



X-ray performance evaluation of Lobster Eye Optics onboard HiZ-GUNDAM

The creation of multi-messenger astrophysics

- The 2nd annual conference -

11/18 – 11/20

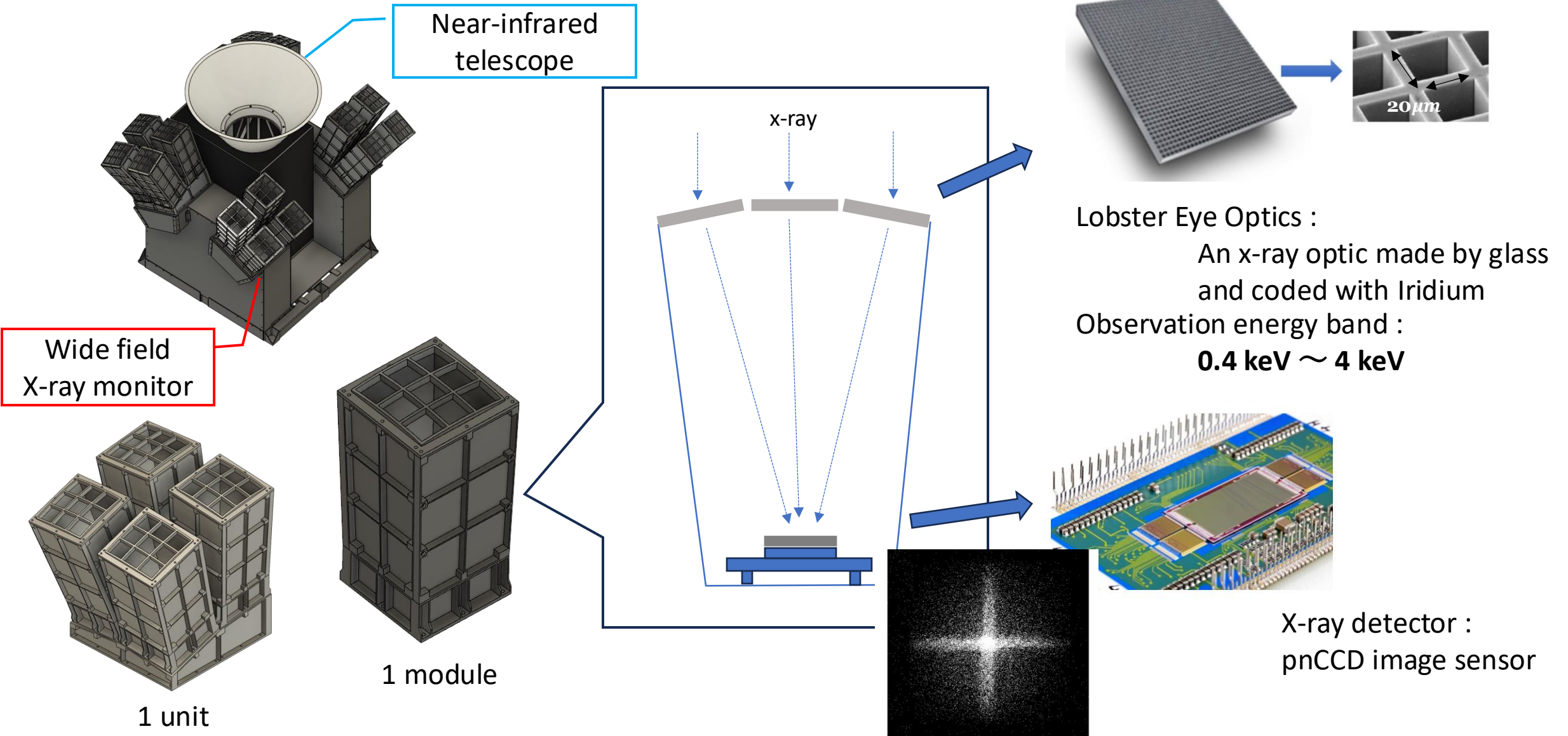
Aoyama Gakuin University, Sakamoto Lab

M2 LI JUNYI

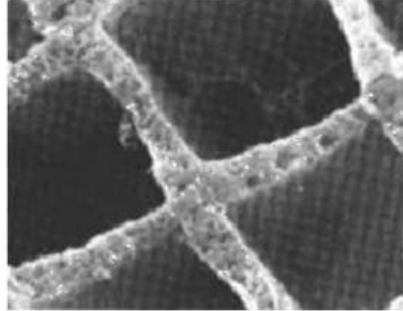
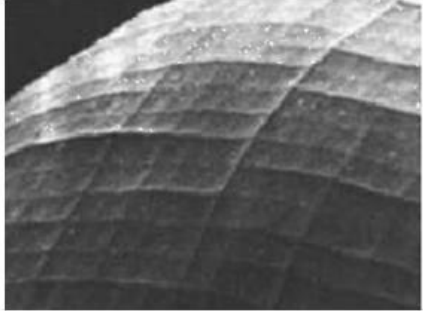
&

