

Hitomi hackathon



Hitomi hackathon

| No | Presentator | Duration (min) | Topic |
|----|--------------|----------------|---------------------------|
| 1 | M. Tsujimoto | 10 | Brief introduction of SXS |
| 3 | M. Tsujimoto | 15 | Some features of SXS data |



Goals, Targets

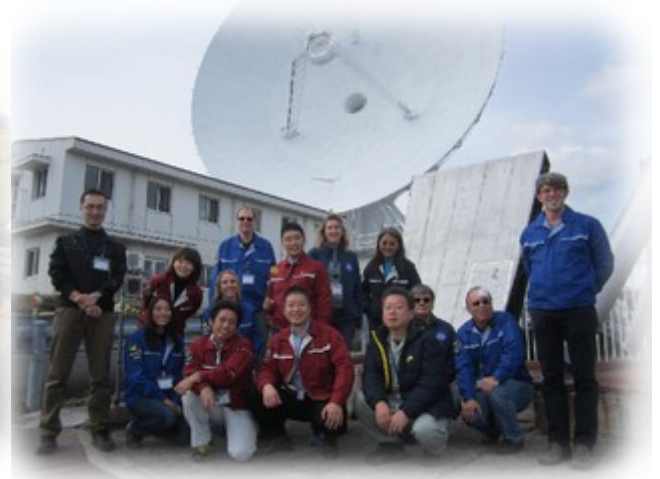
- Goals
 - To give an overview of Hitomi/SXS.
 - To give useful pointers for data reduction.
for better preparing for future μ -cal data.
- Target audience
 - Familiar with X-ray astronomy, FTOOLS.
 - Not familiar with X-ray μ -cal and its data.



SXS (Soft X-ray Spectrometer)

Kelley+18, SPIE; Mitsuda+12, JLTP

- First X-ray μ -cal for making observations in orbit.
- Collab of ~ 100 people (US, NL, CH, JP), ~ 10 yrs.





L2 event screening

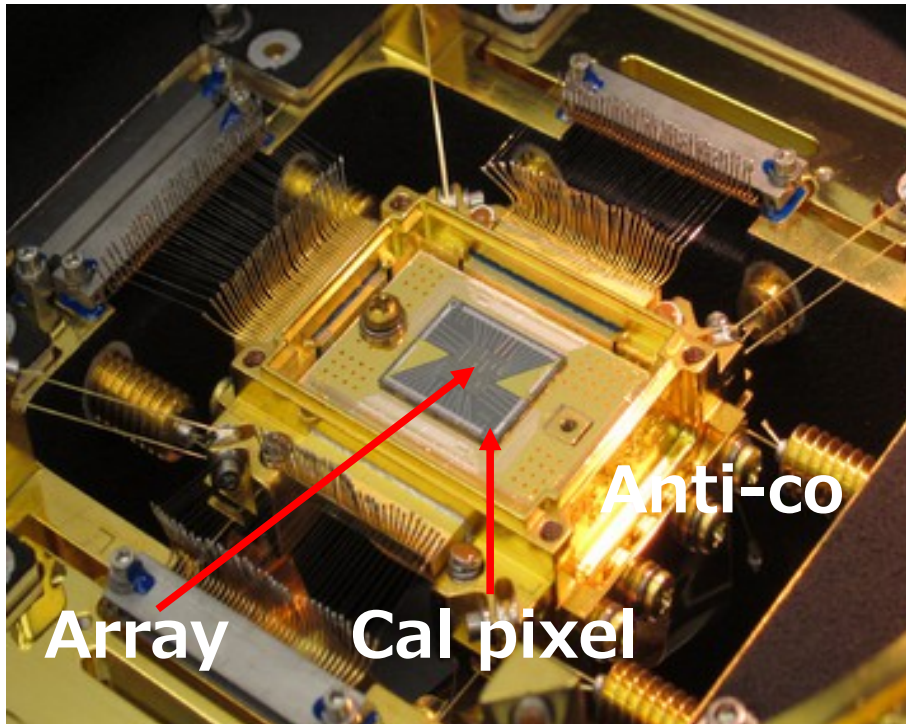
Angelini+18 JATIS; Data Reduction Guide at <https://heasarc.gsfc.nasa.gov/docs/hitomi/analysis/>

| Type | File | Criterion | Comments |
|-------------|----------------------------------|--|---|
| event-based | event_uf/OBSIDsx_s_uf. evt | ITYPE<5 && (SLOPE_DIFFER==b0 PI>25000) && QUICK_DOUBLE==b0 && STATUS[3]==b0 && STATUS[6]==b0 && STATUS[2]==b0 && PI>600 && RISE_TIME<127 && PIXEL!=12 && TICK_SHIFT>- 8&&TICK_SHIFT<7 | Indicates X-ray event Indicates X-ray event Indicates single X-ray event Not anticom coincidence Not recoil crosstalk Not in per-pixel lost GTI Eliminates cross-talk events Indicates X-ray event Not the calibration pixel Indicates X-ray event |
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| GTI-based | \$LHEA_DATA/ahsxs_ adr.gti | inside GTIADROFF | Excludes times of unstable gain during ADR cycle |



X-ray detector

Porter+18 JATIS; Kilbourne+16 JATIS; Chiao+16 JATIS



X-ray photon

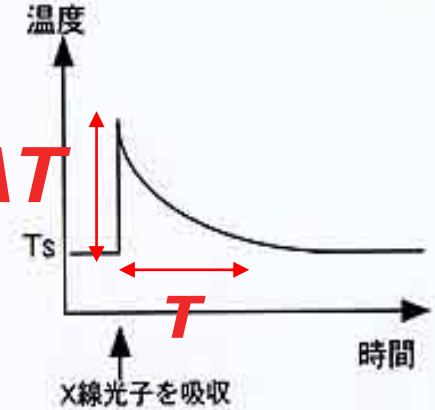
$$E \sim 1 \text{ fJ}$$

$$\Delta T = E/C$$

$$\sim 1 \text{ mK}$$

Thermister (Si)

Absorber (HgTe)
 $\sim 10 \mu\text{m}$



C

Thermal link

G

Thermal bath
(50 mK)

$$T \sim G/C$$

$$\sim 3 \text{ ms}$$

- X-ray micro-calorimetry.
- Array of 6x6 pixels = 5 mm² = 3x3 arcmin²
- Each pixel has $R = E/\Delta E \sim 1000$.



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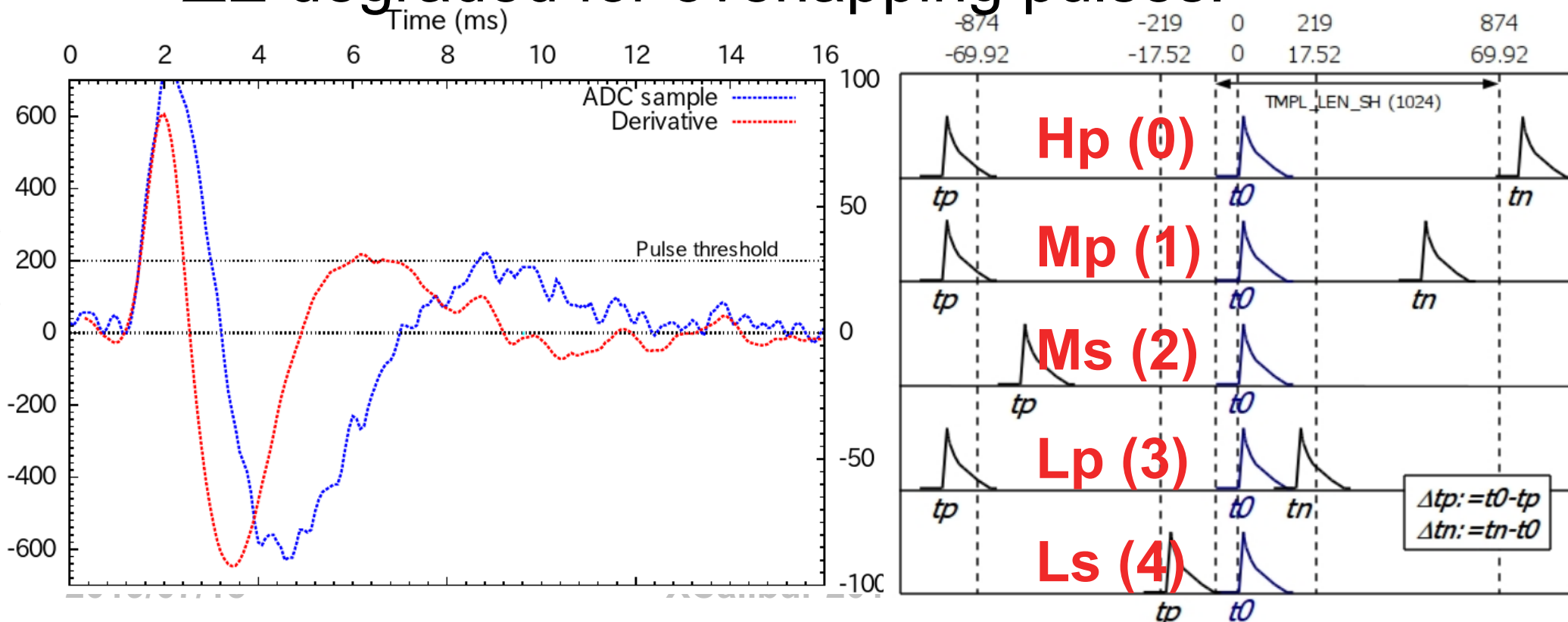
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| | | STATUS[2]==b0 && PI>600 && RISE_TIME<127 && | Not in per-pixel lost GTI Eliminates cross-talk events |
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Components (1) signal chain

