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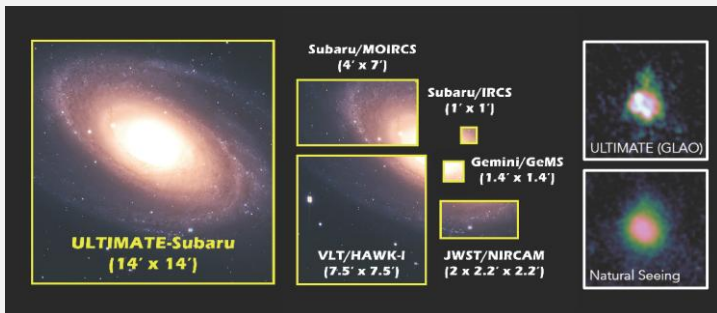
ULTIMATE-Subaru Wide Field Imager (WFI)

Kosuke Kushibiki (Advanced Technology Center, NAOJ)
on behalf of ULTIMATE-Subaru WFI development team

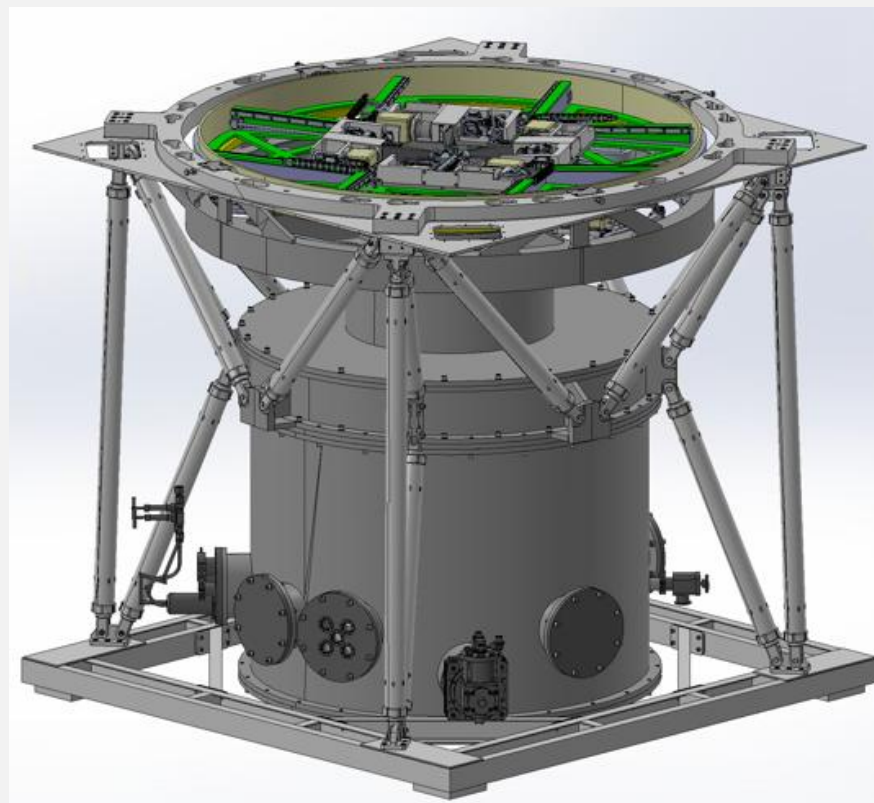
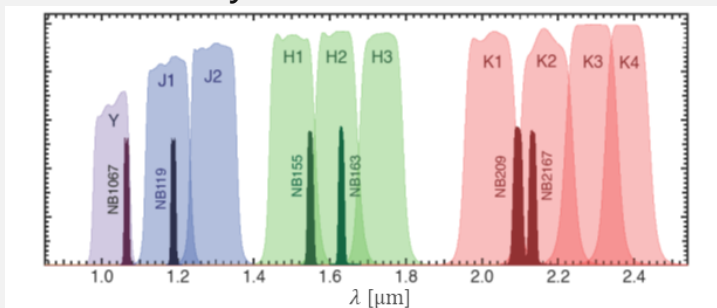
WFI Overview

Near-Infrared Imager for ULTIMATE-Subaru: Final design phase

- Widest AO corrected science FoV $\sim 14' \times 14'$
- Image quality comparable to HST
FWHM $\sim 0.2''$ at K-band



