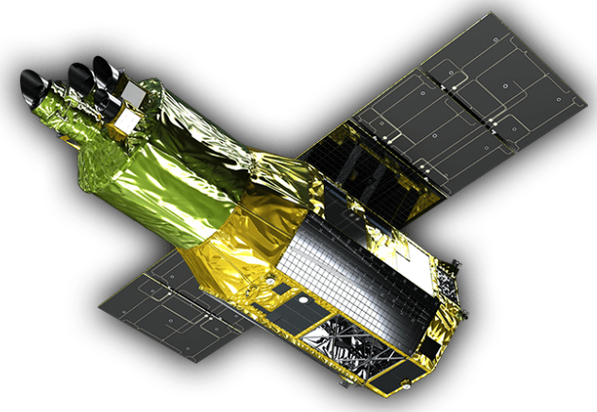
XRISM
X-Ray Imaging and Spectroscopy Mission

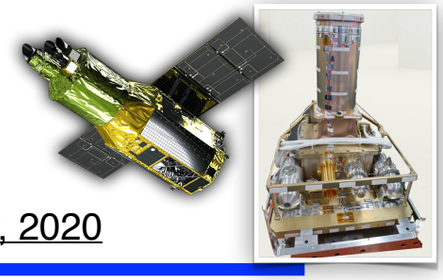


Flaring events seen by XRISM/Xtend during night-Earth observations

Yui Tagi,
Hiromasa Suzuki
(U. of Miyazaki),
and the XRISM CaI-IP BGD team

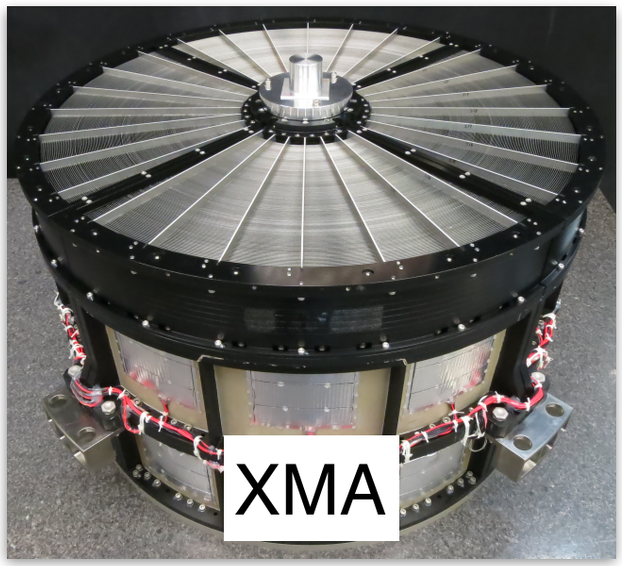
Yui

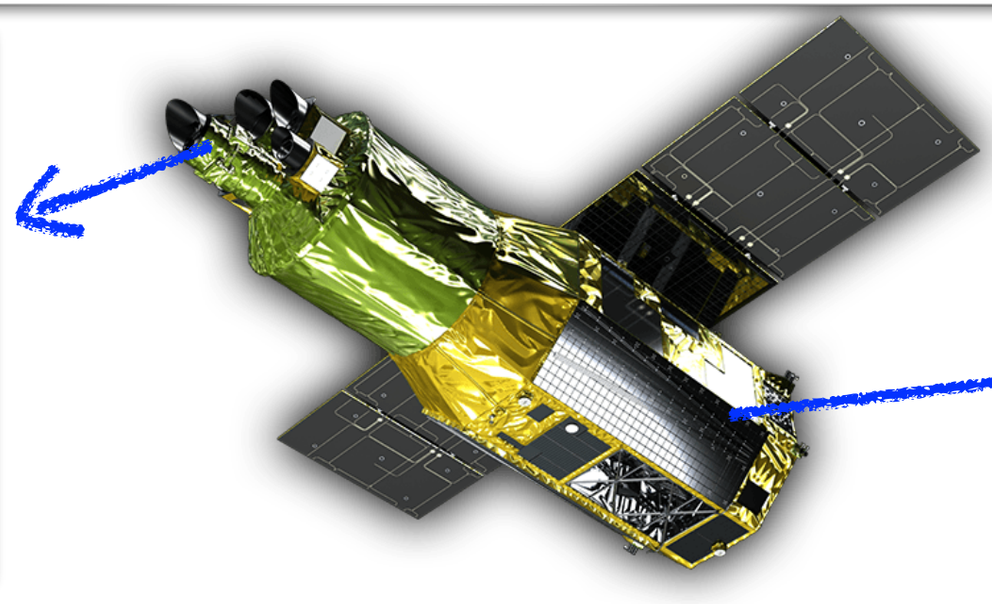
XRISM Xtend

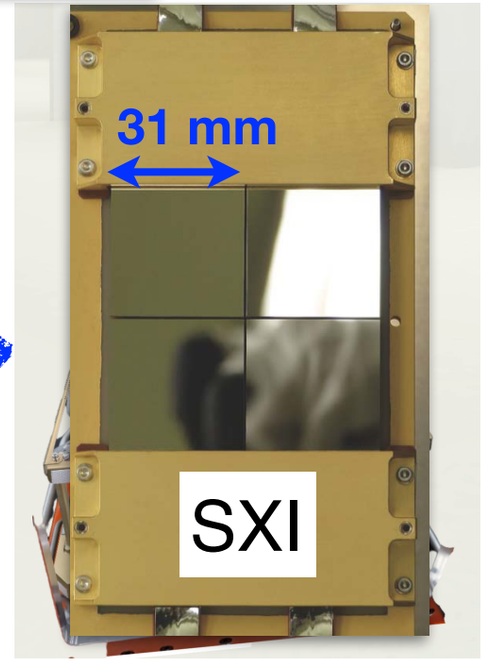


XRISM white paper, 2020

Xtend = XMA (X-ray Mirror Assembly) + SXI (Soft X-ray Imager)





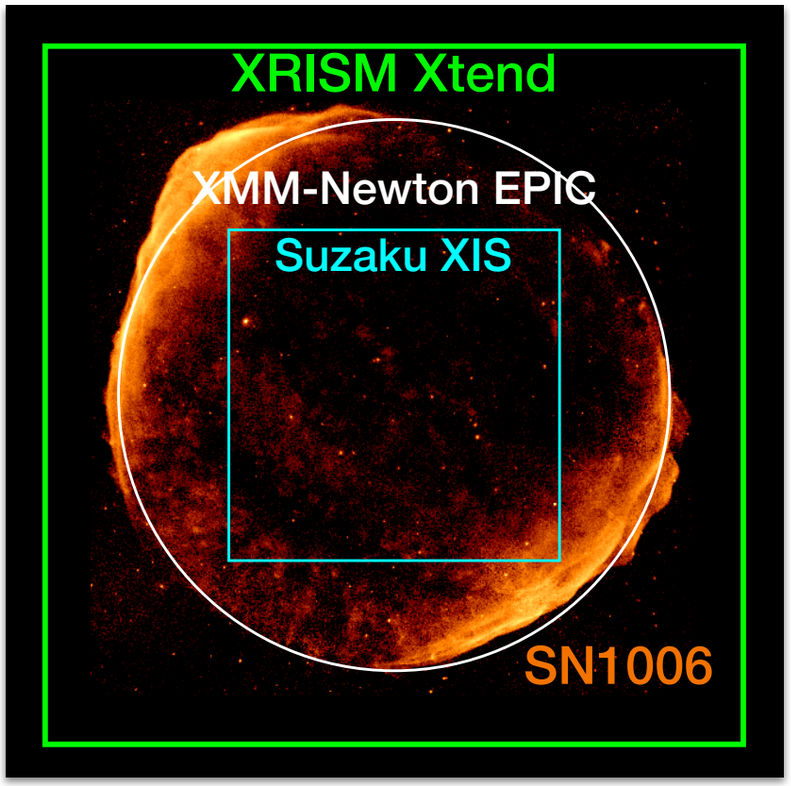


- **XMA**：Wolter type I mirror optics

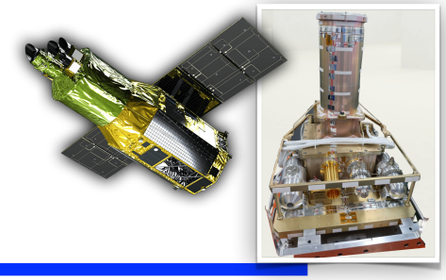
- **SXI**：X-ray CCDs

  ✓back-illuminated P-channel CCDs

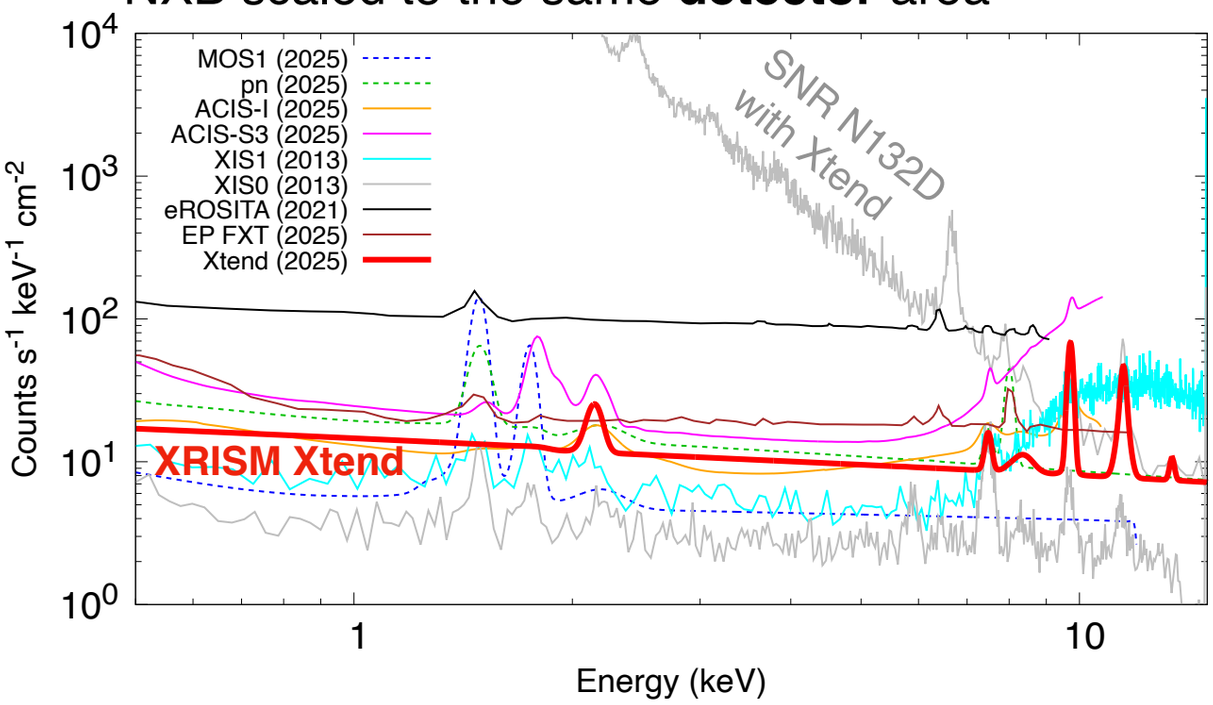
- Energy range：0.4–13 keV
- FoV：38.5 arcmin × 38.5 arcmin
- Energy resolution: < 180 eV @5.9 keV
- Ang. resolution: ~1.4’ (Half Power Diameter)