Ishisaki+18, JATIS; Tsujimoto+18, JLTP; Terada+17, JATIS

- Events reconstructed onboard.
 - By correlating w. templates in time-domain.
 - Data sampled at 12.5 kHz (80 μ s).
 - ΔE degraded for overlapping pulses.

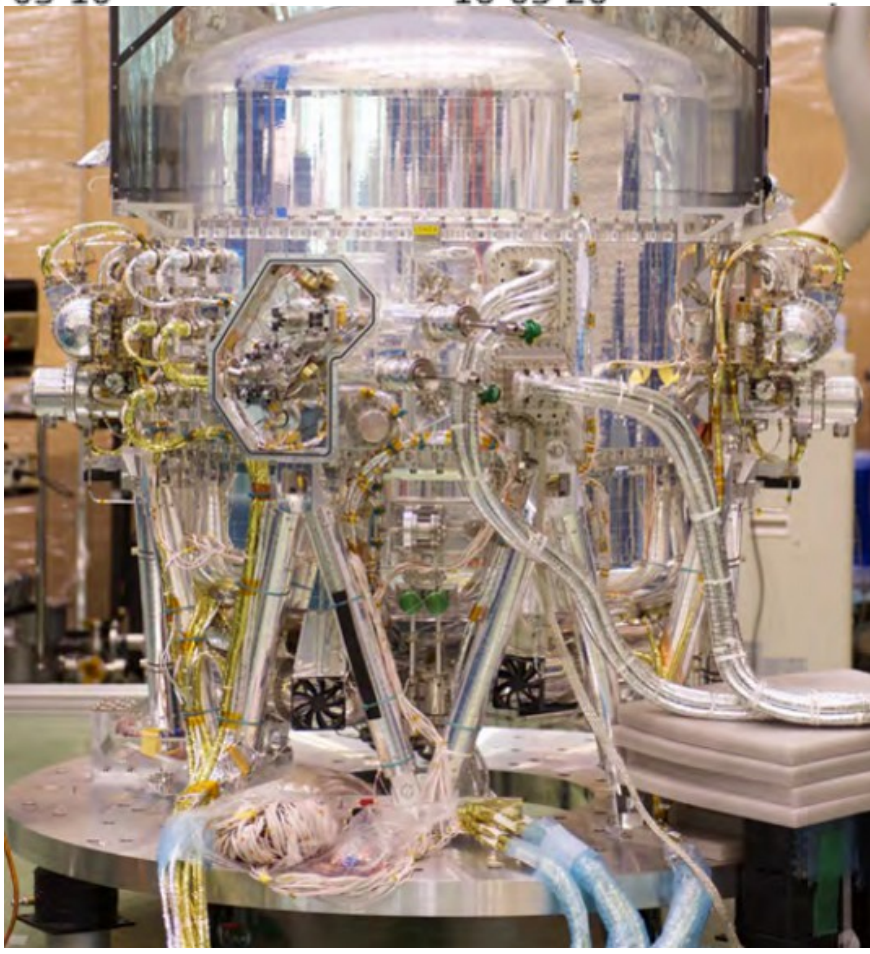
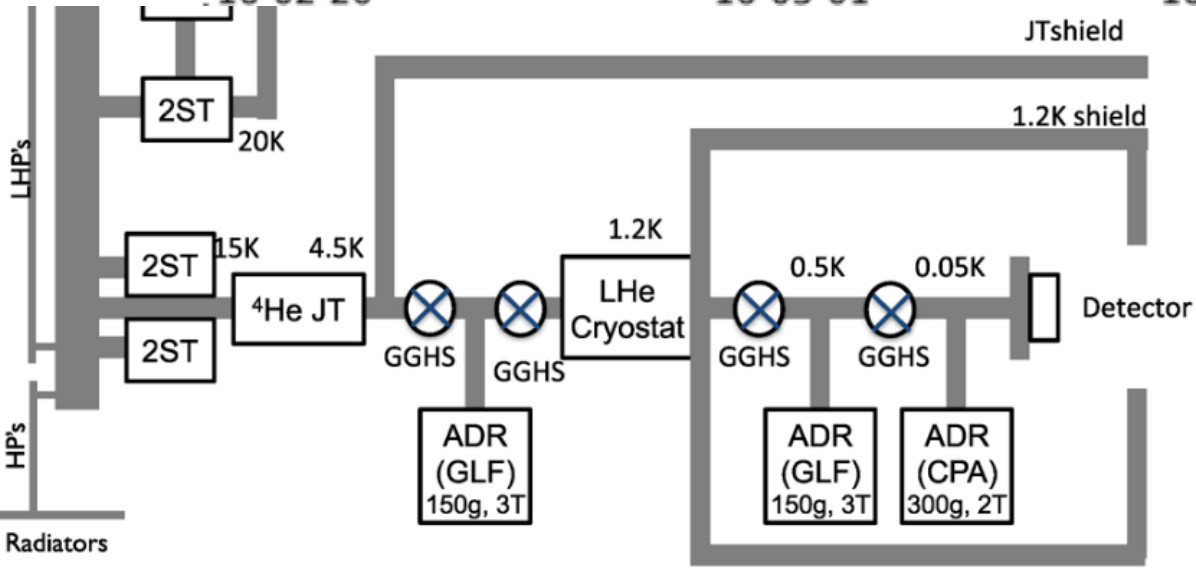
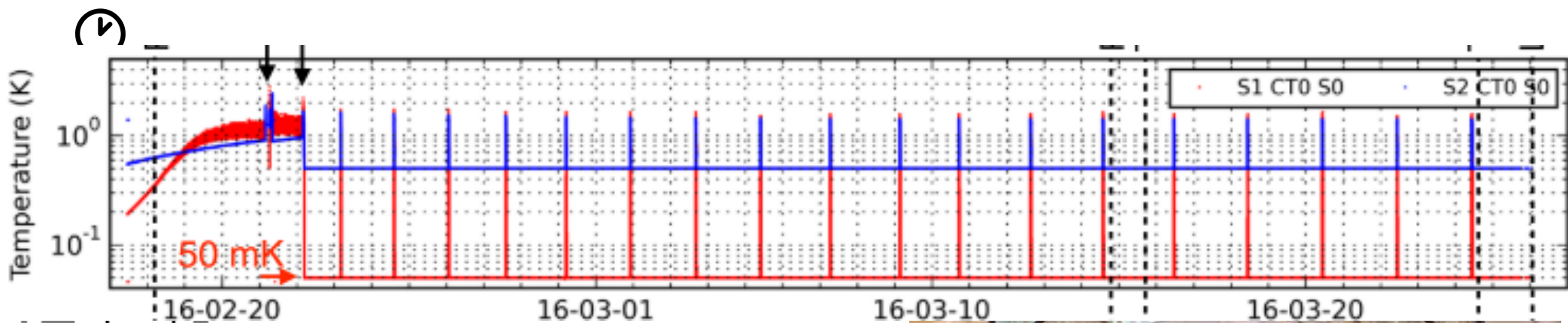