HiZ-GUNDAM team

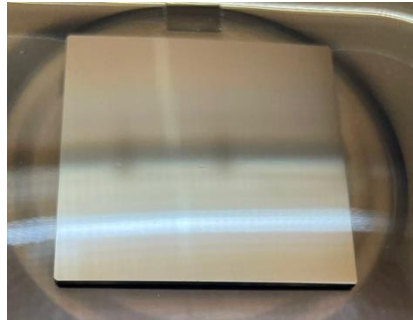
HiZ-GUNDAM (High-Z Gamma-ray bursts for Unraveling the Dark Ages Mission)



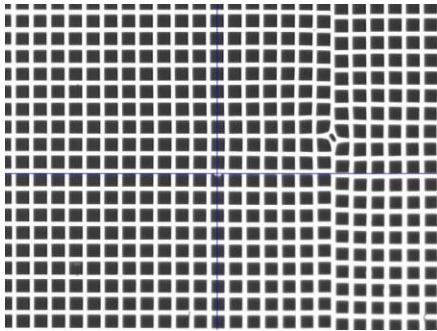
Lobster Eye Optics : LEO



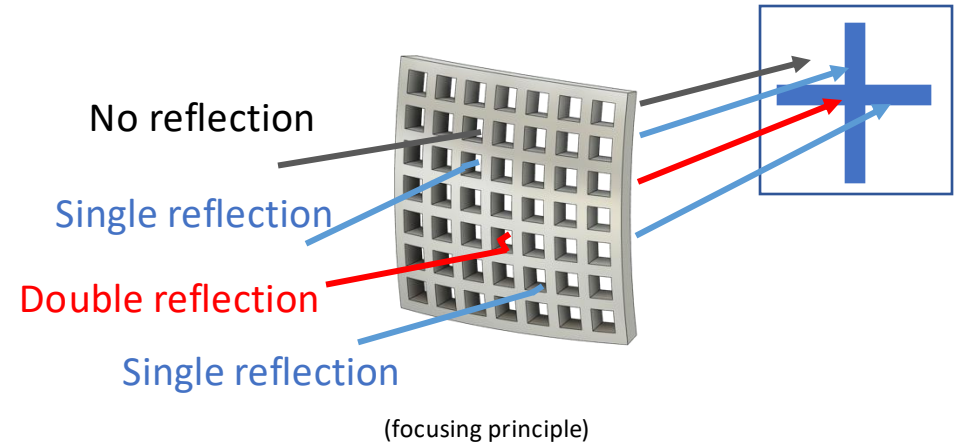
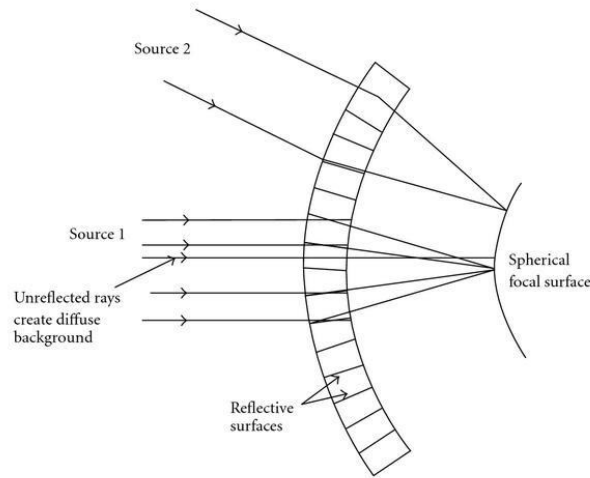
(image of lobster eye)



(LEO)



(zoom in)



A total of **144** LEOs will be used on HiZ-GUNDAM

Focal length measurement accuracy of 1.5 mm or less is required to reduce errors in the focusing position of LEOs attached to the same module.



Evaluation of newly purchased elements
&
Put LEOs with close focal lengths on the same module

LEO made by Photonis

field of view	4° × 4°
mass	About 2.55 g
size	40 mm × 40 mm × 1.2 mm
pore size	20 μm × 20 μm
focal length	300 mm

Experiment results by using ISAS 30m X-ray beam line

Purpose :

Investigate the focusing performance by
Irradiating X-rays along the two LEOs.

Adjustment at Kanazawa
University using 5 m beam line
(<5 arcmin)