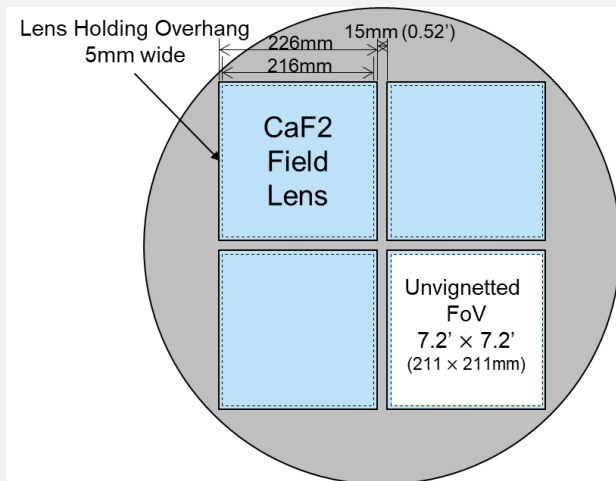
- Wide variety of MB/NB filters



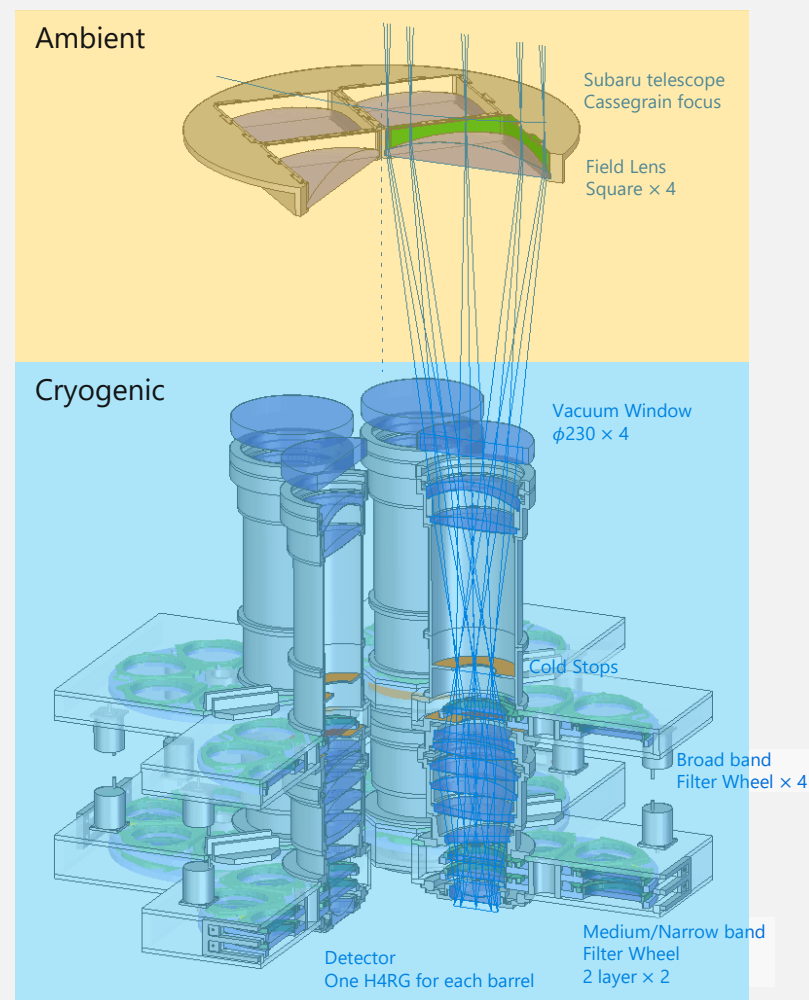
Optical Design

Four-barrel optics by OptCraft

- Covers $\sim 14' \times 14'$ with four identical barrels
 $\rightarrow 7.2' \times 7.2' \times 4 = 207 \square'$



- 3 filter wheels containing max. 15 filters
 \rightarrow Accept many filters (BB, MB, NB)
- Field lenses are in ambient temperature & following optics in cryogenic condition
 \rightarrow Reduce the size of the vacuum windows and cryostat



