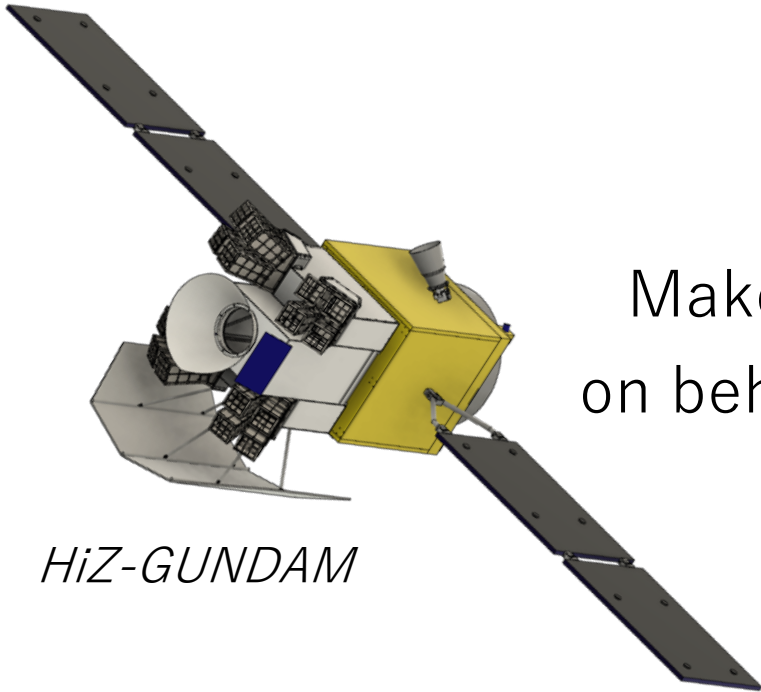


B02: HiZ-GUNDAM

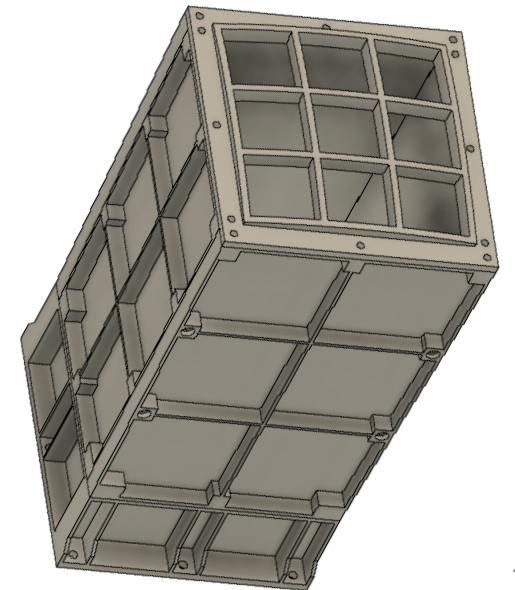
Development & Current Status of the Wide-Field X-ray Monitor onboard HiZ-GUNDAM



HiZ-GUNDAM

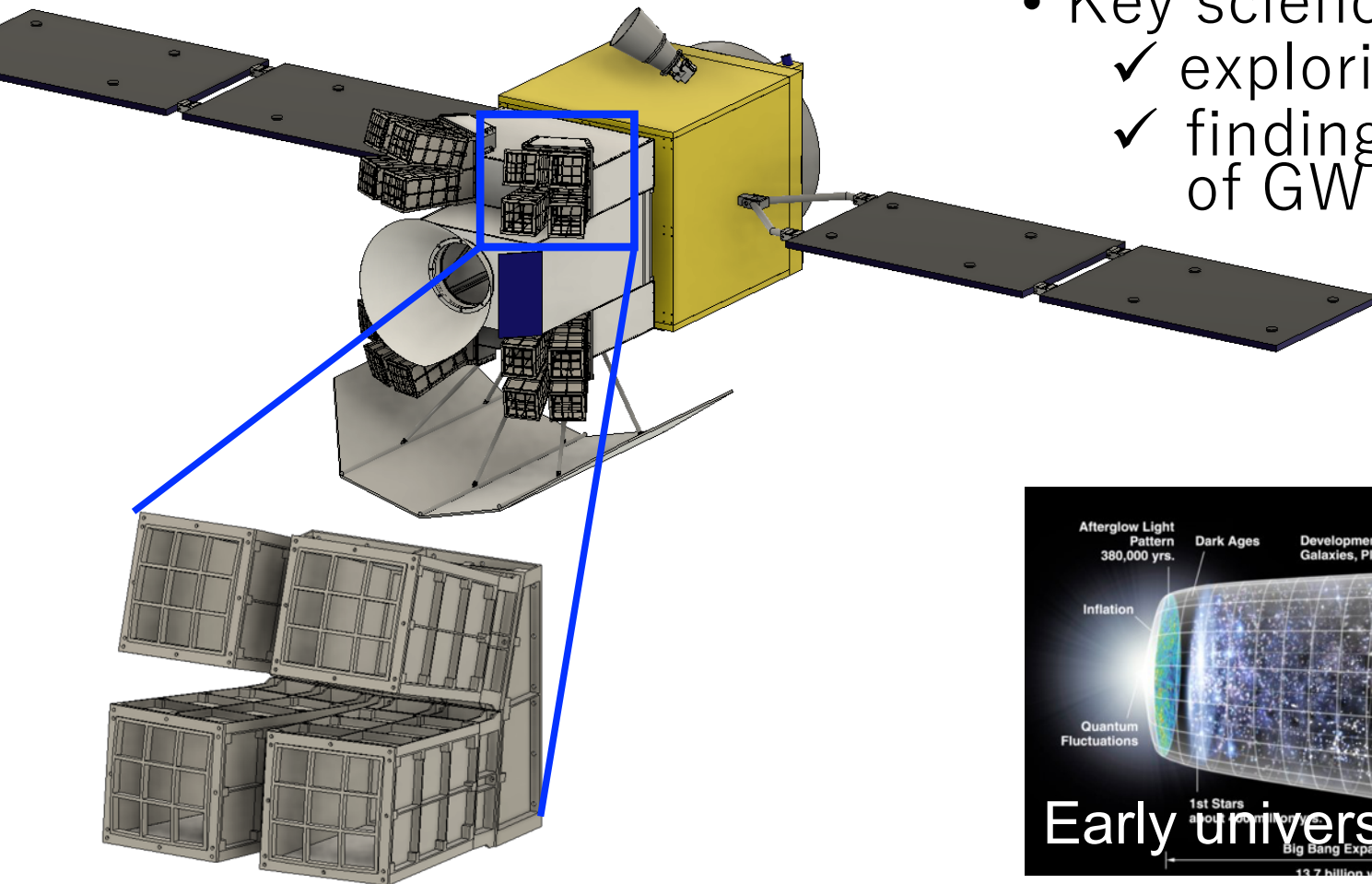
Makoto ARIMOTO (Kanazawa University)
on behalf of the HiZ-GUNDAM Collaboration

Wide-Field X-ray Monitor



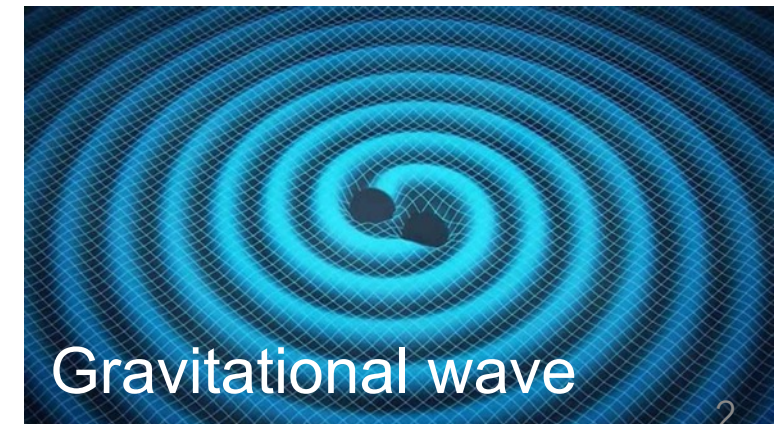
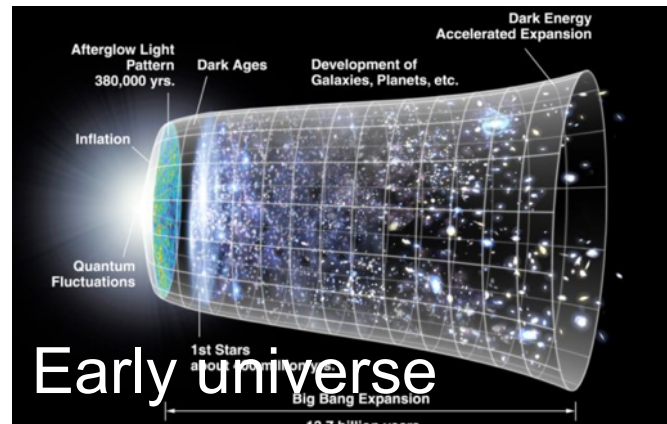
HiZ-GUNDAM: High-z Gamma-ray bursts for Unraveling the Dark Ages Mission

- Launch: Early 2030s
- Key sciences via GRBs
 - ✓ exploring early universe at $z > 7$
 - ✓ finding electromagnetic counterparts of GW events