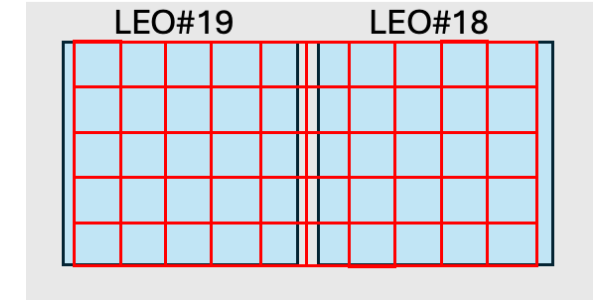
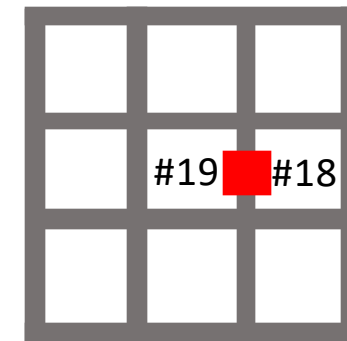
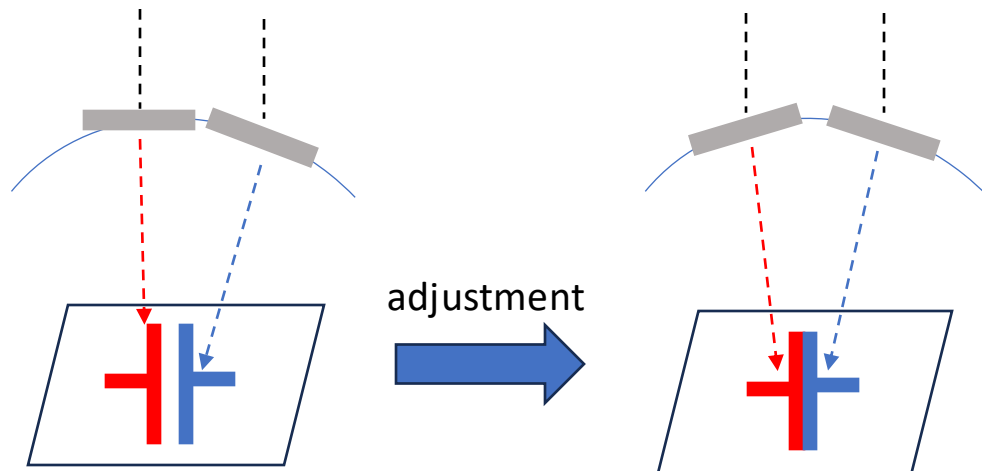
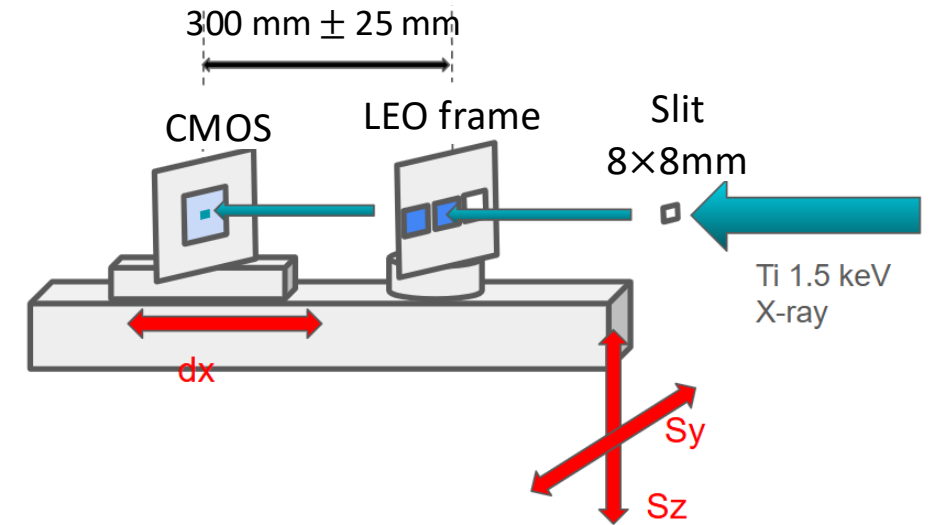
glue with adhesive

Evaluate alignment again using
ISAS 30 m beam line

Compare the results



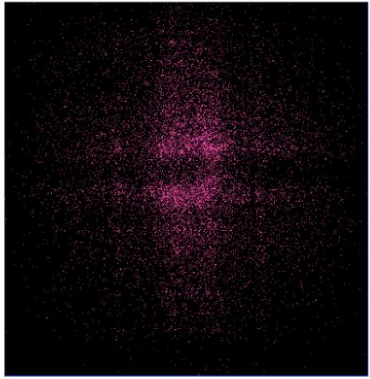
Set up at ISAS



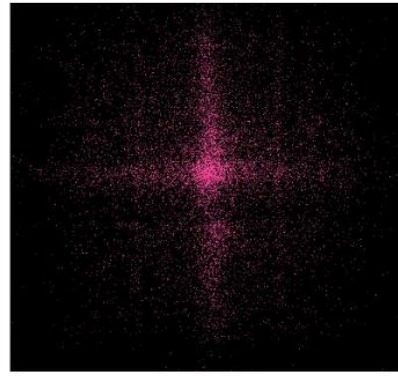
5×10 pointing scan at 5 mm intervals
over a 300 mm \pm 25 mm area

