NIR INSTRUMENT FOR GLAO

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Instrument for GLAO

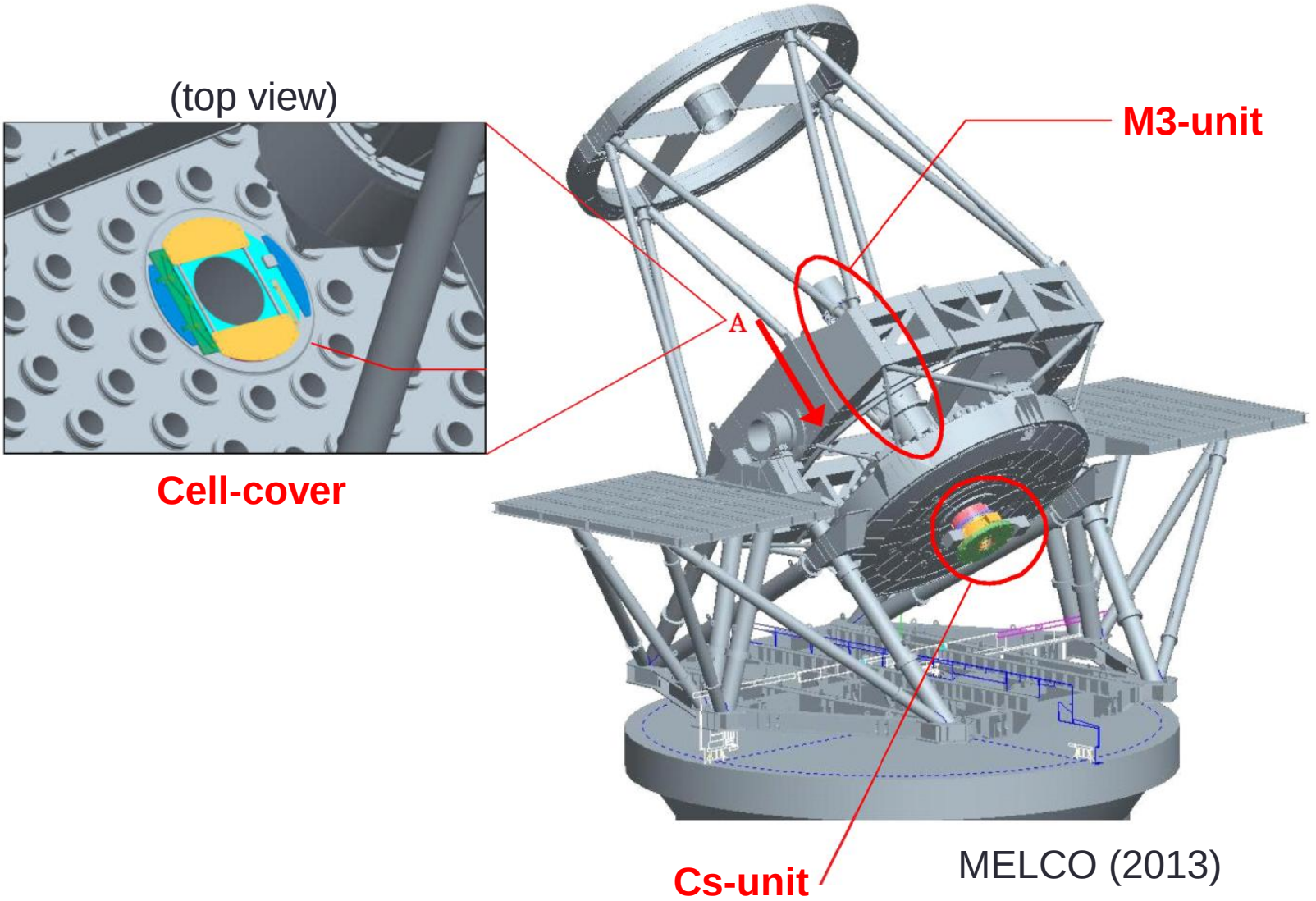
- Need for wide field NIR instrument
  - GLAO : good image quality over 15’ FoV
  - cf. current Cs NIR instrument (MOIRCS) has 4’ x 7’ FoV

- Three Candidates
  - Wide-Field Imager
    - conceptual study by Dr. John Pazder (HIA)
  - Wide-Field Imager and Multi-Object Spectrograph
    - optical designs by OptCraft
  - Multi-Object Integral Field Spectrograph
    - KMOS-like instrument?