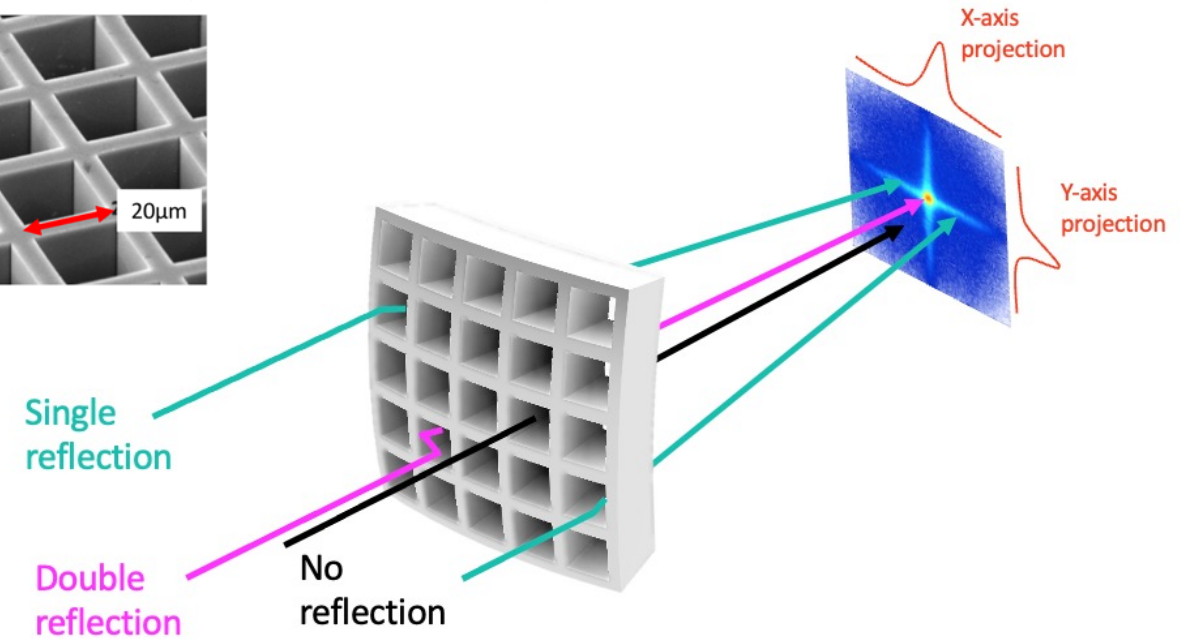
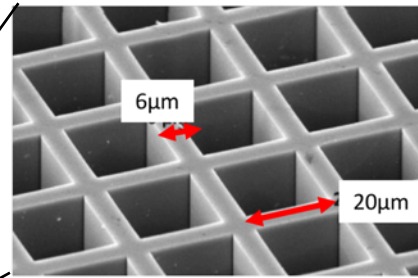
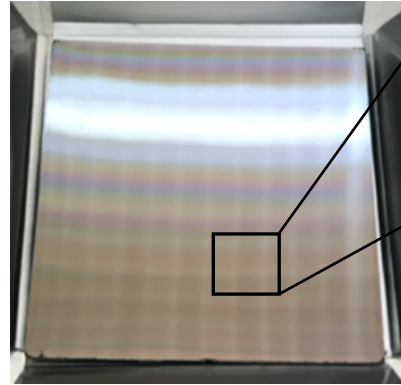
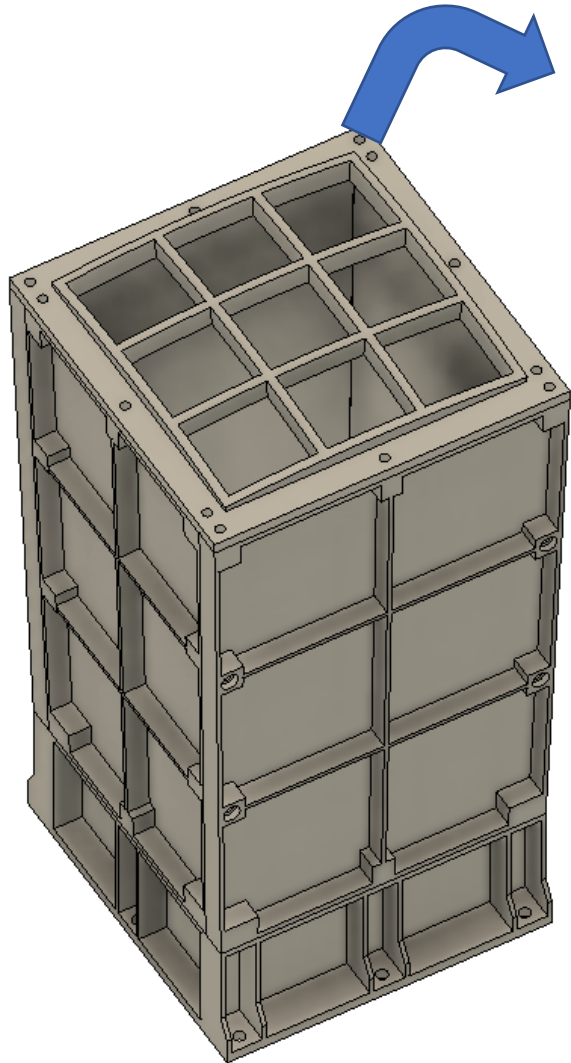
Required spec.:

- ✓ Wide field of view
- ✓ Moderate sensitivity



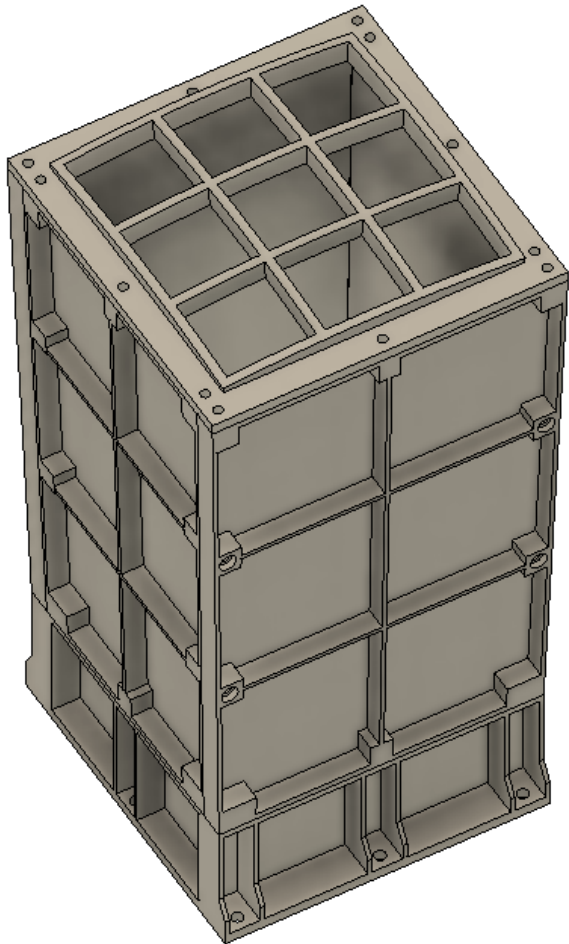
Wide-Field X-ray Monitor (WFXM)

Lobster-eye optics

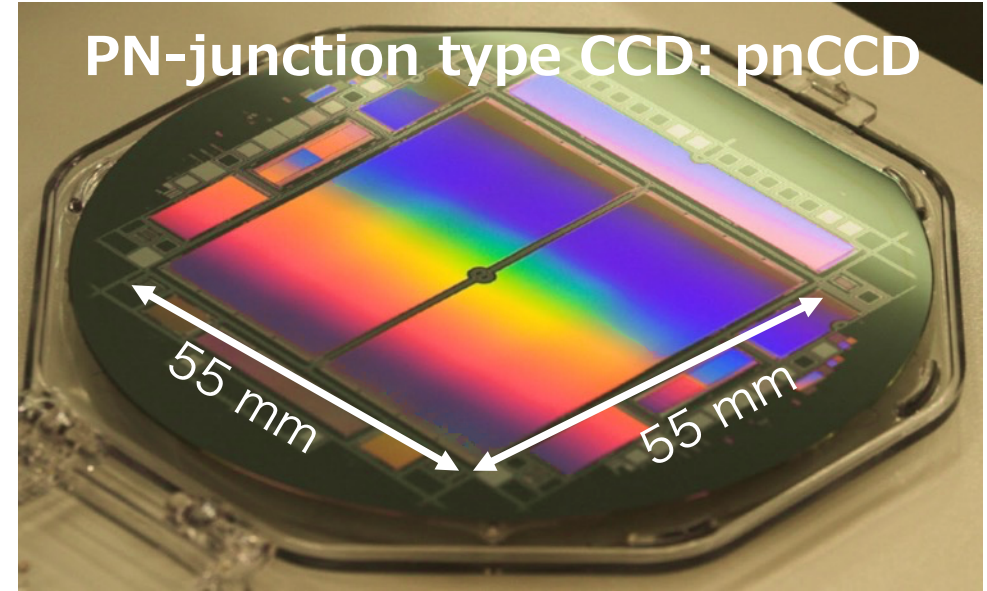
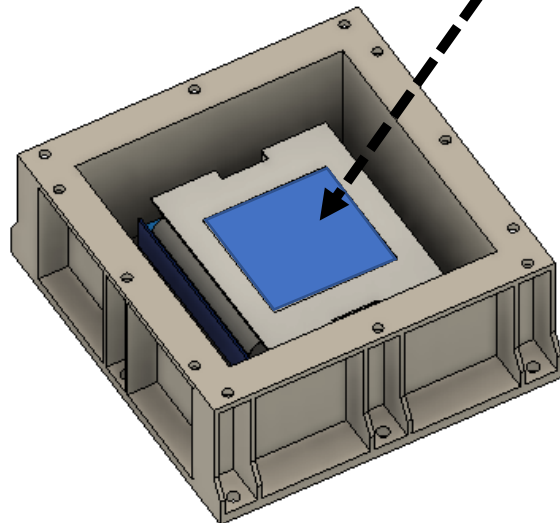


Items	Parameters
Energy range	0.4 – 4 keV
Field of view	~0.6 str for 16 units (3 arcmin accuracy)
Time resolution	< 0.1 s
Focal imager	Total area: 55 x 55 mm ² , pixel size: ~70-100 um

Wide-Field X-ray Monitor (WFXM)