Experiment results by using ISAS 30m X-ray beam line

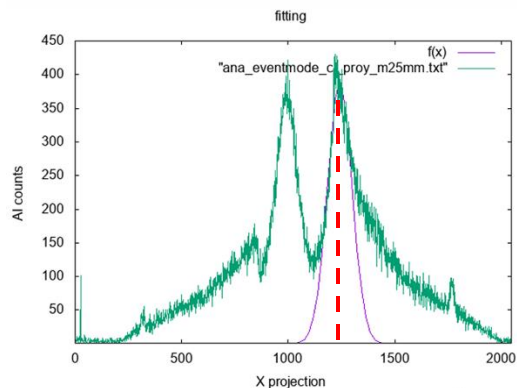
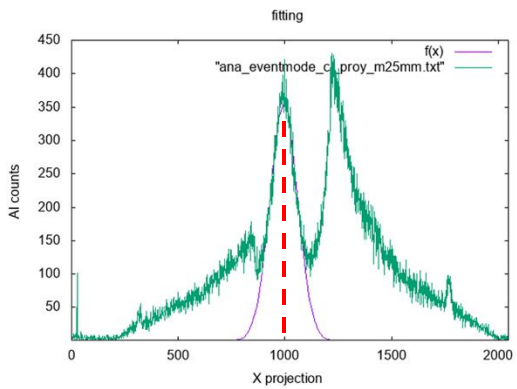
(325mm)



(295mm)

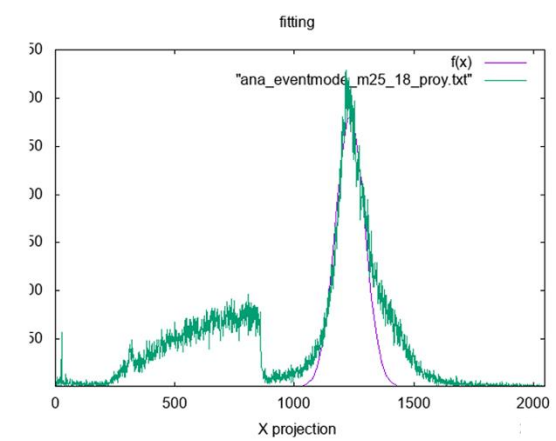
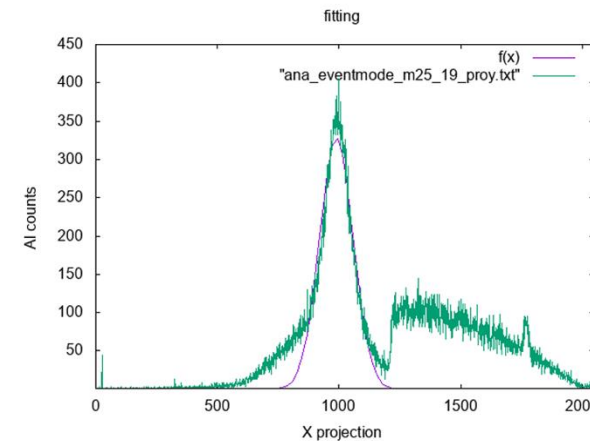
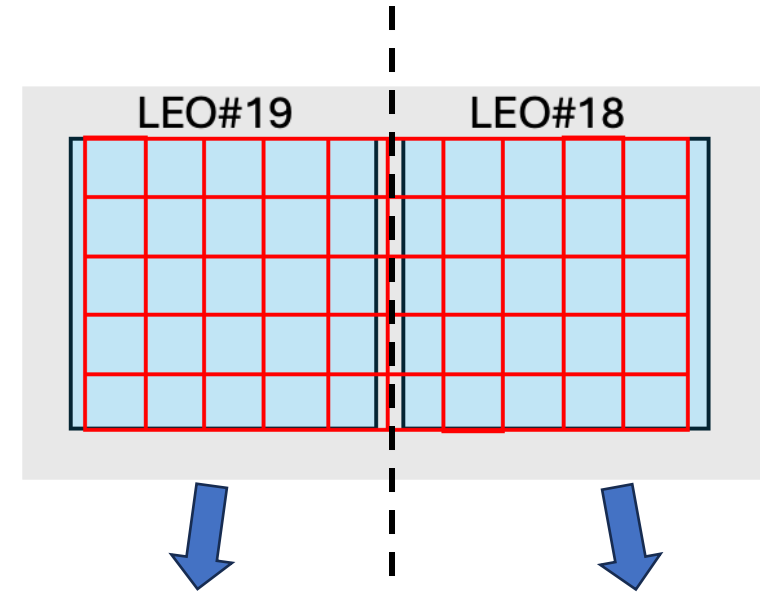


