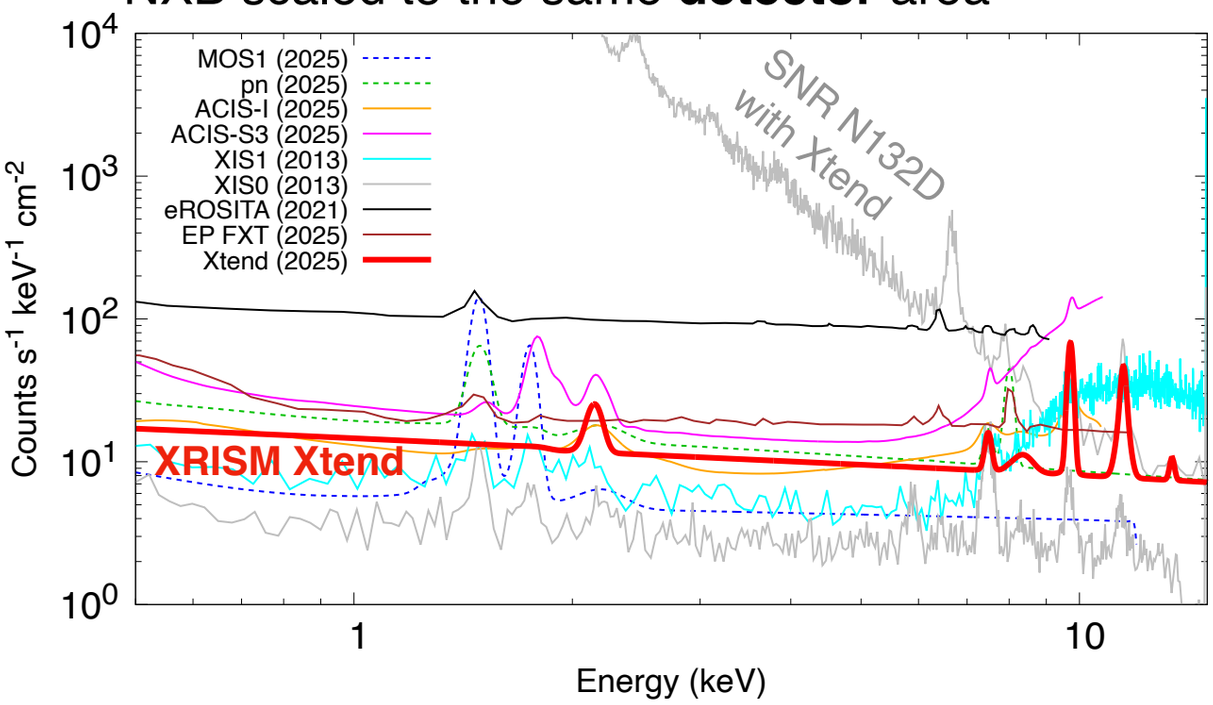


- Detector response
- Consistency between full-win and 1/8-win data
- **Non X-ray background**
- CCD behavior after a rebooting of electronics in 2024 Nov