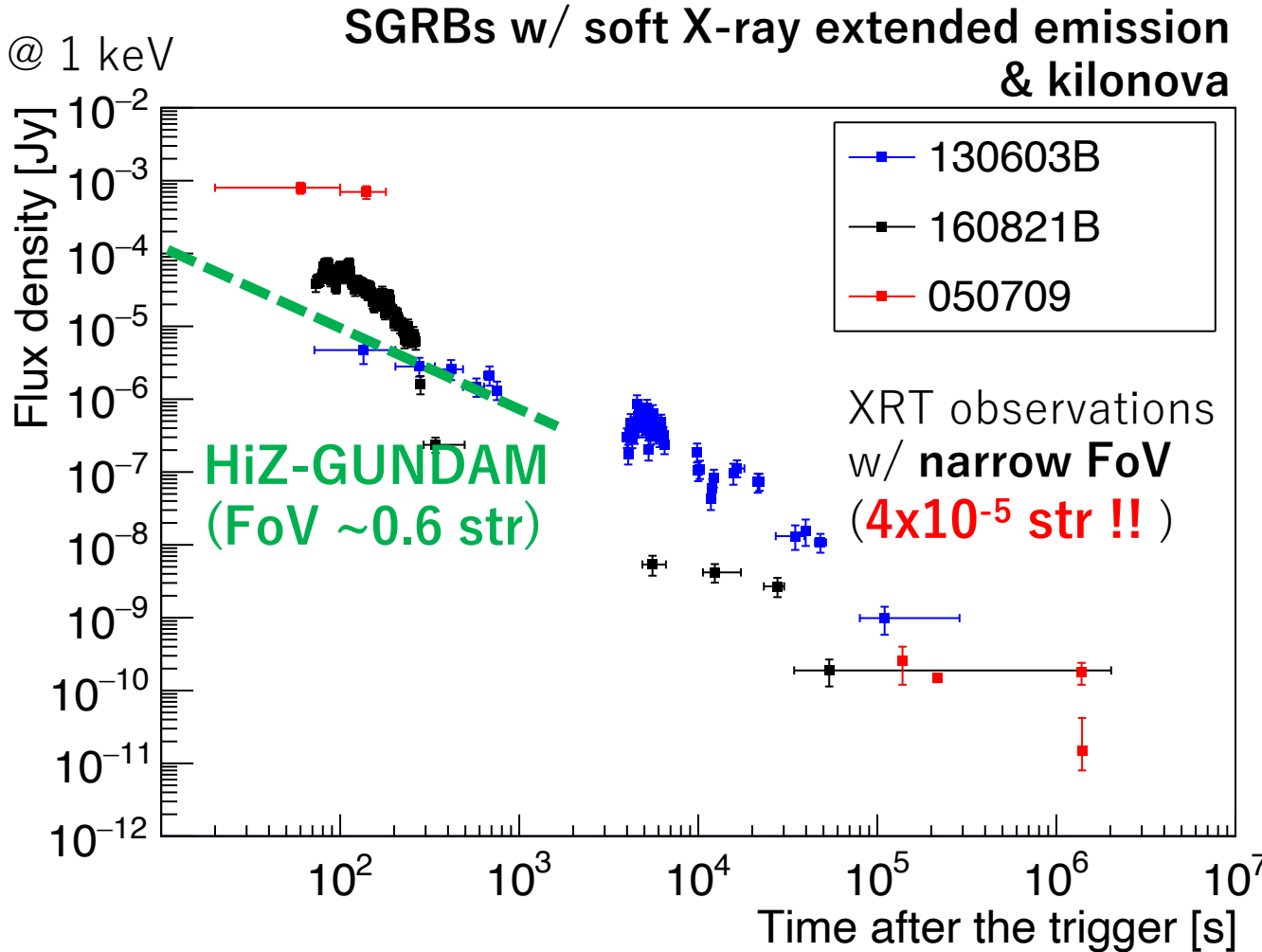
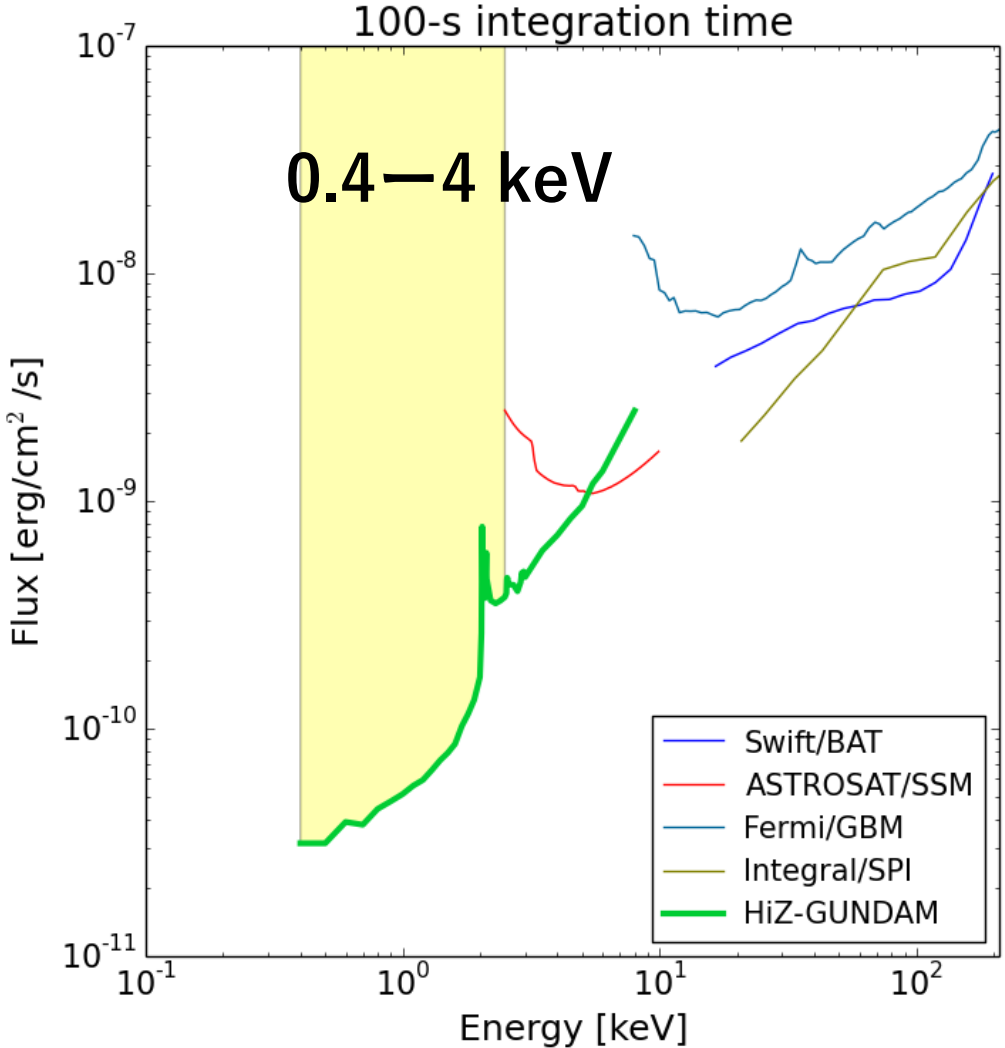


Focal X-ray imager



Items	Parameters
Energy range	0.4 – 4 keV
Field of view	0.6 str for 16 units (3 arcmin accuracy)
Time resolution	< 0.1 s
Focal imager	Total area: 55 x 55 mm ² , pixel size: ~70-100 μm

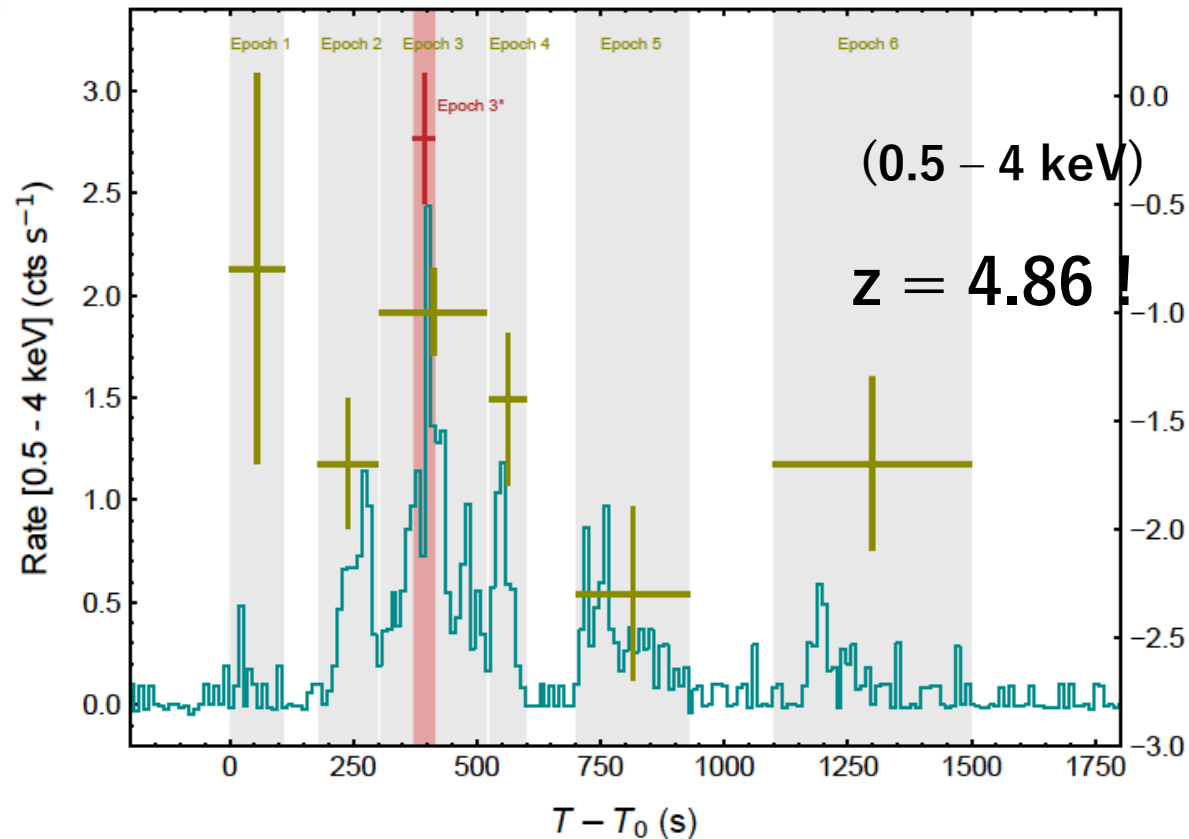
Discovery space of WFXM



Einstein Probe (Launched in 2024 Jan.)

