MOIRCS Upgrade Project - 'nuMOIRCS': *The First Near-IR IFU for Subaru Telescope*

I. Iwata (Subaru Telescope)
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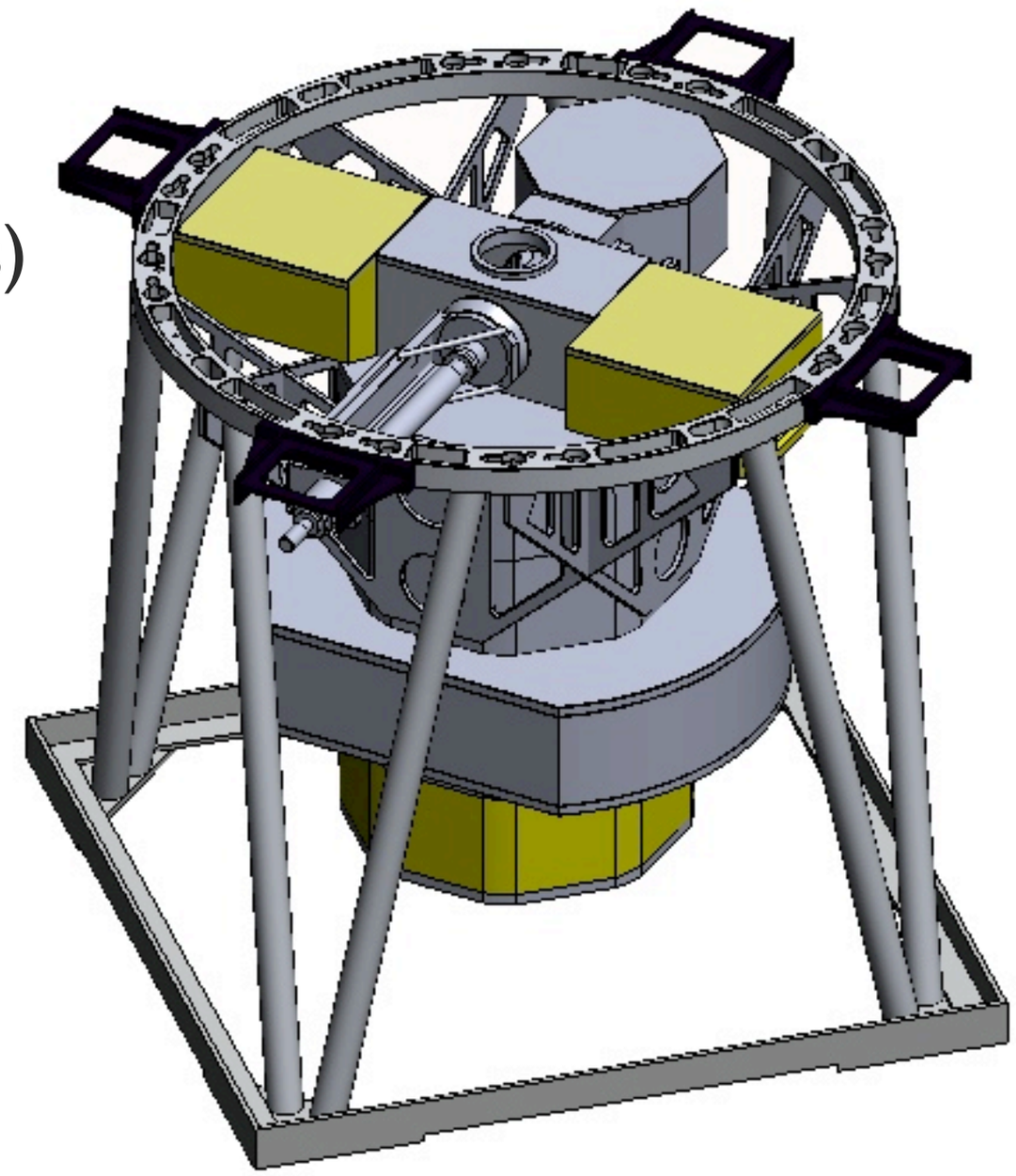
N. Arimoto, T. Kodama, A. Ferré-Mateu (Subaru Telescope)
S. Ozaki (TMT, NAOJ)

MOIRCS Basic Parameters

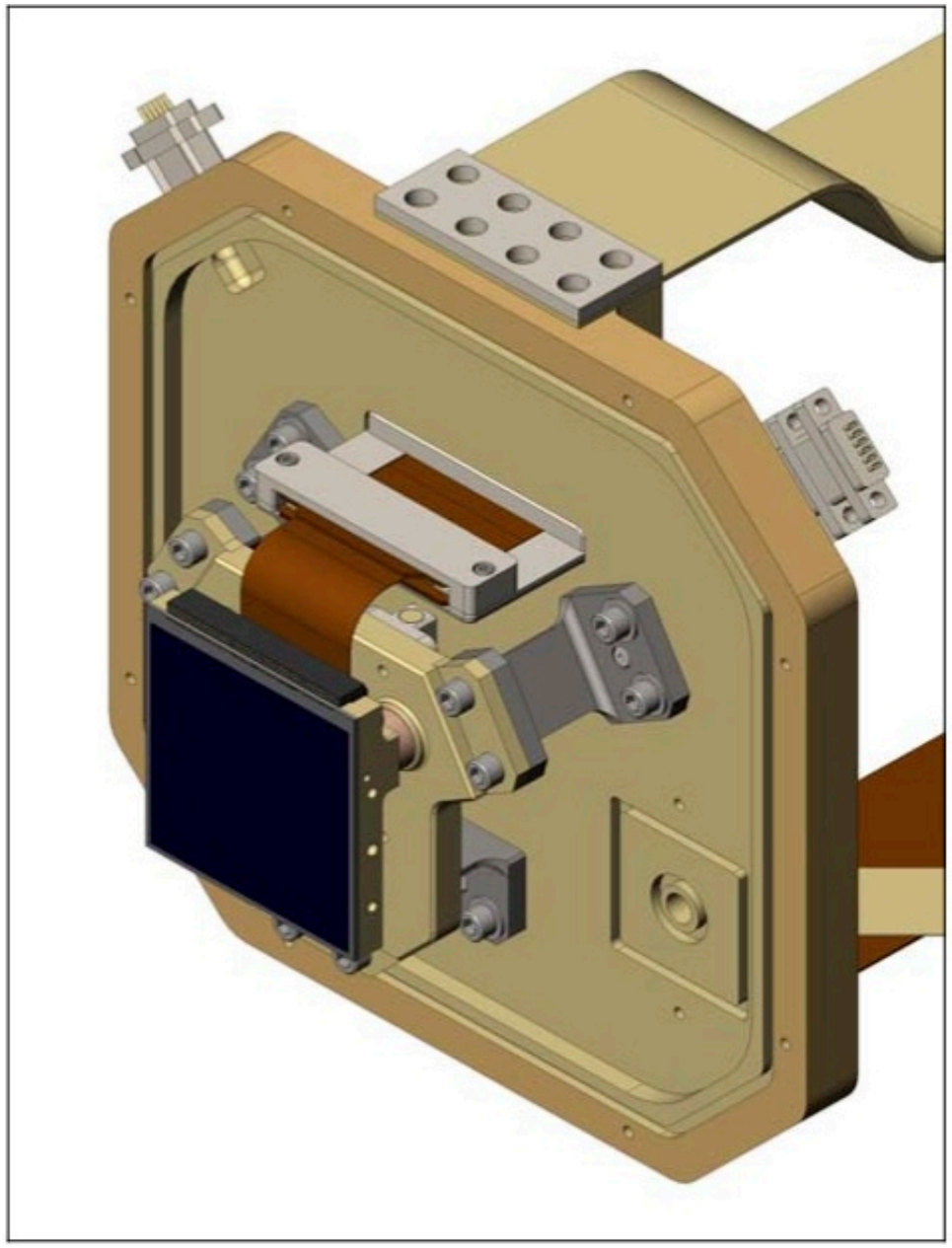
Detectors	HAWAII-2 (2k x 2k) x 2
Pixel Scale	0.117”
Field of View	3.94’ x 6.90’
Filters	Broad and Narrow Band Filters
Grisms	zJ, HK, R1300, VPH
# of MOS masks	15