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- Passive cooling
 - Radiative, He vapour
- Active cooling
 - 4 Stirling, 1 Joule-Thomson, 2 ADRs



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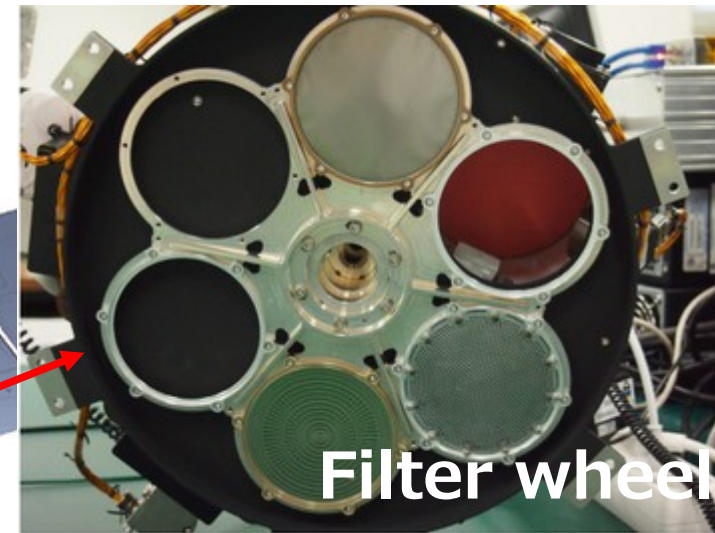


Components (3) optical chain

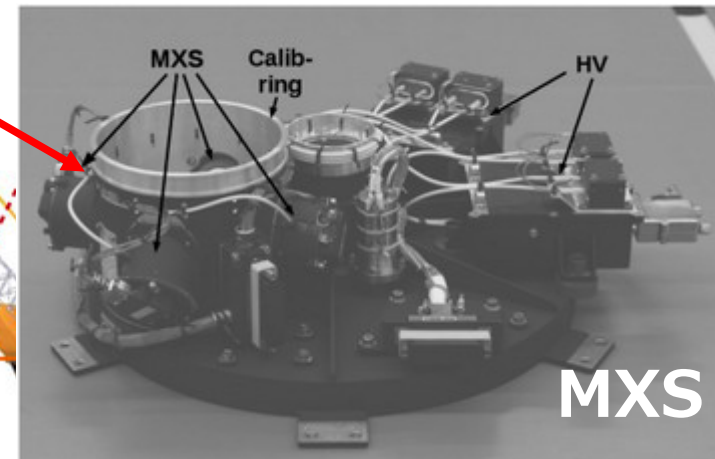
Okajima+16, SPIE; Maeda+18 PASJ; de Vries+18, JATIS

X線を集める望遠鏡

- 軟X線望遠鏡 (SXT-S)
- 軟X線望遠鏡 (SXT-I)
- 硬X線望遠鏡 (HXT) x2



Filter wheel



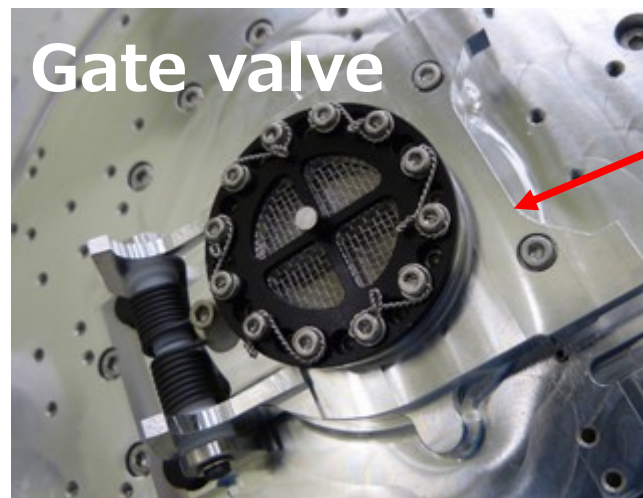
MXS

検出器

- X線撮像検出器 (SXI)
- X線分光検出器 (SXS)
- ガンマ線検出器 (SGD) x2
- X線撮像検出器 (HXI) x2



X-ray telescope



Gate valve



L2 event screening

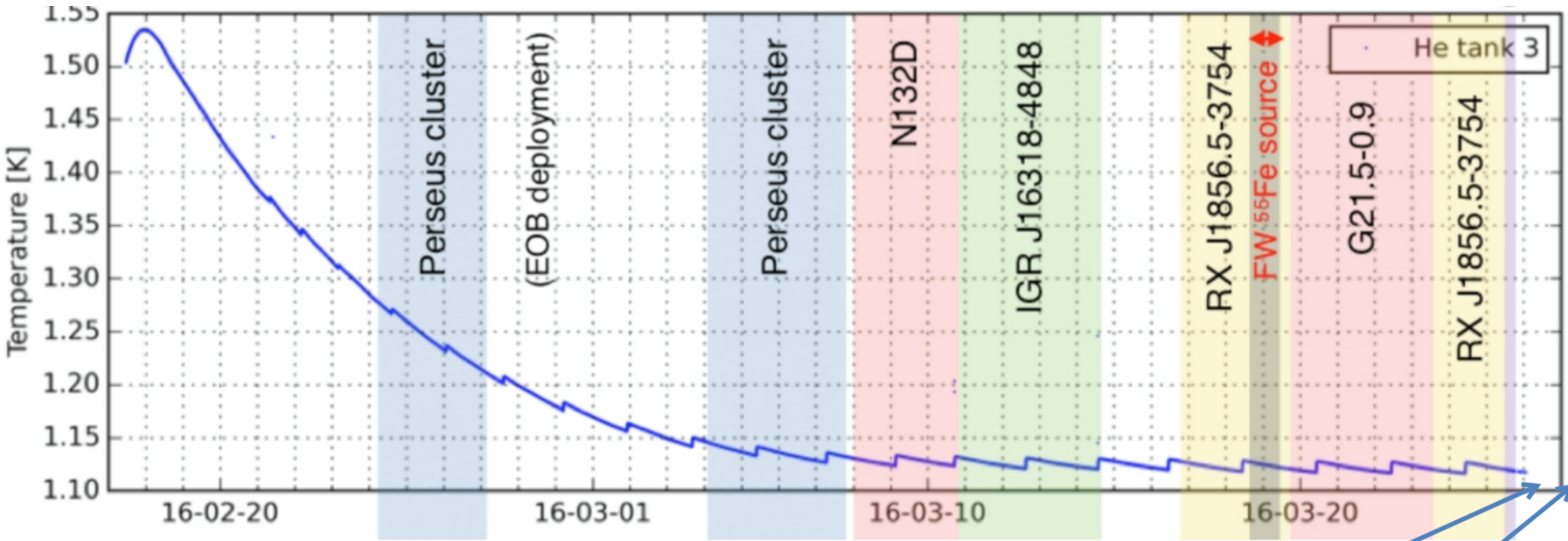
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In-orbit operation

Tsujimoto+18, JATIS



- 19 ADR recycles, 34d at 50 mK. 5 sources.
- Low-Earth orbit.