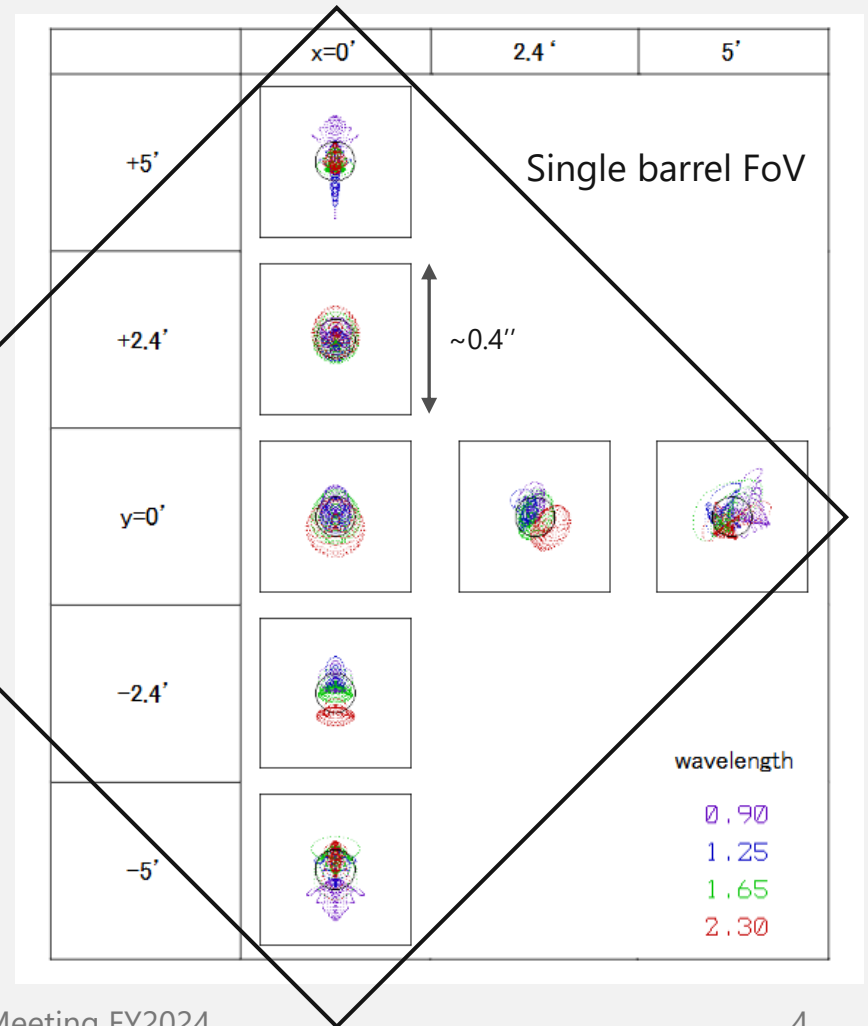
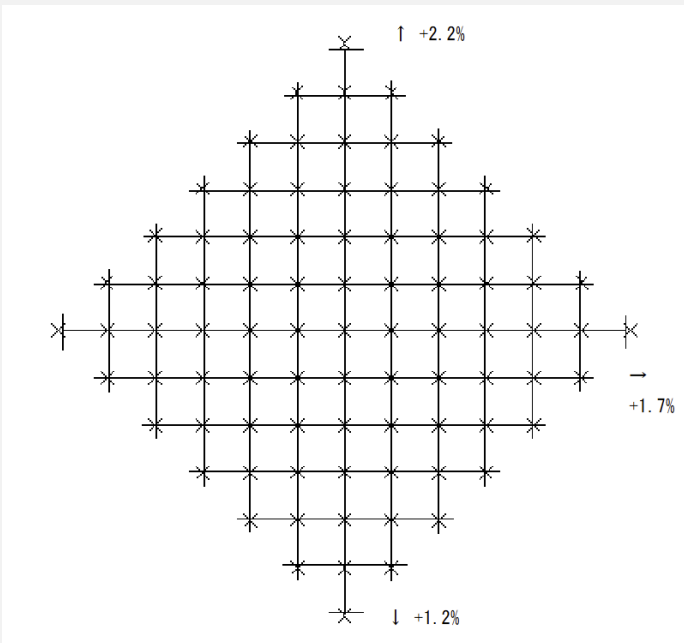
Optical Performance