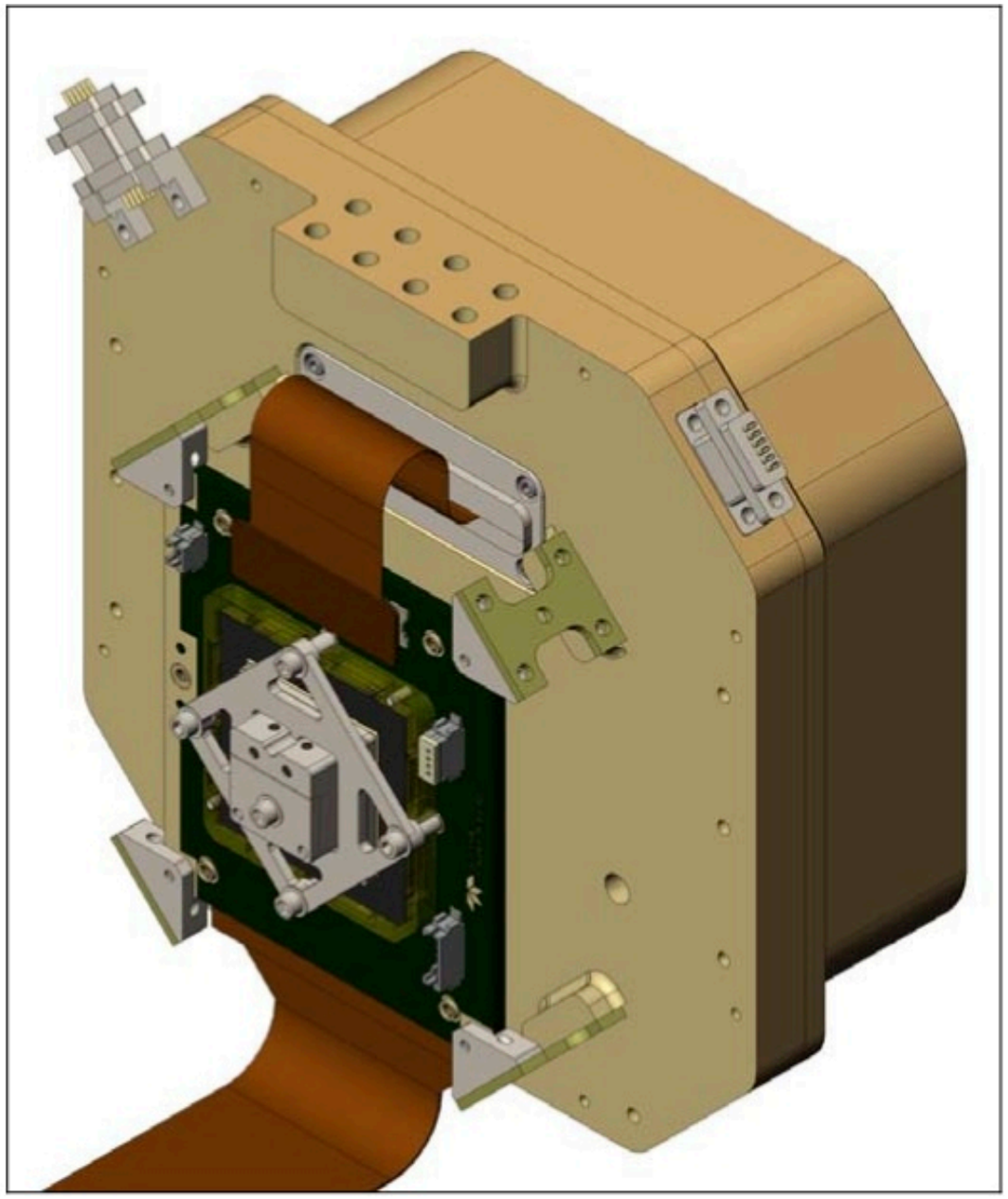
MOIRCS Upgrade Project

- Replacement of Detectors
  - HAWAII-2 to H2RG
- Installation of Integral Field Unit(s)
- Miscellaneous Improvements
  - More stable mask exchanger
  - Adjustment of focus position