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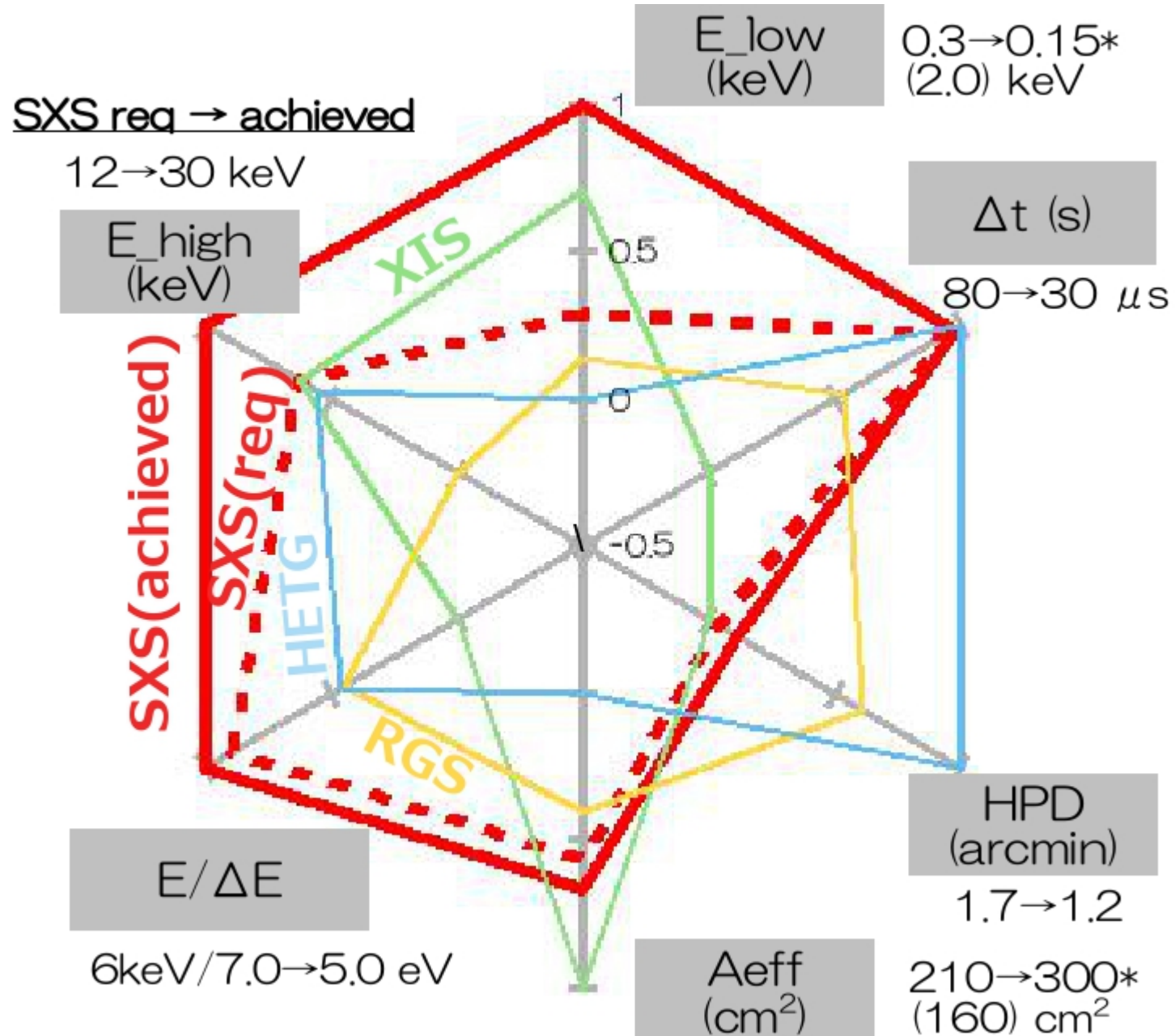
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In-orbit performance

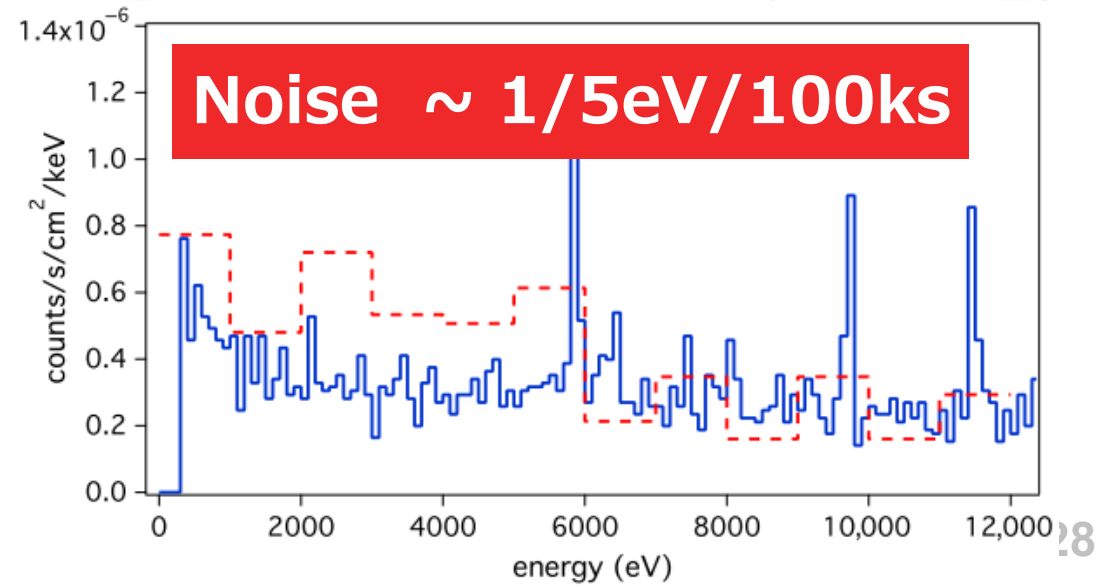
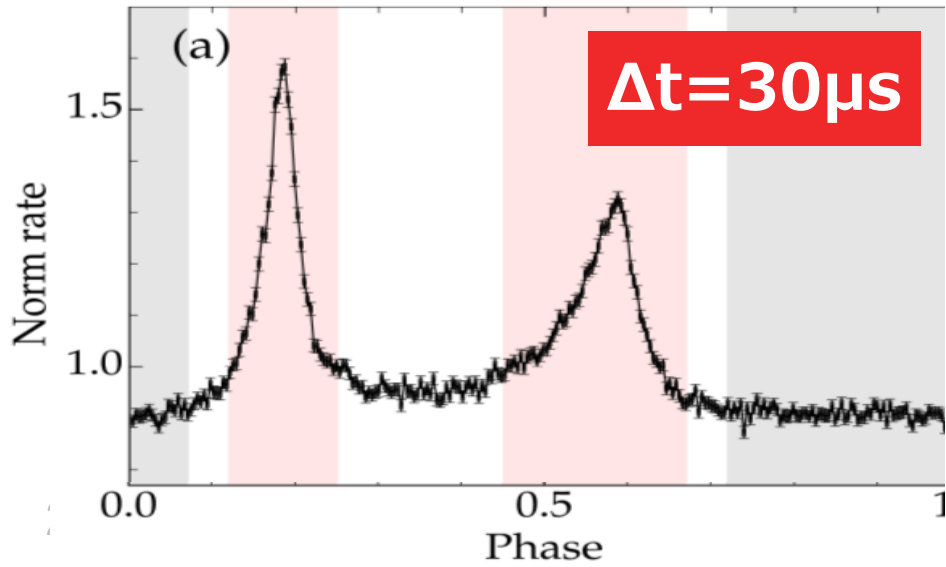
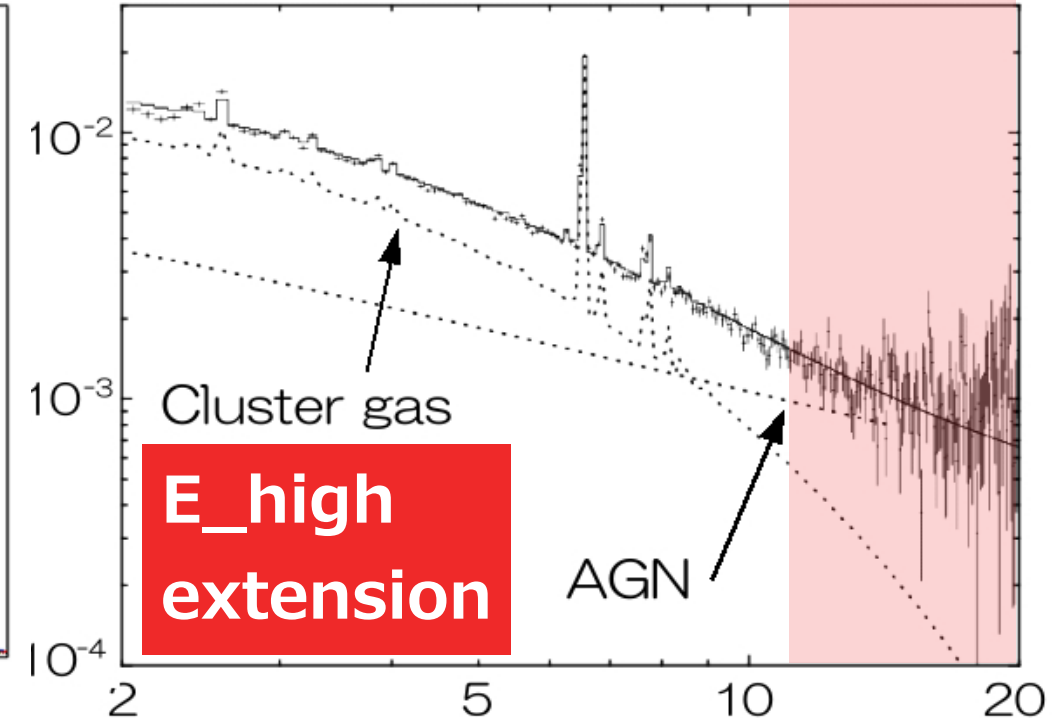
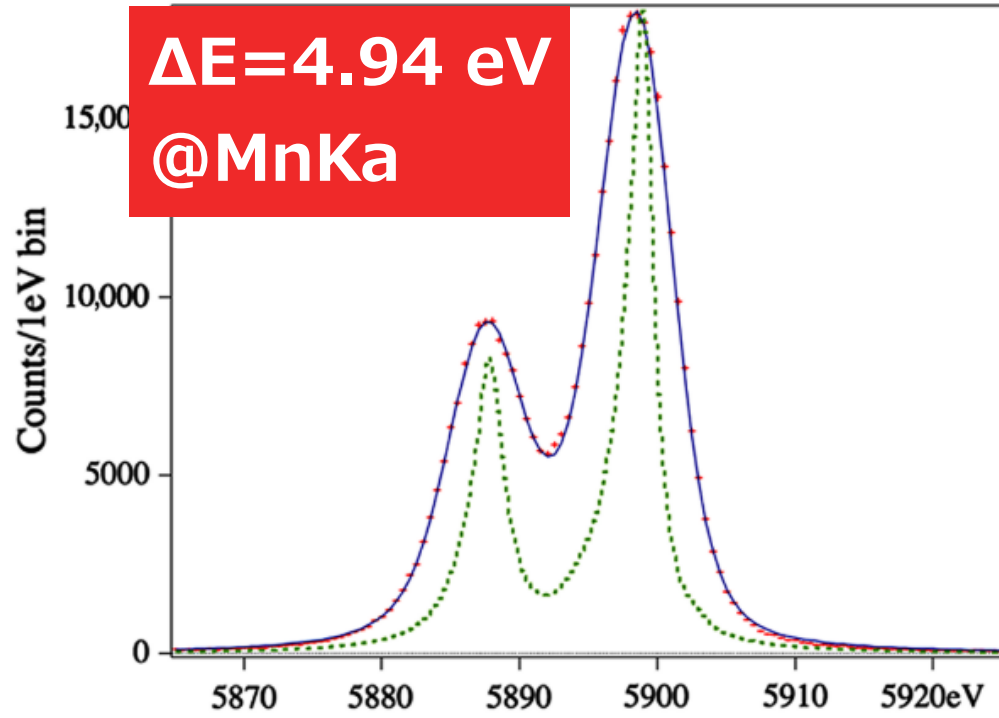
Porter+18 JATIS; Terada+17 JATIS; Kilbourne+18 PASJ