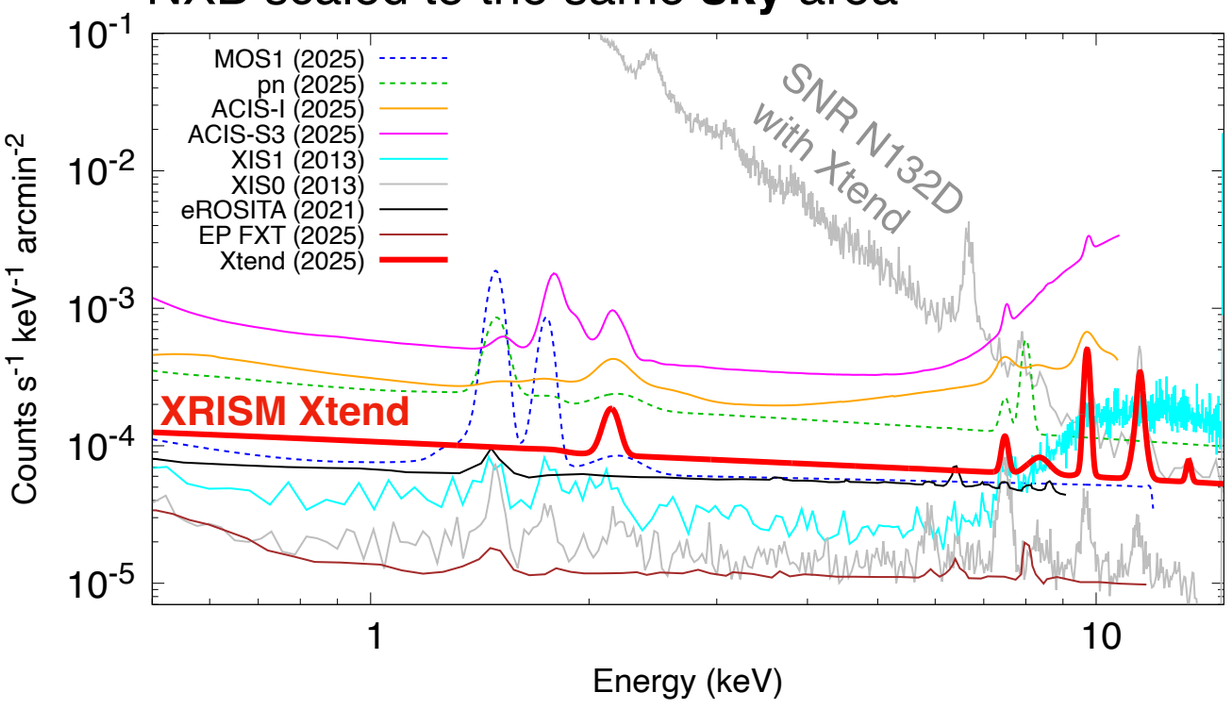
Non X-ray background



NXB scaled to the same **detector** area

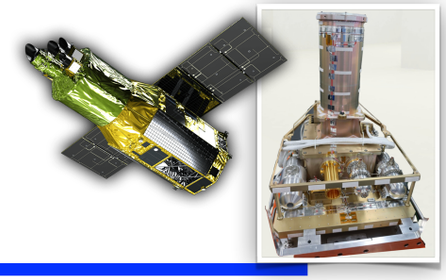


NXB scaled to the same **sky** area

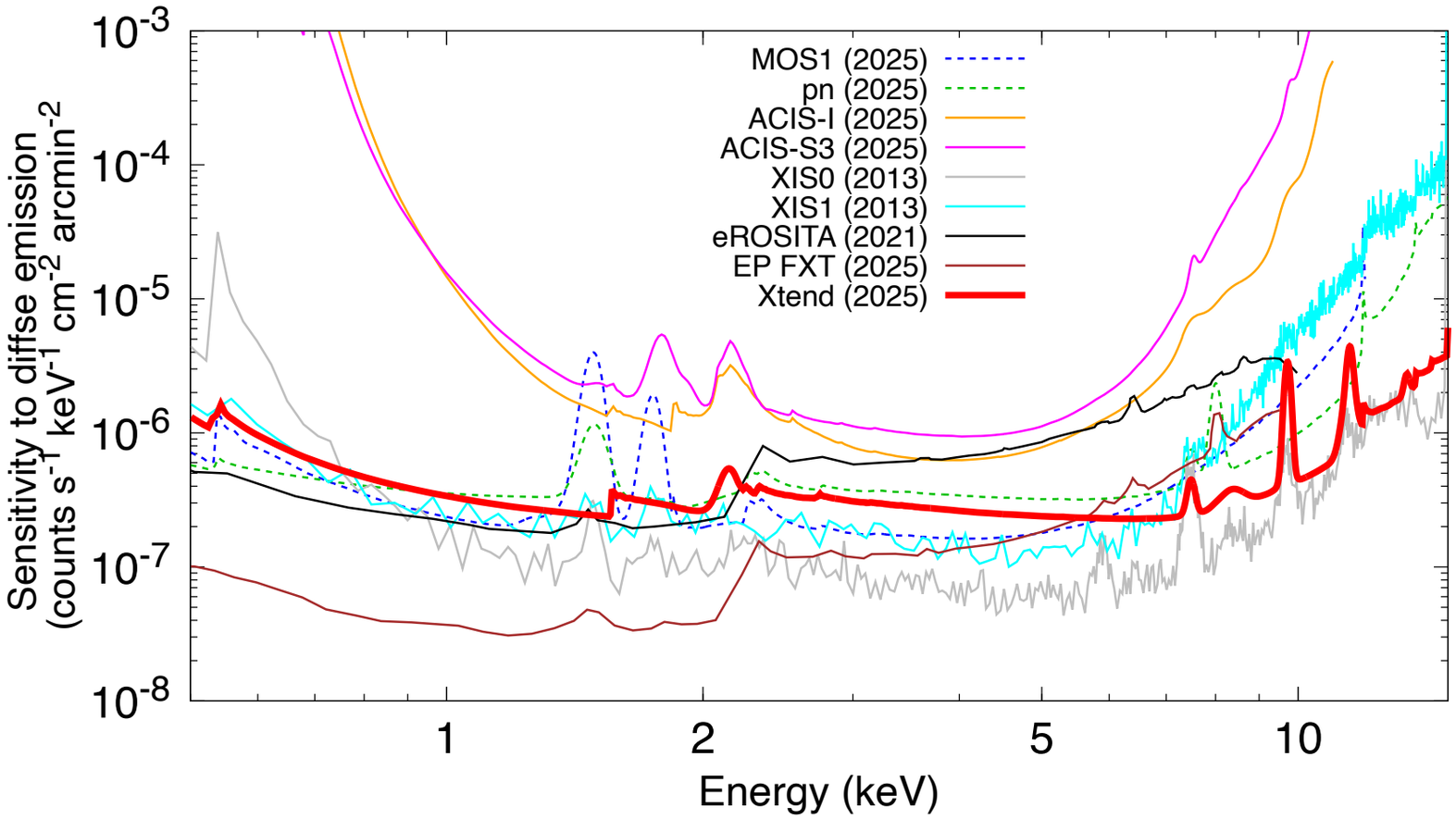


- Non X-ray background level of Xtend is moderately low
- When scaled by detector area, FI sensors (XIS0, MOS1, ACIS-I) are generally low and eROSITA@L2 is high, and the others are similar
- When scaled by sky area, eROSITA and EP are low, thanks to a large "sky area per det. area" (1280 arcmin/cm)

Non X-ray background

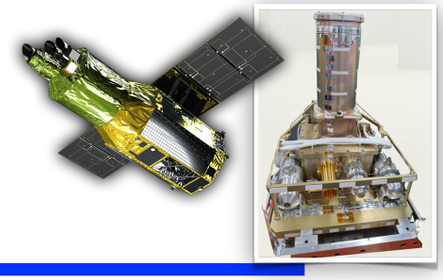


NXB per "eff. area times sky area" = sensitivity to diffuse sources (∝ NXB counts/Diffuse-source counts)



- eROSITA and EP-FXT are good at low-E
- Xtend is very good at > 6 keV thanks to large effective areas at high-E