EP240315a (Y. Liu+ 2024)

b



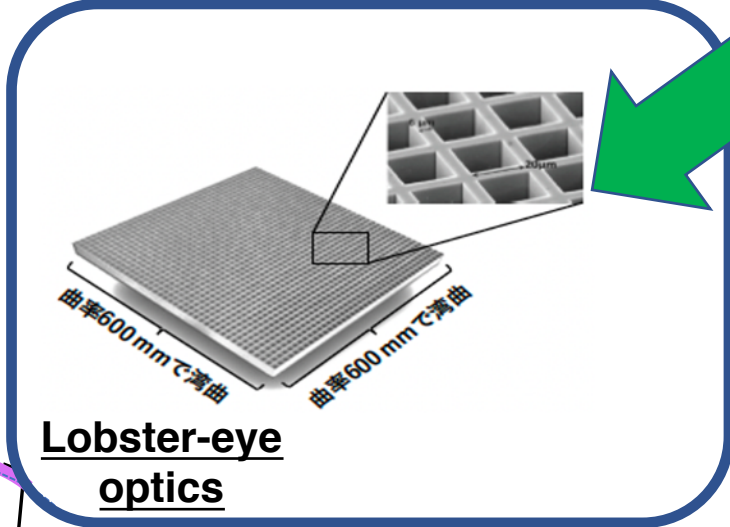
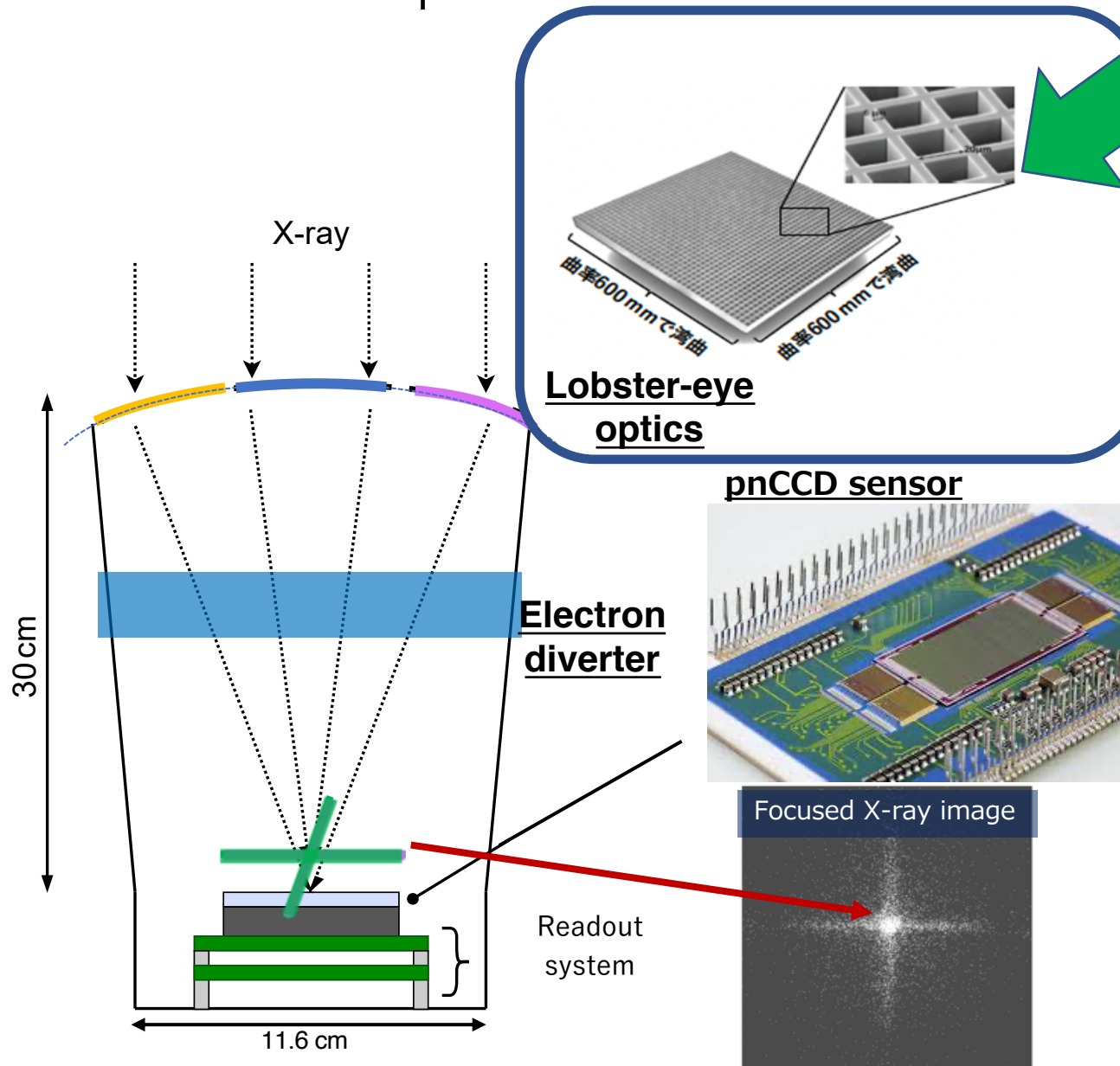
Einstein Probe



- ✓ For the initial ~6 months, 5 GRBs with $z \sim 0.5 - 4.86$ detected by EP.

HiZ-GUNDM has a NIR telescope
→ Advantage of detecting distant GRBs

Development items



Lobster-eye optics

Localize X-ray photons within ~3 arcmin

- LEO alignment
- Performance evaluation

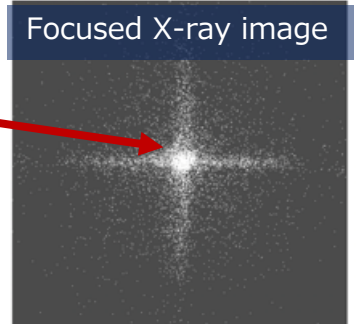
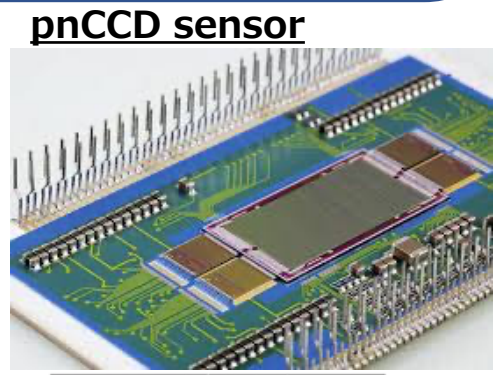
Electron diverter

Reject electron events as false detections

Focal X-ray pixel sensor pnCCD

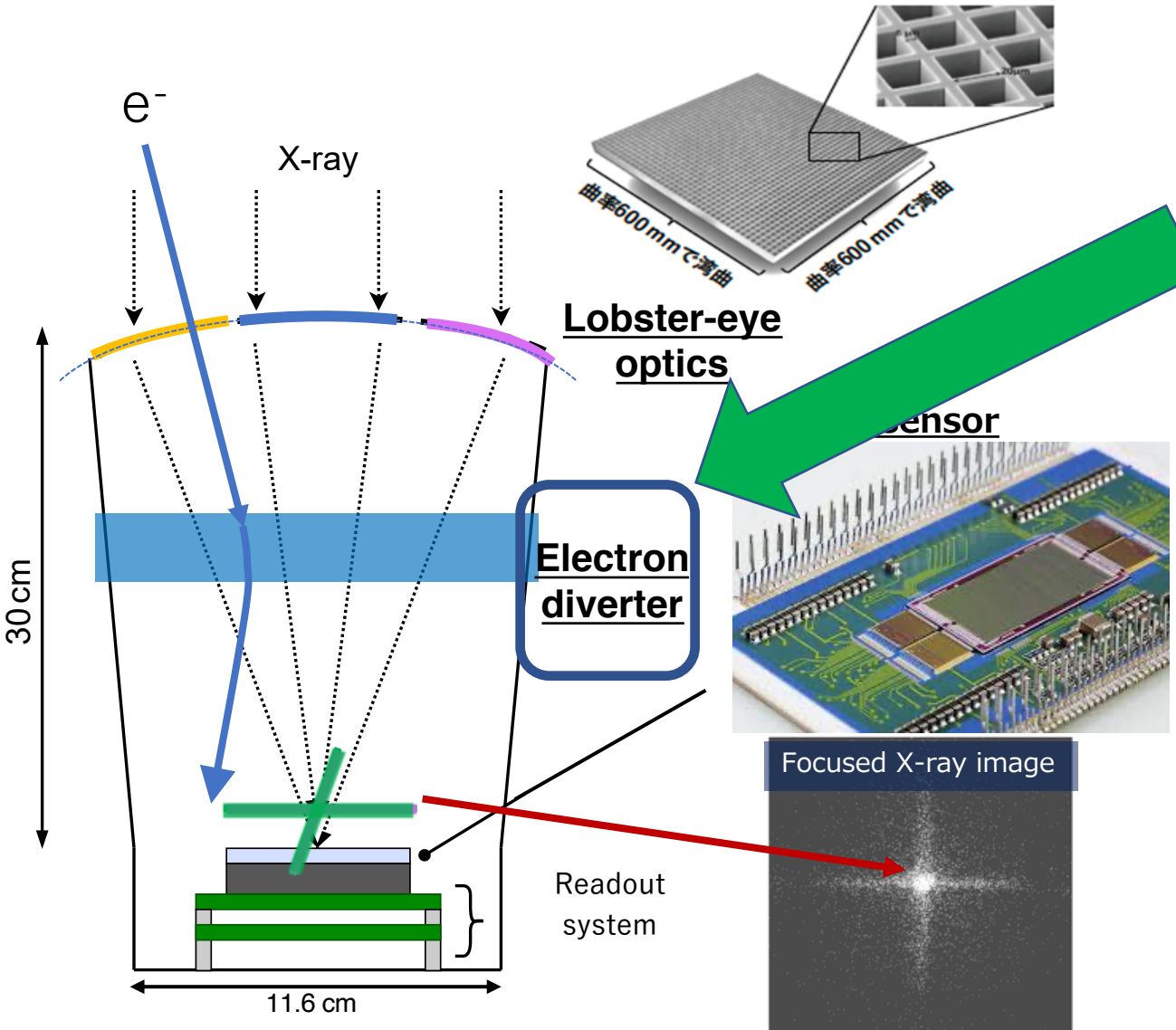
Detect X-ray photons over a large area quickly

- Driver and readout electronics
- A large-area pnCCD
- Evaluation of the radiation tolerance
- Design of the radiator cooling system
- etc.