approaching the best focus



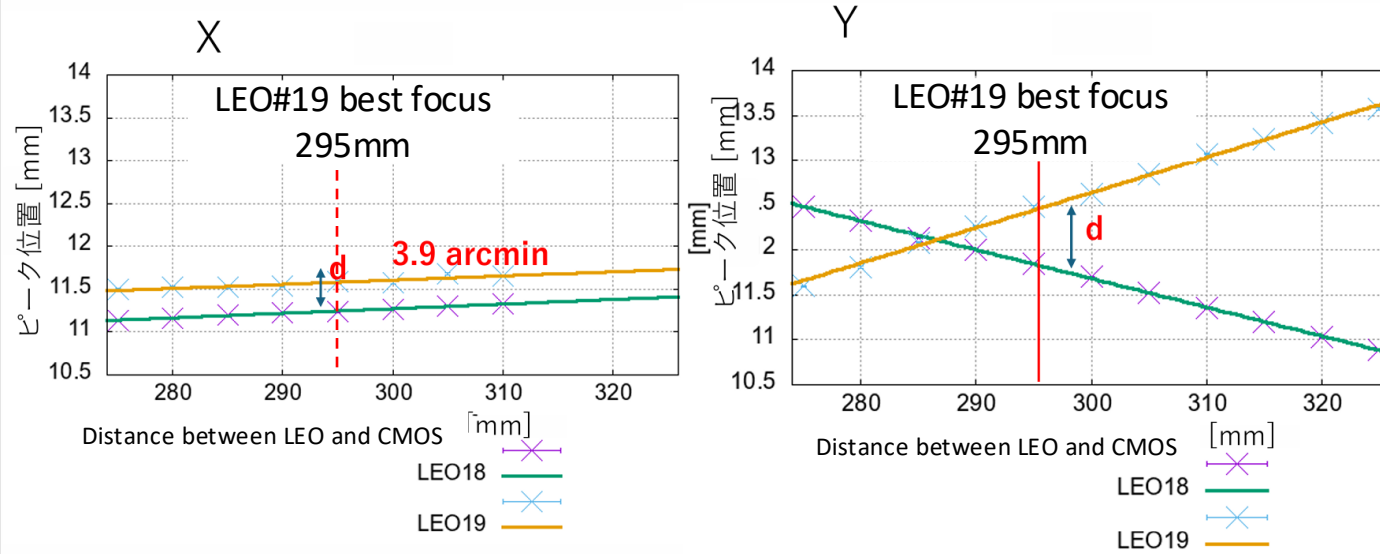
Distance between two cross images is too close
Can not be calculated

Separate projection



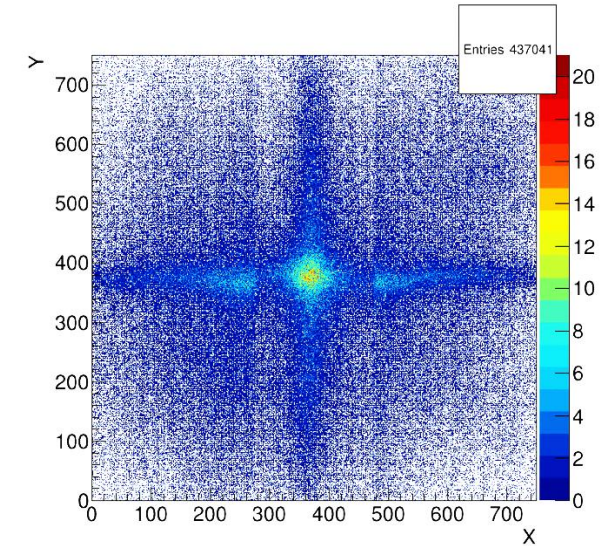
Experiment results by using ISAS 30m X-ray beam line

Results of experiments at ISAS



axis	Distance between two cross center
X	3.90 ± 0.06 arcmin
Y	6.80 ± 0.04 arcmin > 5 arcmin

Results of experiments at Kanazawa University

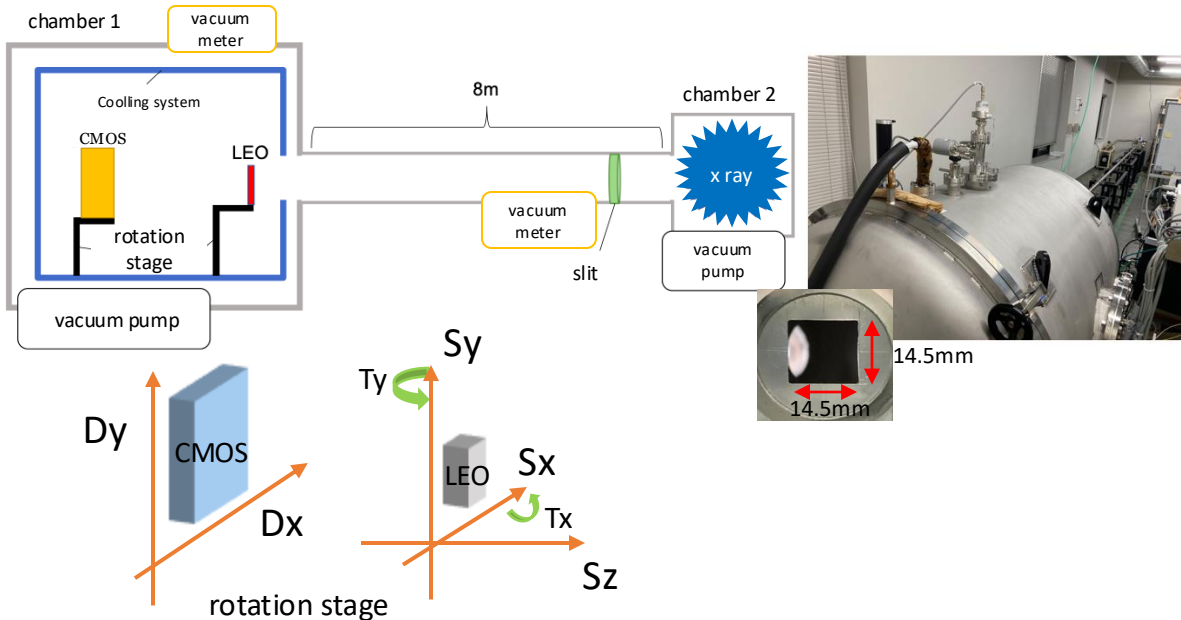


axis	Distance between two cross center
X	2.67 ± 0.09 arcmin
Y	1.34 ± 0.53 arcmin

For more details : poster by Ando (Kanazawa university)