Non X-ray background



Night-Earth (= pure NXB) data

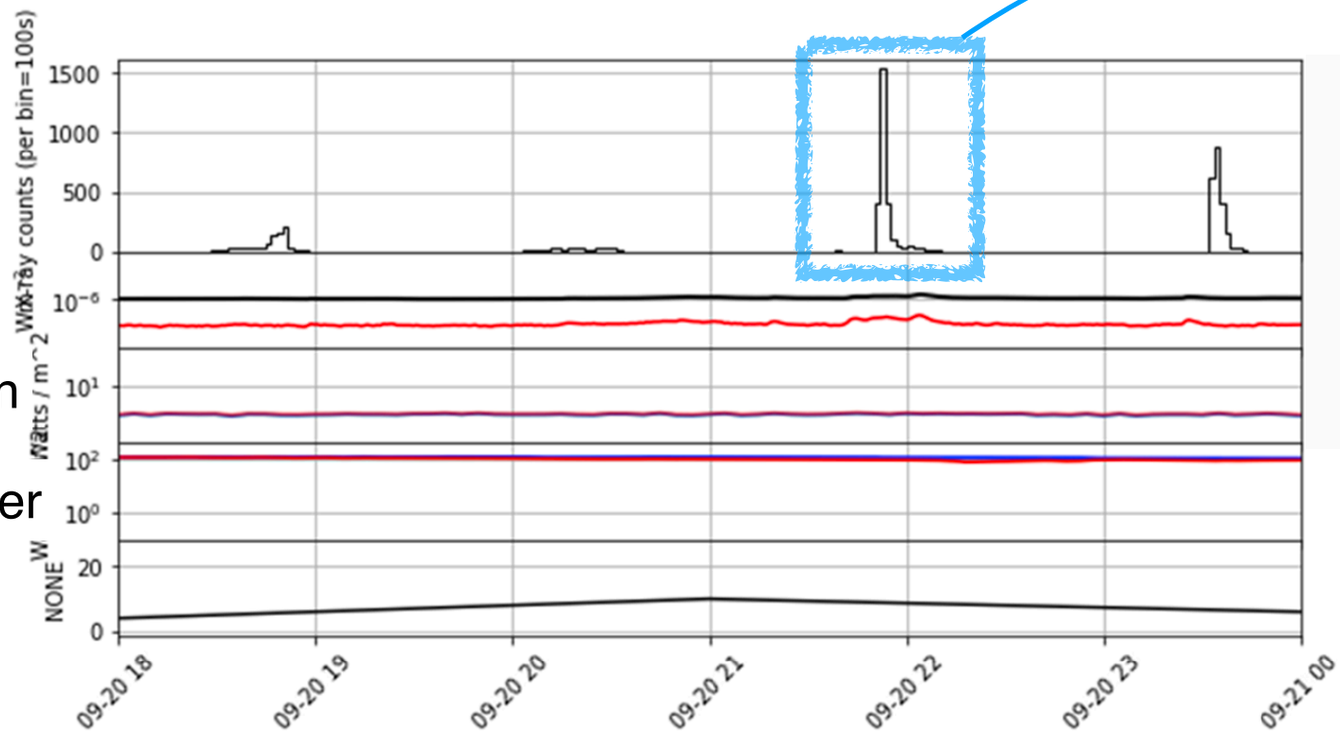
Xtend counts

GOES X-ray

GOES proton

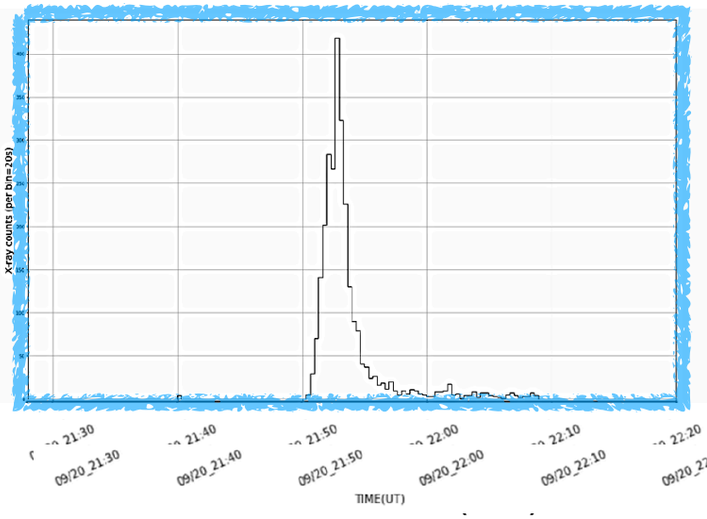
Magnetometer

Kp index



Time in 2024 (UT)

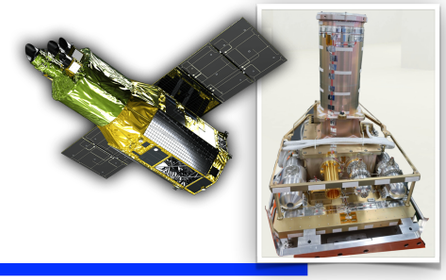
Xtend counts



↔ 5 min

- Flaring events are sometimes seen during night-Earth observations
- ~40 clear events found in 2 years (2023.10–2025.08)
- mostly not coincident with solar activities
  —> precipitating electrons from the radiation belts?

Non X-ray background



Night-Earth (= pure NXB) data

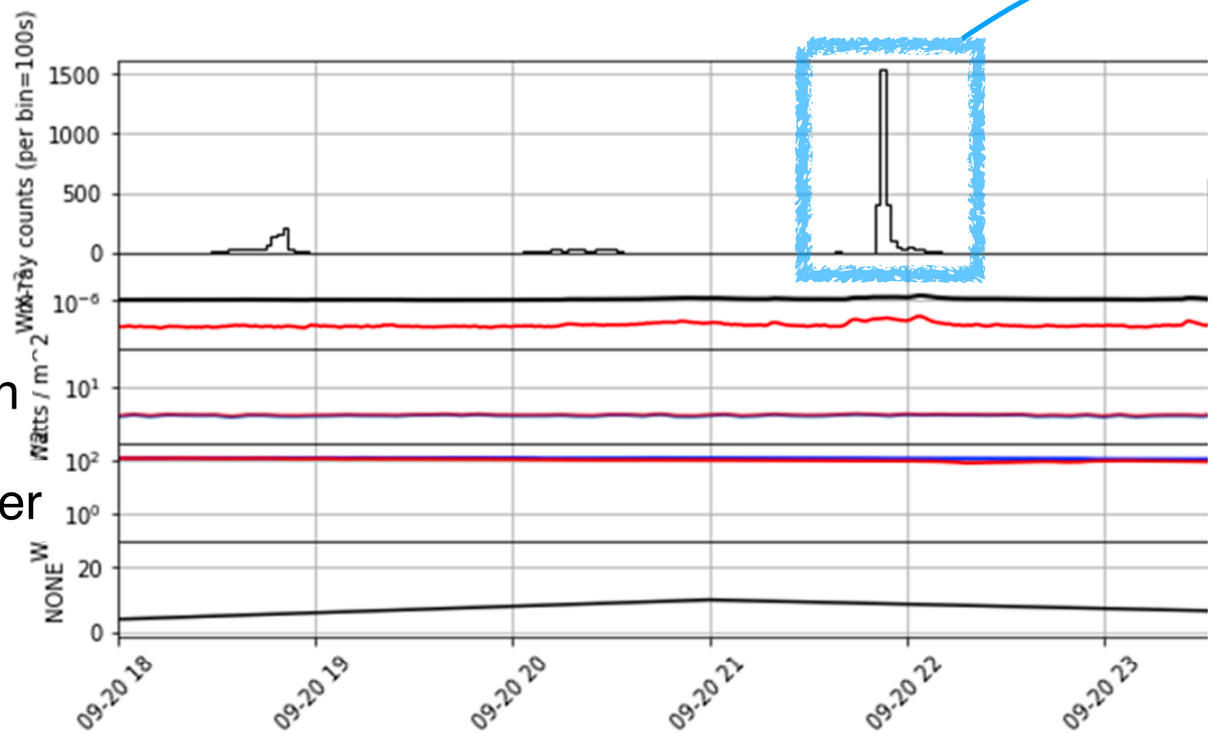
Xtend counts

GOES X-ray

GOES proton

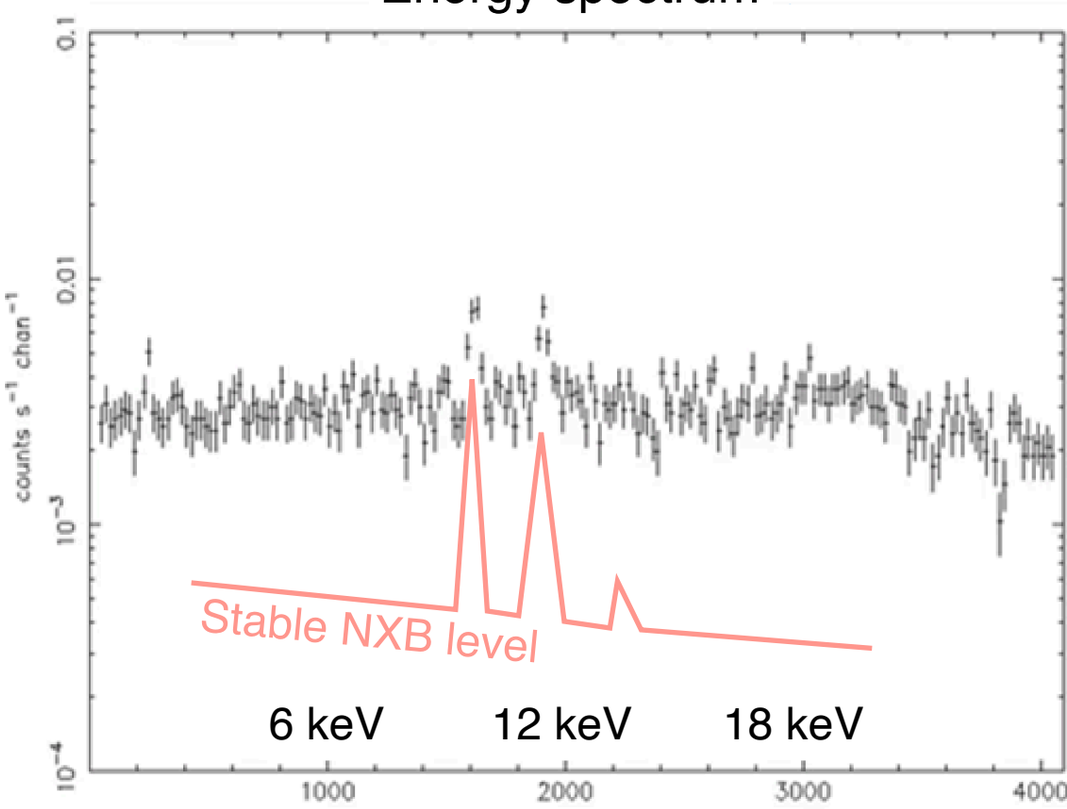
Magnetometer

Kp index



Time in 2024 (UT)