In-orbit performance

Porter+18 .IATIS· Terada+17 .IATIS· Kilbourne+18 PAS.I





In-orbit calibration

Eckart+18 JATIS; Leutenegger+18 JATIS; Maeda+18 PASJ; Tsujimoto+18 PASJ, Iizuka+18 JATIS

- Many cal req verified in orbit despite poor data.

| Cal item | Gain | ΔE | Abs timing |
|----------|---------|--------------------------|---------------------|
| | | | |
| Data | Perseus | Onboard ^{55}Fe | Crab |
| Req | < 2 eV | < 1 eV | < 10 ms |
| Achieved | < 2 eV | << 1 eV | < 100 μs |

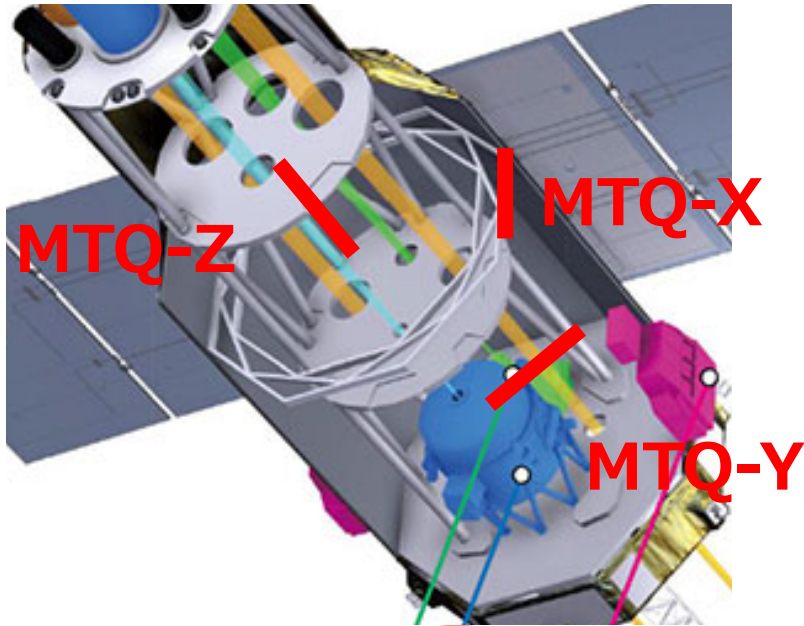


Cautions

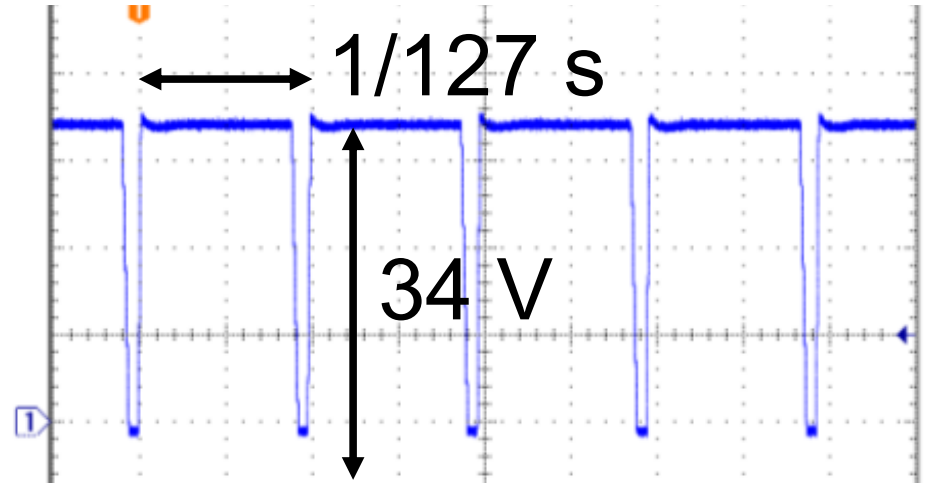
- Do not assume:
 - CALDB is perfect.
 - CALDB implements all what Inst team knows.
 - Inst team knows everything about instrument.
- Particularly true for inst w. extreme sensitivity.
- A few examples follow.