Modifications to the Telescope

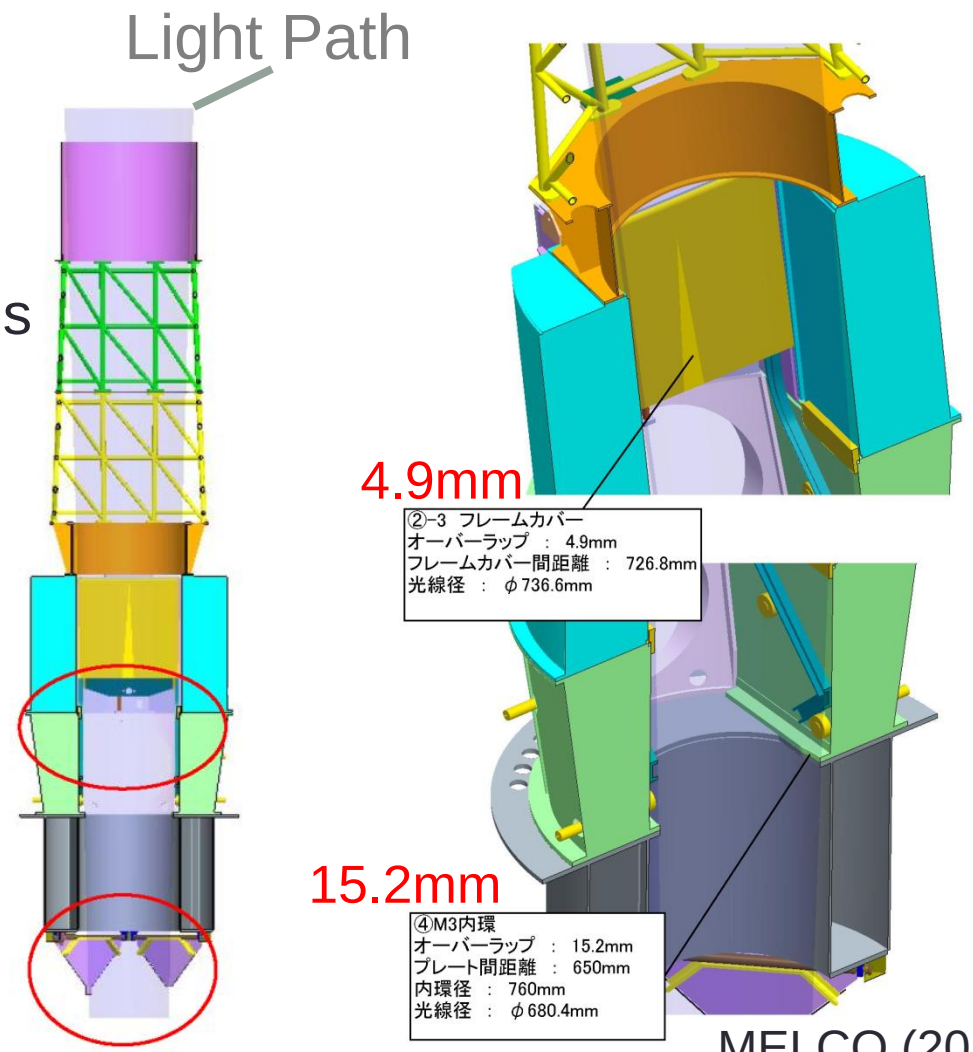
- original design of the telescope : *Φ*6’ FoV for Cs
  - modifications are necessary for wider FoV
  - may affect the plan of the new instrument
- study by MELCO
  - FoV up to ***Φ*20’** at Cs
  - vignettings by telescope structures : Cassegrain-unit, M3-unit, and Cell-cover

Vignettings by Telescope Structure



Vignettings by Telescope Structure

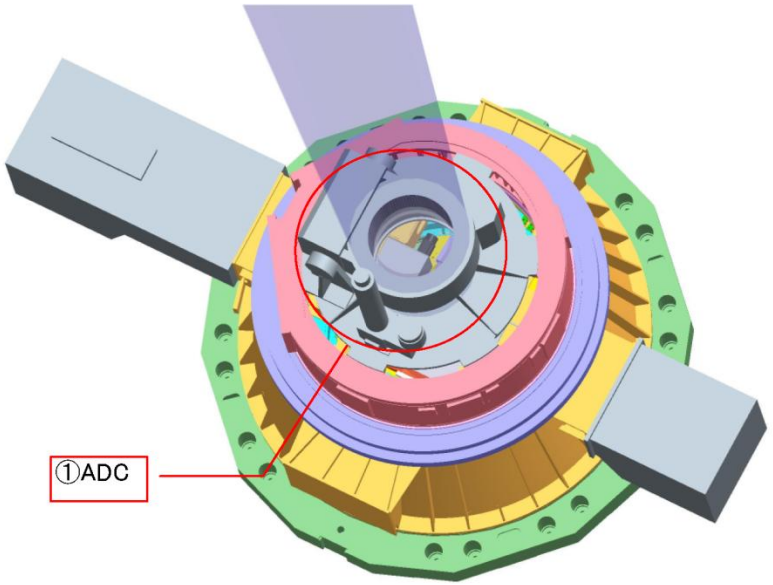
- 14’ FoV
  - M3-unit
    - 2 small overlaps
    - only small modifications are necessary

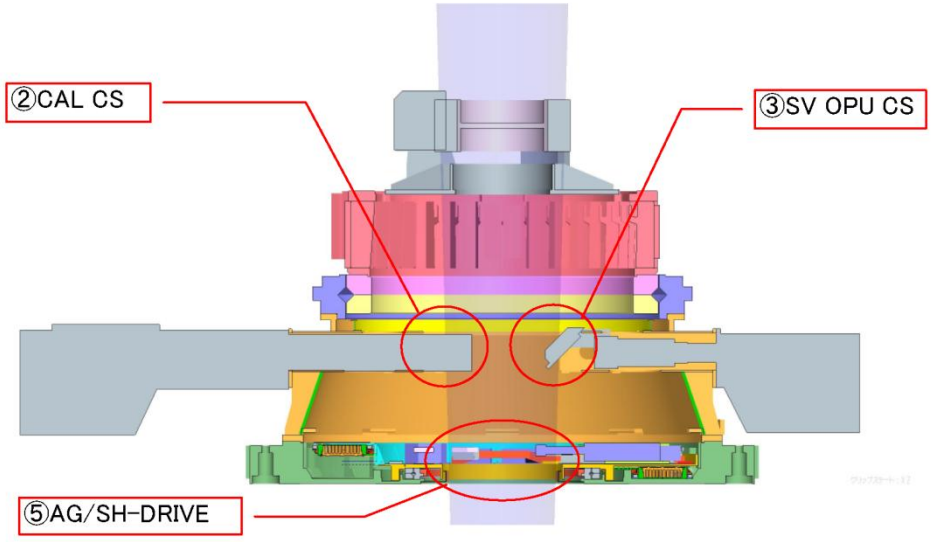


MELCO (2013)

Vignettings by Telescope Structure

- 14’ FoV
  - Cs-unit
    - ADC, AG/SH, CAL, and SV are need to be removed and implemented to the new instrument if necessary