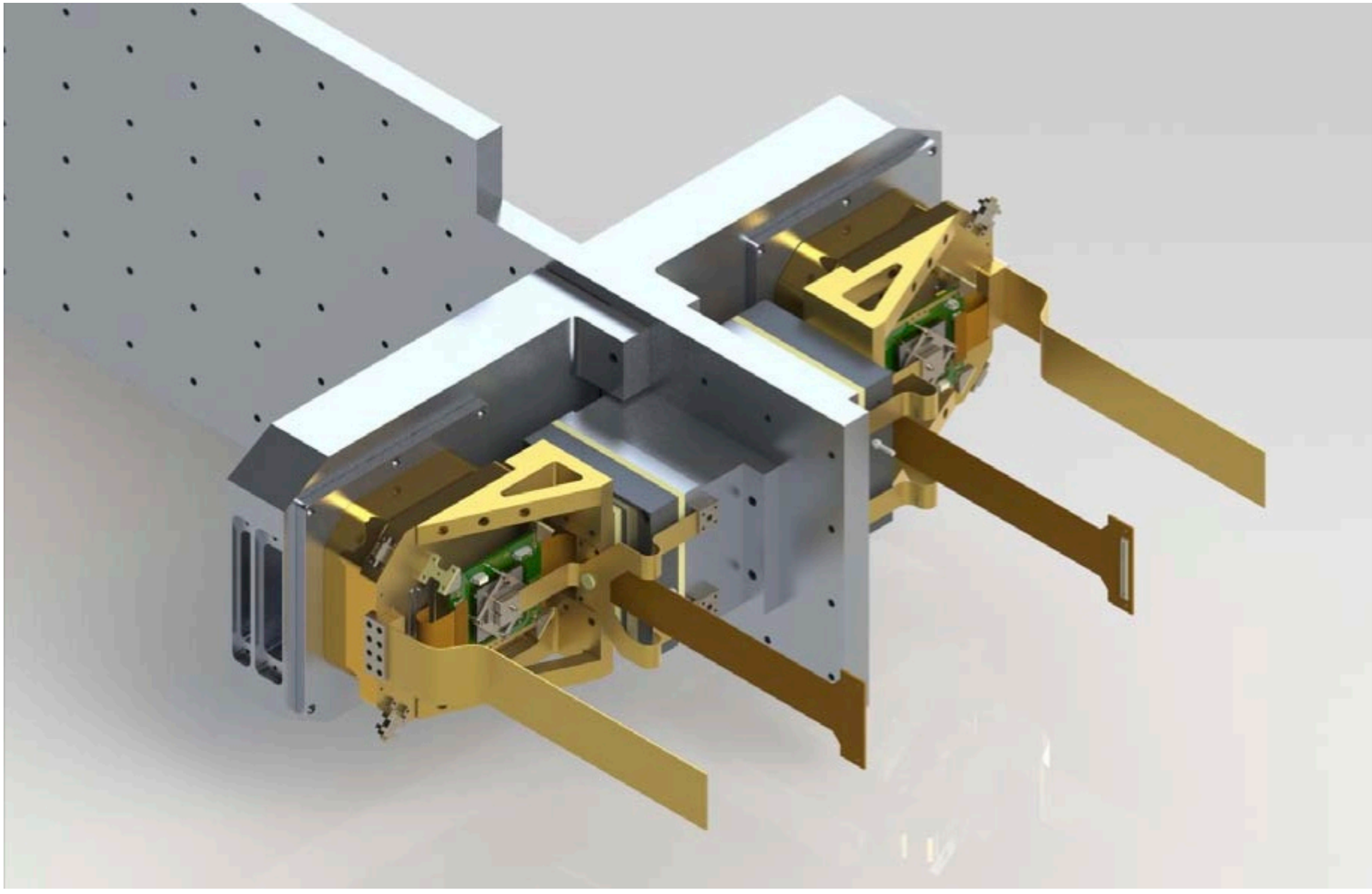


H2RG Focal Plane Unit Design





H2RG Focal Plane Unit Design



Detector Replacement

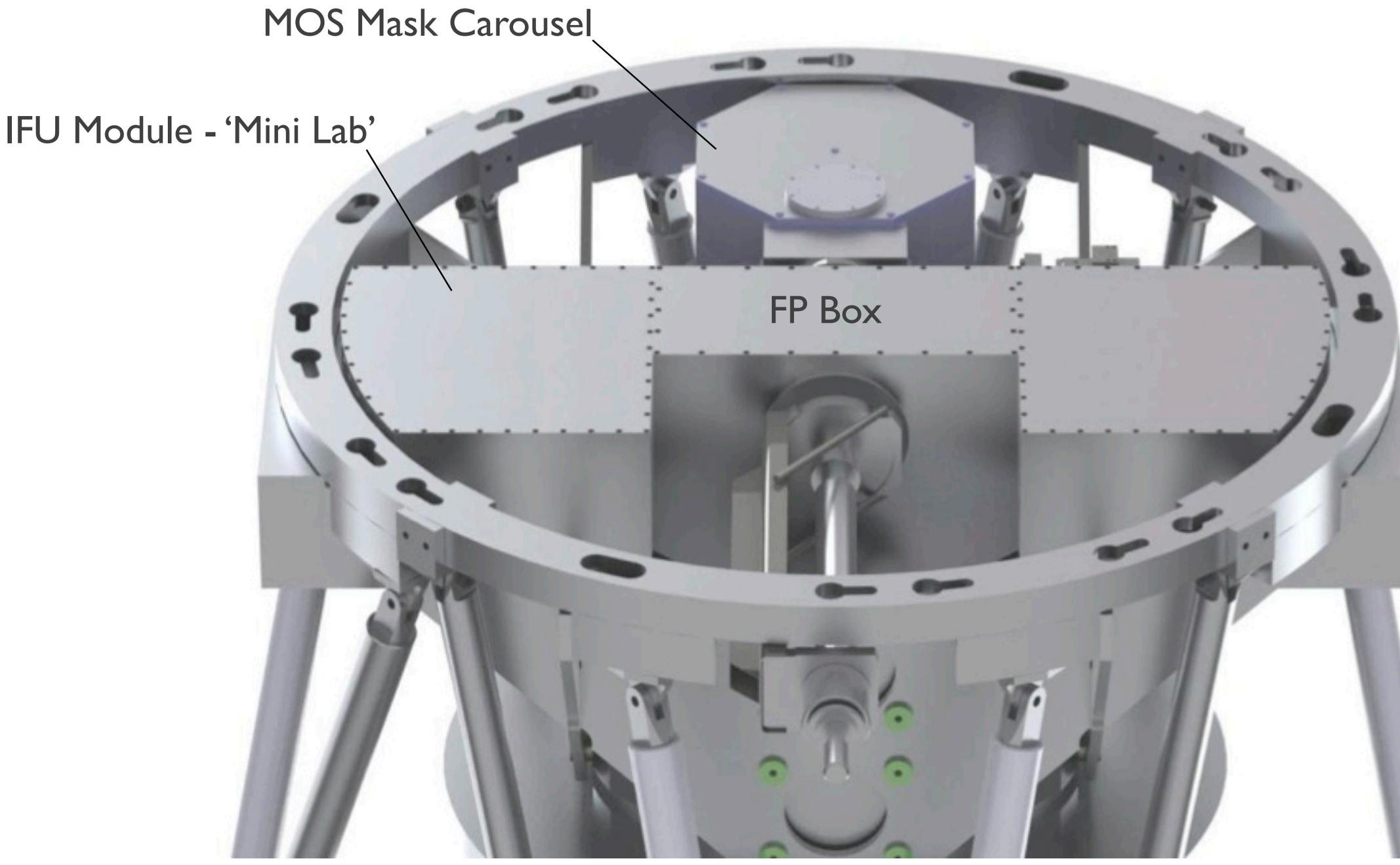
- HAWAII-2 + TUFPAC → H2RG + SIDECAR-ASIC + SAM (SIDECAR Acquisition Module)
- Focal Plane Module Design by GL Scientific, Honolulu
  - Fabrication design finished
  - Now considering focus adjustment mechanism
- Software Development and Integration to Instrument Control Software: ASIAA

Integral Field Units

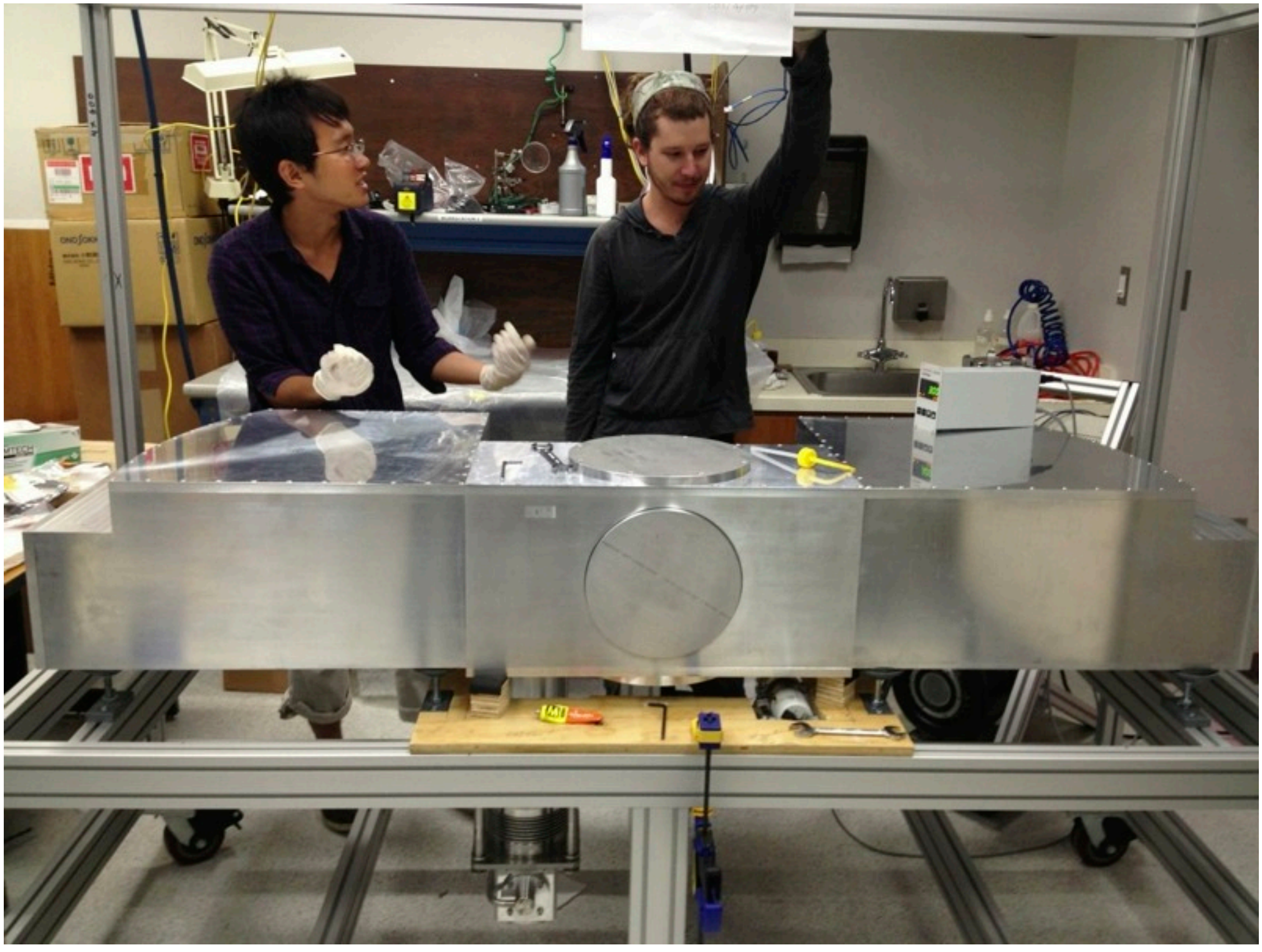
1. Fiber IFU (Nishimura)
2. Micro-Lens Array (MLA) IFU (Ishigaki)