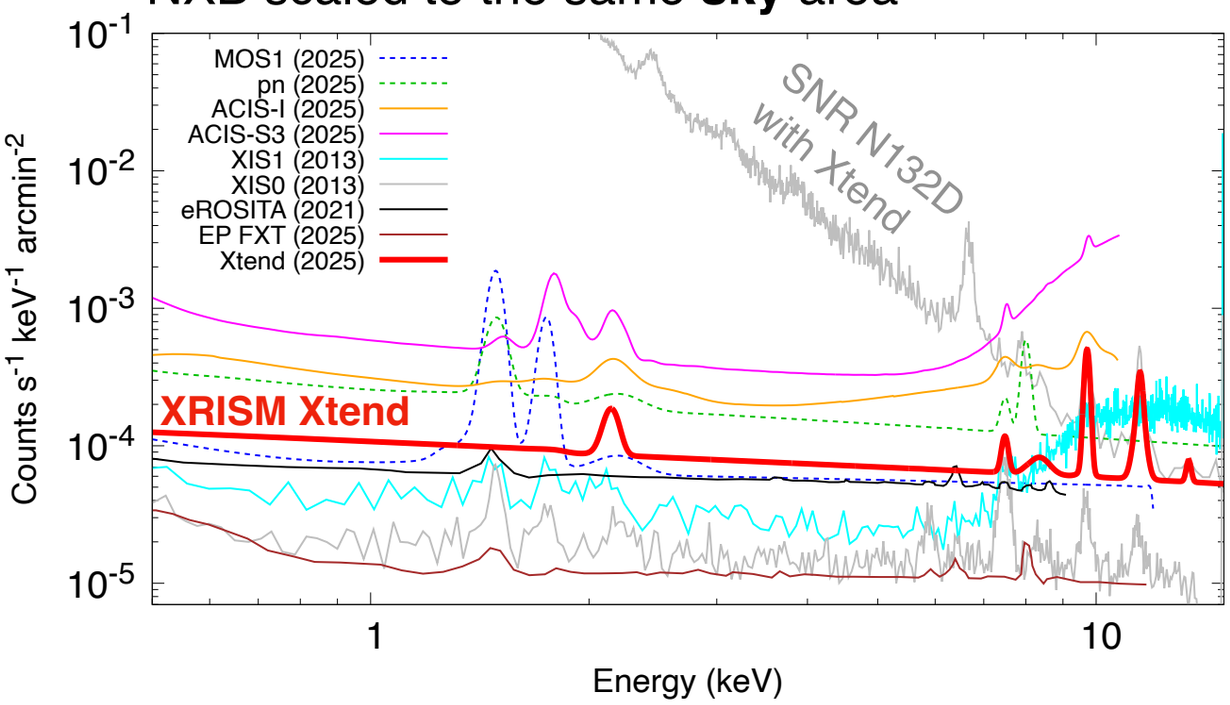
Non X-ray background



NXB scaled to the same **detector** area

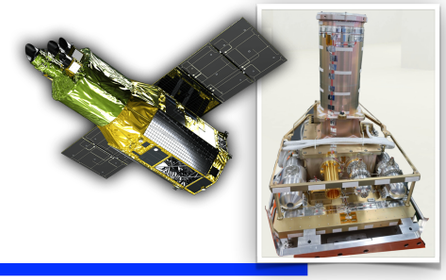


NXB scaled to the same **sky** area

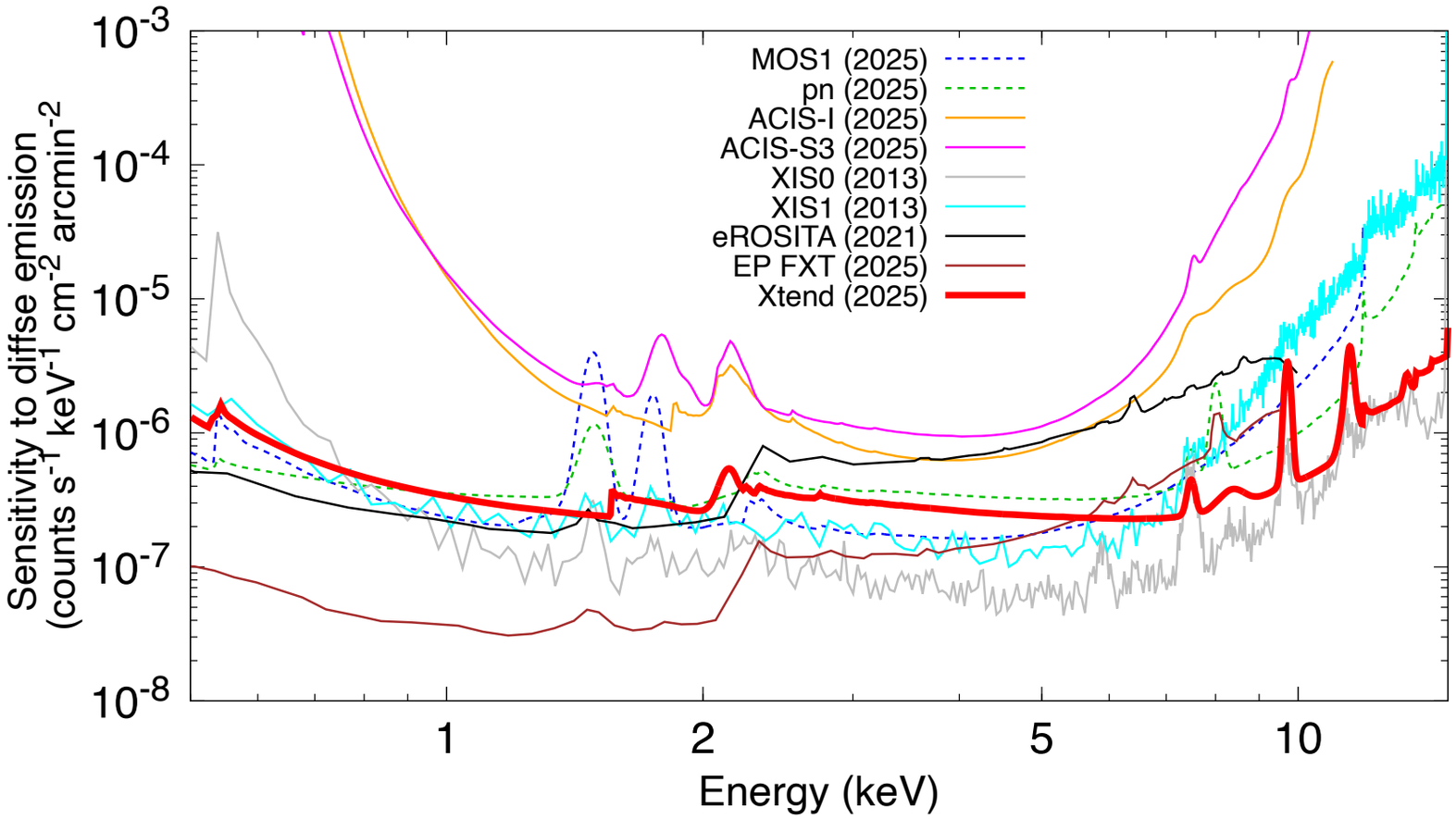


- Non X-ray background level of Xtend is moderately low
- When scaled by detector area, FI sensors (XIS0, MOS1, ACIS-I) are generally low and eROSITA@L2 is high, and the others are similar
- When scaled by sky area, eROSITA and EP are low, thanks to a large "sky area per det. area" (1280 arcmin/cm)

Non X-ray background

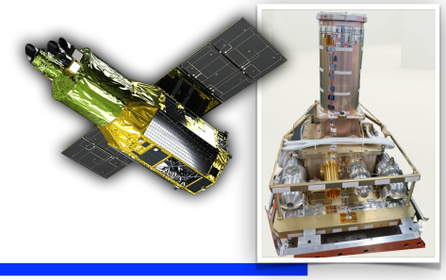


NXB per "eff. area times sky area" = sensitivity to diffuse sources (∝ NXB counts/Diffuse-source counts)