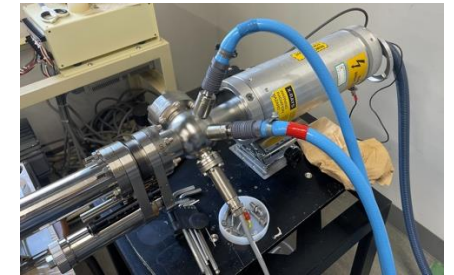
Construction of the AGU X-ray beam line

To evaluate the performance of LEO at AGU, Sakamoto Lab began building an X-ray beamline in 2020.



In 2024, we upgraded the X-ray beamline with a new X-ray generator, XR-50 from SPECS.

- Power of the X-ray generator can be changed at any time.
- Real-time display of the current value of the ferrament, etc.

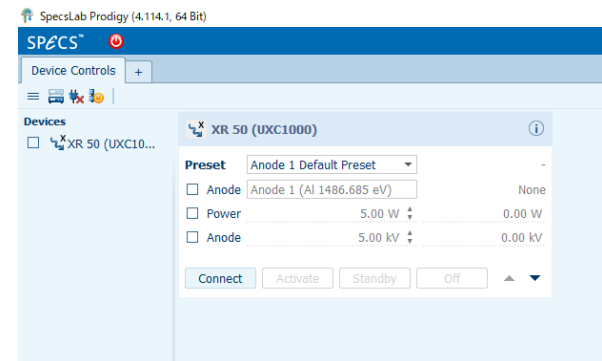
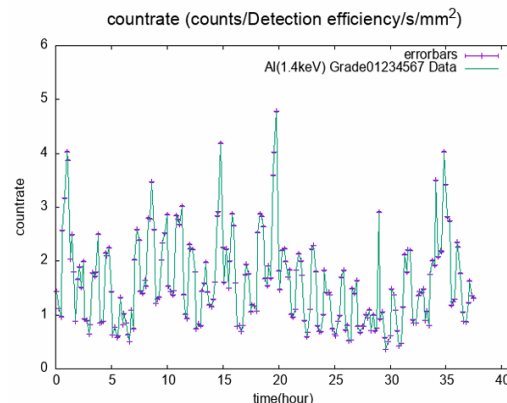


(XR-50)

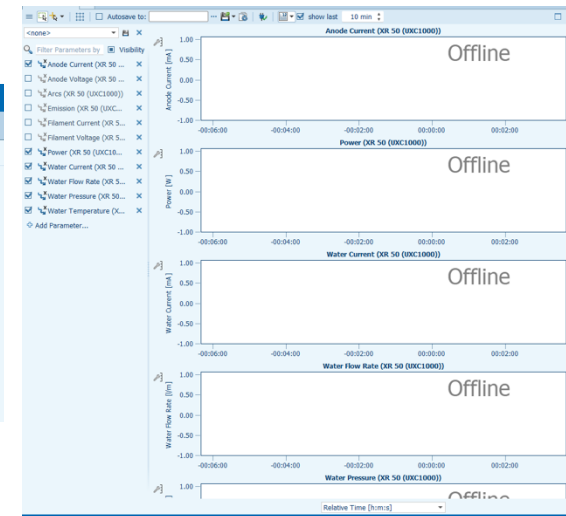
Low intensity stability of the MANSON X-ray generator



Evaluation take a long time (8h) & Whether the results are really correct or not



monitor screen



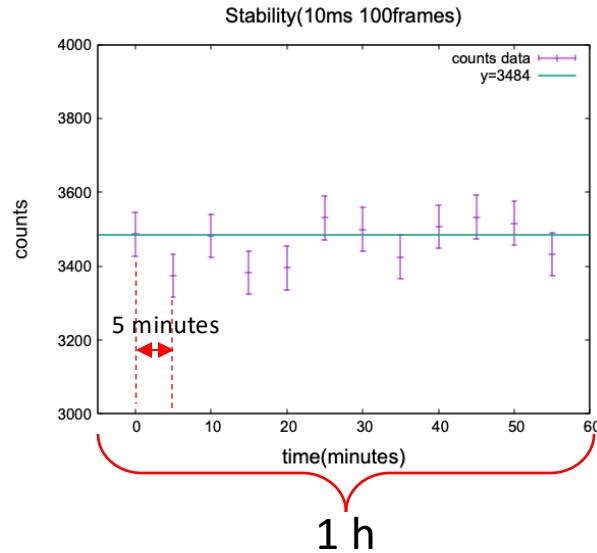
Evaluation of performance of the XR-50 was carried out.