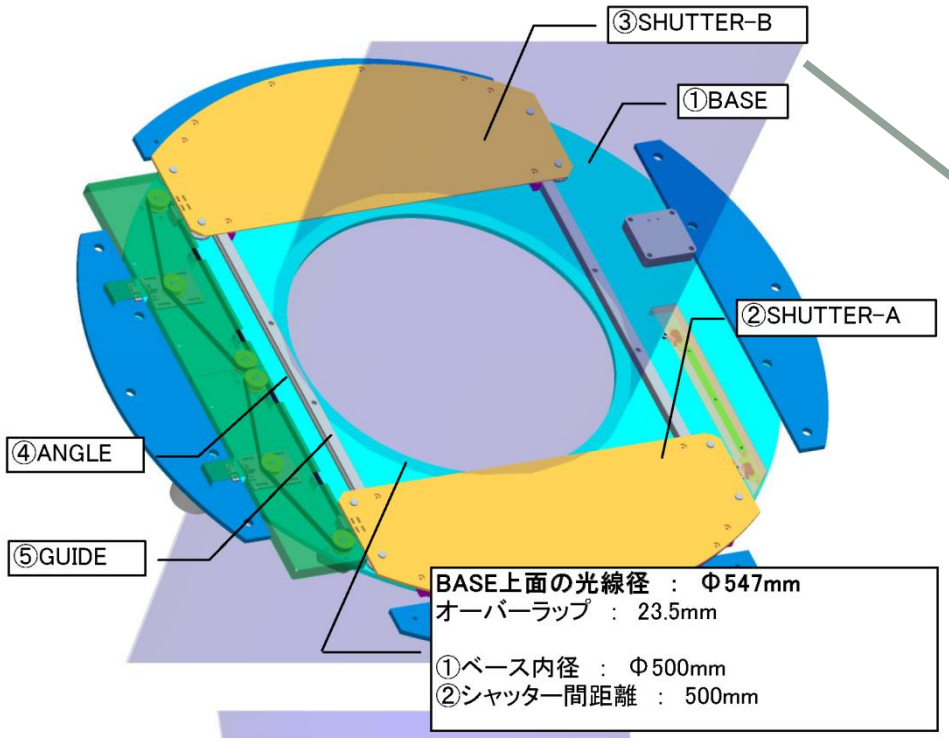




MELCO (2013)

Vignettings by Telescope Structure

- 14’ FoV
  - Cell-cover
    - has to be removed/replaced for FoV > Φ12’

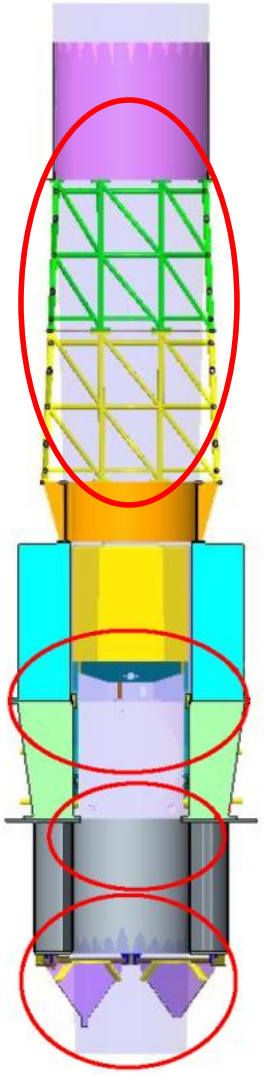


Light Path
(Φ14’)

MELCO (2013)

Vignettings by Telescope Structure

- 20’ FoV
  - most structures of M3-unit overlap Φ20’ light path
  - new development of M3-unit is necessary



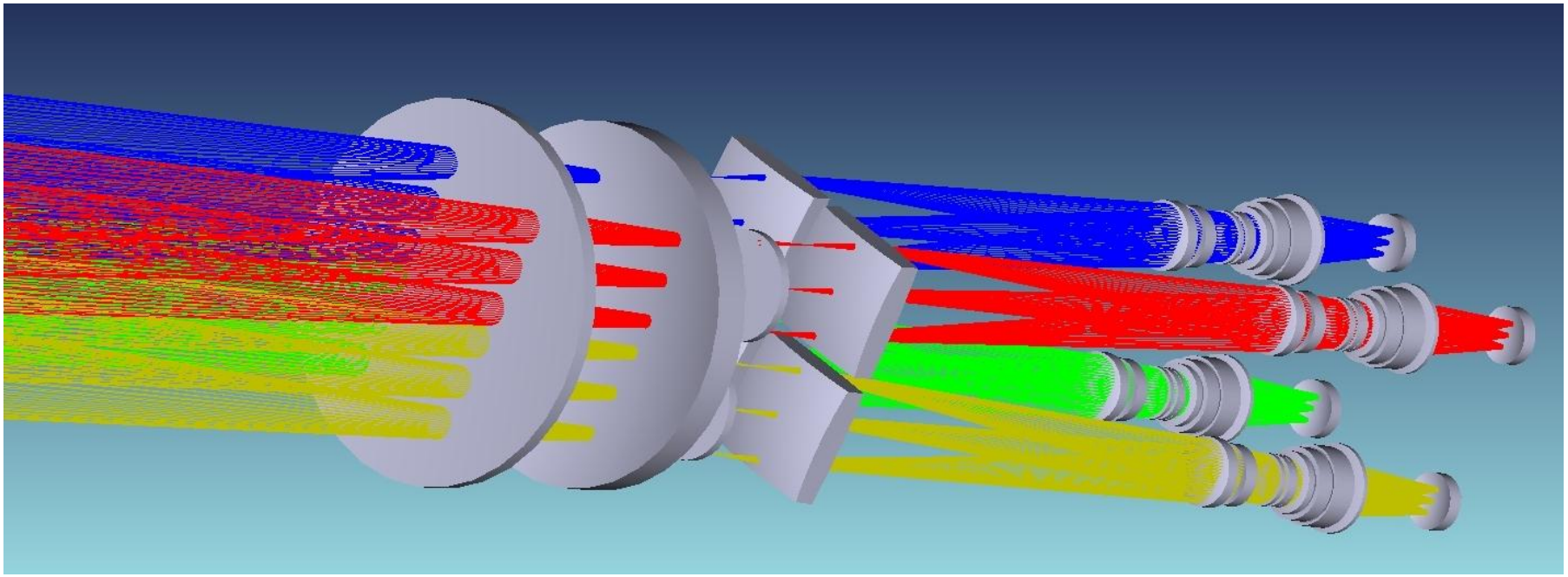
MELCO (2013)