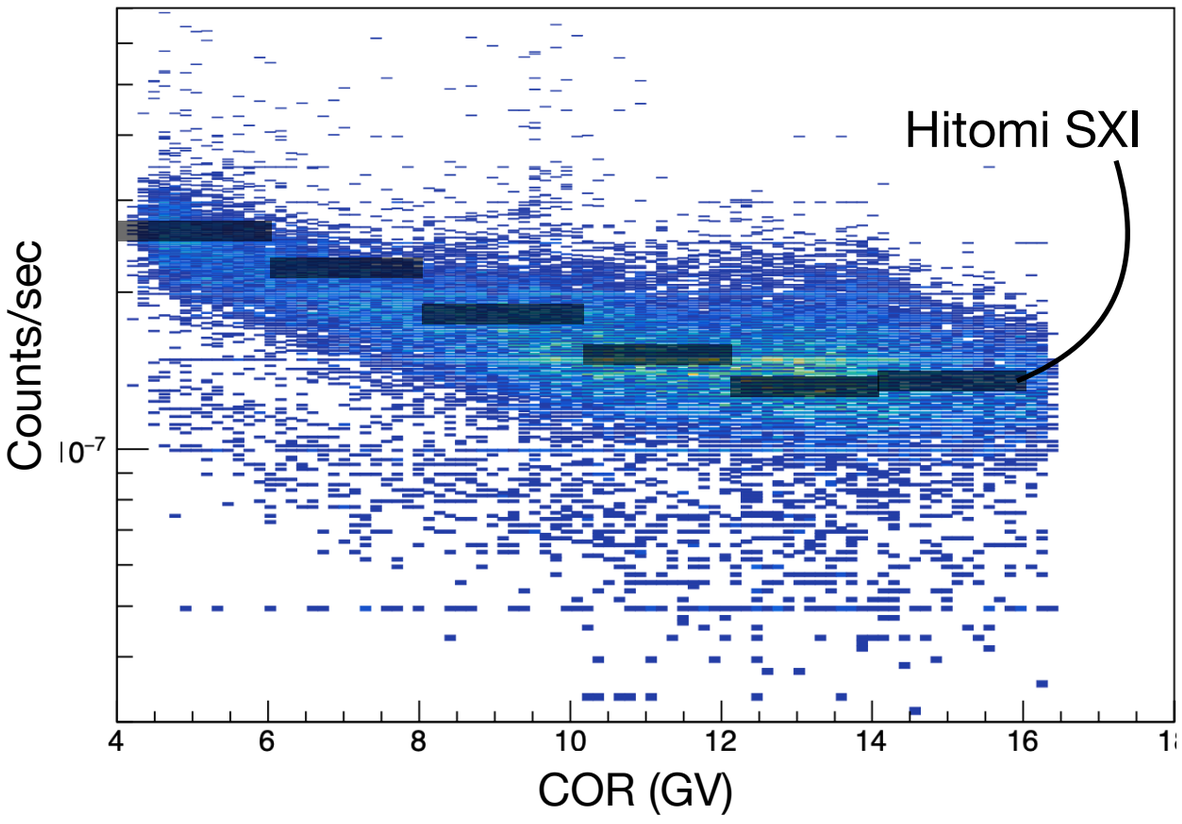


- eROSITA and EP-FXT are good at low-E
- Xtend is very good at > 6 keV thanks to large effective areas at high-E

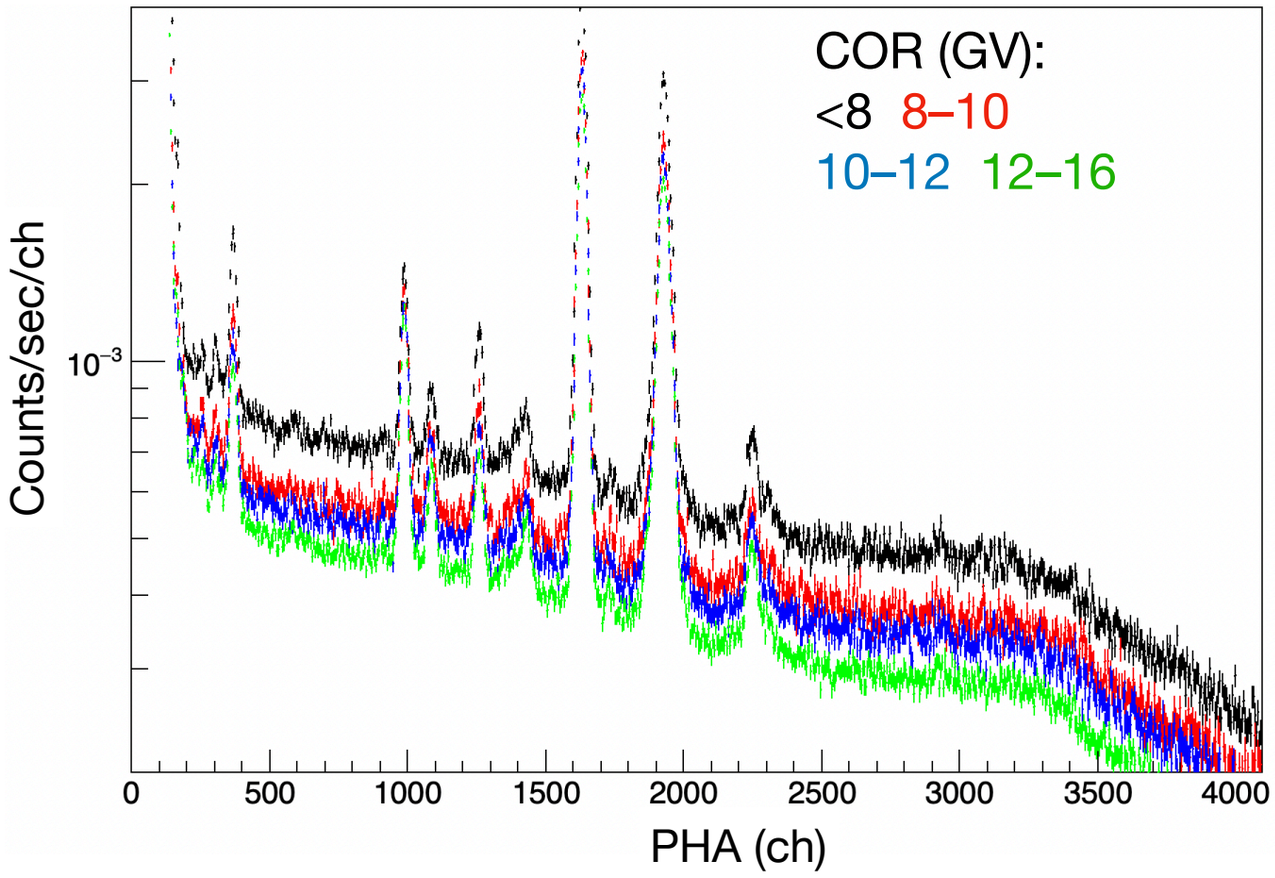
XRISM Xtend NXB spectra



COR dependence of Xtend background rate

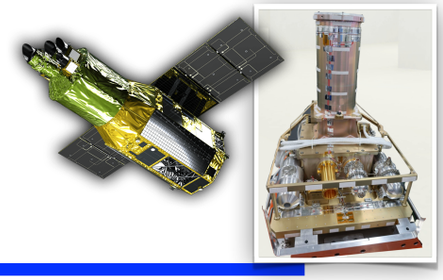


… and spectra



- Night-Earth count rates are mostly stable as expected, but sometimes show flare-like events

XRISM Xtend NXB spectra



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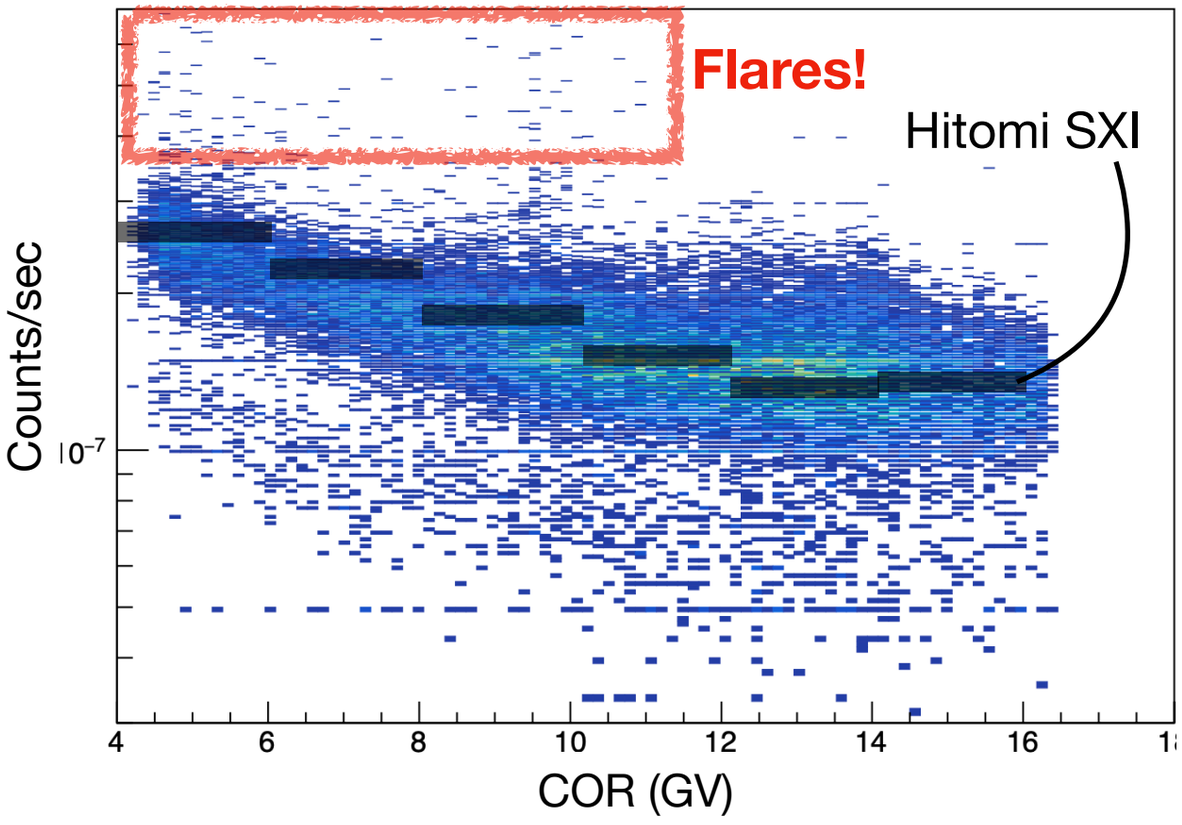