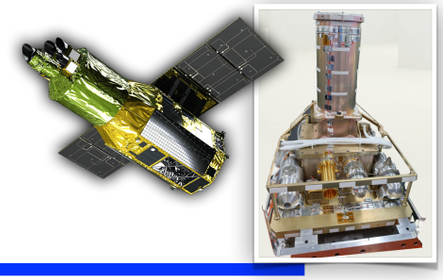
Energy spectrum



Energy (ch)

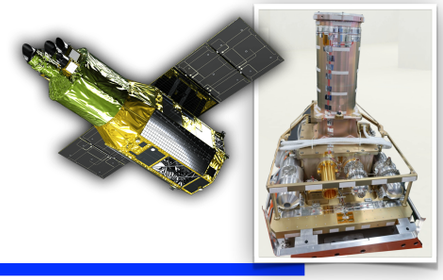
- Flaring events are sometimes seen during night-Earth observations
- ~40 clear events found in 2 years (2023.10–2025.08)
- mostly not coincident with solar activities
  —> precipitating electrons from the radiation belts?

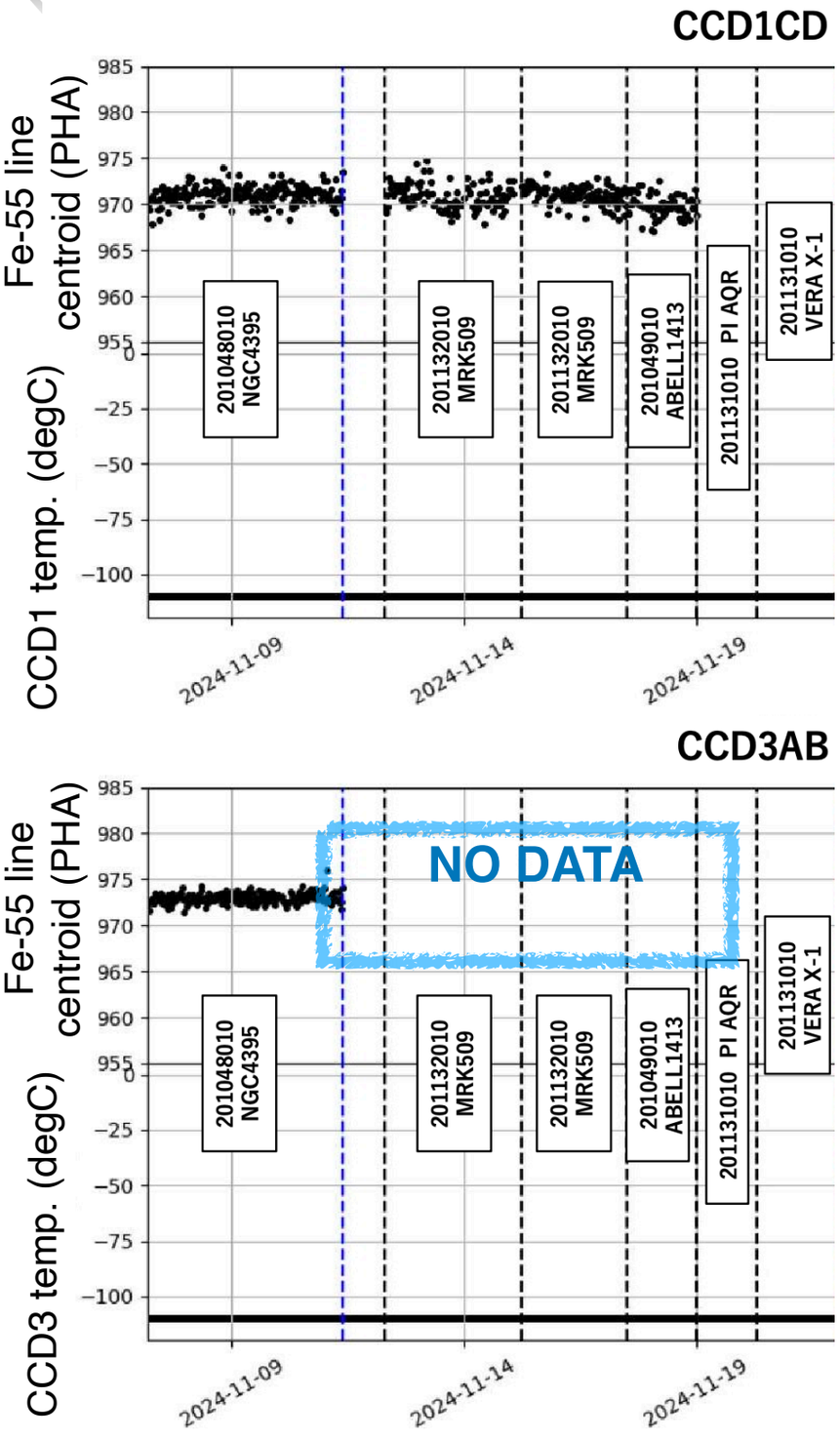
Updates



- Detector response
- Consistency between full-win and 1/8-win data
- Non X-ray background
- **CCD behavior after a rebooting of electronics in 2024 Nov**

Reboot of electronics in 2024 Nov.