- 'MiniLab': a copy of Focal Plane Box of MOIRCS + New Boxes for IFUs
  - Development and test of IFUs can be made independently from MOIRCS

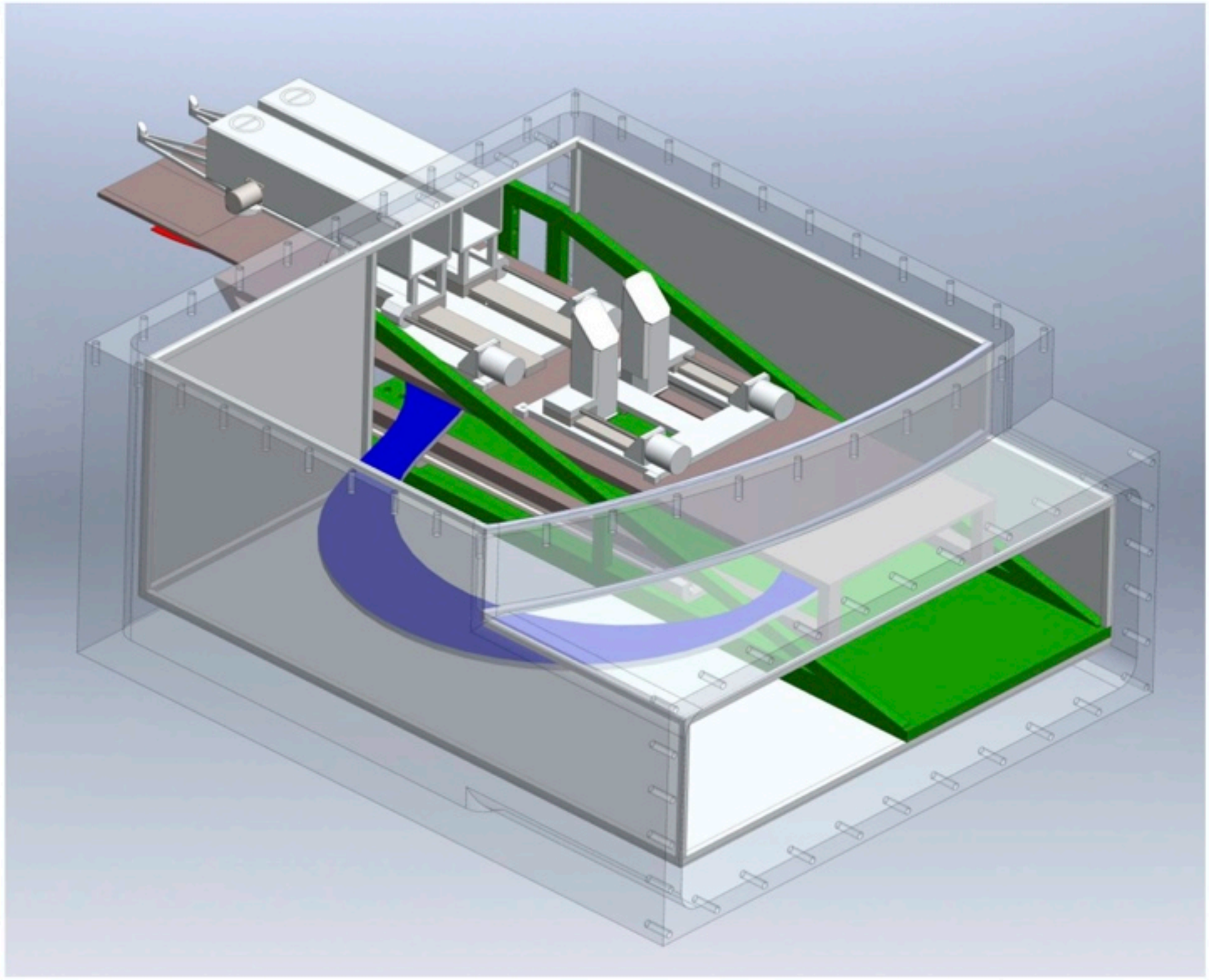
MOIRCS Focal Plane



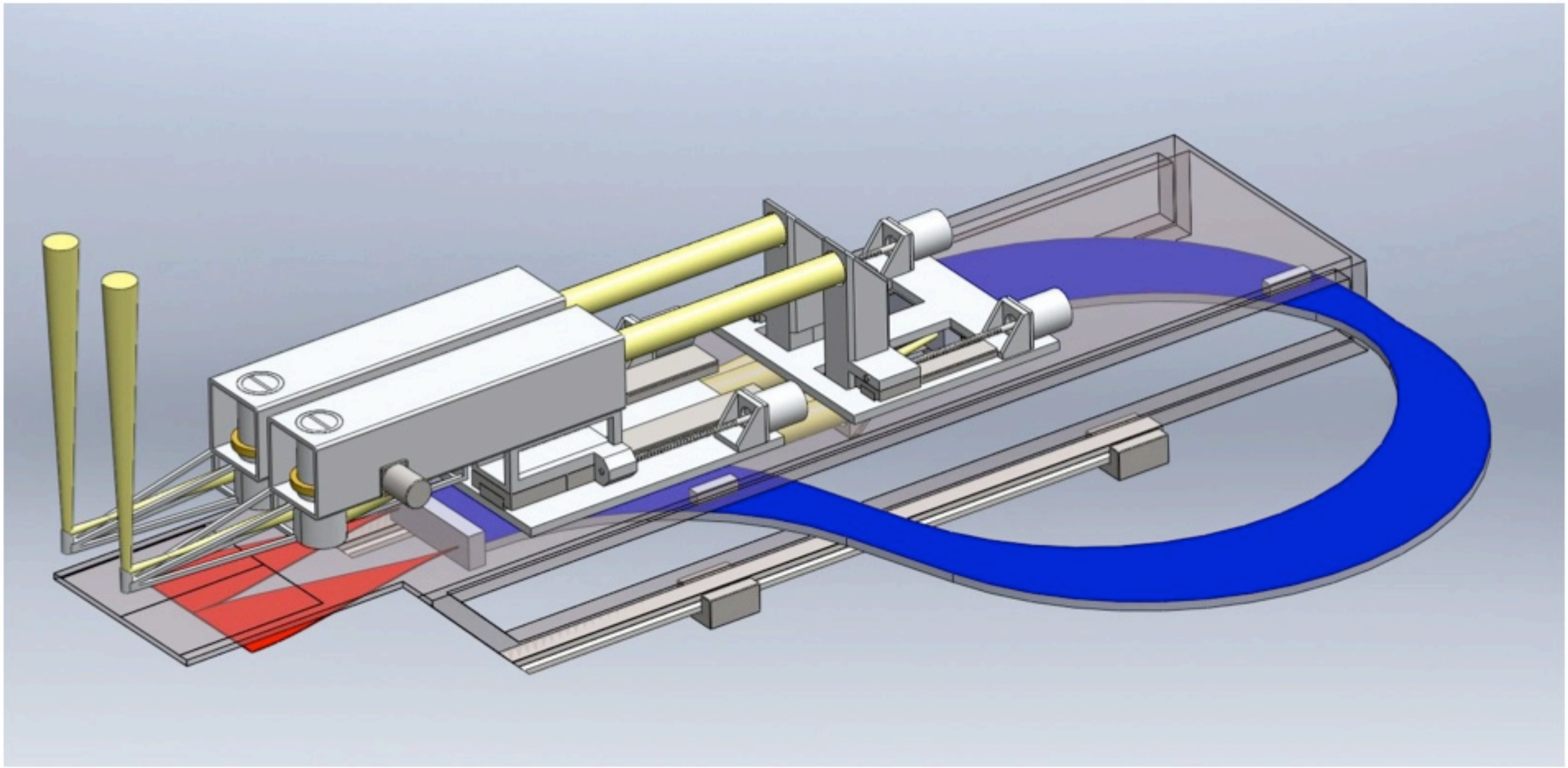
First MiniLab Assembly in Hilo (Sept. 2013)