Modifications to the Telescope

- Summary
  - ≦Φ12’
    - remove/replace ADC, AG/SH, CAL, and SV in Cs-unit
  - Φ14’
    - remove/replace cell-cover
    - small modifications to M3-unit
  - Φ20’
    - new development of M3-unit
      - significant modification to the telescope
    - need more study

(1) Wide Field NIR Imager

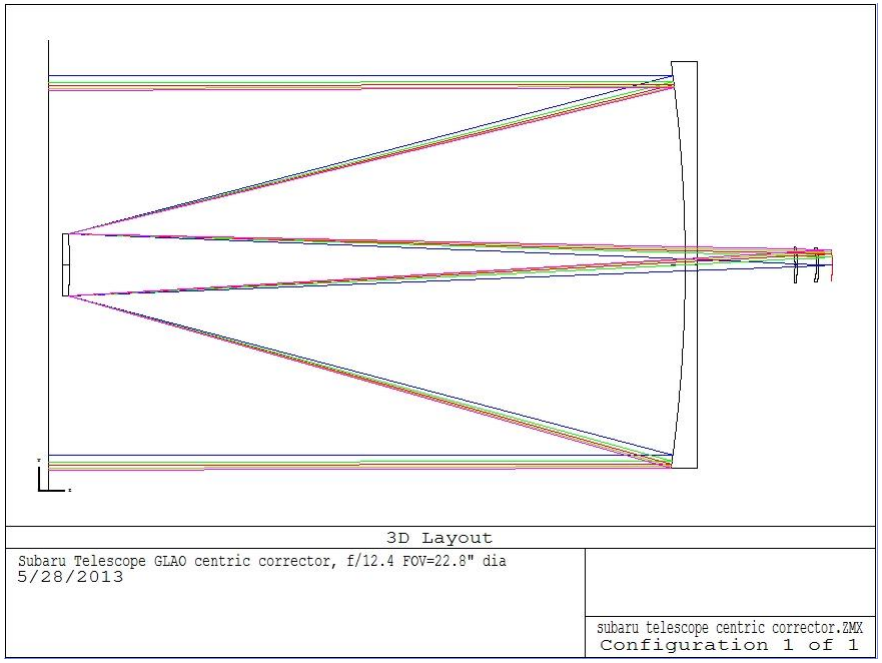
- conceptual study by Dr. John Pazder (HIA)
- concentric corrector + 4-barrel imaging system

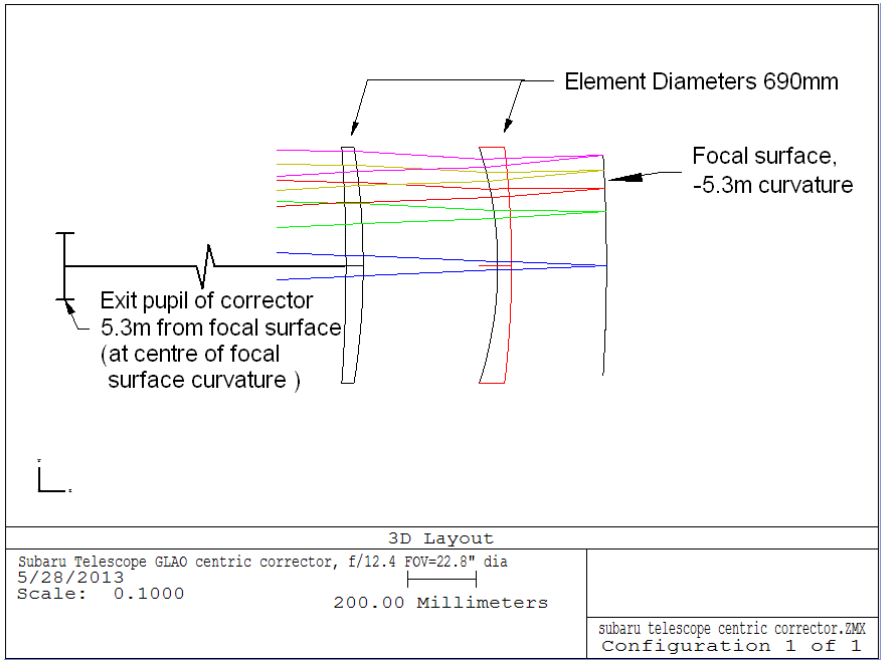


Pazder (2013)

(1) Wide Field NIR Imager

- concentric corrector
  - universal GLAO focus station (22'.8 FoV)
  - image quality < 66mas at the telescope focus
- **<u>require significant modification to the telescope</u>**