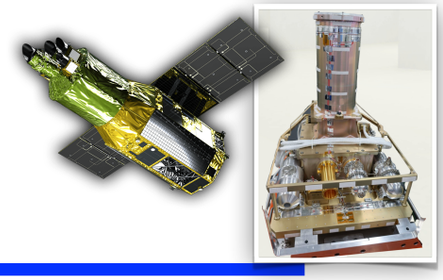


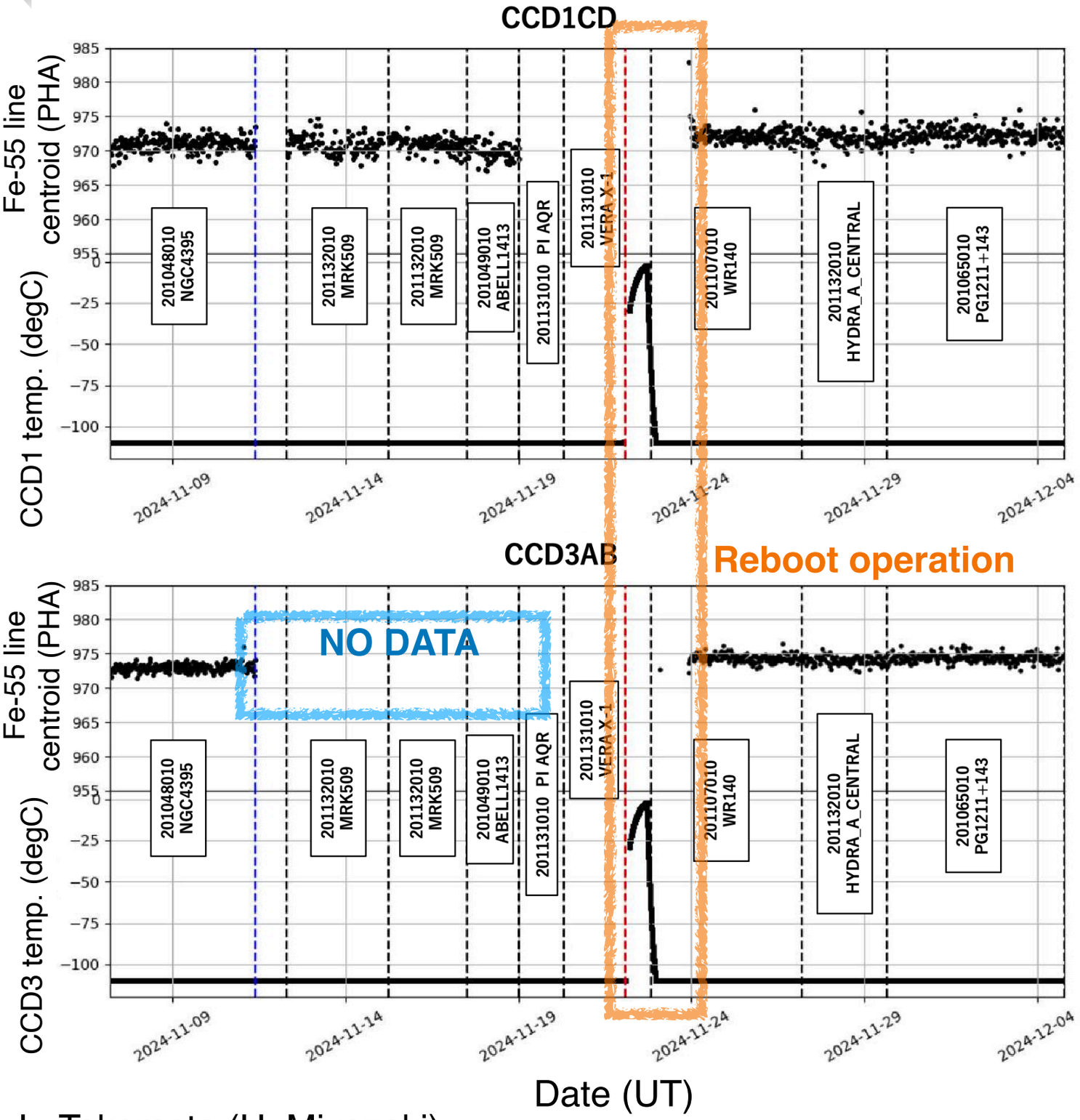


- CCD1&2 and CCD3&4 are operated by separate electronics
- On 2024 Nov. 11, the electronics managing CCD3&4 abruptly stopped operation (single event upset?)
- Rebooting operation was done in 11 days

L. Takemoto (U. Miyazaki)

Reboot of electronics in 2024 Nov.

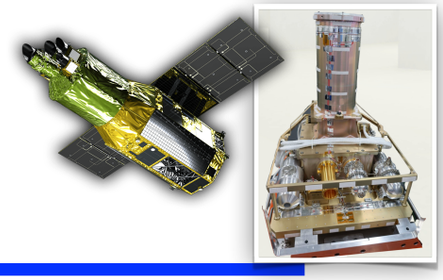




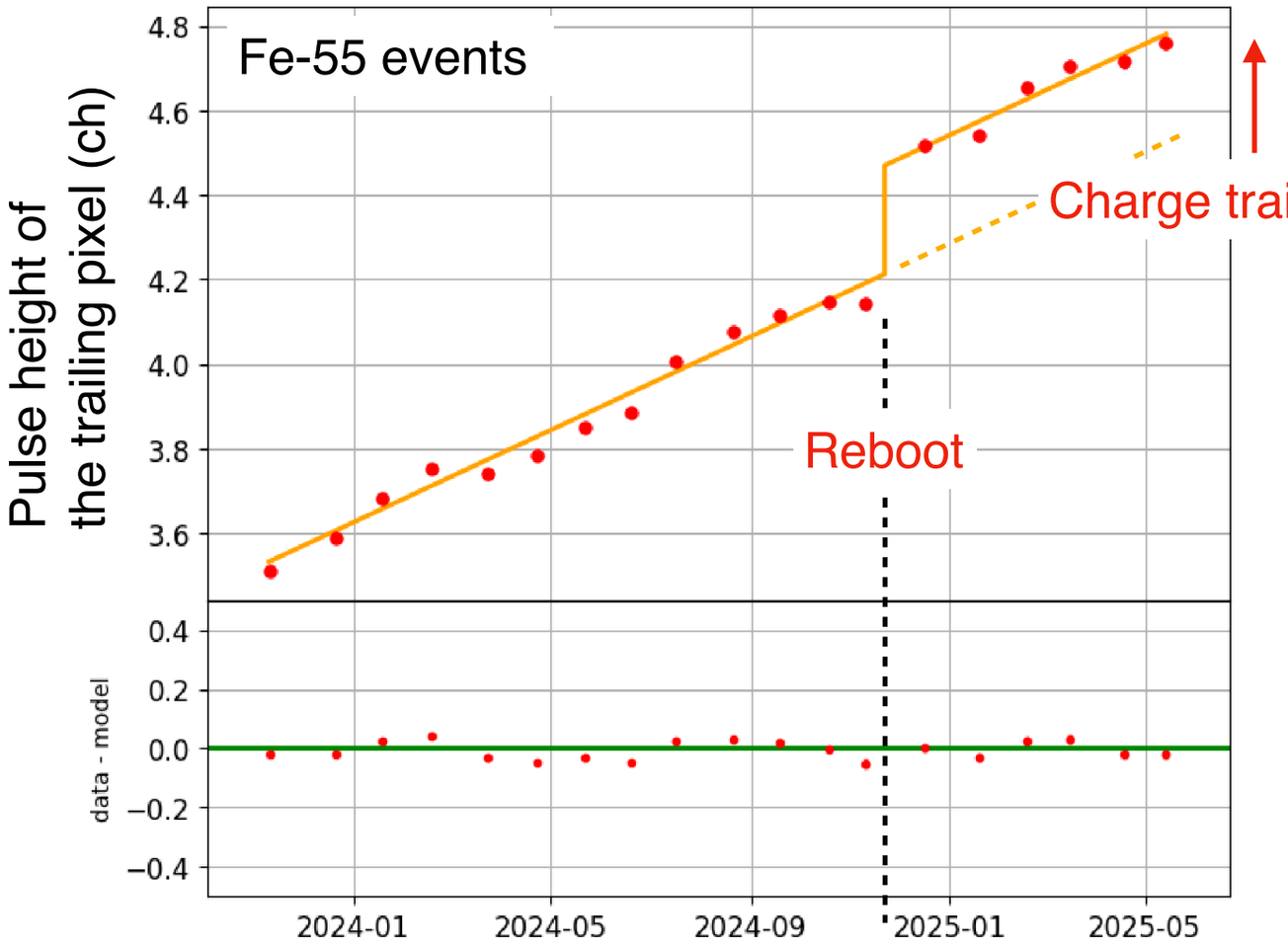
- CCD1&2 and CCD3&4 are operated by separate electronics
- On 2024 Nov. 11, the electronics managing CCD3&4 abruptly stopped operation (single event upset?)
- Rebooting operation was done in 11 days
- CCD temperatures temporarily increased to **~0 degC** from nominal -110 degC (annealing!)