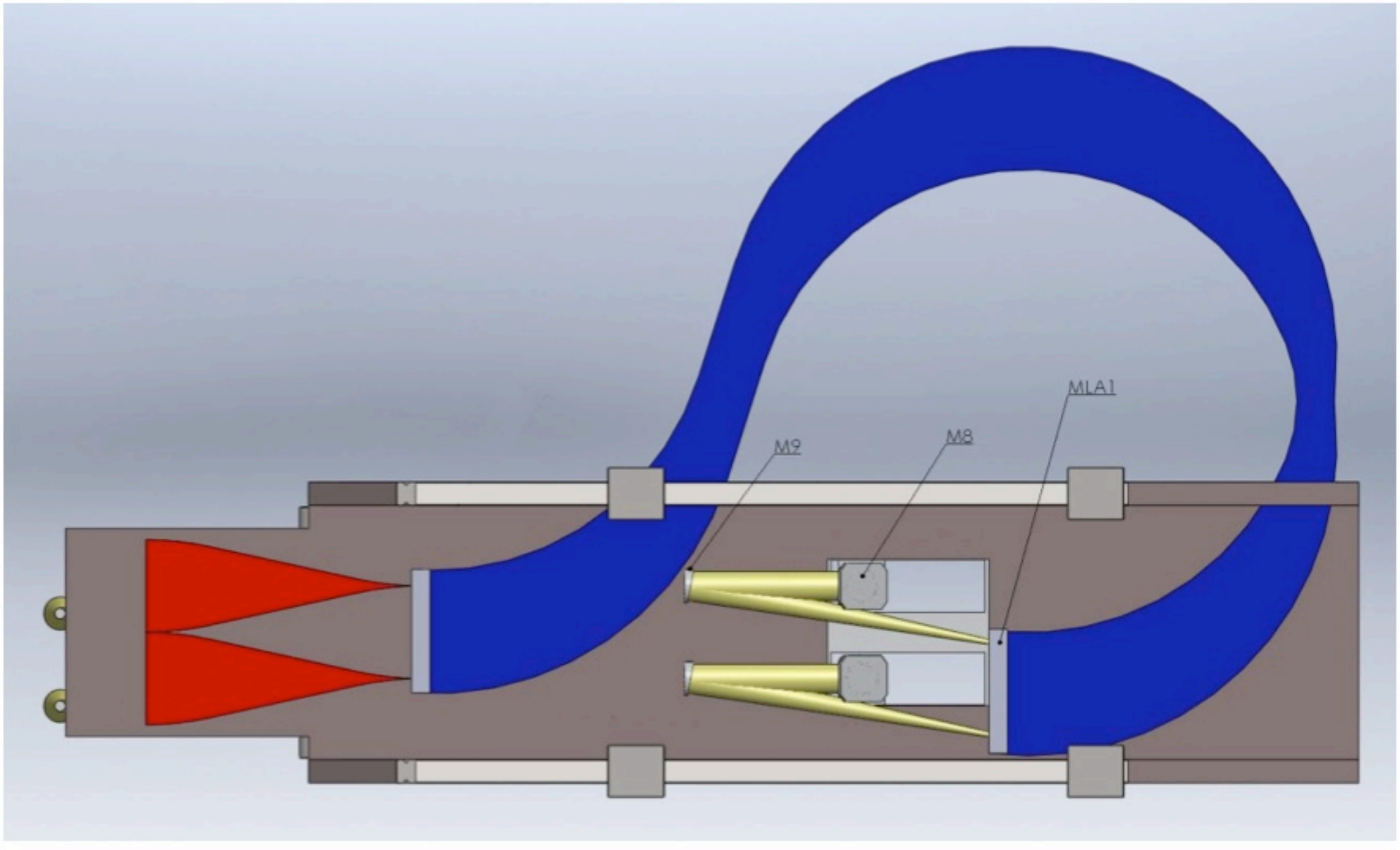
Fiber IFU Design by STM



Fiber IFU Design by STM

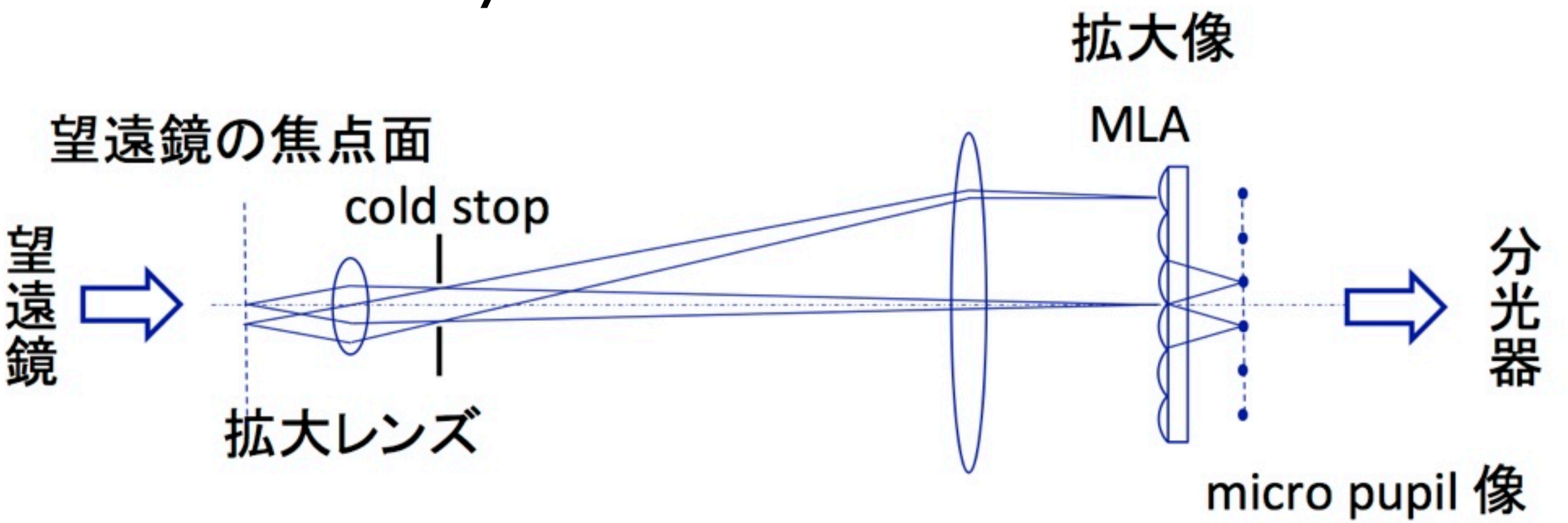


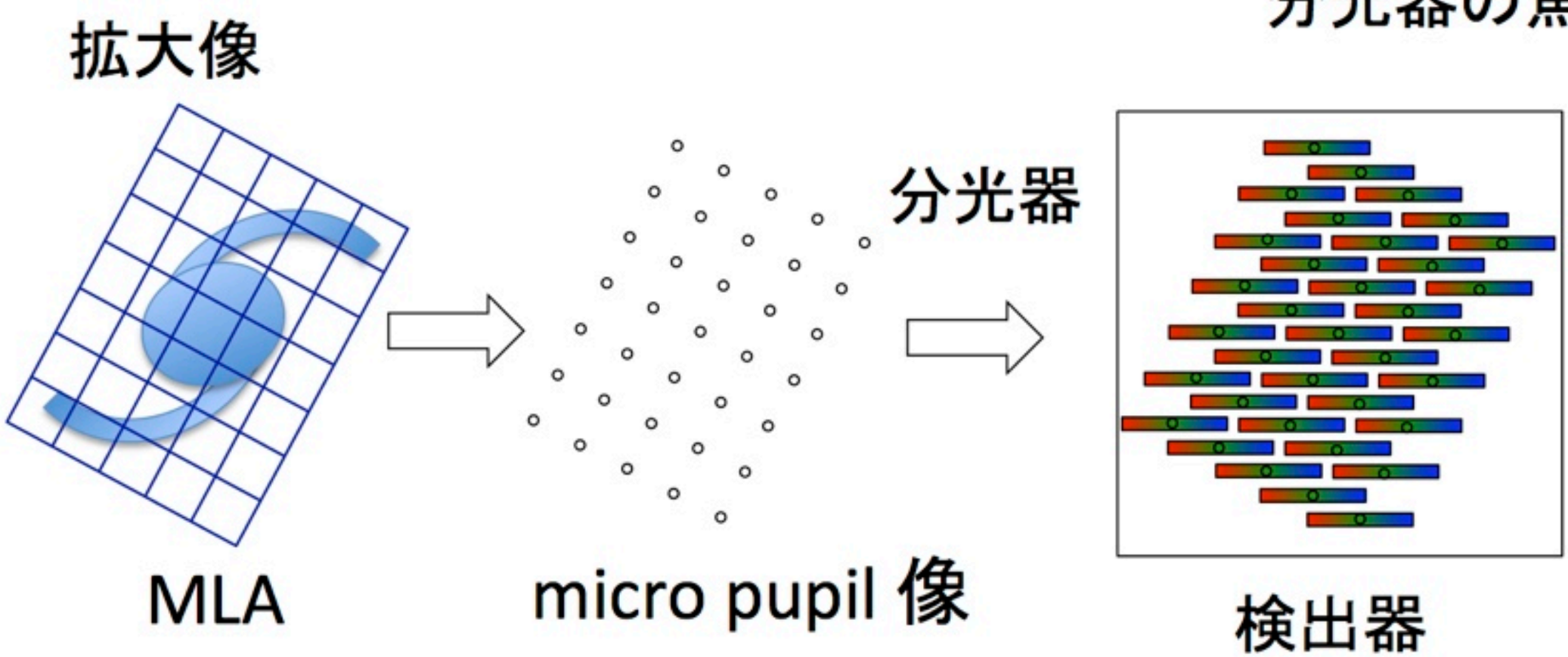
Fiber IFU Design by STM