Readout system

Development items



Lobster-eye optics

Localize X-ray photons within ~ 3 arcmin

- LEO alignment
- Performance evaluation

Electron diverter

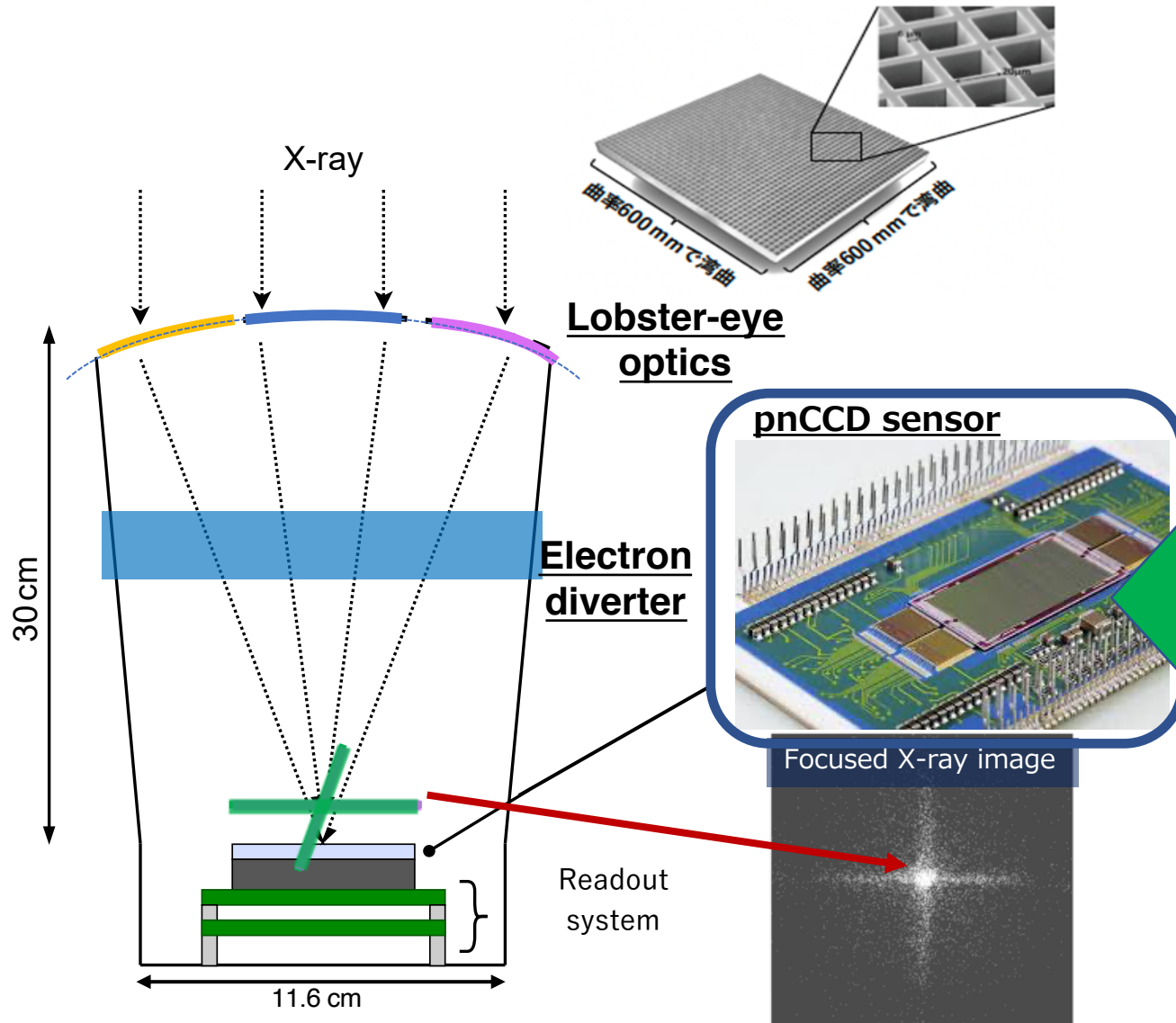
Reject electron events as false detections

Focal X-ray pixel sensor pnCCD

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Development items



Lobster-eye optics

Localize X-ray photons within ~ 3 arcmin

- LEO alignment
- Performance evaluation

Electron diverter

Reject electron events as false detections

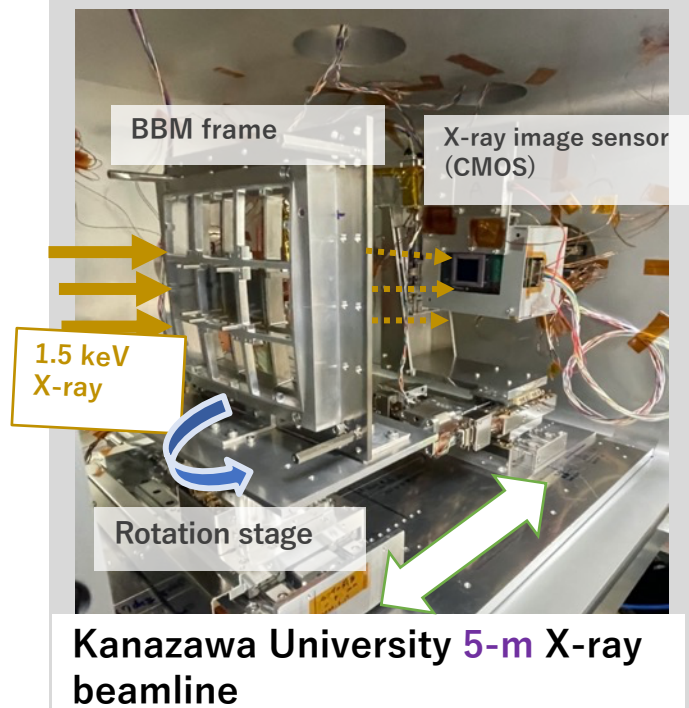
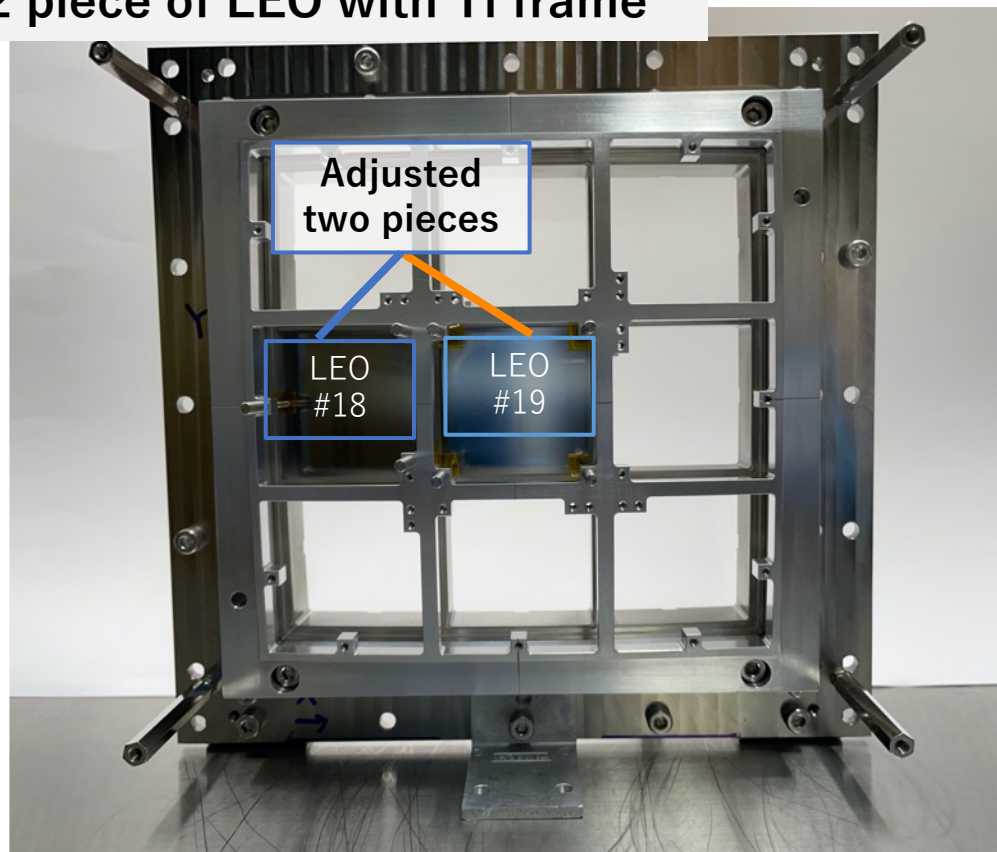
Focal X-ray pixel sensor pnCCD

Detect X-ray photons over a large area quickly

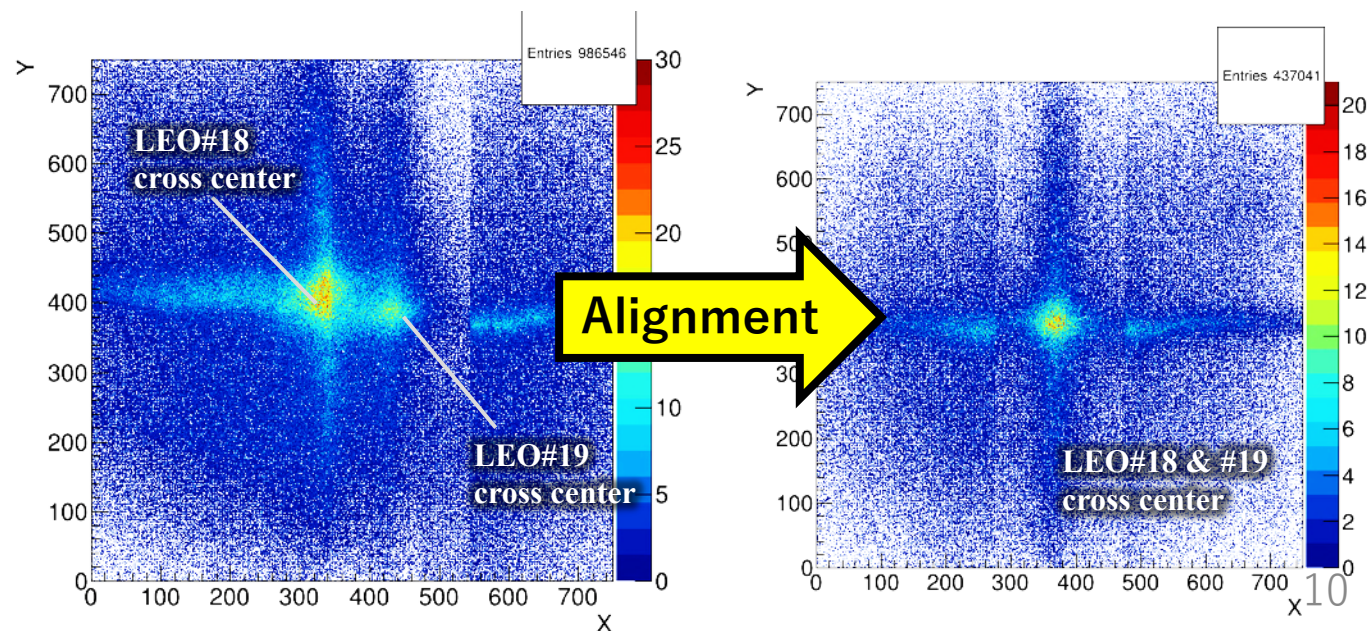
- Driver and readout electronics
- A large-area pnCCD
- Evaluation of the radiation tolerance
- Design of the radiator cooling system
- etc.