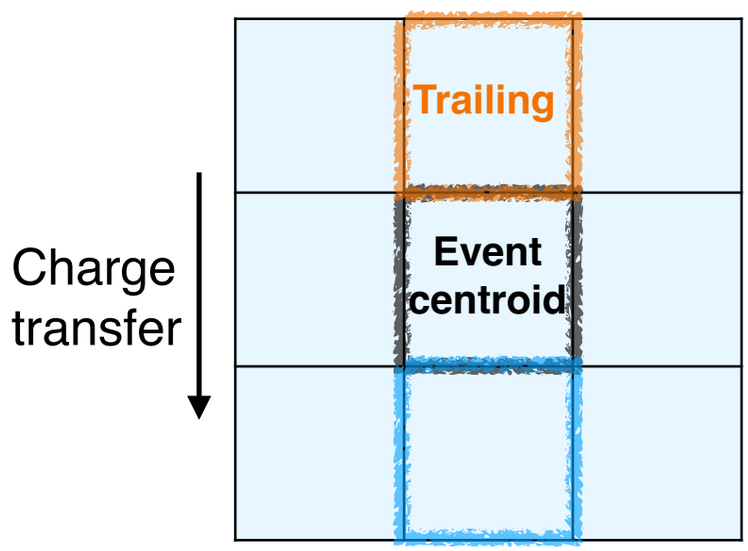
L. Takemoto (U. Miyazaki)

Reboot of electronics in 2024 Nov.



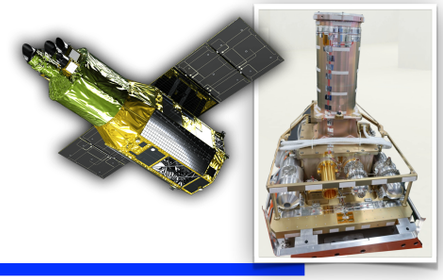
- After the reboot, short-timescale charge traps, which produce charge trails, **increased**



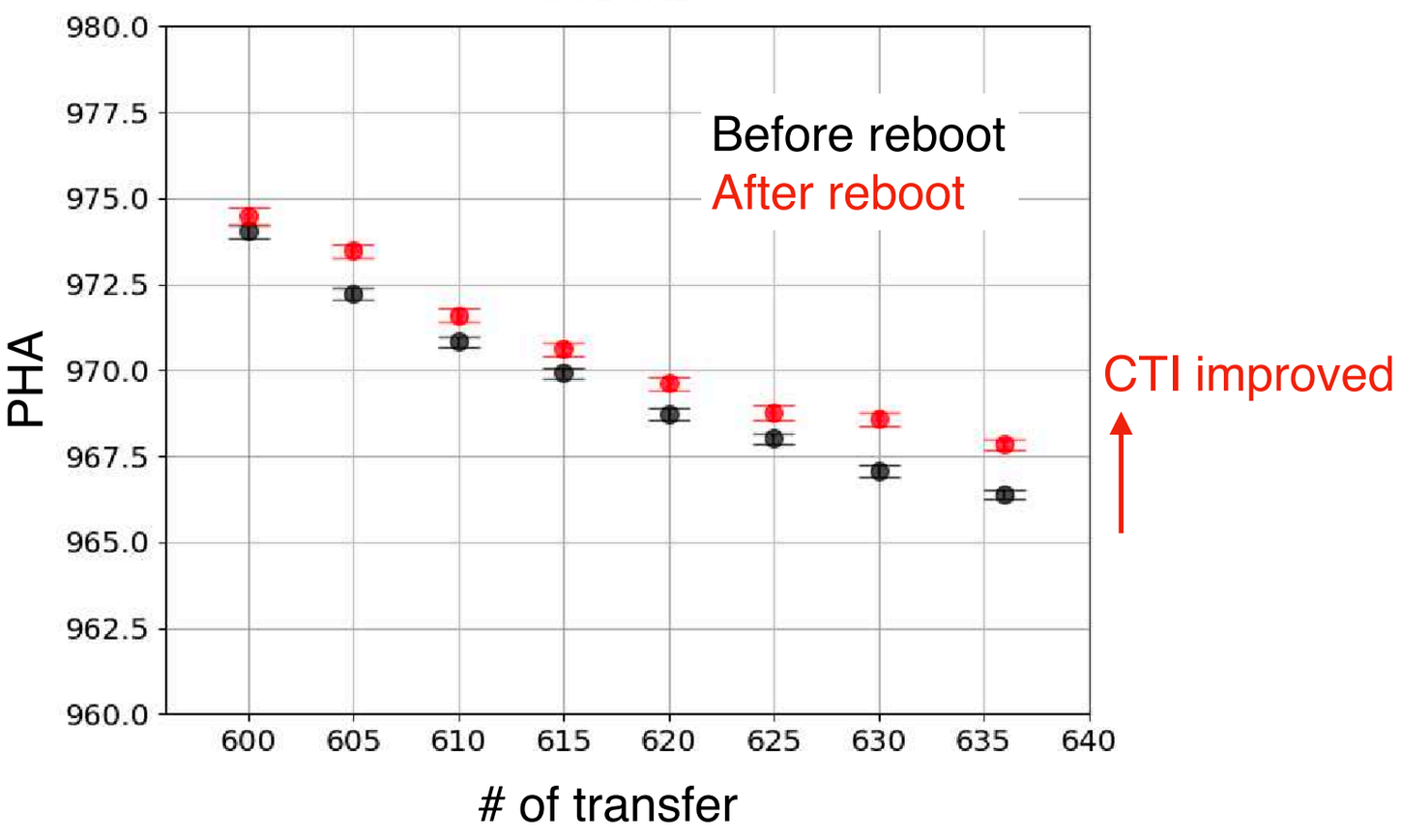


L. Takemoto (U. Miyazaki)

Reboot of electronics in 2024 Nov.