Slide by T. Ishigaki

Micro-Lens Array IFU





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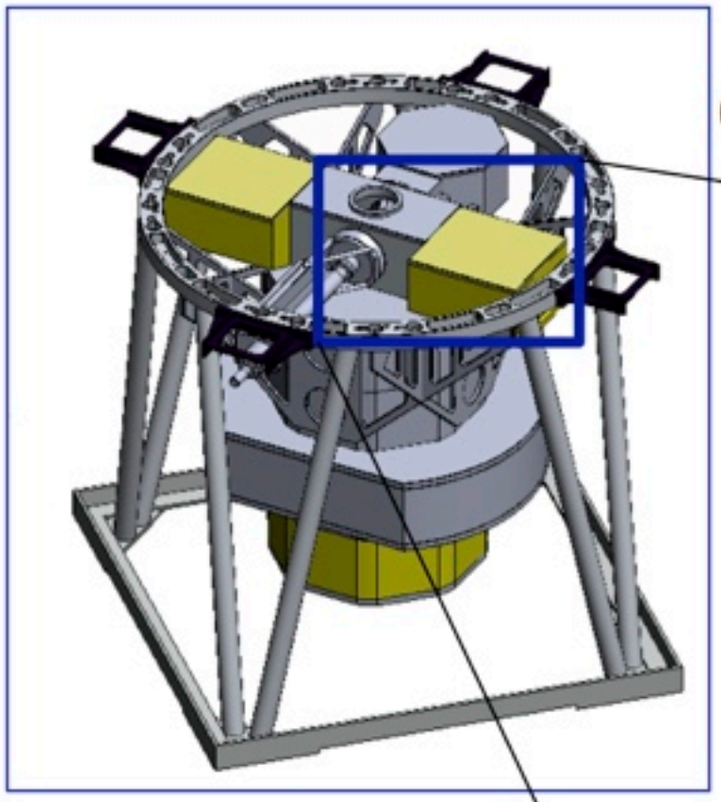
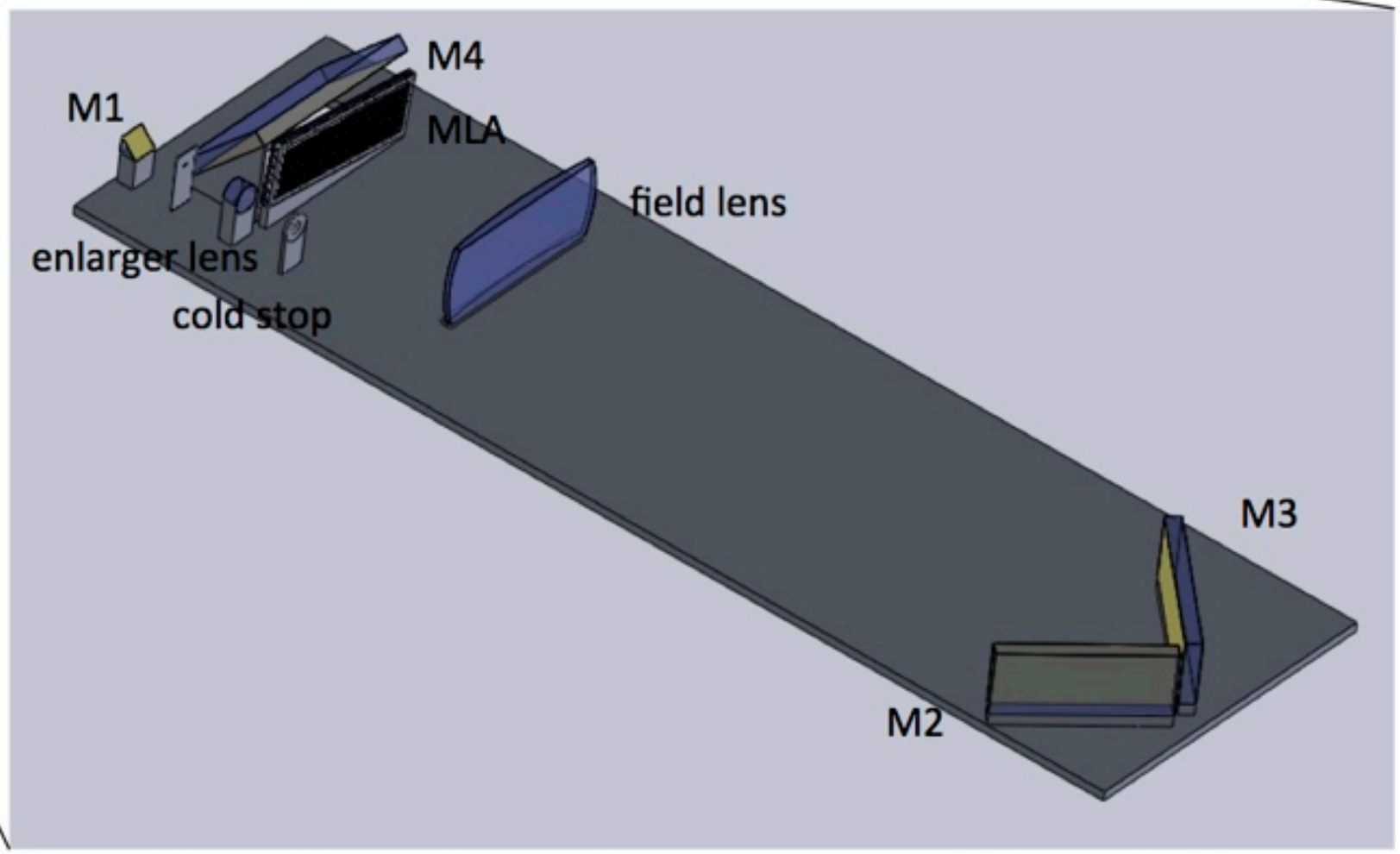
Micro-Lens Array IFU: Layout