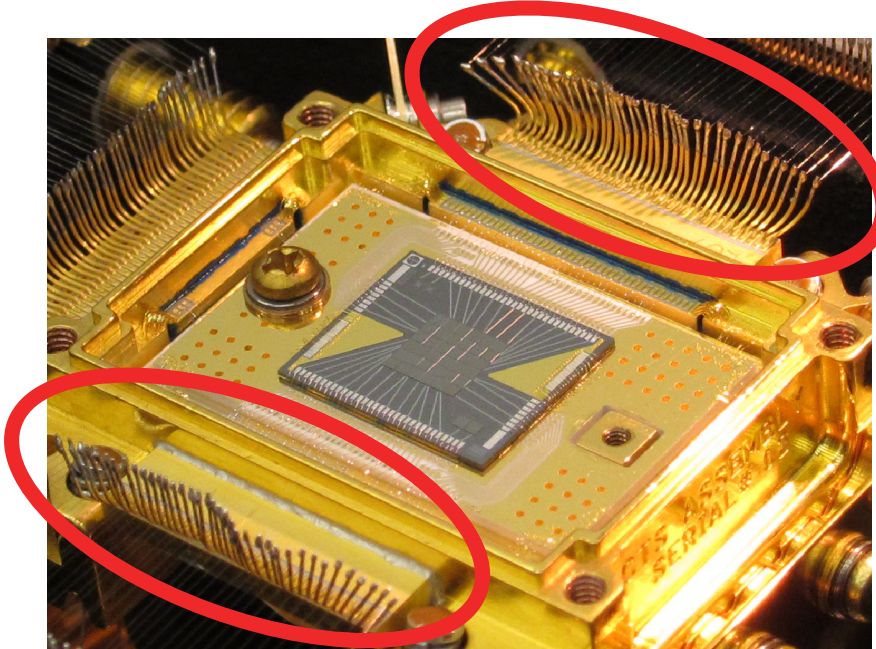
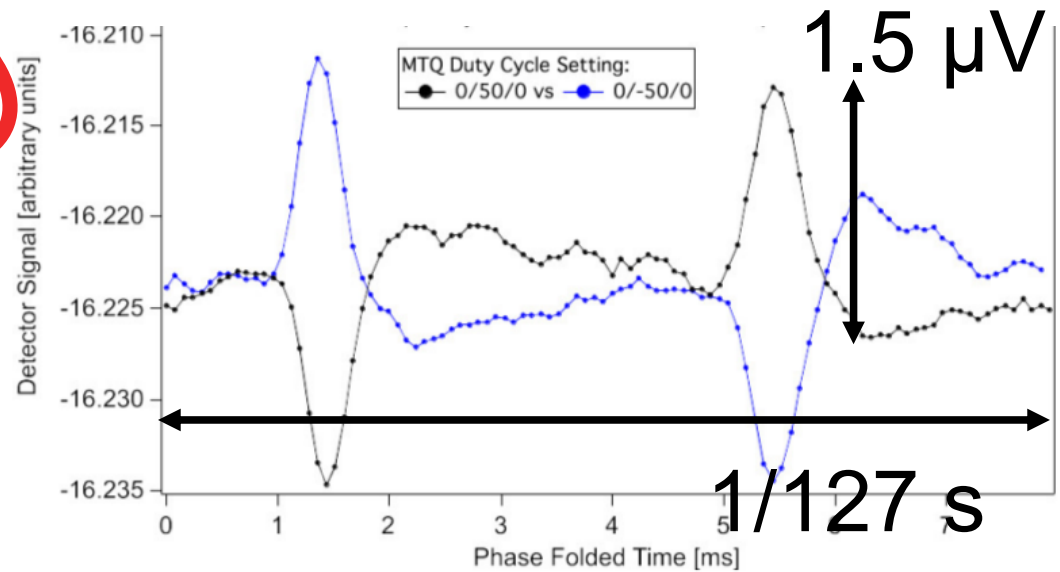
Interferences



MTQ voltage (90% duty)

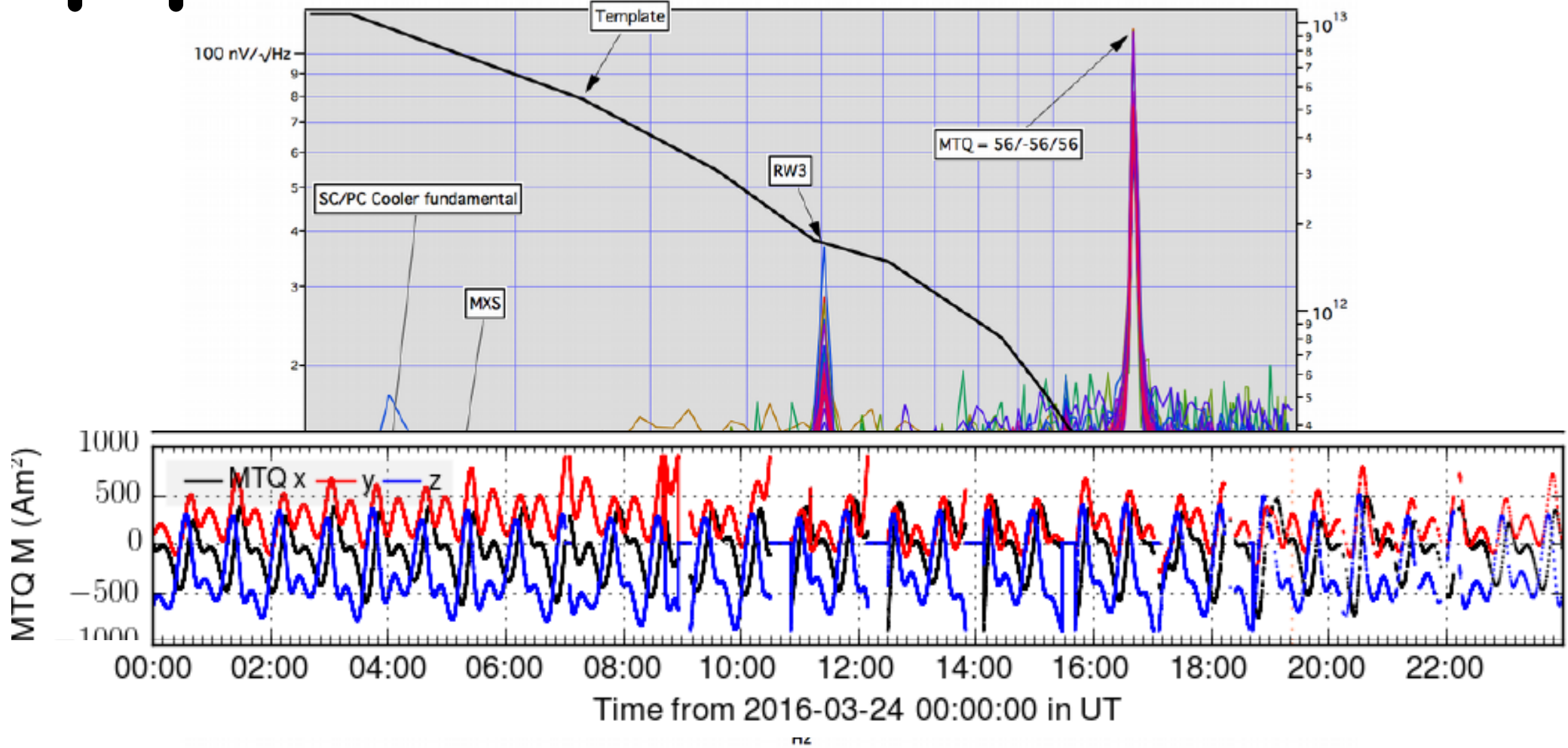


Sensor response (50% duty)