Lobster-eye optics (LEO)

2 piece of LEO with Ti frame

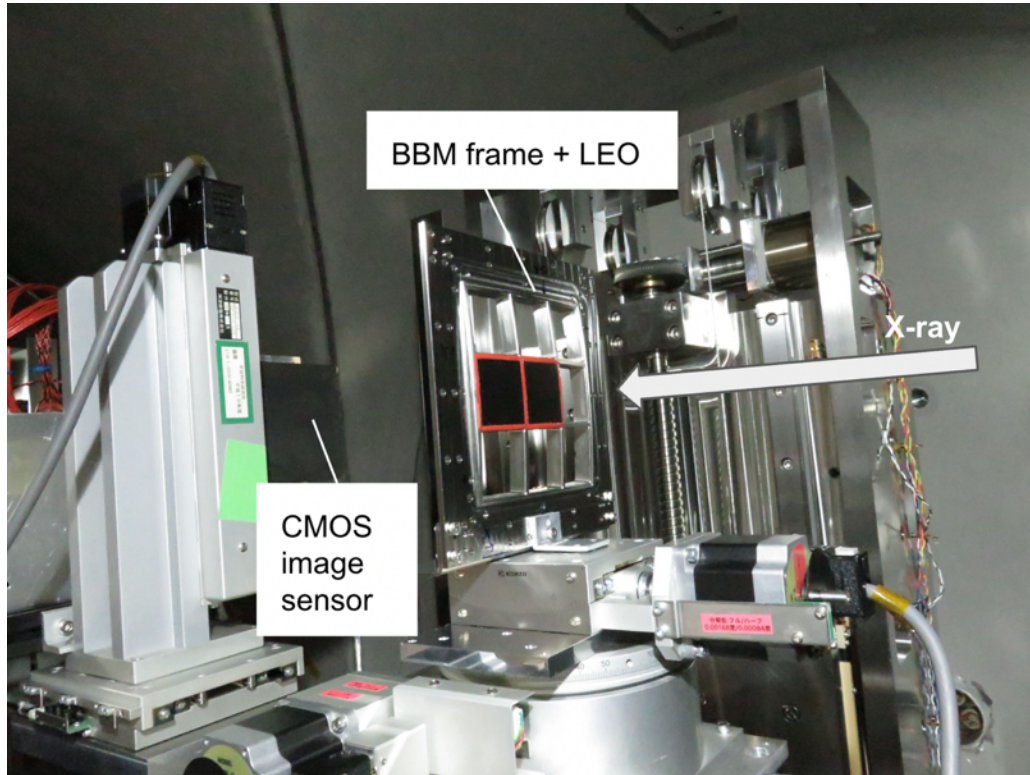


(now in France)

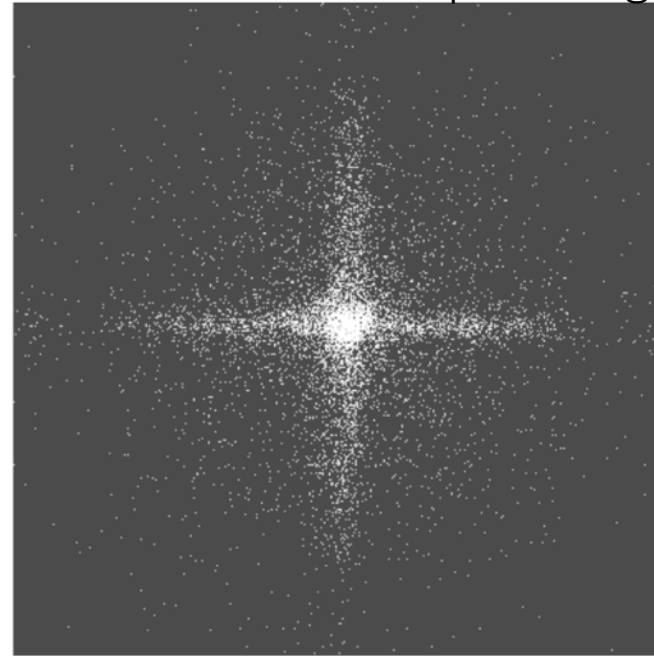


Lobster-eye optics (2)

- ✓ Measurements in the 30 m X-ray beamline of ISAS/JAXA
(Photons' parallelism is < 1 arcmin)