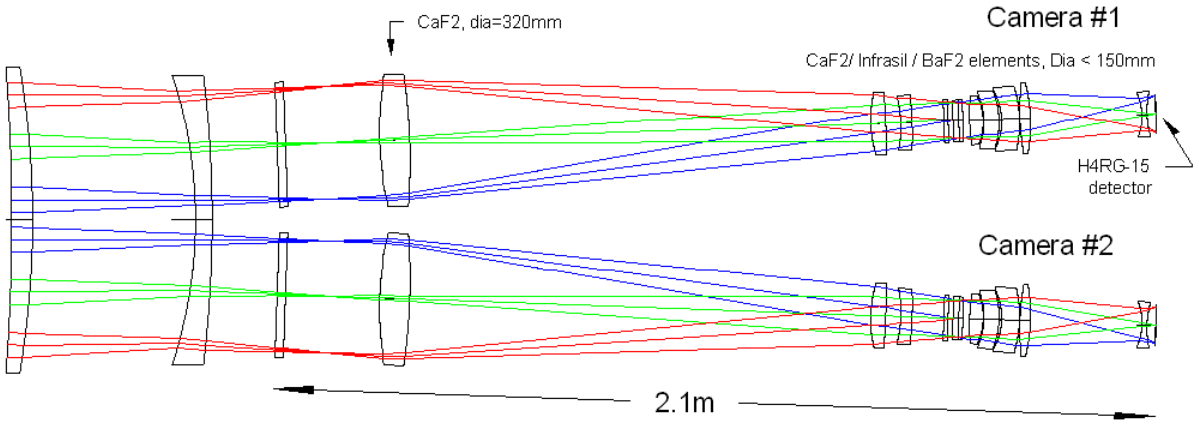


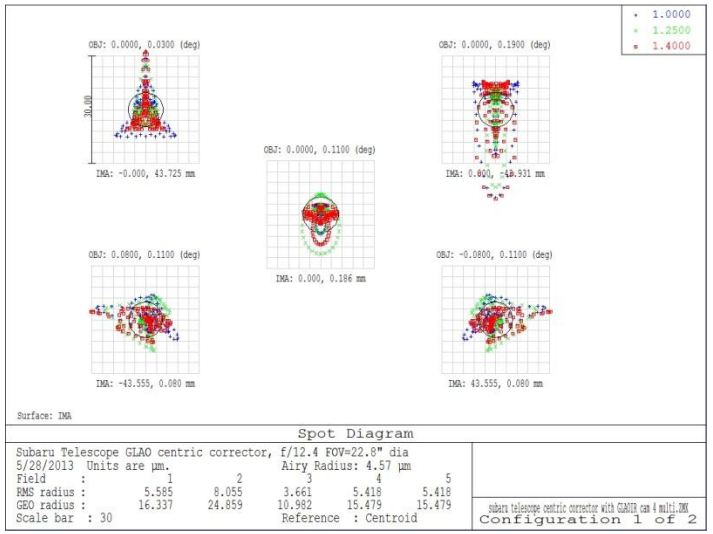
Pazder (2013)

(1) Wide Field NIR Imager

- imaging system
  - each camera covers 6’.8x6’.8
    - 0”.1 sampling with one H4RG-15
  - image quality at the detector

    < 1pixel (except at the outer corner, rms diameter~16μm)





Pazder (2013)

(1) Wide Field NIR Imager

- specifications

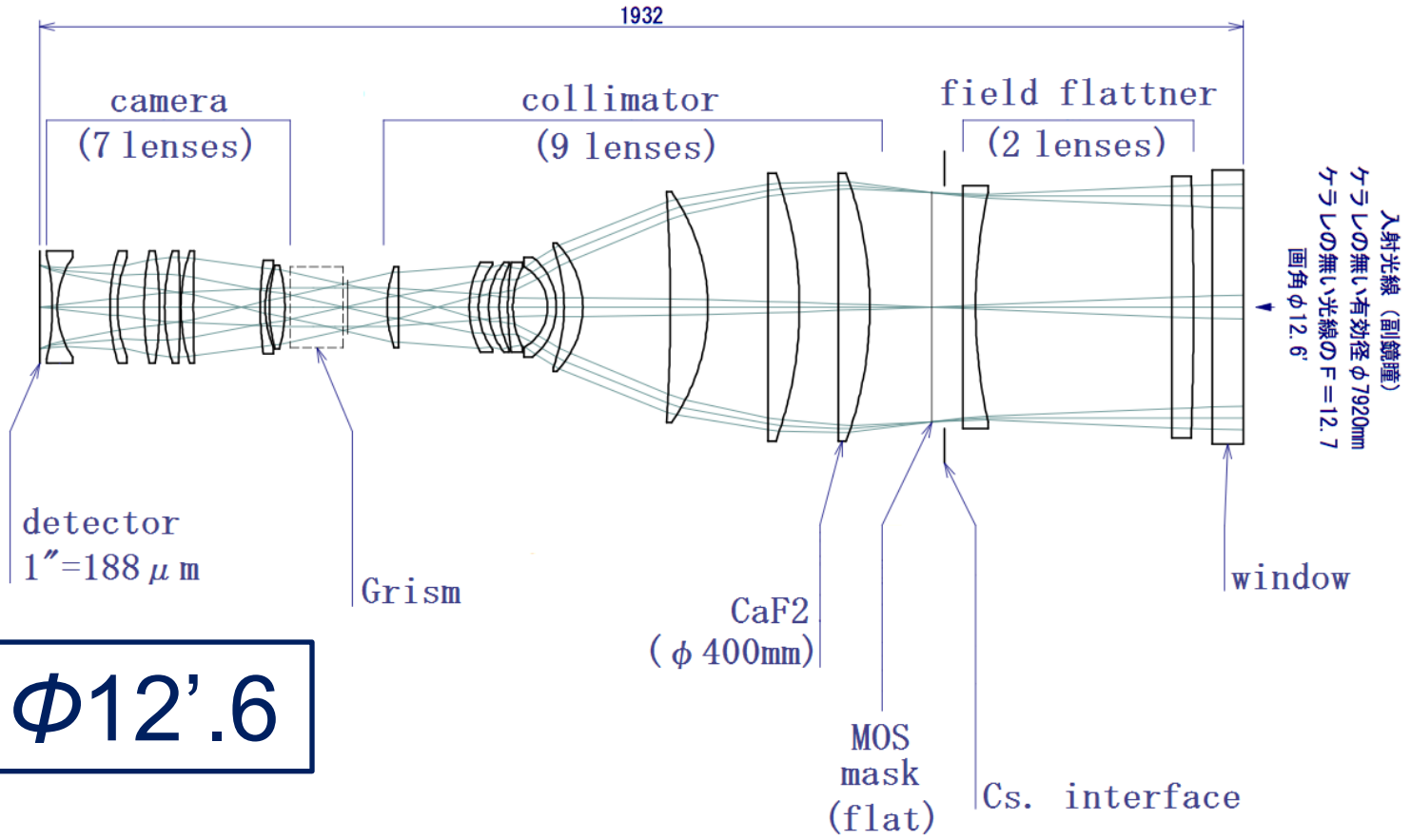
Wavelength	0.8-2.5μm
Pixel Scale	0”.1 / pixel
FoV	6’.8x6’.8x4 (185□’)
Detectors	H4RG x 4
Filters	Broad + Narrow