Construction of the AGUX-ray beam line

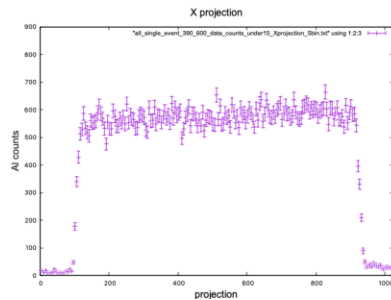
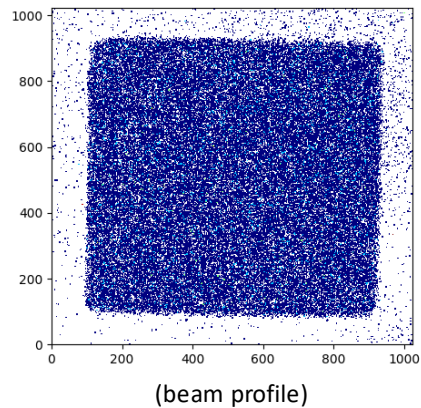
XR-50 Performance Evaluation of stability

Exposure time: 0.01s
Number of frames: 100

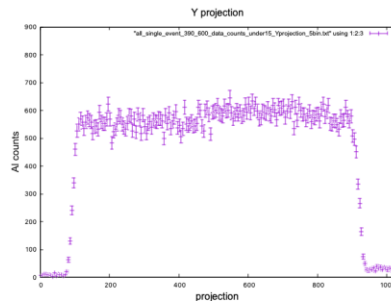
Stable at $\pm 5\%$ based on median of 3484 counts



Projection distribution

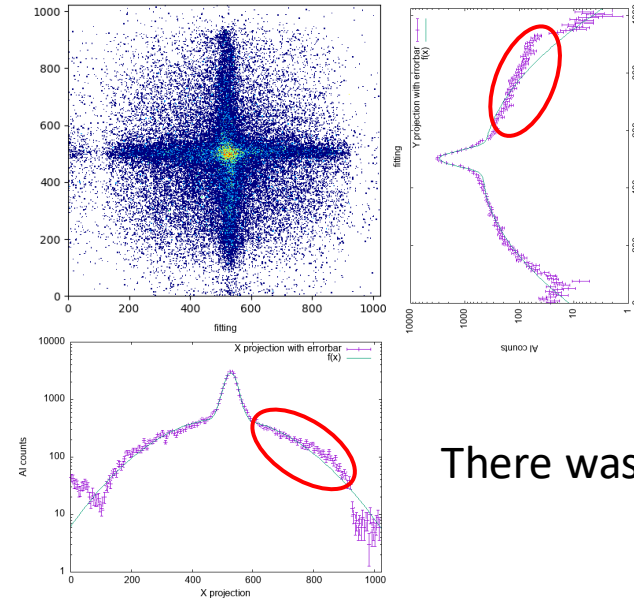


X projection



Y projection

Evaluation of focal length

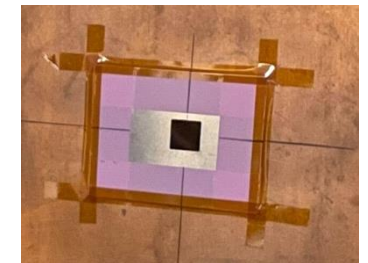


Photons are concentrated in the bottom half of CMOS

There was asymmetry in the projection

Possible Causes :

- LEO alignment
 - alignment adjustment procedure
 - ~~fixture~~
- Beamline alignment
 - ~~parallelism~~