(注) レンズホルダー、ミラーホルダー等は描かれていない。

MLA-IFU Parameters

Spatial Sampling	0.2 arcsec
MLA Format	9 x 31 Lenses
Field of View	1.8 arcsec x 6.2 arcsec
MLA Mode	Broad-band Mode (1 spectrum / row)
Separation of Spectra	5.8 pixels
Pick-off Mirror Offset	110” x 10” from Center

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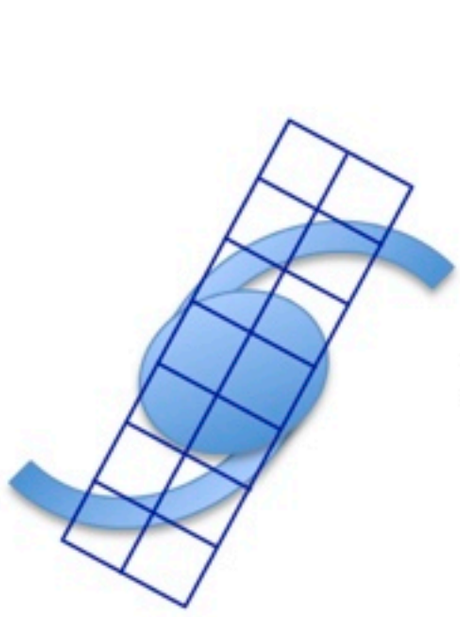
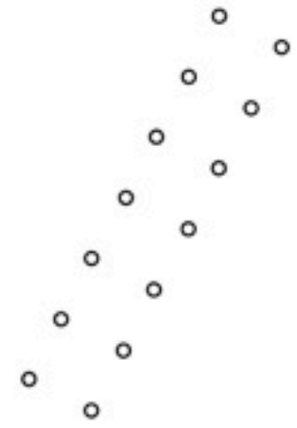
Broad-band Mode MLA-IFU



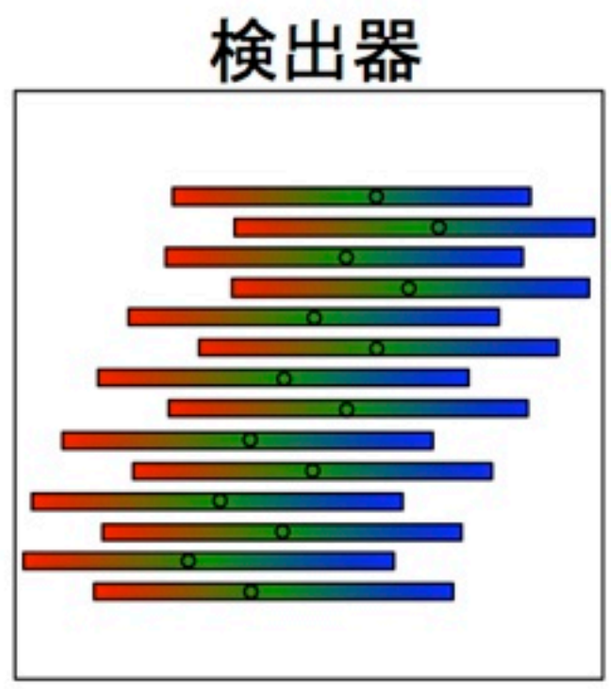
MLA

1.8” x 6.2”



micro pupil 像

分光器



分散方向に1スペクトルずつ

>1400 pixels / Spectrum
5.8 pix separation

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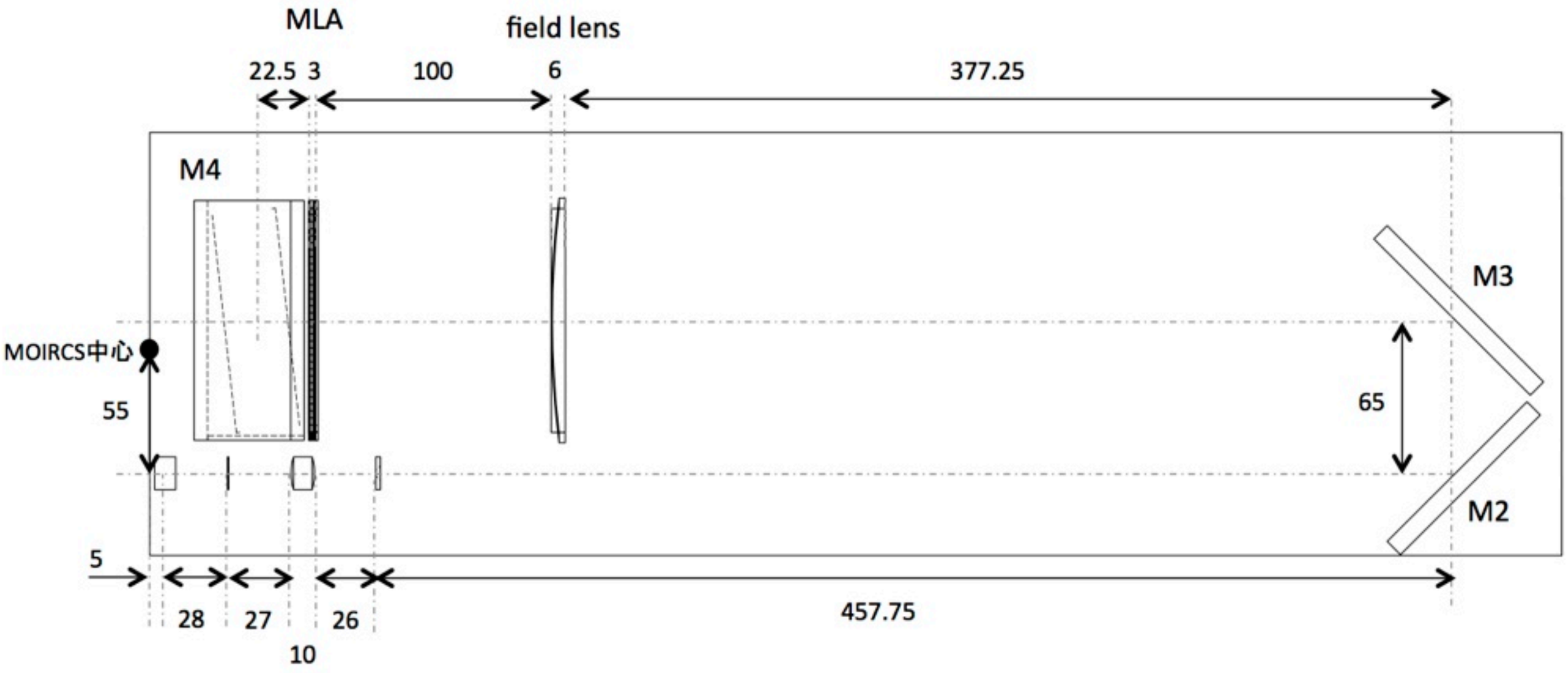
Optical Layout (viewed from the telescope side)