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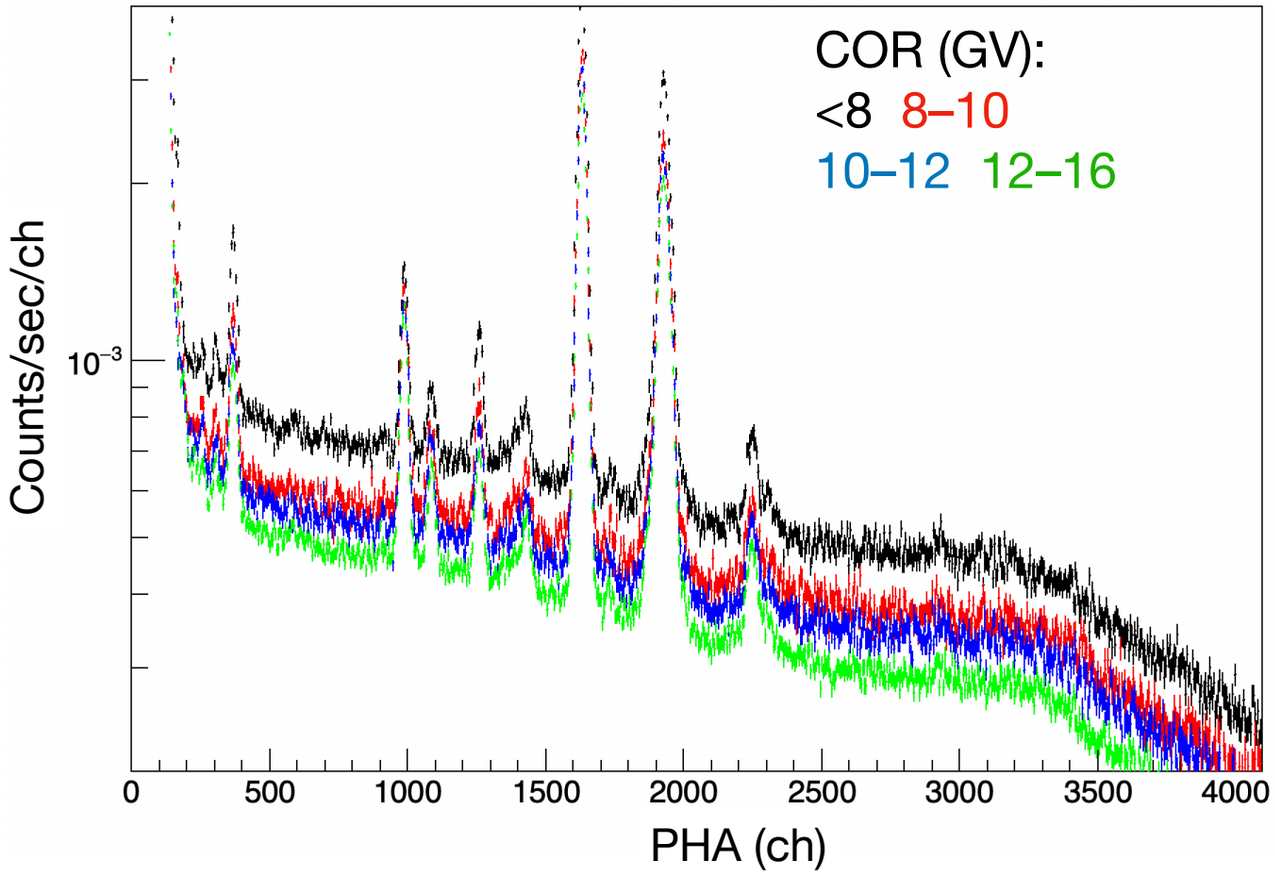

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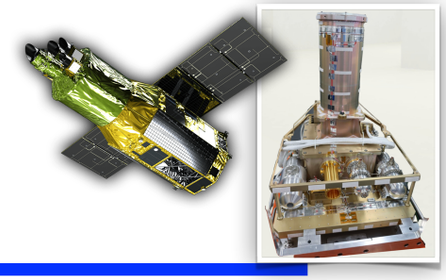
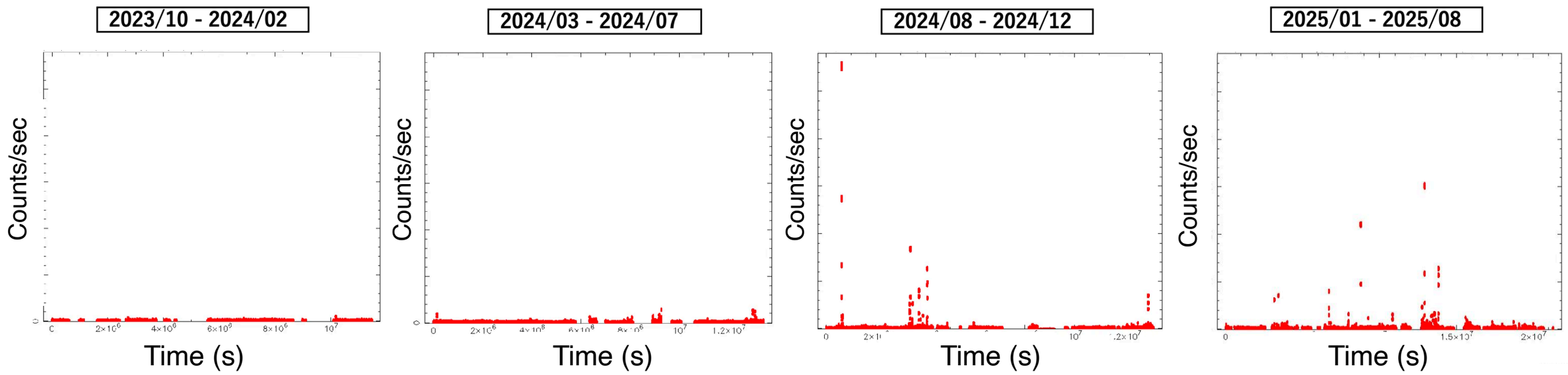
Xtend NXB light curves



Night-Earth (= pure NXB) data



- Night-Earth count rates are mostly stable as expected, but sometimes show flare-like events
- Usually ~0.2 counts/sec, flares reach ~50 counts/sec in full detector array

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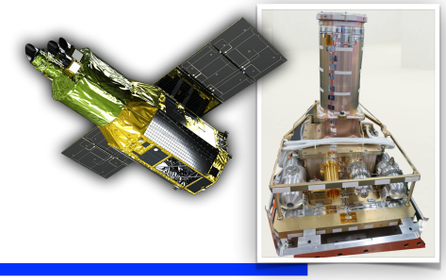

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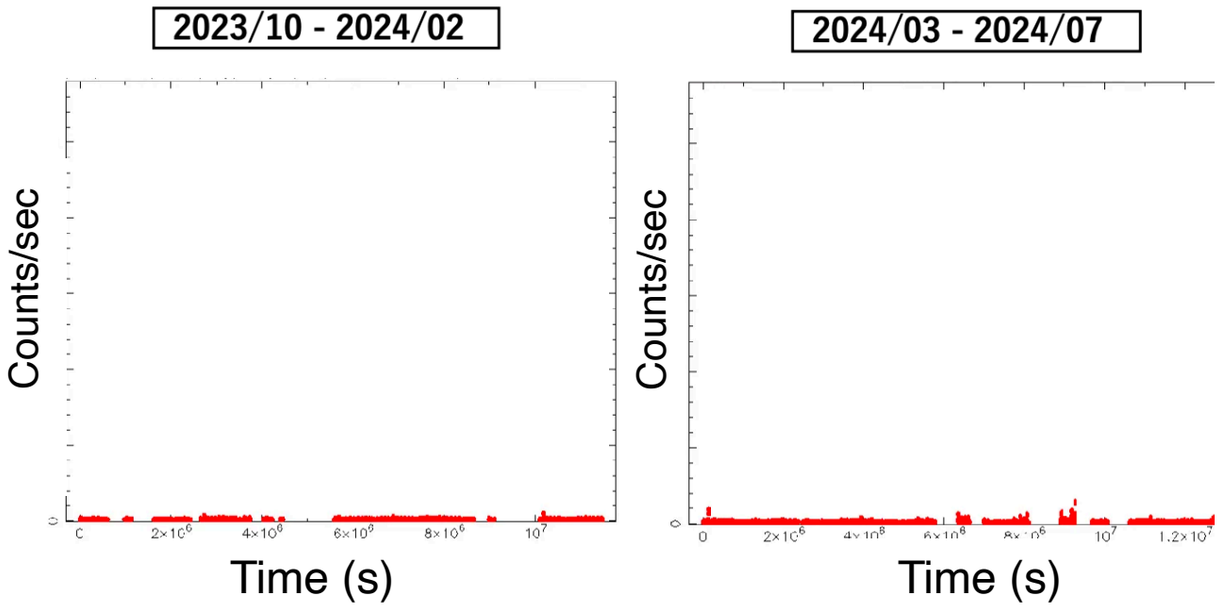