Spot diagram for half of a single barrel

→ RMS spot diameter smaller than 0.1"

Distortion

→ 2.2% = 61 pix at maximum

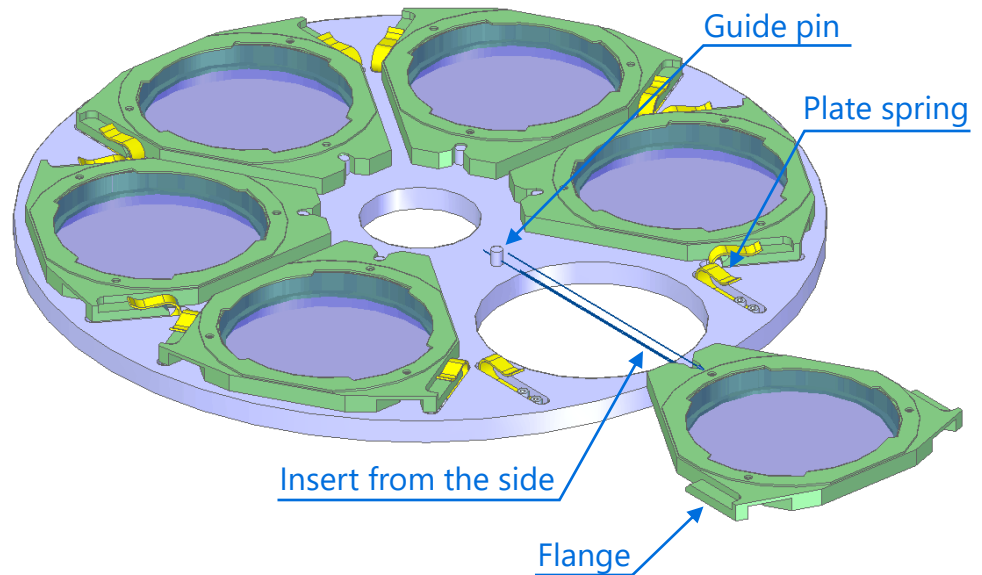
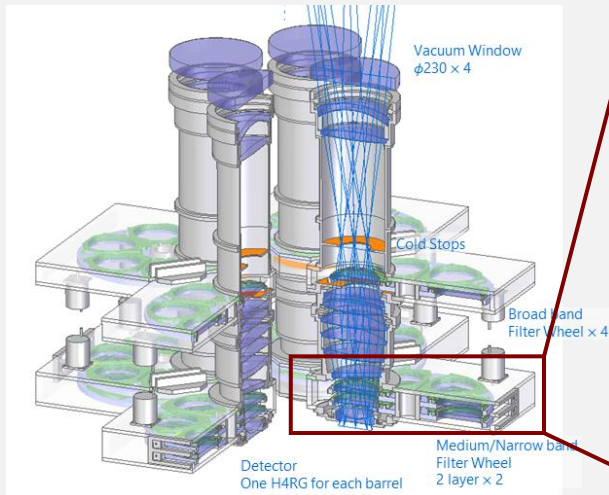


Exchangeable Filter Wheels

Capacity of filter wheels per barrel = 15 < Total filters proposed in scientific studies
 → Easy filter replacement during downtime