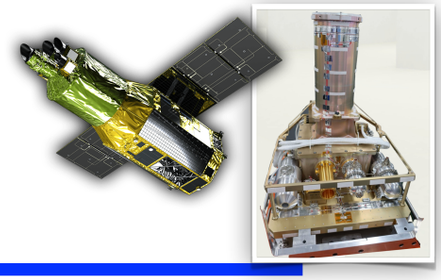
Fe-55 pulse heights

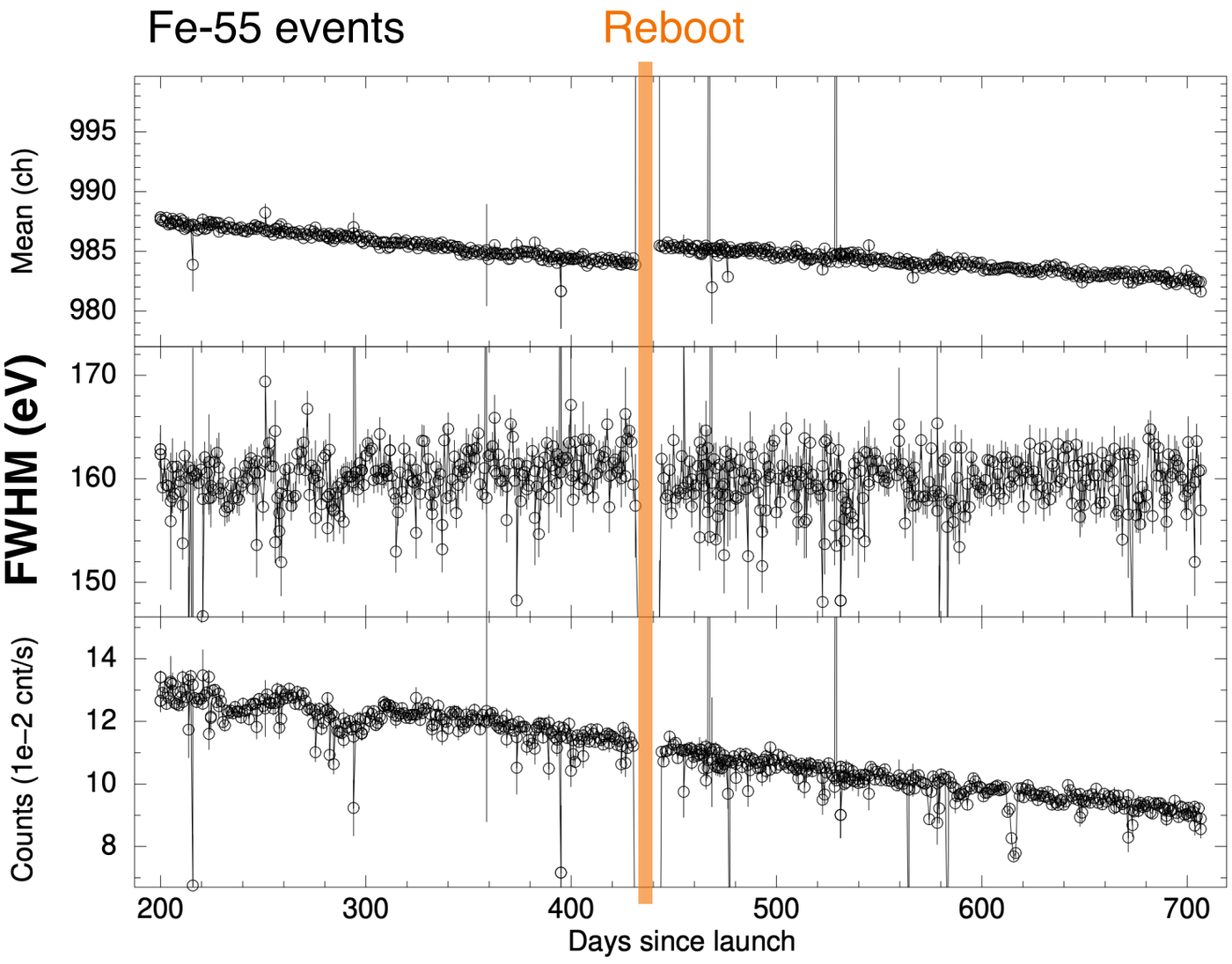


- After the reboot, short-timescale charge traps, which produce charge trails, **increased**
- Long-timescale charge traps **decreased** on the other hand = CTI is improved
- Energy resolution improved a bit as a result
- This phenomenon still not fully understood

L. Takemoto (U. Miyazaki)

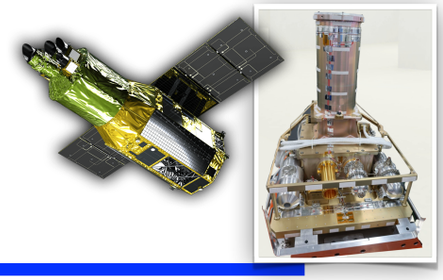
Reboot of electronics in 2024 Nov.





- After the reboot, short-timescale charge traps, which produce charge trails, **increased**
- Long-timescale charge traps **decreased** on the other hand = CTI is improved
- **Energy resolution improved a bit as a result**
- This phenomenon still not fully understood

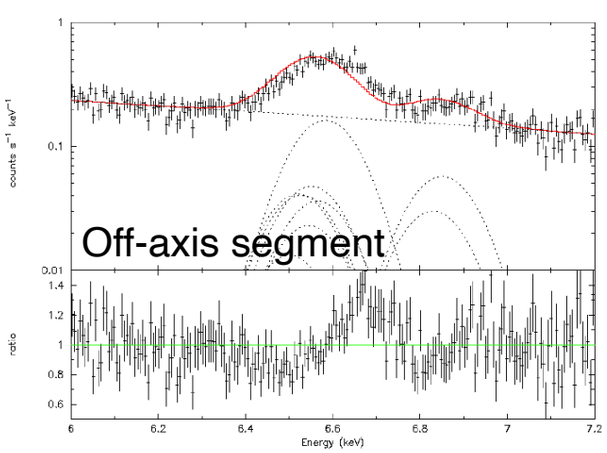
Summary

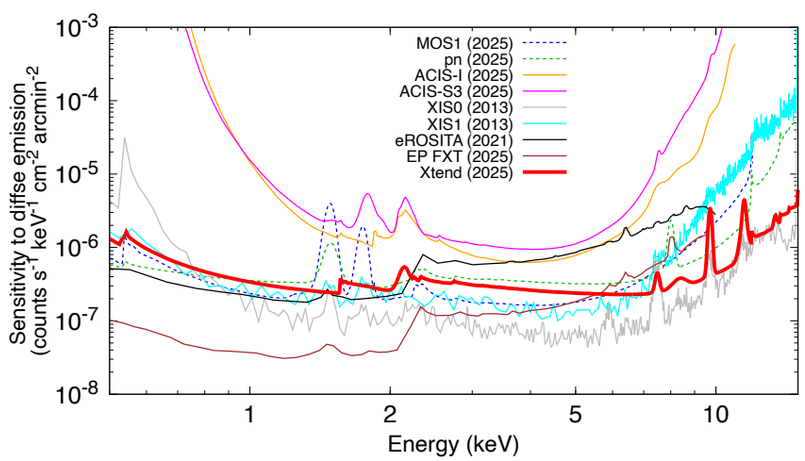


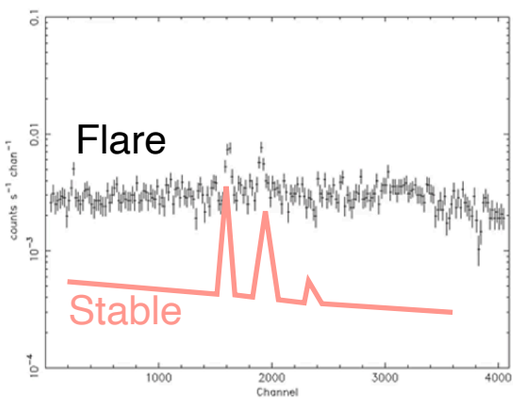
- We keep watching how the Xtend detector response works for new data
- Detector response requires improvements in the segments without Fe-55 cal source irradiation
- Full-win vs. 1/8-win spectra are likely consistent (confirmed with Cygnus loop)