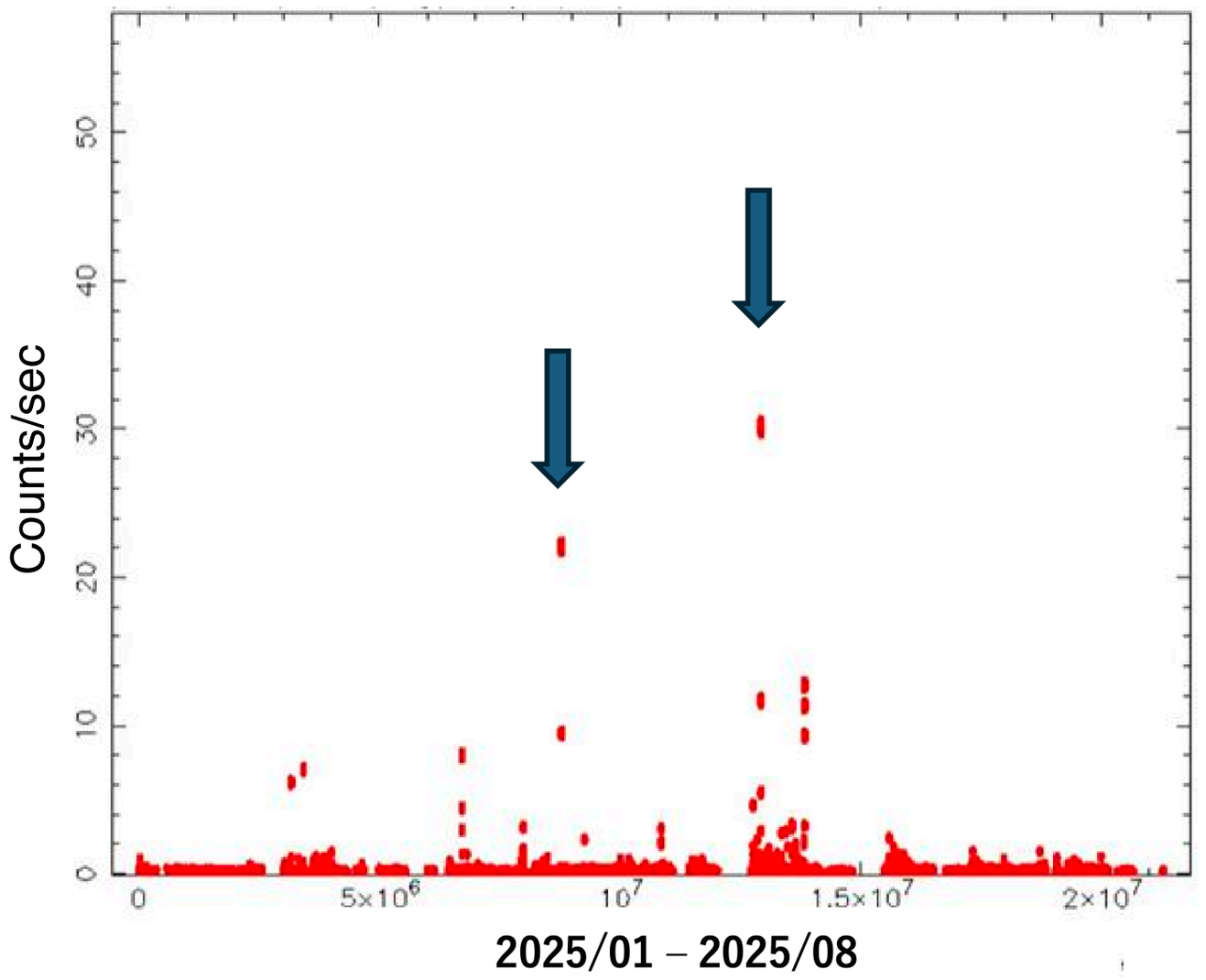

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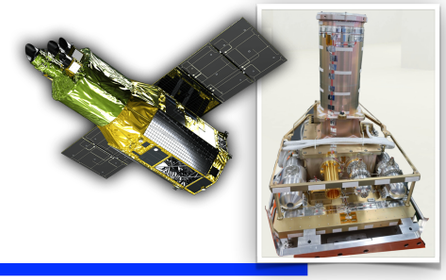
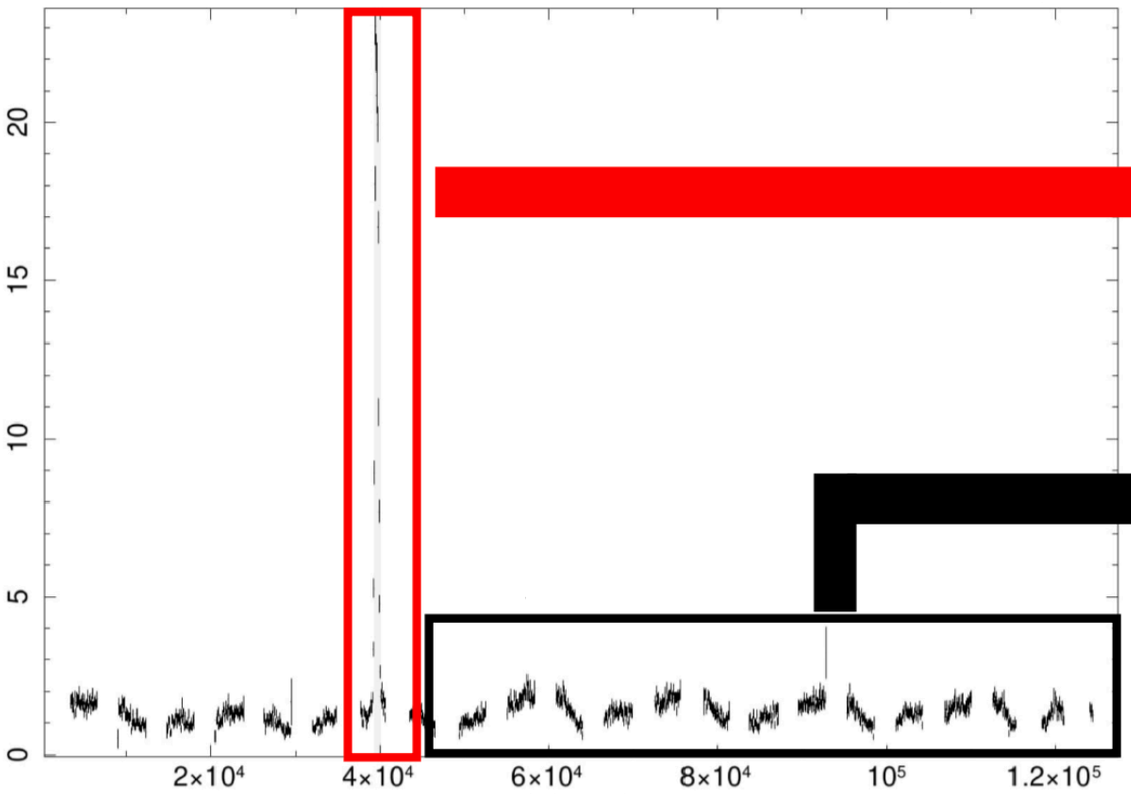
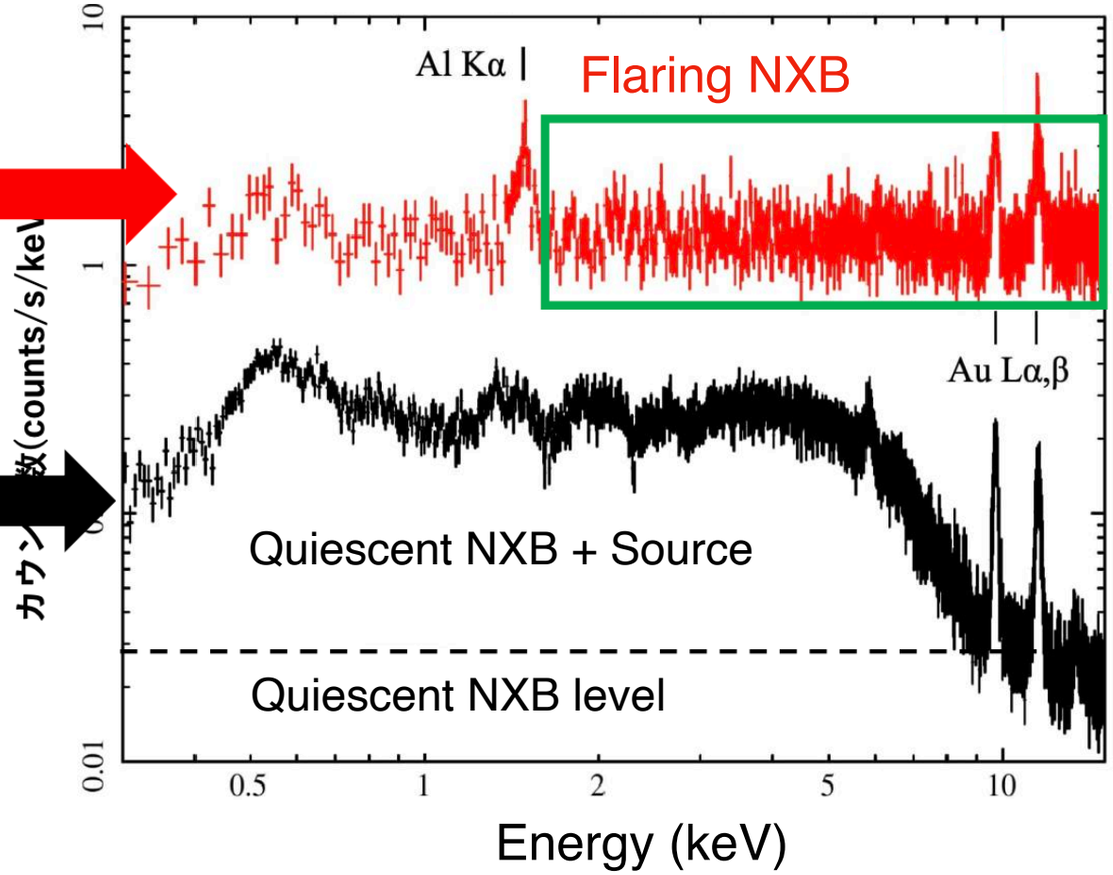


Sometimes in **science** data… (big geomagnetic storm in 2024.05)





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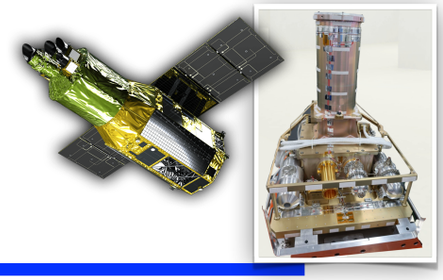
Xtend NXB flares: individual events