Design study is ongoing

- How to exchange the filters
- Impact on cryostat design



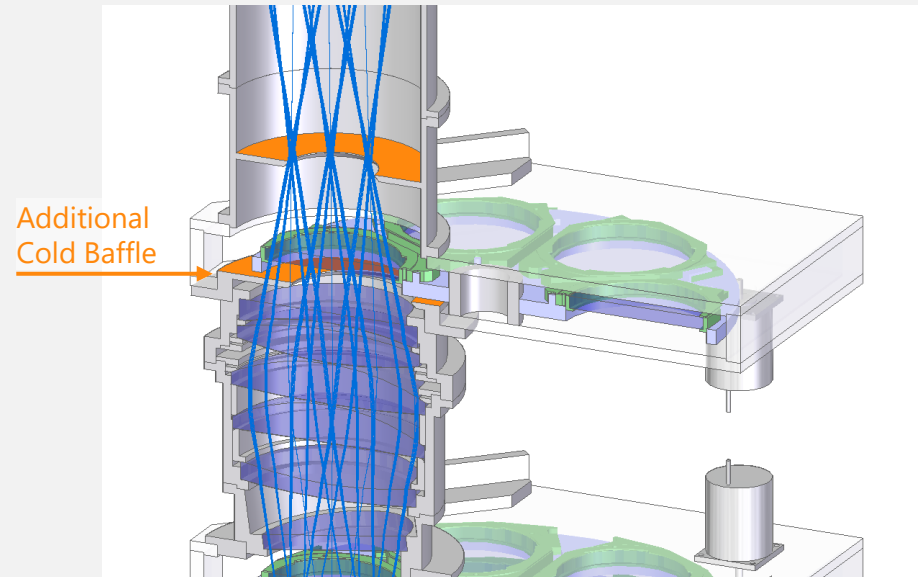
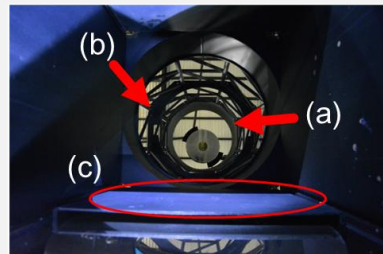
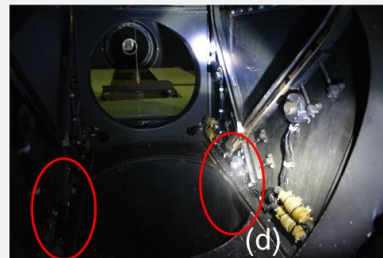
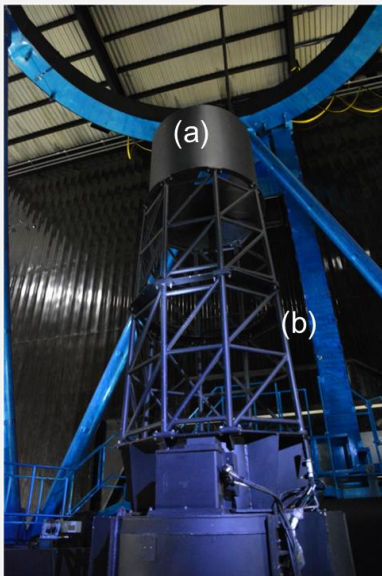
Additional Cold Baffles