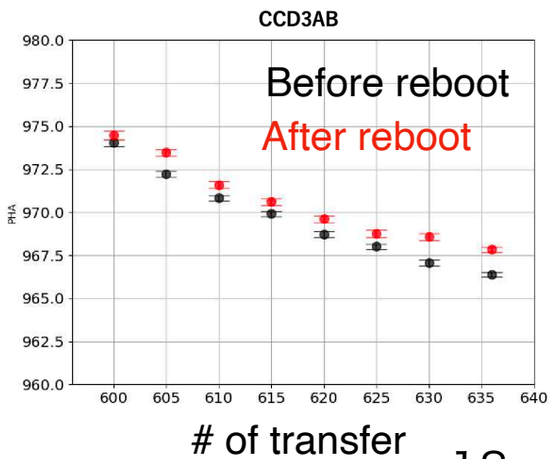
- Non X-ray background level of Xtend is moderately low, and diffuse-source sensitivity at E > 6 keV is very good
- NXB flaring events are sometimes seen, physical mechanism under investigation

- After reboot of electronics in 2024 Nov. (where CCD temperatures increased to ~0 degC), short-timescale traps increased and long-timescales traps decreased

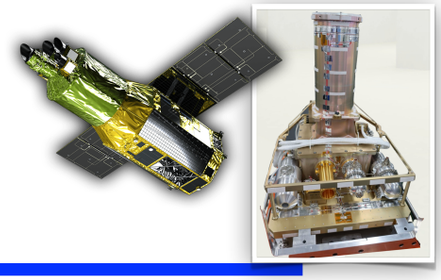




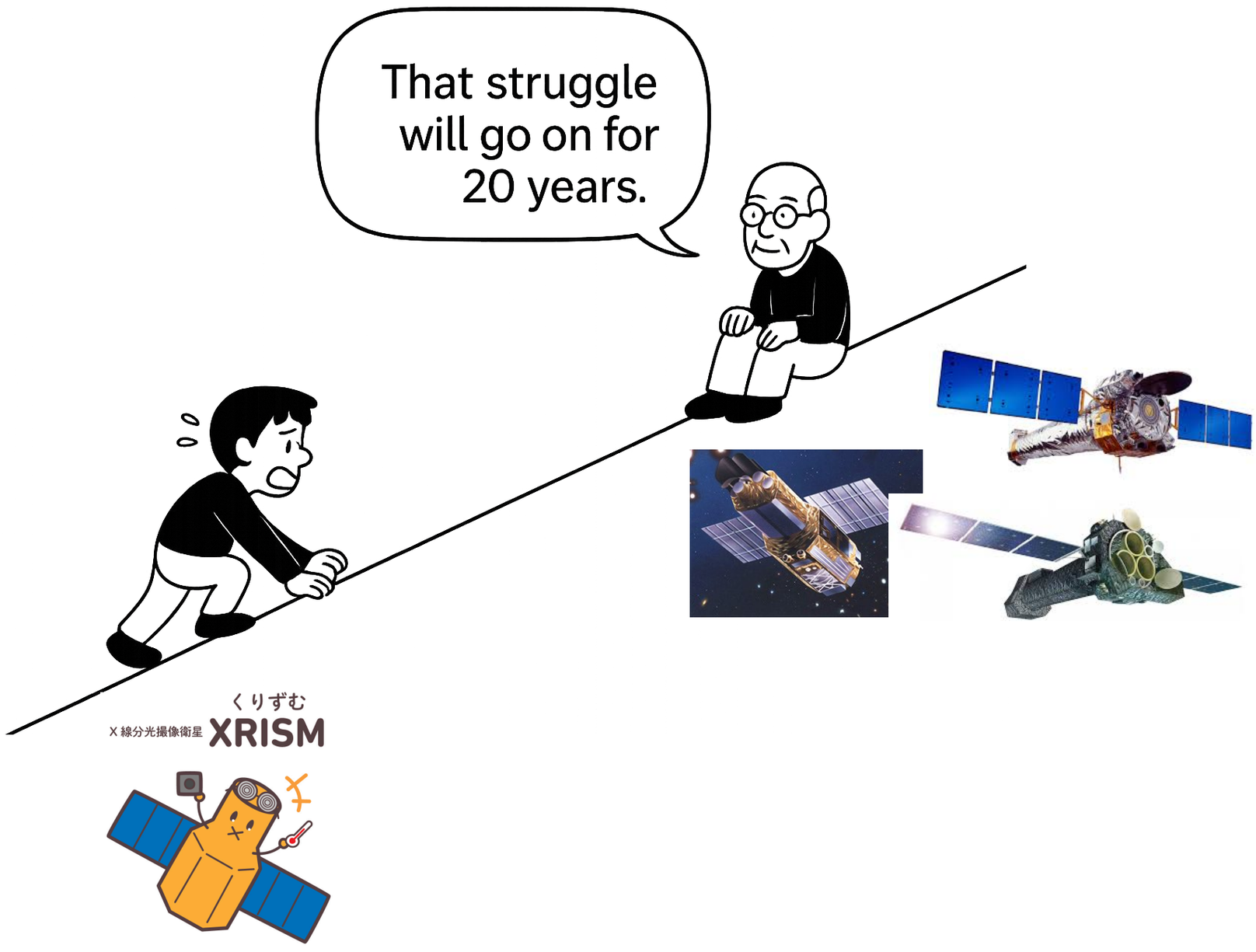




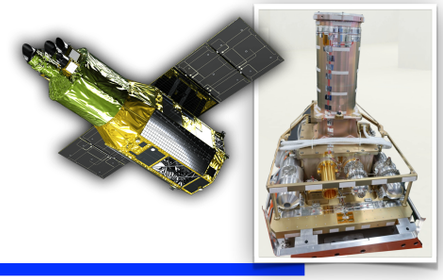
Summary



Detector response of CCDs may be never-ending story…



Data set/references



NXB date/model, ARF are calculated using recent science data

- XRISM Xtend: OBSID 201014010 (2025.03)
  - HEASOFT v6.34
  - CALDB v20250915
- XMM MOS1 & pn: OBSID 0903300301 (2025.03)
  - SAS v22.1
- Chandra ACIS-I & S3: OBSID 32208 & 31129 (2025.03)
  - CIAO v4.18
- Suzaku XIS0 & XIS1: OBSID 508071010 (2013.12)
  - HEASOFT v6.34
  - CALDB v20181023

Adopted from papers

- SRG eROSITA
  - effective area: Predhl et al. 2021
  - background: Perinati et al. 2025
- Einstein Probe FXT
  - effective area: Yang et al. 2023
  - background: Zhang et al. 2025