Obtained cross-shaped image



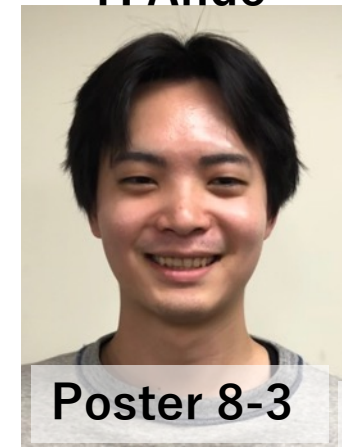
J. Li



R. Kamimura



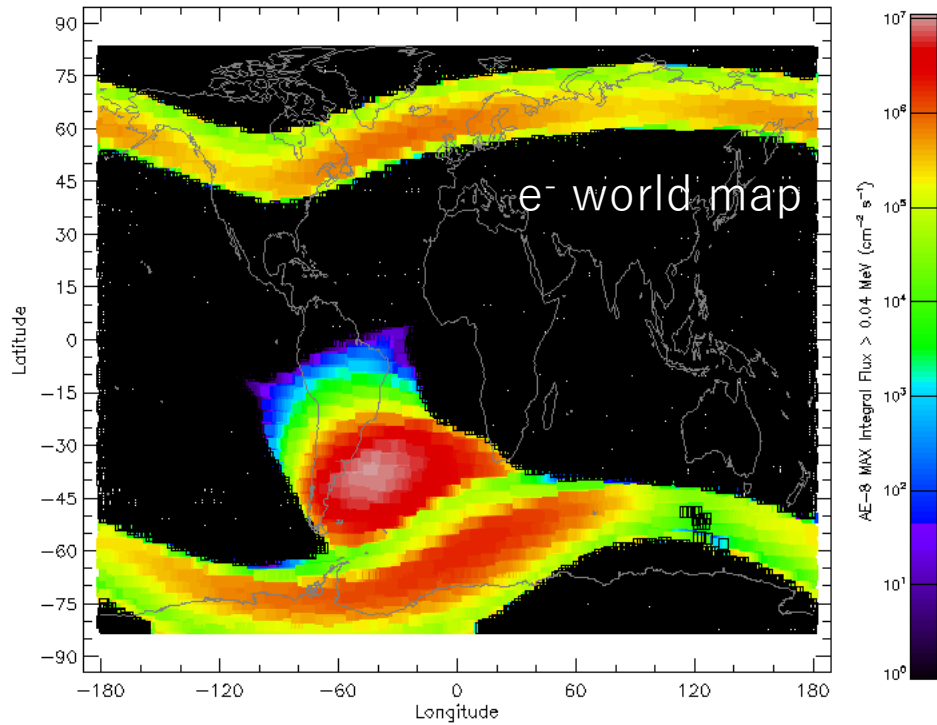
Y. Ando



I. Nagataka



Electron diverter



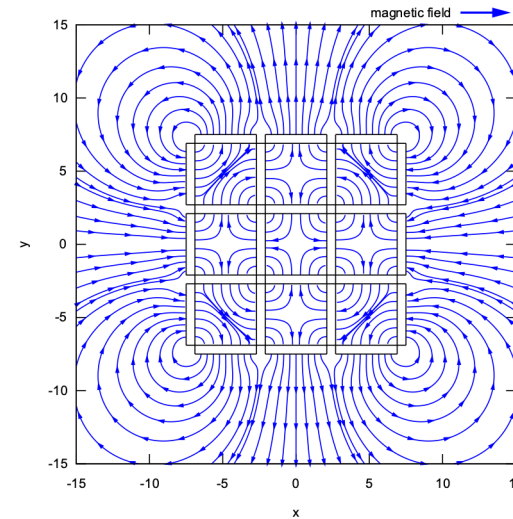
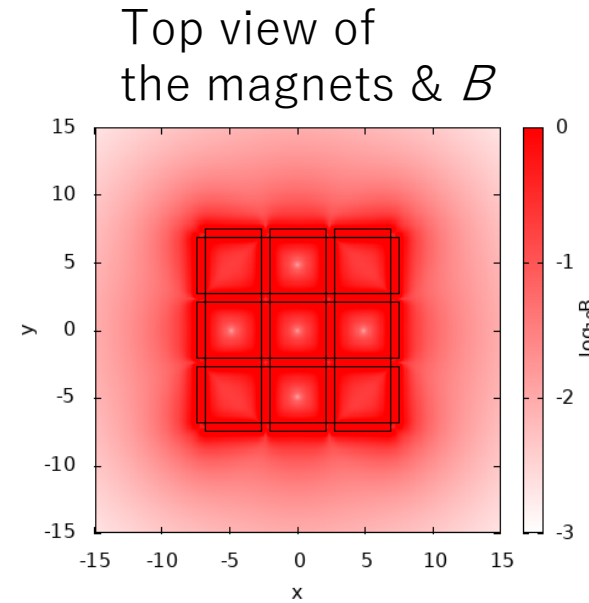
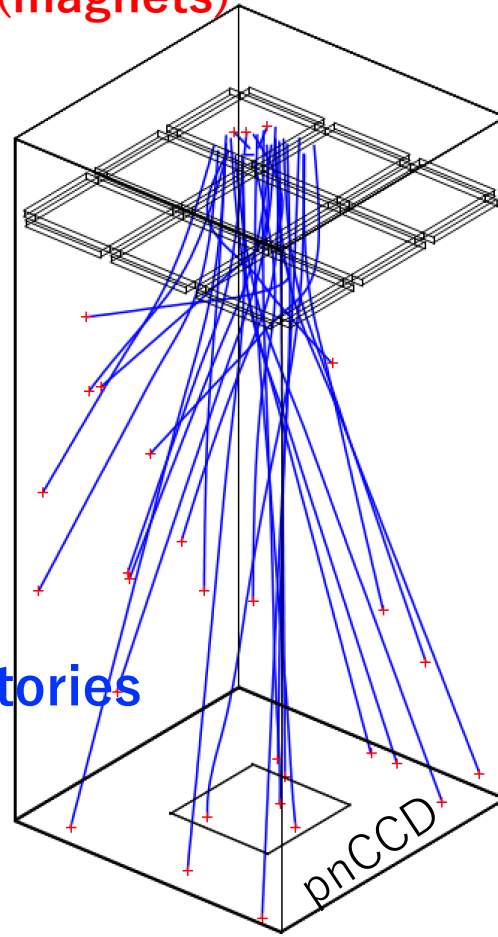
e⁻ world map

✓ A lot of electron background events in orbit

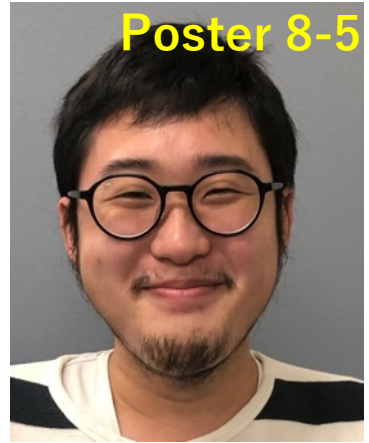
Electron trajectories

Geant4

Electron diverter (magnets)



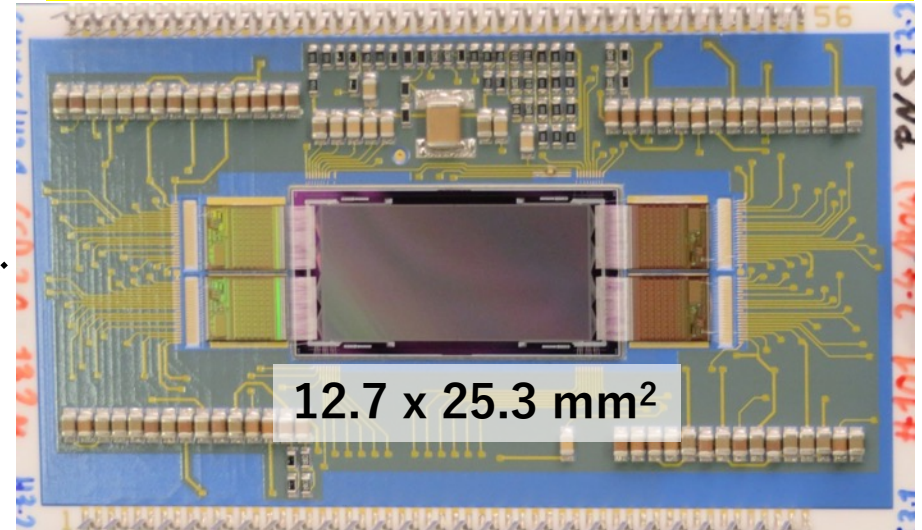
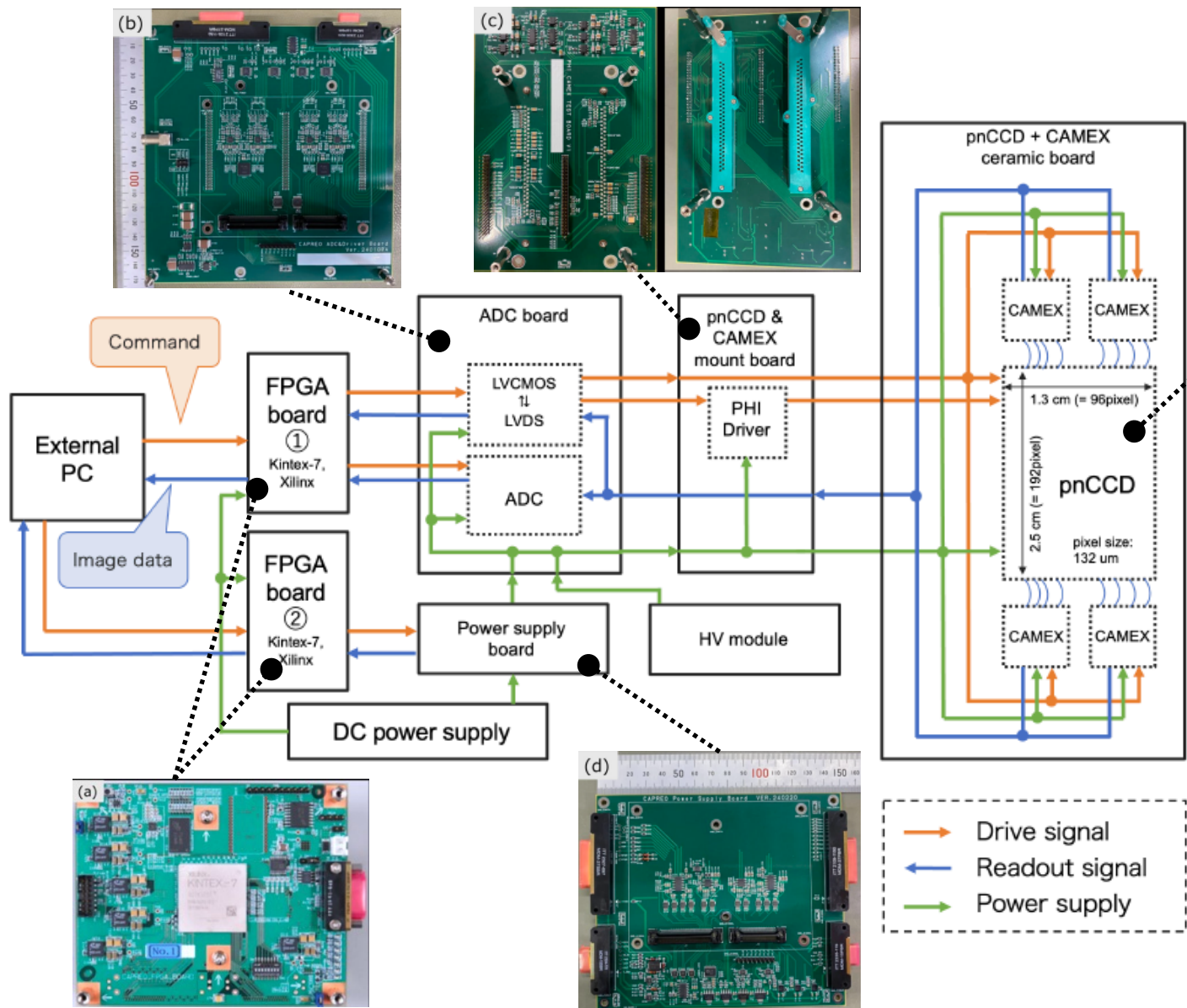
The detailed rejection evaluation is in progress.



A. Kutsumi

pnCCD and its readout system

Our system is almost ready for pnCCD operation !