The telescope is not designed to have $\Phi 20'$ FoV

→ Many ambient structures contribute to the thermal background

→ Need additional Cold baffles

→ Throughput considering only vignetting: 68% ~ 92.4% within $\Phi 20'$ FoV



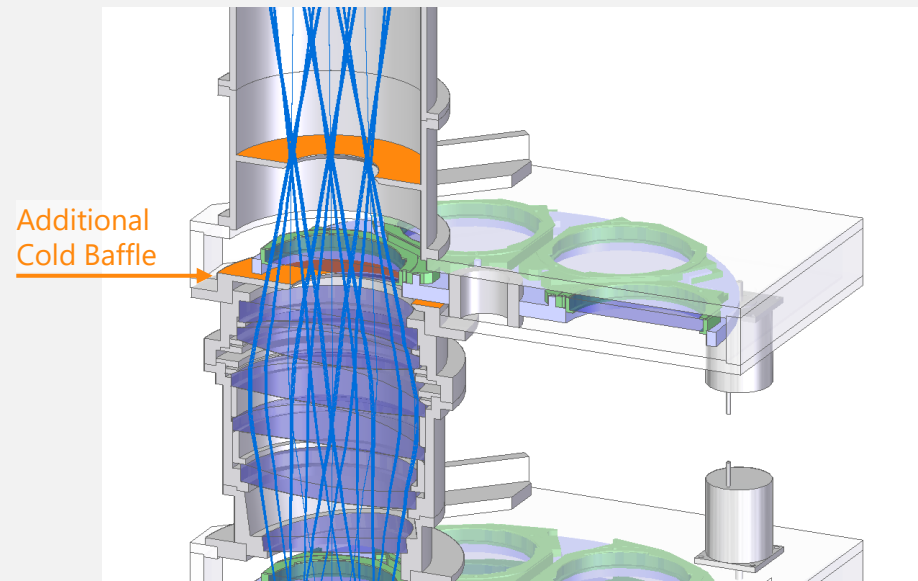
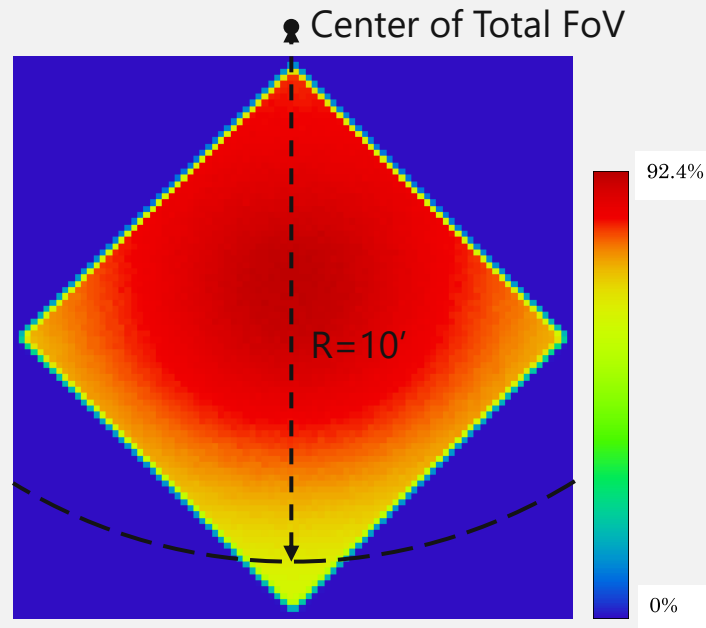
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Cryostat Design

Sumitomo Heavy Industries design

- Cylindrical shape cryostat dewar
- Truss support structure
- Two GM-cycle cooler

Should fit the requirements of Subaru Cassegrain instrument interface

- Weight requirement < 2 ton
- Current projected weight > 3 ton
- Instrument exchange with CIAX is not possible
- Height requirement < 1.91 m → OK