(2) Wide Field NIR Imager and MOS

- optical designs by OptCraft
  - with/without FoV splitting
  - with/without change in M2 parameters (and M1 deformation)
  - optical components (CaF2) < 400mm
  - image quality < 0”.15 in 0.8-2.5μm (goal)
  - flat focal plane for MOS
- MOS mask exchanger, narrow-band filter
  - need studies

(2) Wide Field NIR Imager and MOS

- single FoV, no-change to M2 parameters

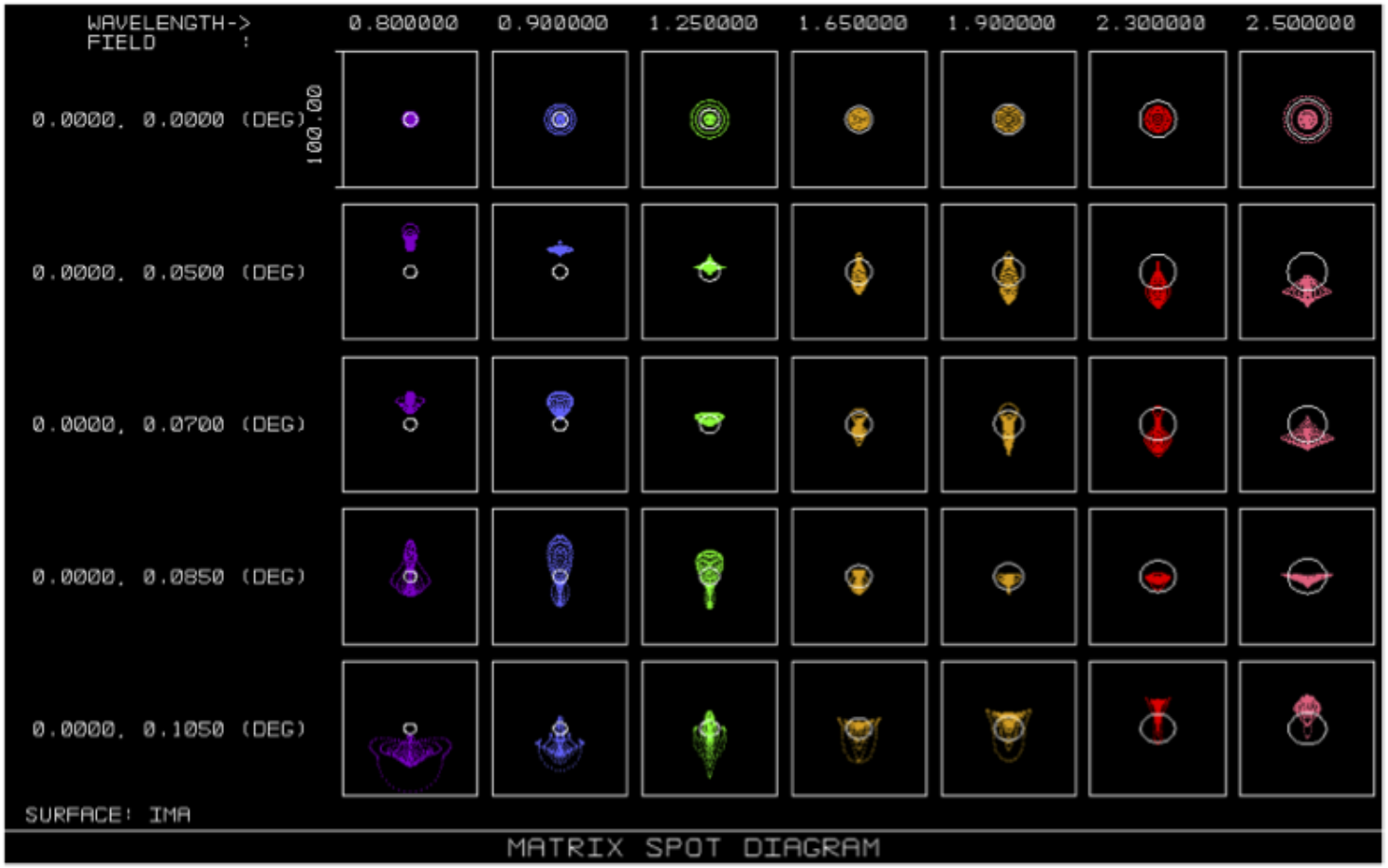


FoV Φ12’.6

OptCraft (2012)

(2) Wide Field NIR Imager and MOS

- single FoV, no-change to M2 parameters (imaging)
  - image quality <0”.15 rms except for 800-900nm (<0”.18)



100μm
=0”.53

OptCraft (2012)

(2) Wide Field NIR Imager and MOS

- specifications under consideration

Wavelength	0.8-2.5μm
Pixel Scale	0”.06 – 0”.1 / pixel
Detectors	H4RG x 4
Filters	Broad + Narrow
MOS	Multi Slit Mask
Dispersion	R=2000-3000