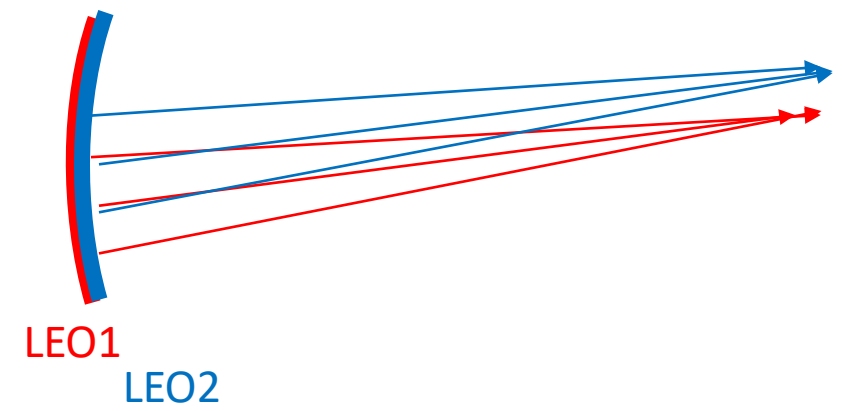
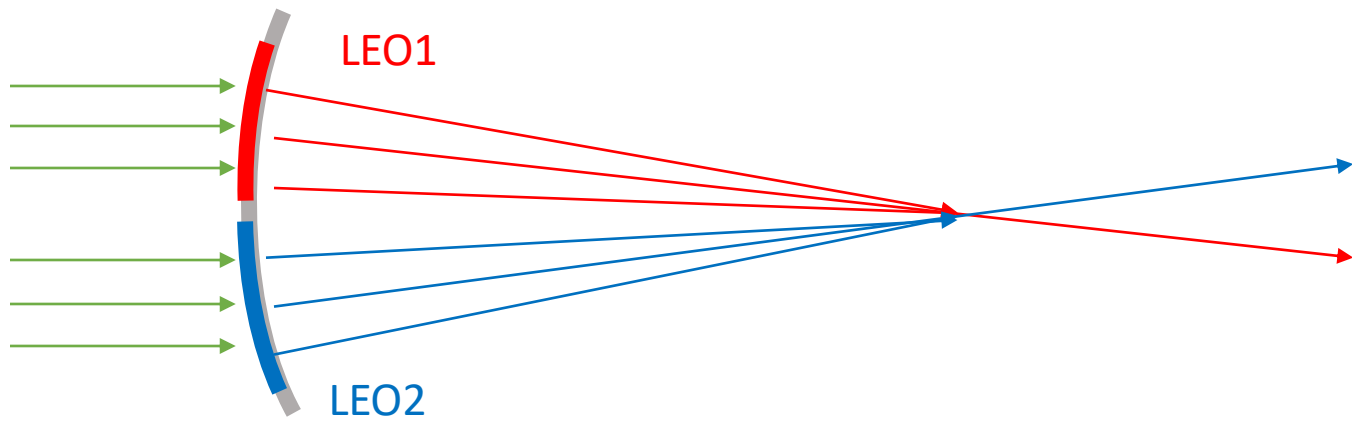
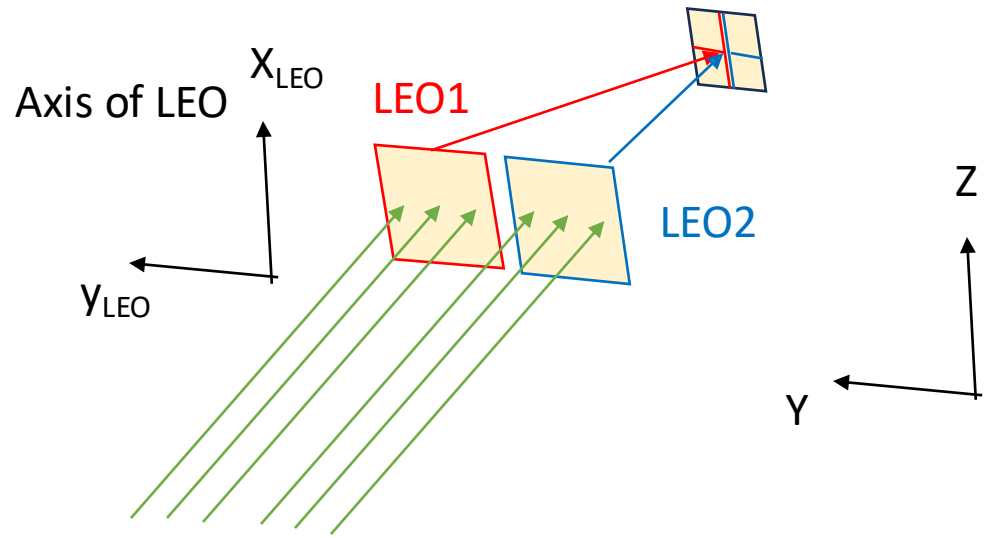
Summary

- The focusing performance by irradiating X-rays along the two LEOs has been investigated.
- X-ray generator of the AGU X-ray beam line has been updated, and the performance is acceptable to perform our X-ray measurement of LEOs.
- The alignment adjustment using the 8 m AGU X-ray beam line is still not enough.
We are reviewing the alignment procedure of our setup.

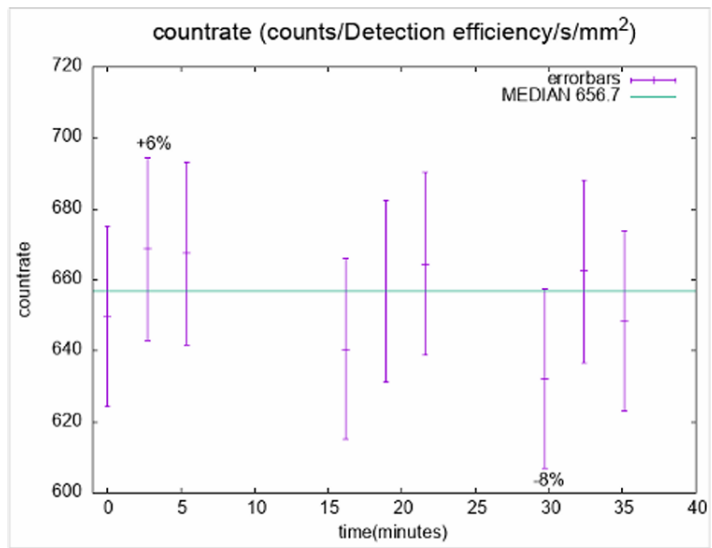
In the future

- We are planning to introduce the X-ray slit to be able to change the beam size to increase the accuracy of the alignment.
- The vibration test to the LEO folder mounting a LEO will be performed at ISAS around December.

Appendix



Stability of ISAS beam line



Stability of AGU beam line