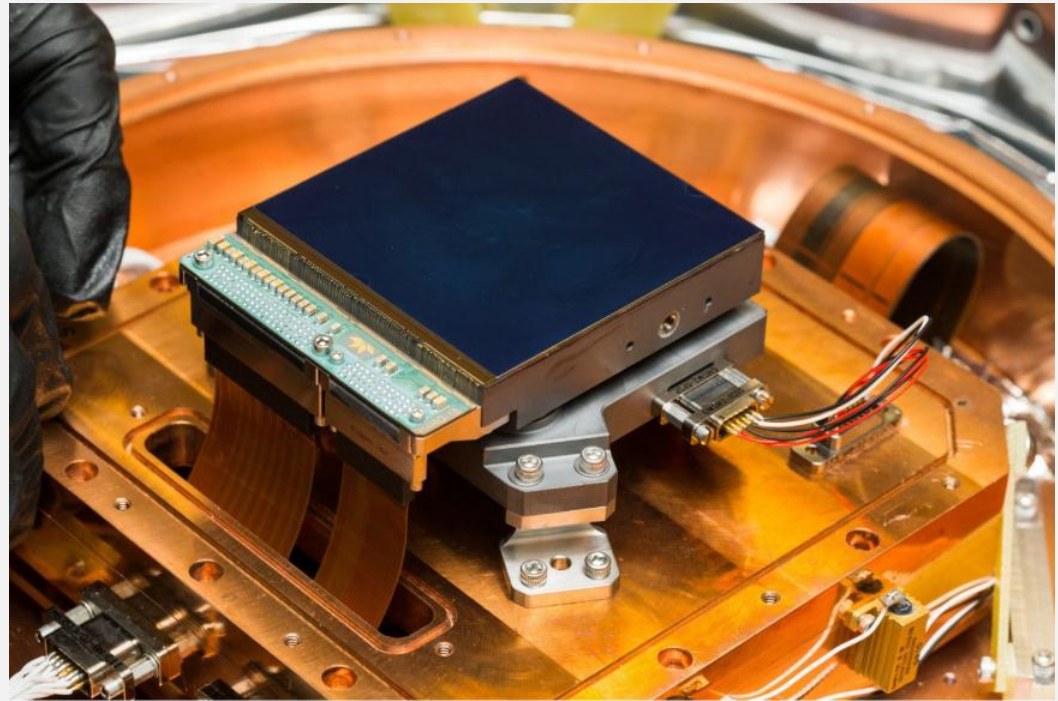
H4RG Detector

One HAWAII-4RG-15 per barrel

- 4088 × 4088 sensitive pixels
- 15 $\mu\text{m}/\text{pix}$

Procurement of only one H4RG just started

- Will be delivered in mid-2025
- Readout electronics:
2 SIDECAR-ASICs
- Expensive ...



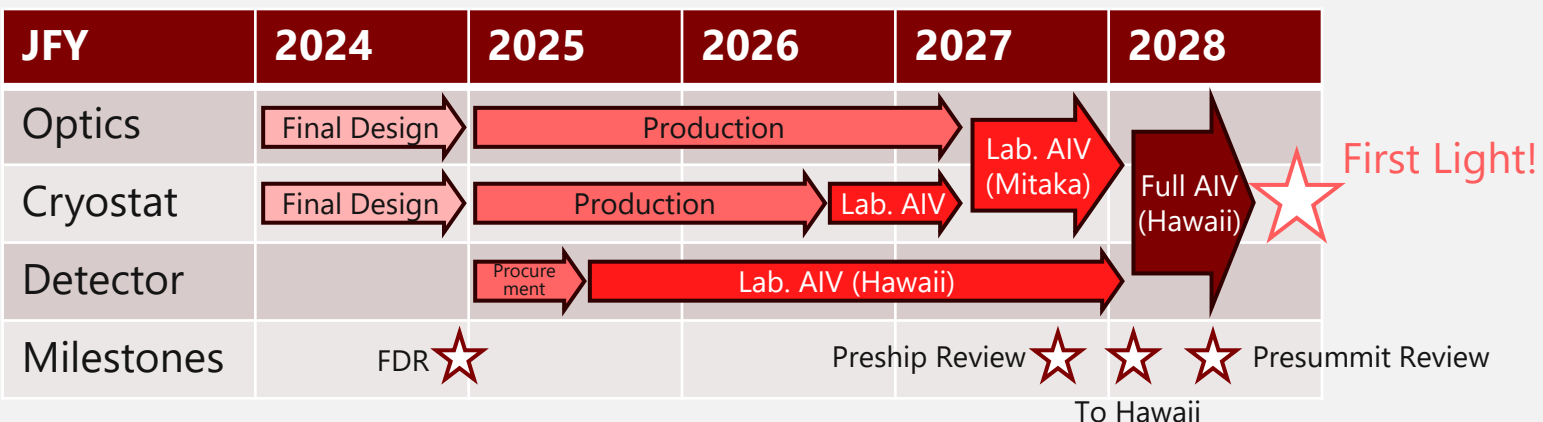
Hall et al. 2016

Funding Status & Schedule

Awarded JSPS Grant-in-Aid for Specially Promoted Research

- PI : Tadayuki Kodama (Tohoku Univ.)
- ~4.5M USD over 7 years (2024-2030)
- Only 1~2 out of 4 barrels will be fabricated
- The rests are expected through additional contributions from NAOJ and international collaborations (but not secured yet)

Schedule



Summary

- ULTIMATE-Subaru WFI is a near-infrared wide field imager that covers a wide and high-resolution image formed by GLAO.
 - FoV $\sim 14' \times 14'$
 - FWHM $\sim 0.2''$ at K-band
 - Various MB/NB filters
- The final design of the optics and cryostat is ongoing.
 - Four-barrel optical design
 - Exchangeable filter wheel
 - Additional cold baffles
 - Should meet the requirement of Subaru Cassegrain instruments
- Procurement of only one H4RG just started.
- Funding for only 1-2 optical barrels is awarded.

We are actively seeking opportunities to secure additional funding by establishing international collaborations.

- **Cash / In-kind contribution**
- **Participation in ULTIMATE-SSP**