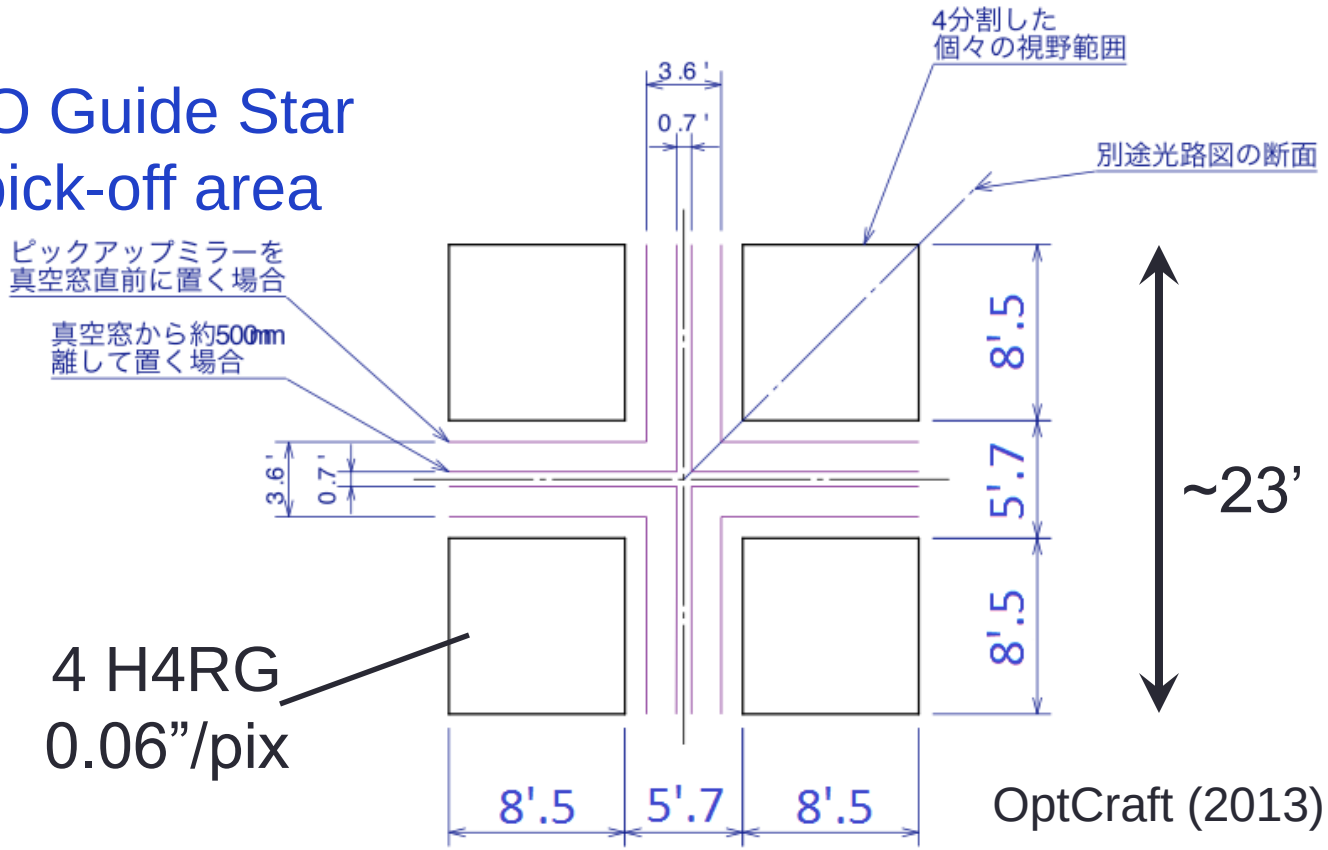
(2) Wide Field NIR Imager and MOS

- spatial sampling and FoV

Pixel Scale	FoV for 4 H4RGs
0.06	8’.19
0.07	9’.56
0.08	10’.92
0.09	12’.29
0.10	13’.65

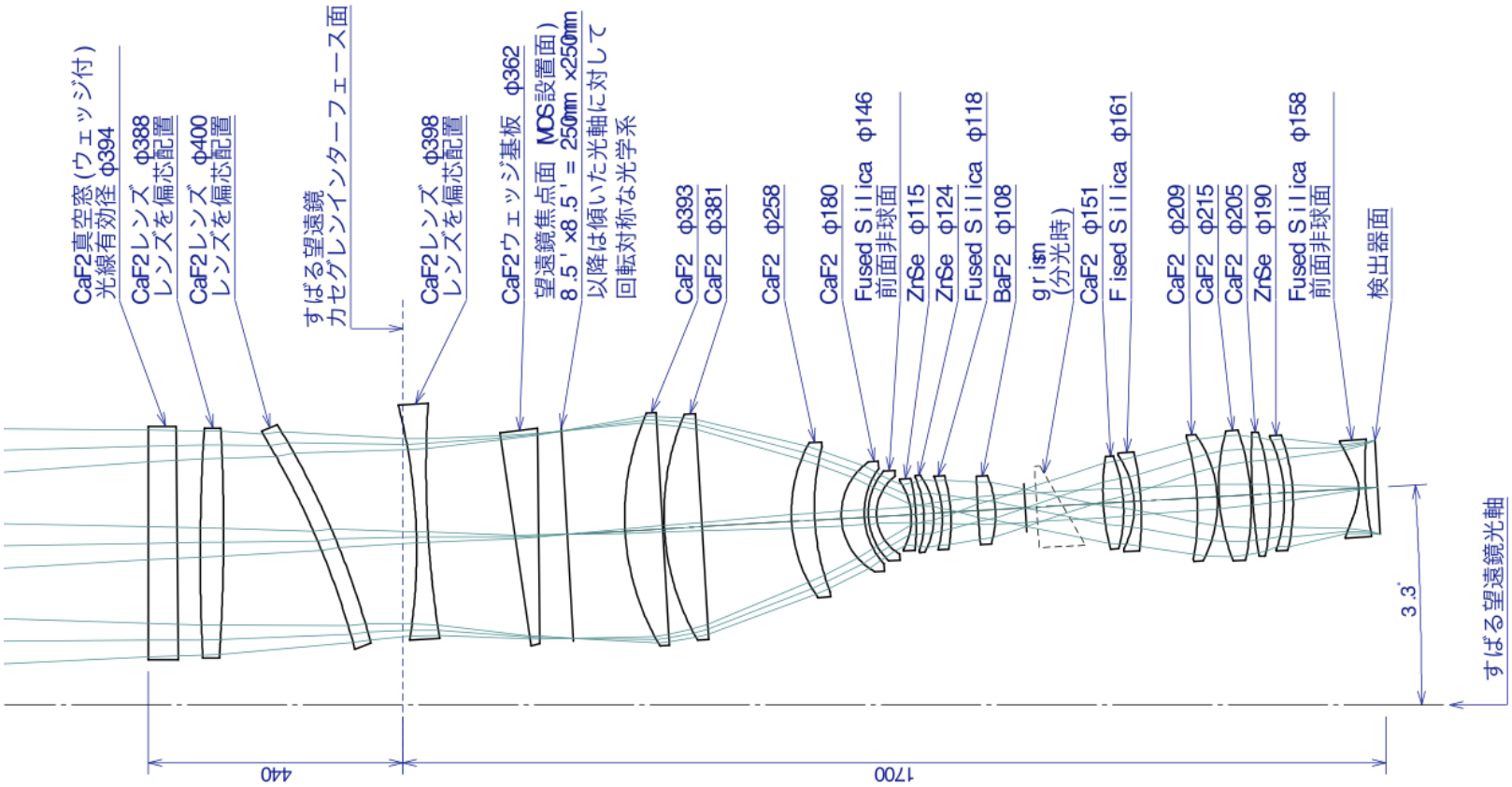
(2) Wide Field NIR Imager and MOS

- A case with FoV splitting
  - **require significant modifications to the telescope**