- ✓ Thickness: 500 μm
- ✓ Pixel size: 132 μm



K. Sei



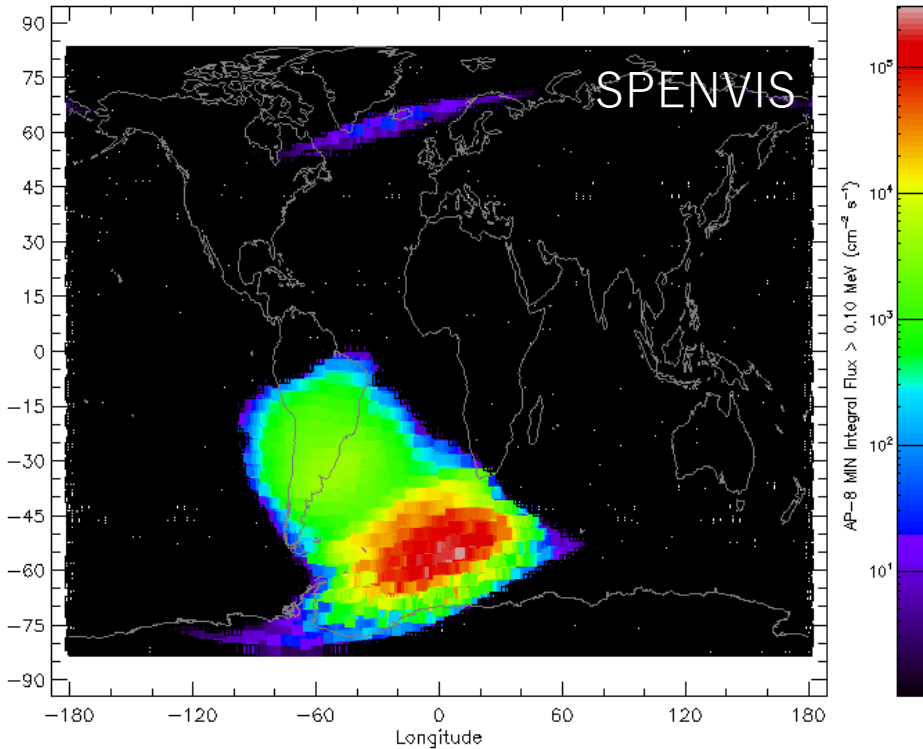
R. Kondo



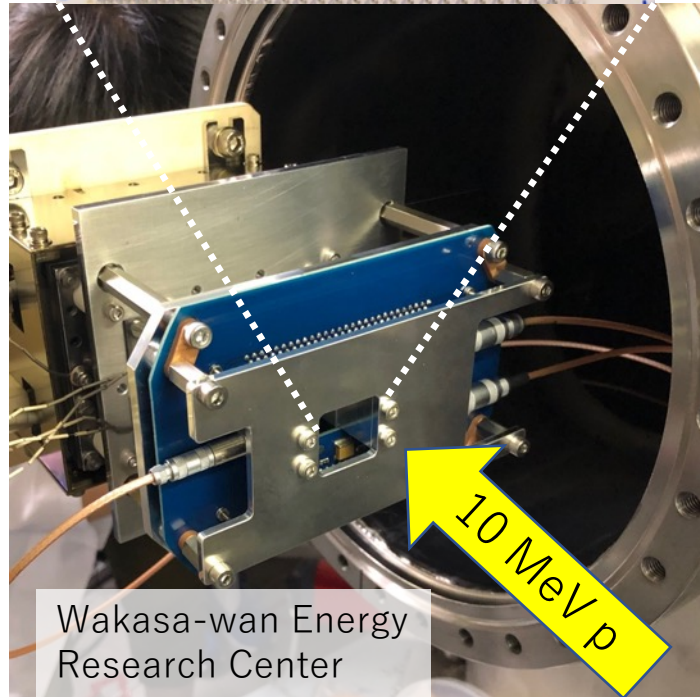
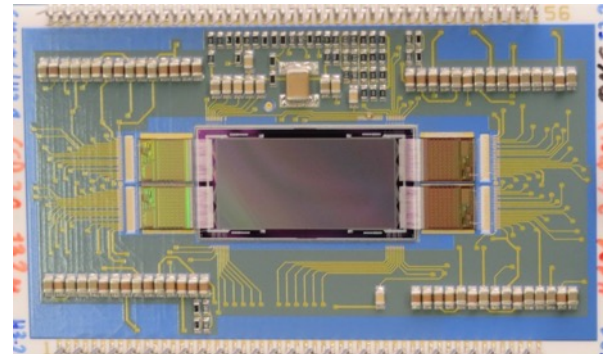
H. Otsuka

pnCCD radiation tolerance tests

Proton map



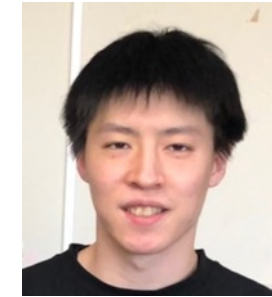
- ✓ Radiation damage can degrade the X-ray detection capability



Talk



R. Kondo

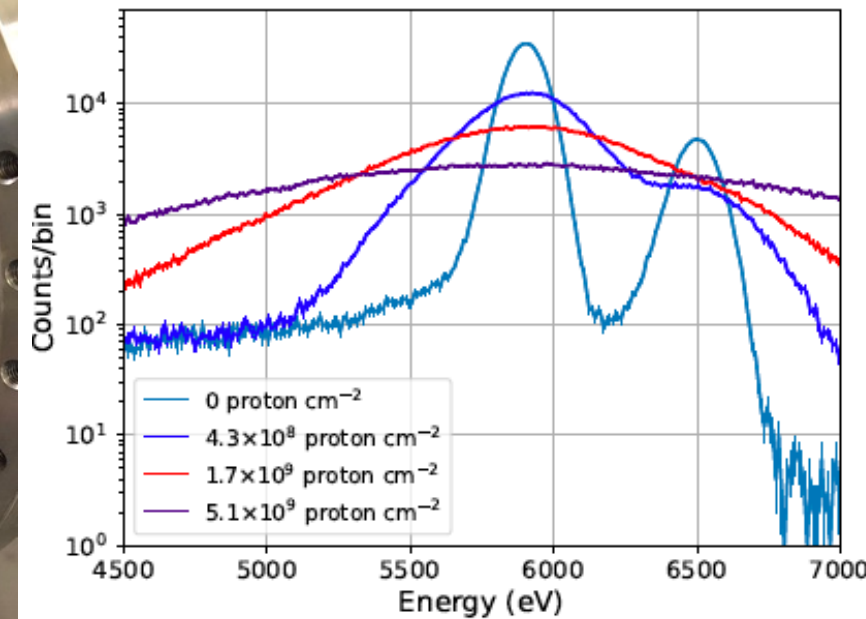


S. Takahashi
(graduated)



H. Goto

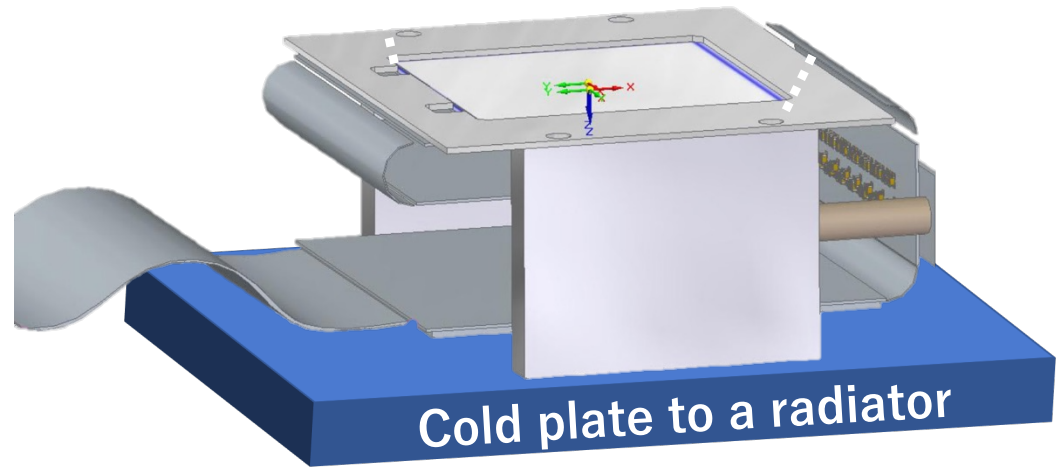
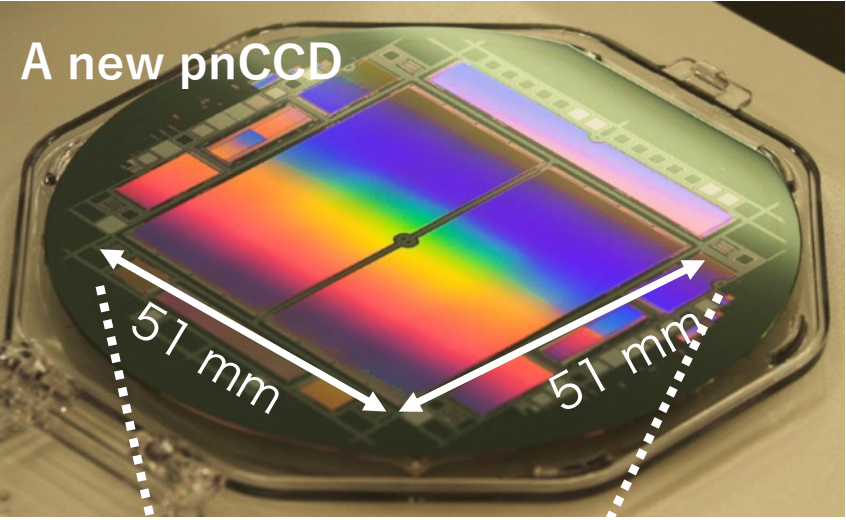
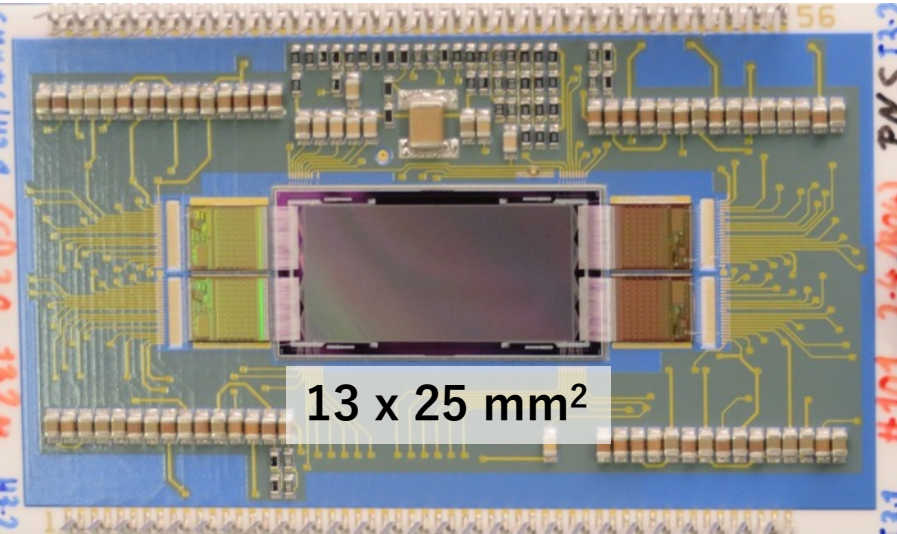
⁵⁵Fe spectra at -35 °C



S. Takahashi, MA et al., NIM-A 169413 (2024)

pnCCD with an expanded area

BreadBoard Model (BBM)
(much **SMALLER** than the flight model !)



✓ Designing the cooling system in progress

Summary

- **Development of WFXM is in progress**
 - **Lobster-eye optics (LEO)**
 - ✓ LEO alignment
 - ✓ Performance evaluation
 - **Electron diverter**
 - ✓ Development of the simulator
 - **Focal X-ray pixel sensor pnCCD**
 - ✓ Driver and readout electronics
 - ✓ Evaluation of the radiation tolerance
 - ✓ A pnCCD with an expanded area
 - ✓ Design of the radiator cooling system
 - ✓ etc.

Schedule

- Downselection review in ~2 years
- Our developments are key for the review
- Many reviews are waiting