Night-Earth (= pure NXB) data

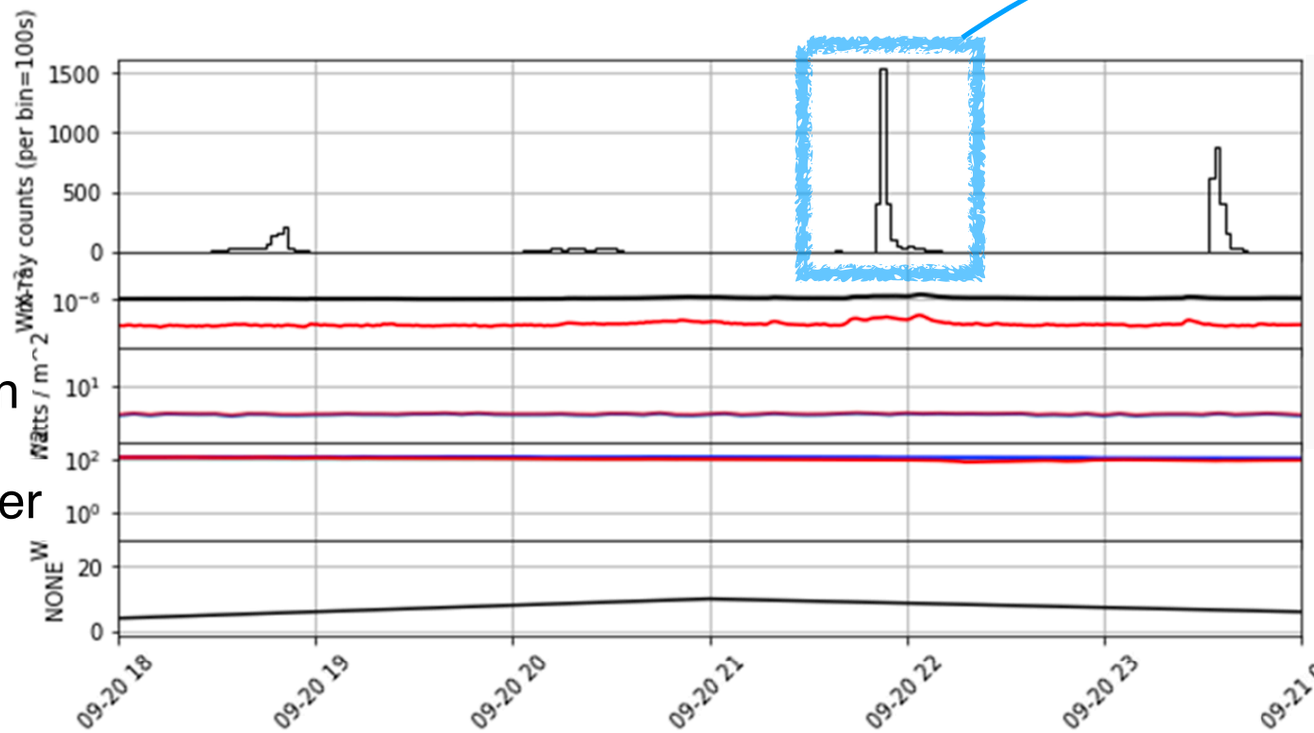
Xtend counts

GOES X-ray

GOES proton

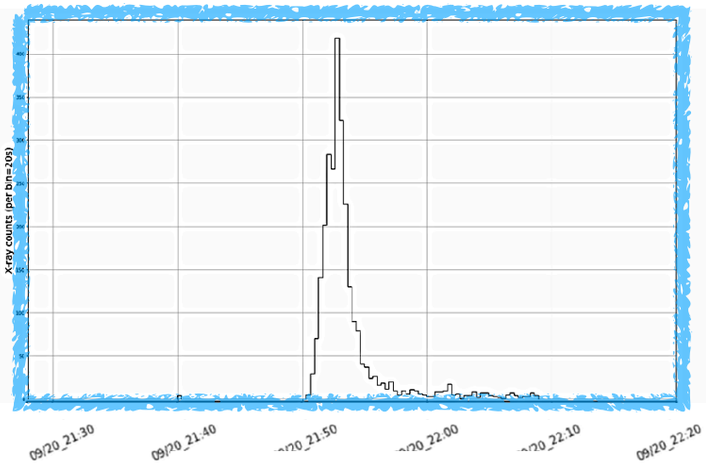
Magnetometer

Kp index



Time in 2024 (UT)

Xtend counts



Time in 2024 (UT)

↔

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
- duration is 5–10 min

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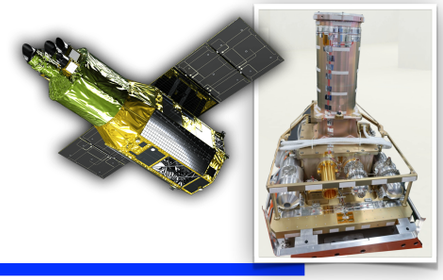

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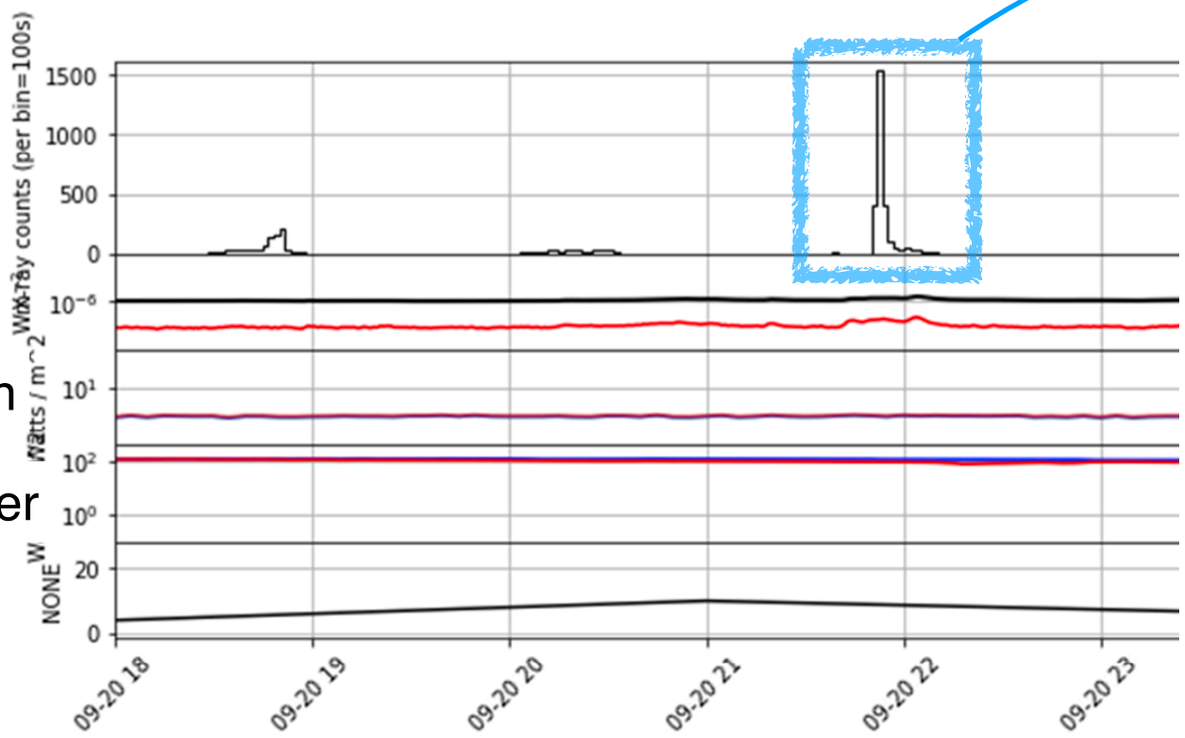
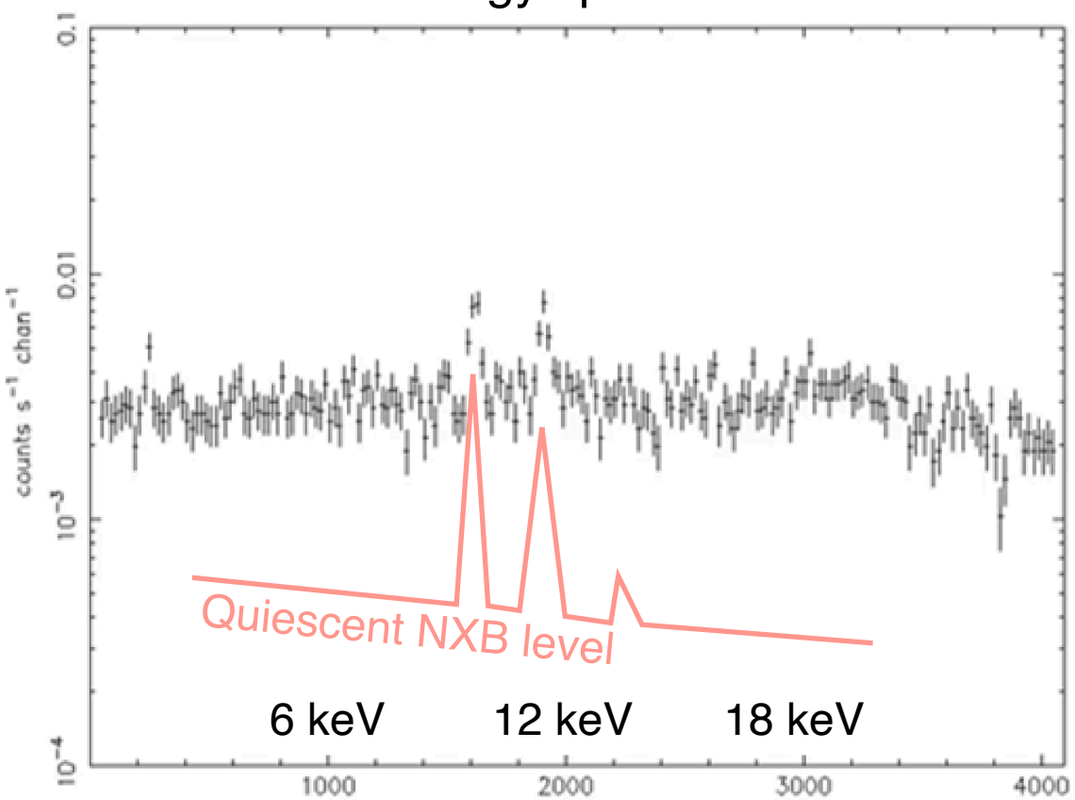


Time in 2024 (UT)

Energy spectrum



Energy (ch)

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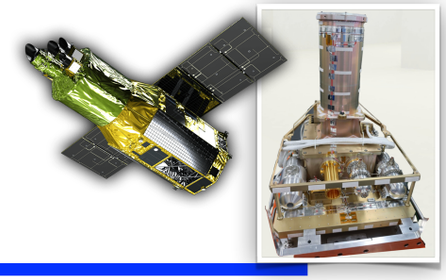
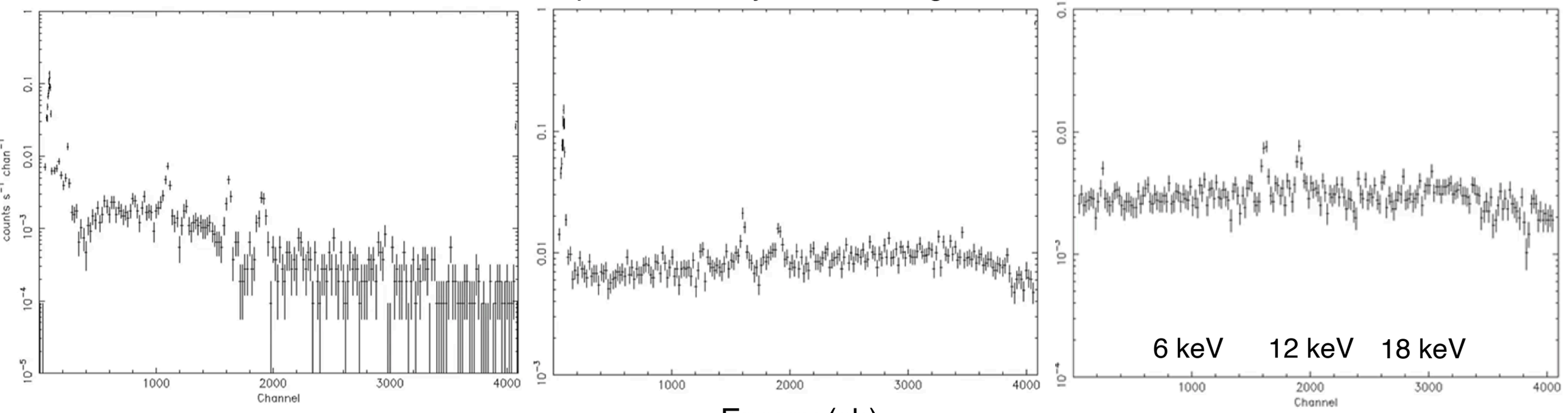