Interferences



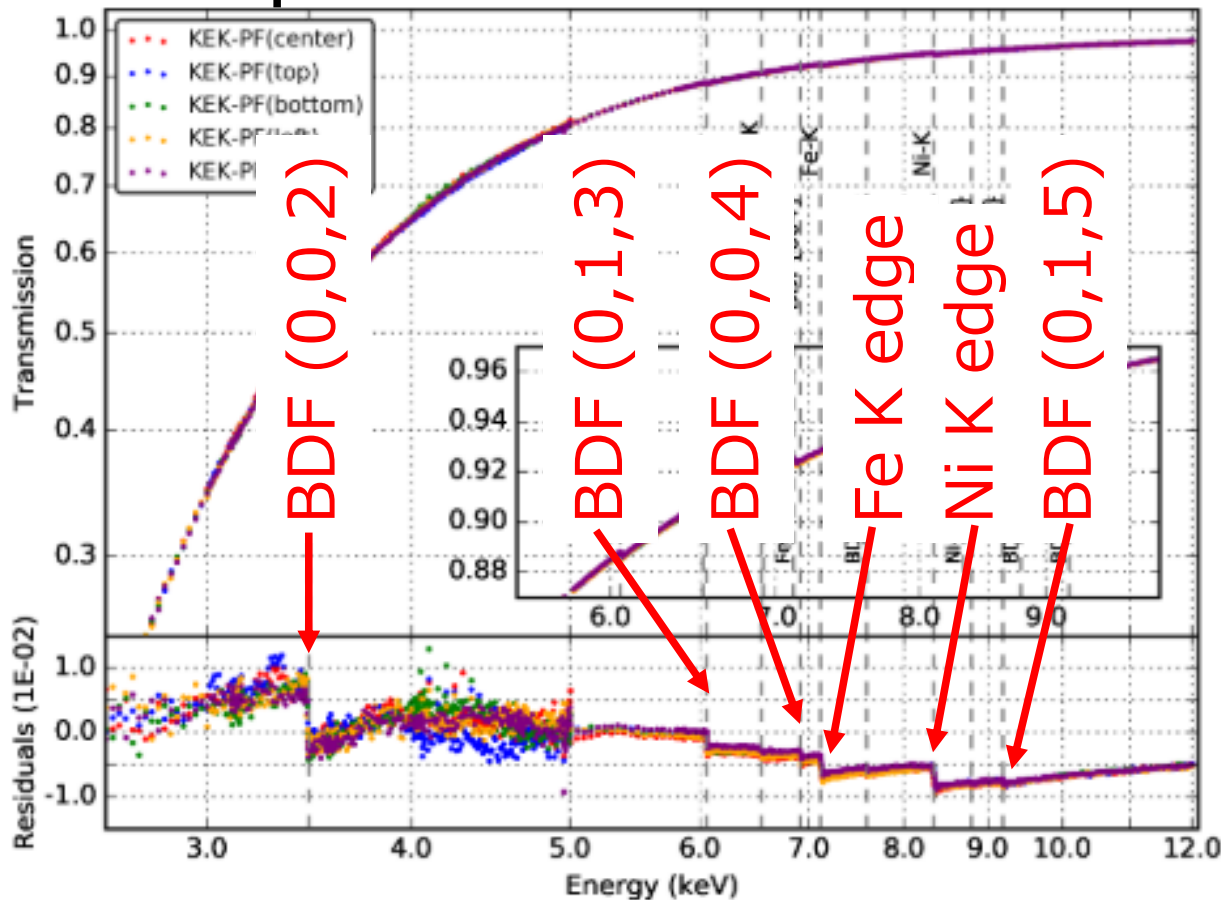
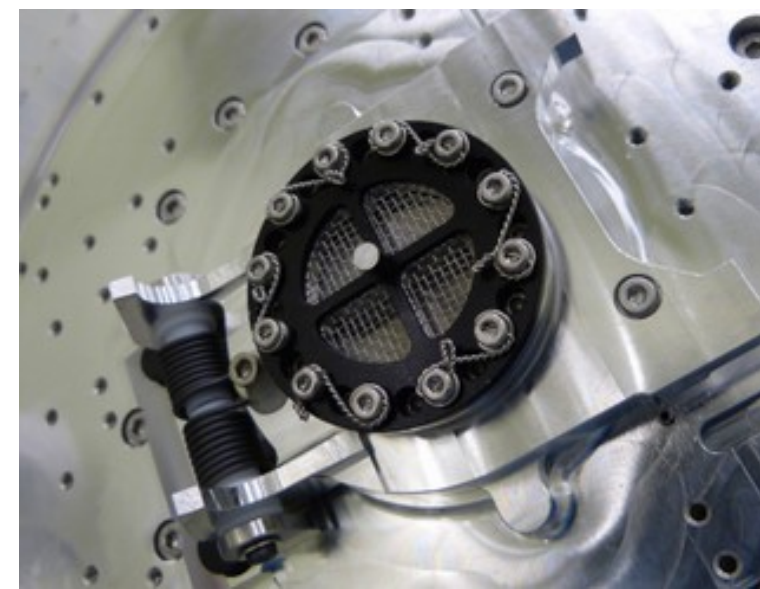
- Serious effects; $\Delta E = 1.7$ eV in quadrature.
- Known, but not char'ed, doc'ed, implemented



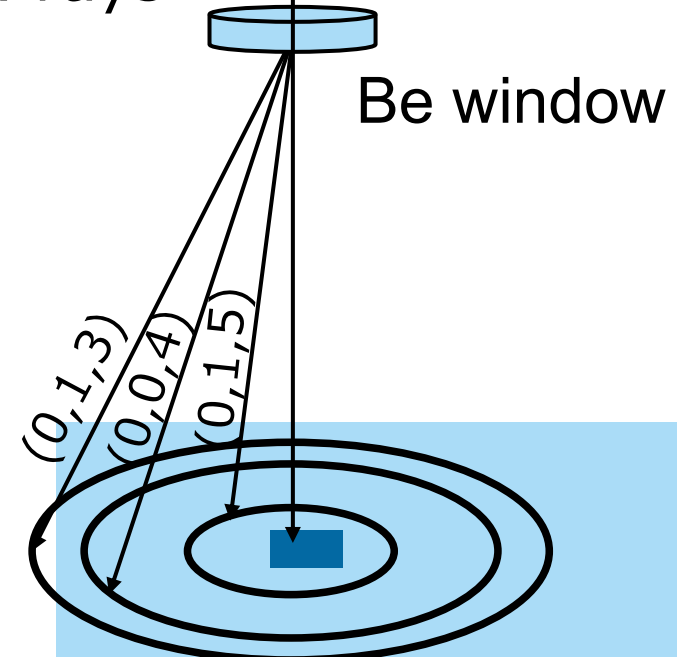
Gate valve

Yoshida+17, SPIE; Hoshino+17, SPIE

- Be window of 300 μm .
- Launched w/o calibration.
- FM spare calibrated after loss in ground.