(2) Wide Field NIR Imager and MOS

- A case with FoV splitting



(1 of the four FoVs)

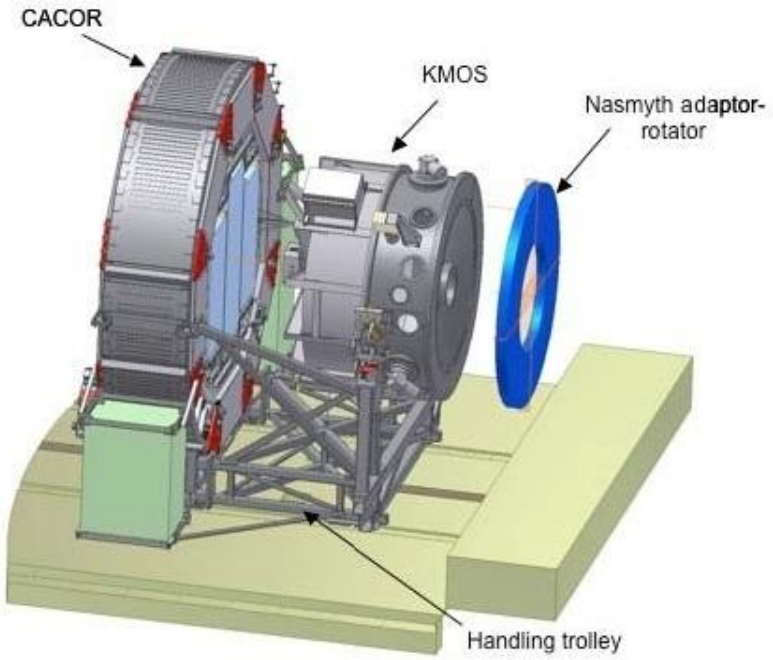
OptCraft (2013)

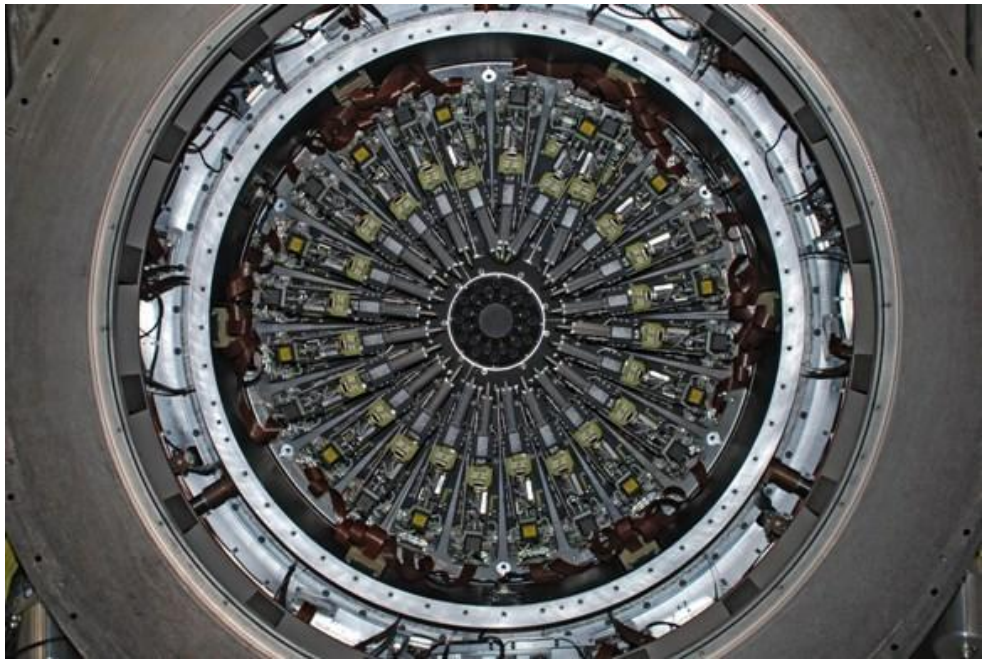
(2) Wide Field NIR Imager and MOS

- grism performance study by Photocoding
  - ZnSe or Si grisms for R=3000-3500
- mechanical feasibility study by SHI
  - the case with FoV splitting
  - ongoing

(3) Multi-Object Integral Field Spectrograph

- no specific study so far
- instrument similar to KMOS (VLT)





KMOS

(3) Multi-Object Integral Field Spectrograph

- specifications under consideration

Wavelength	0.8-2.5μm
Pixel Scale	0”.15 / pixel
Number of IFU	24
FoV/IFU	1”.8 x 1”.8
Patrol Area	13-16’ ?
Dispersion	R=2000-3000 ?

Three Levels of Instrument Plan for GLAO

(0) No new instrument – use MOIRCS
(1) Wide-field NIR Imager
(2) Wide-field NIR Imager + MOS (WFNIRMOS)
(3) Multi-object Integral Field Spectrograph

- Which instrument is essentially important for your science cases?

- What is the optimal sampling/FoV for your science cases?

Spatial sampling vs. FoV

- NIR Imager or Imager+MOS

Pixel Scale	FoV for 4 H4RGs
0.06	8’.19
0.07	9’.56
0.08	10’.92
0.09	12’.29
0.10	13’.65