Night-Earth (= pure NXB) data

Spectral variety of the flaring events



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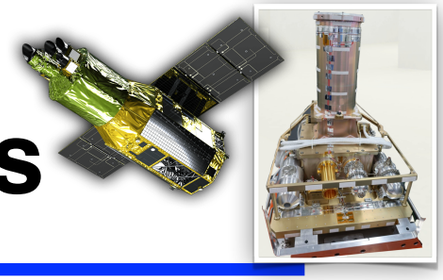
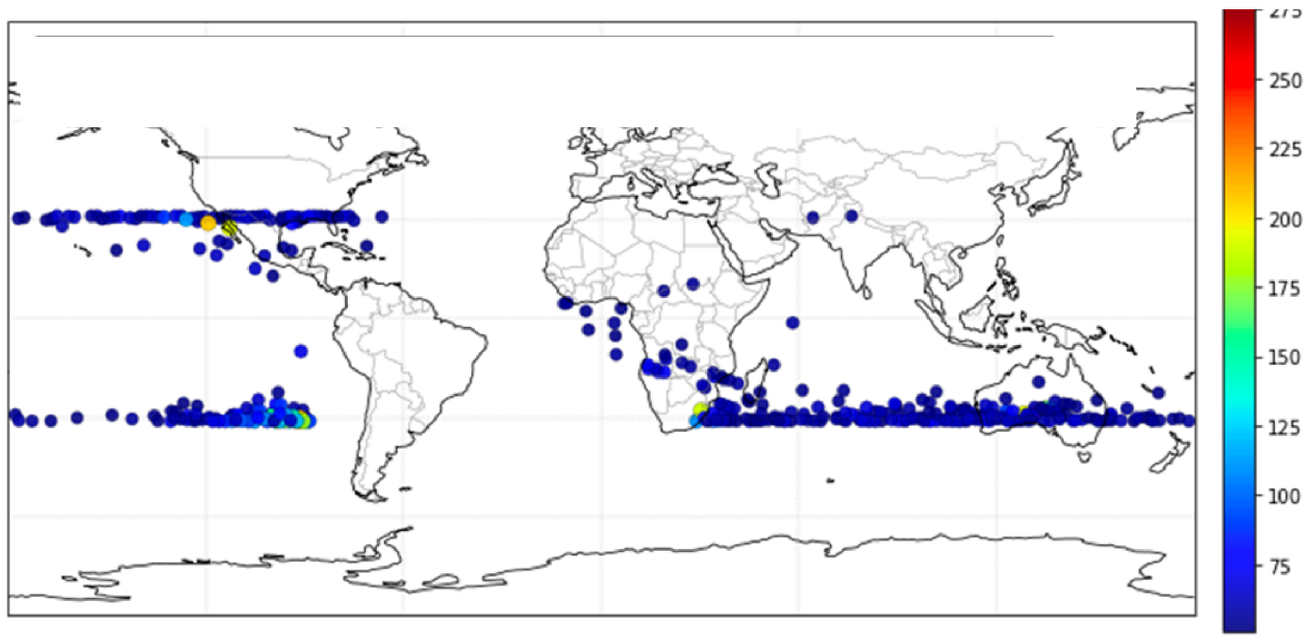
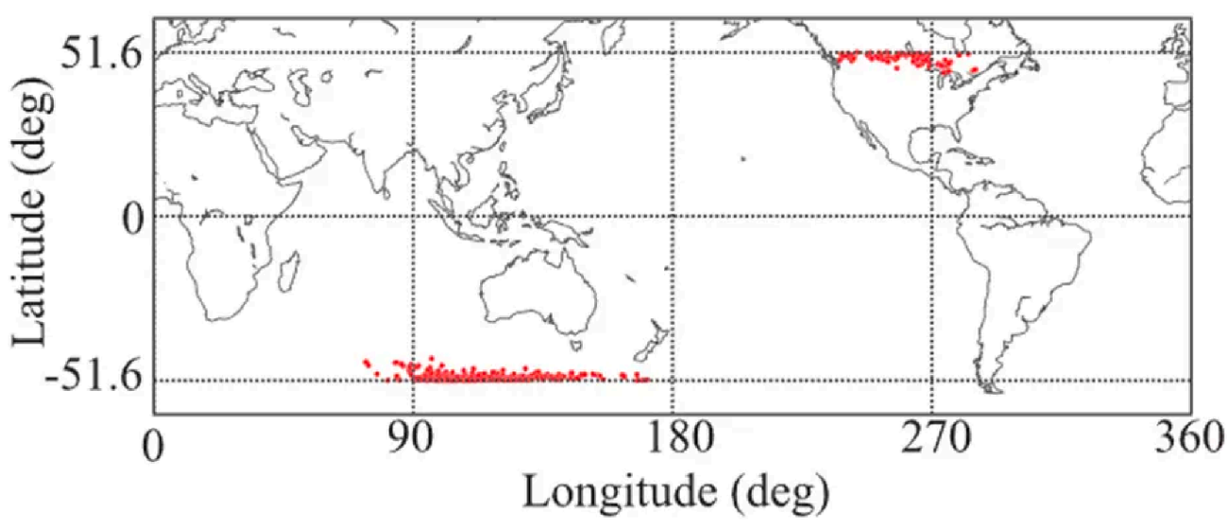
Xtend NXB flares: systematic analysis



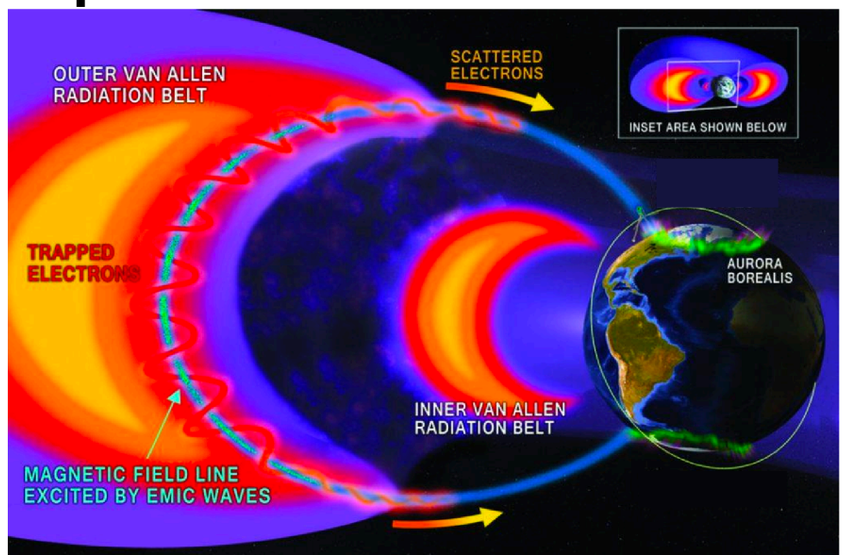
Satellite positions where flaring events were detected



Distribution of electron precipitation events measured with CALET on ISS (Ueno et al. 2019)



- Satellite latitudes are high (~30 deg) when such flares were detected
- Somewhat similar to the distribution of **electron precipitation events**
  - Flare duration and enhanced continuum are also consistent with electron origin



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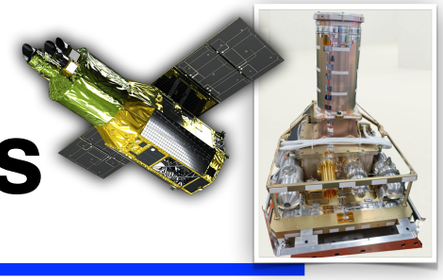
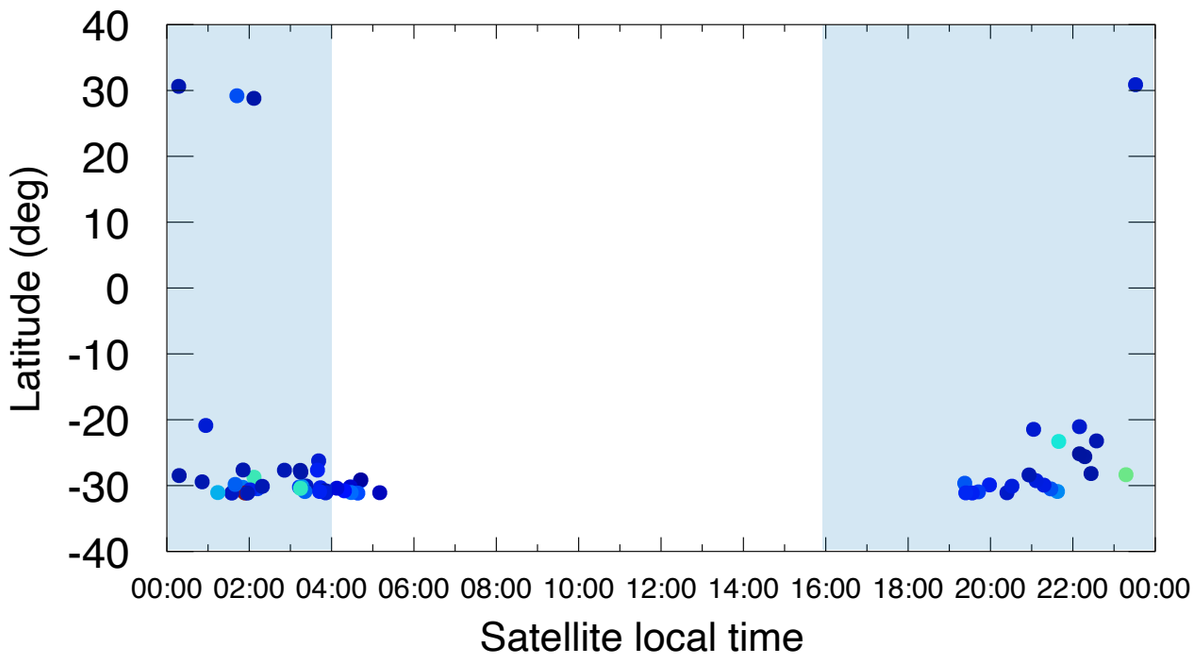
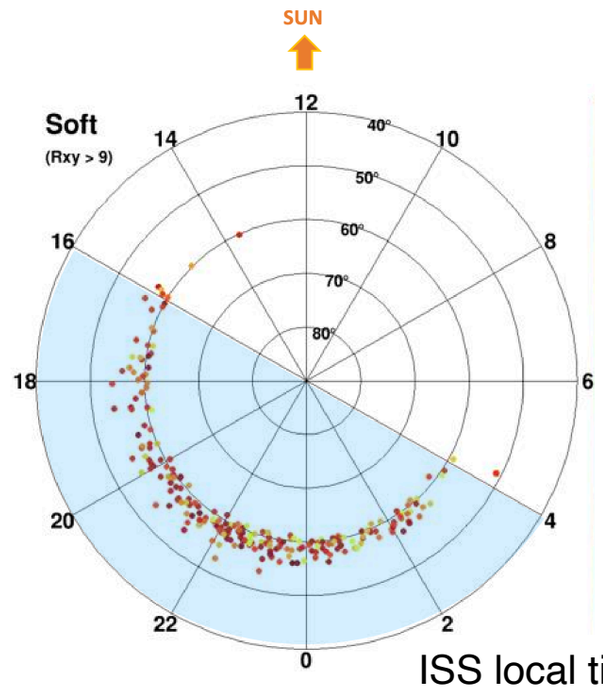


Local time distribution: mostly in the night



CALET results (Bruno et al. 2021, ICRC proc.)