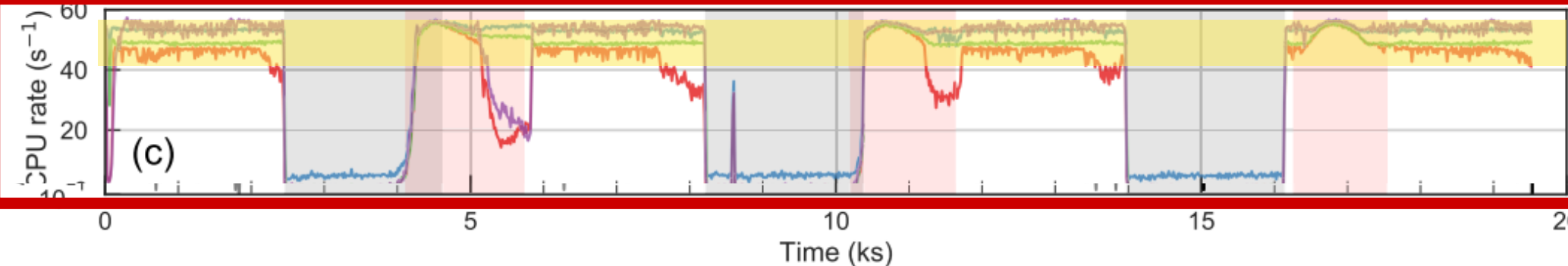
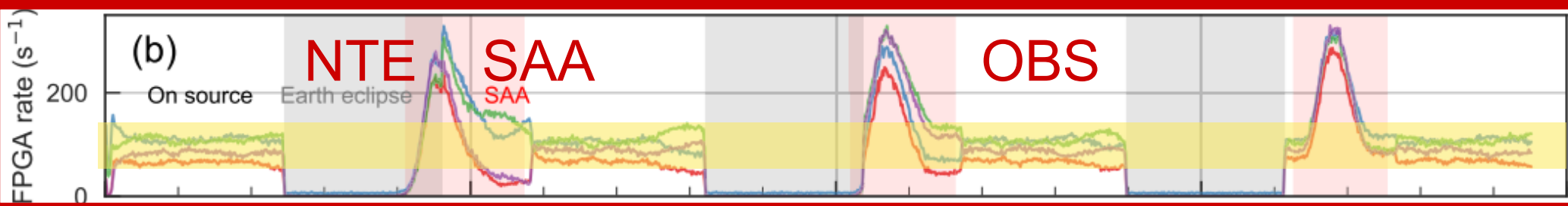
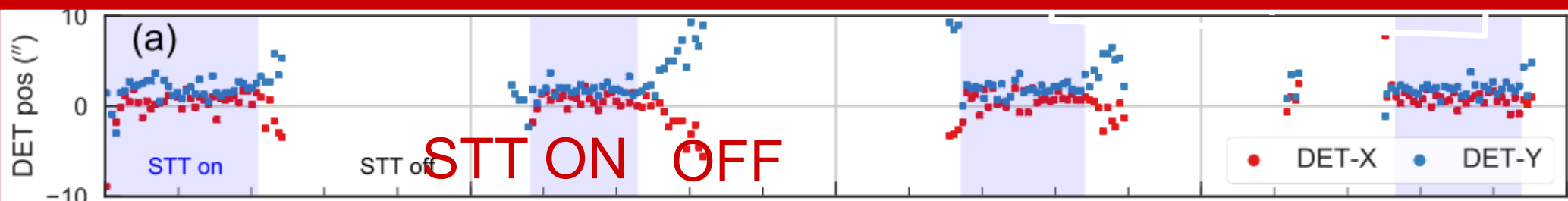
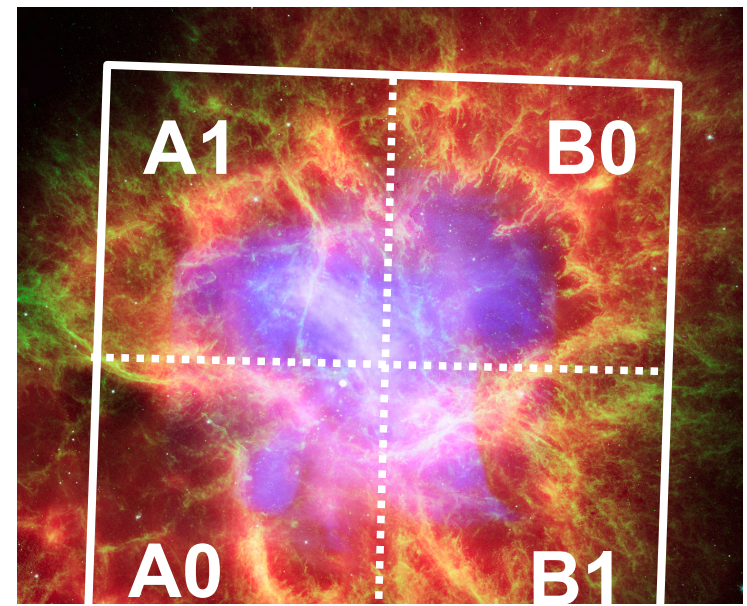
Monochro
X-rays

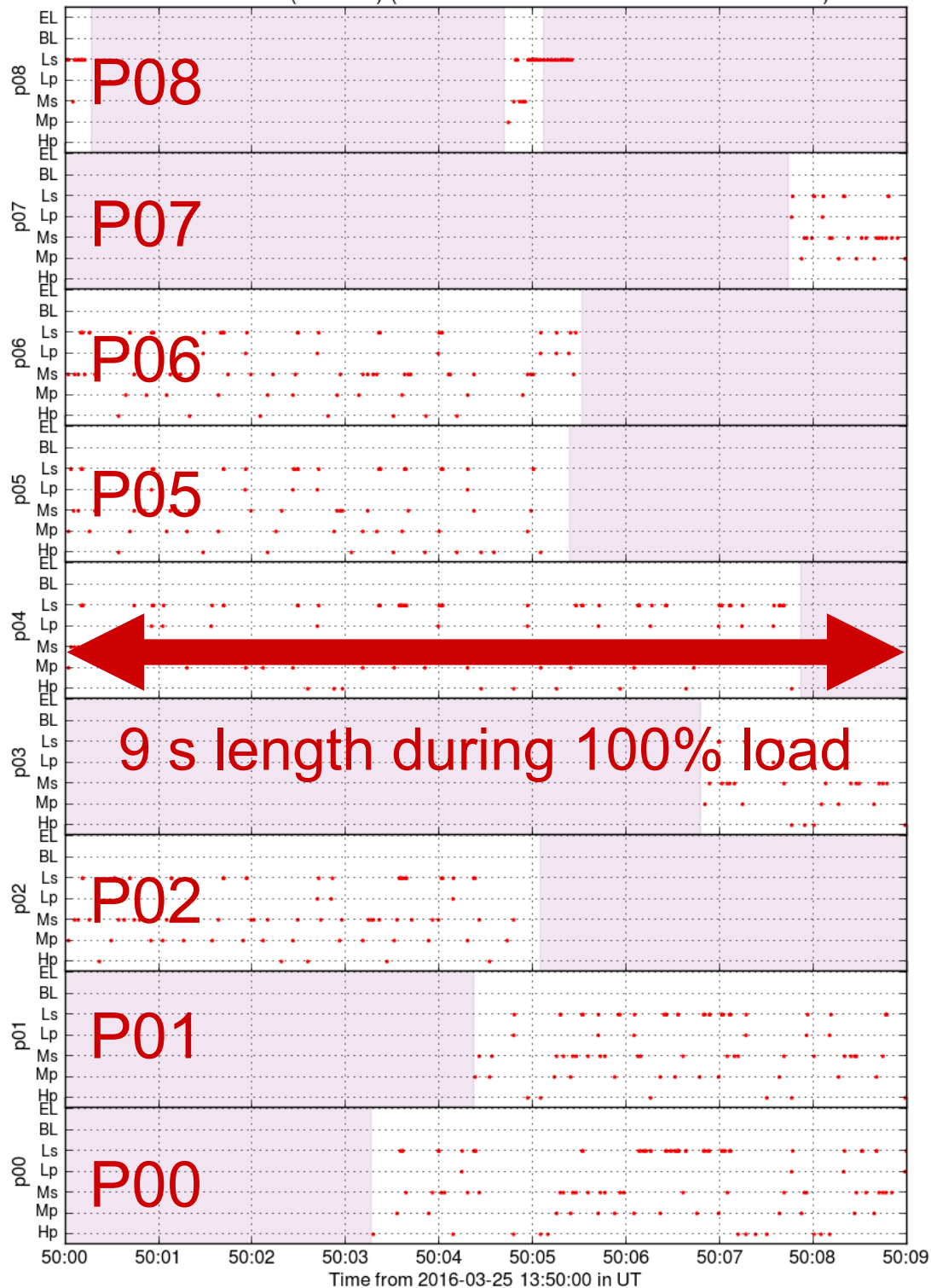




Pointing, High CR

Tsujimoto+18 PASJ





(d)

| | | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | P23 1.00 | P24 1.00 | P26 1.00 | P34 1.00 | P32 1.00 | P30 1.00 |
| | P21 1.00 | P22 0.94 | P25 0.72 | P33 0.98 | P31 1.00 | P29 1.00 |
| acB 1.00 | P19 0.99 | P20 0.61 | P18 0.27 | P35 0.66 | P28 1.00 | P27 0.37 |
| acA 1.00 | P9 0.98 | P10 0.62 | P17 0.37 | P0 0.89 | P2 1.00 | P1 1.00 |
| | P11 0.99 | P13 0.99 | P15 0.92 | P7 1.00 | P4 1.00 | P3 1.00 |
| | | P14 1.00 | P16 1.00 | P8 1.00 | P6 1.00 | P5 1.00 |
| P12 1.00 | | | | | | |

- More illuminated pixels have smaller live time frac.
- Unstructured window functions make PSD noisy.
- Non-deterministic. No model available to describe this behavior.



Toward XRISM/Resolve

- Some changes in H/W design, but none for users.
- Plan for more ground cal, though not secured.
- Enhancements to SXS.
 - GV to be opened for x3 Aeff.
 - MXS to be used for better gain tracking.
- Performance > req. in SXS not guaranteed.
- In-orbit SXS data are the best start for prep.
- Consult to helpdesk with instrument experts.

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