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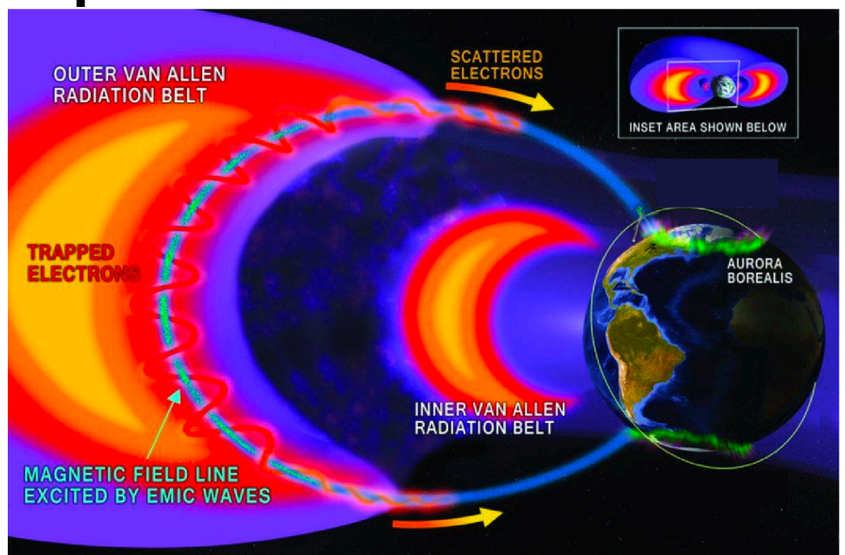

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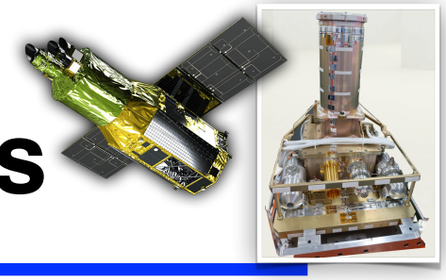
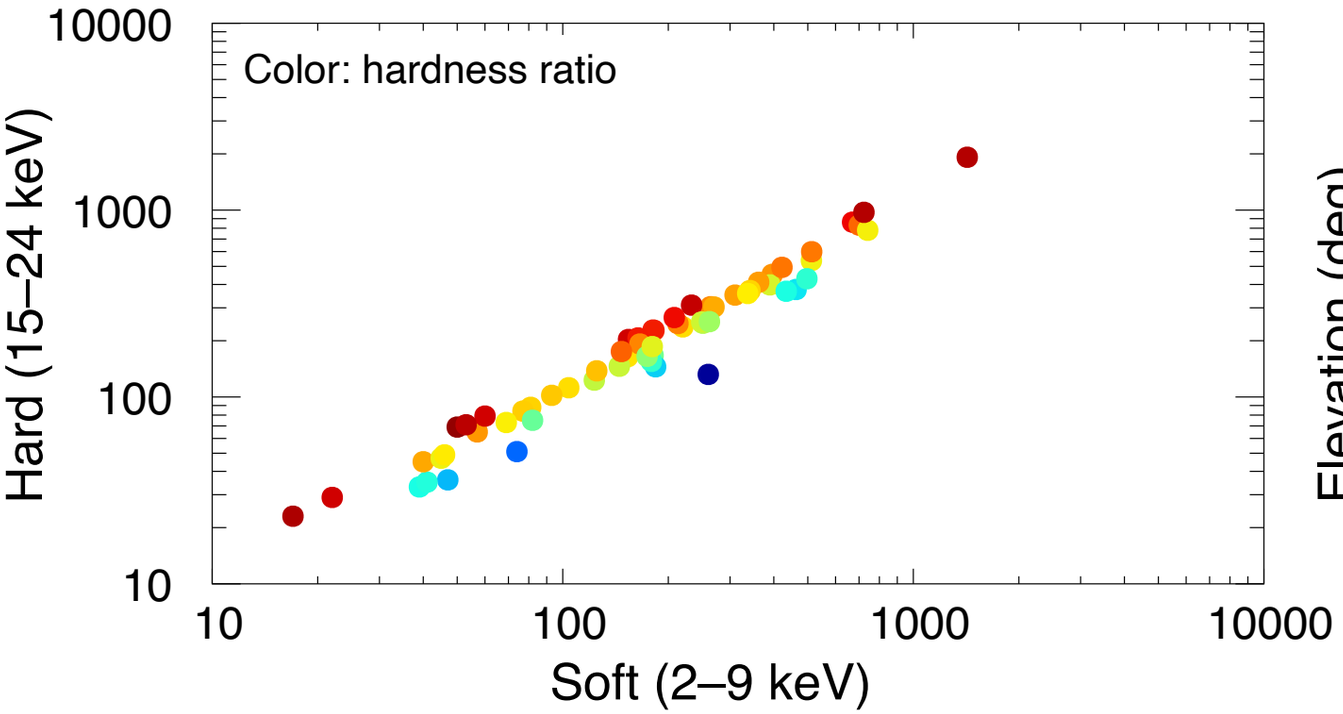
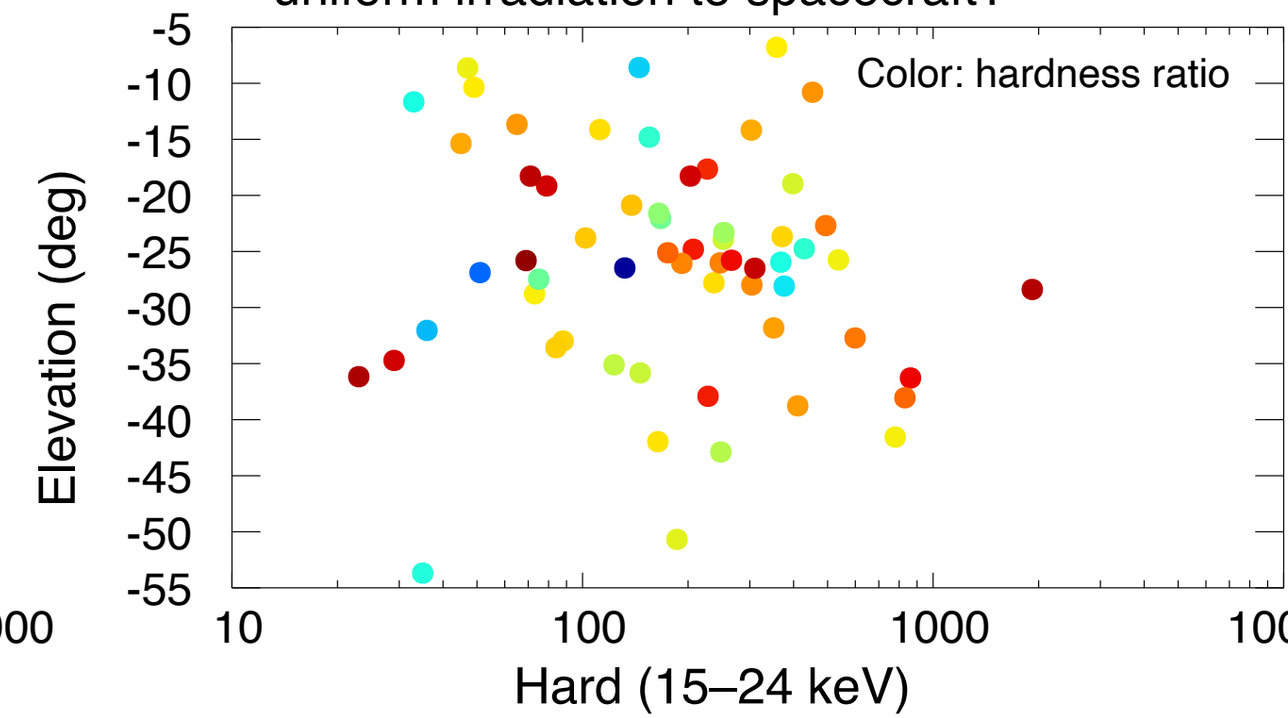


Soft vs. Hard counts indicates spectral variety

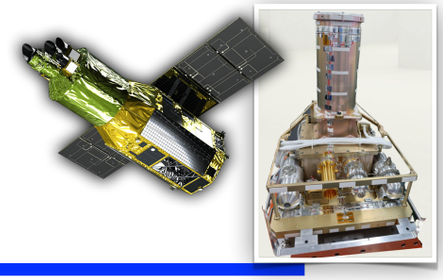


Counts vs. elevation (~sat. attitude):
uniform irradiation to spacecraft?



- Work in progress:
  - Systematic analysis of the Xtend spectra and HK (satellite position, attitude, etc.)
  - Compare with Resolve anti-co data
  - Compare with other observations (MAXI RBM? CALET?)

Summary



- XRISM Xtend in LEO detected ~40 NXB flare events during night-Earth observation in 2 years
  - Mostly not coincident with solar activities
  - Duration is 5–10 min
  - Enhanced continuum in spectra
  - Satellite latitudes are high (~30 deg)
- **Precipitating electrons** from the radiation belts may be hitting Xtend?

We just started collaboration with the experts of the space weather!
Please let us know if you are familiar with these phenomena!