M1　拡大レンズ

telescope focus　cold stop

単位mm

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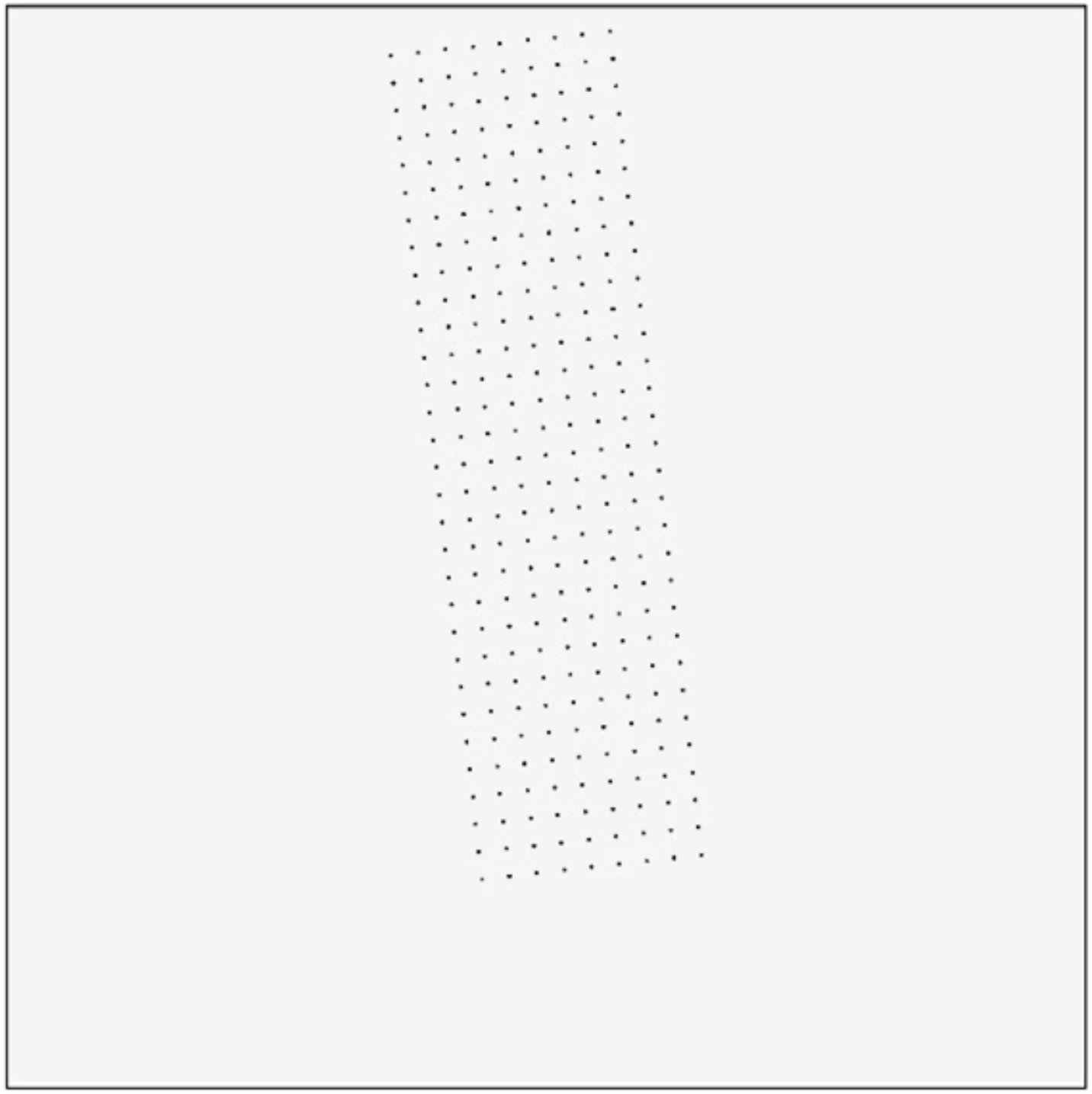
Micro pupils at MOIRCS focal plane



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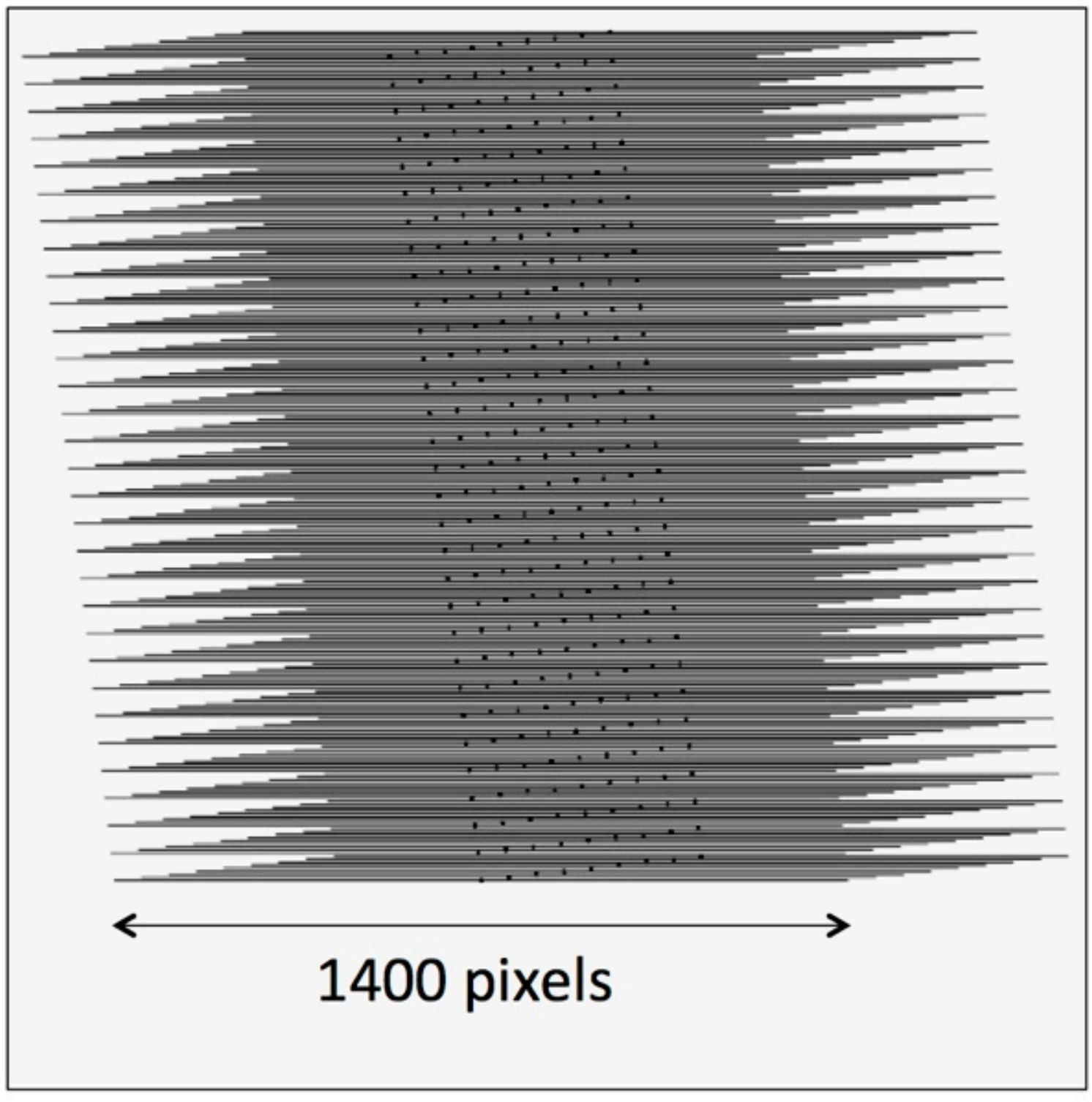
Expected distribution of spectra



Expected Performance of MLA-IFU

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Grisms and Spectral Resolutions

grism	spectral coverage [μm]	spectral resolution(*)
HK500	1.3-2.3	R=860
VPH Y	0.96-1.07	R=5300
VPH J	1.16-1.31	R=4800
VPH H	1.57-1.77	R=4700
VPH K	2.03-2.32	R=4200

(*) 2.7 pixels width で計算

S/N Calculations

- Following Law et al. (2006) AJ 131, 70
- Assuming 0.4” seeing, sky background and atmospheric transmission from Gemini web
- readout-noise 15e-, dark 0.08e-/s
- 900 sec x 8 = 2 hrs on-source exposure
- 2 pixel binning in wavelength dispersion direction

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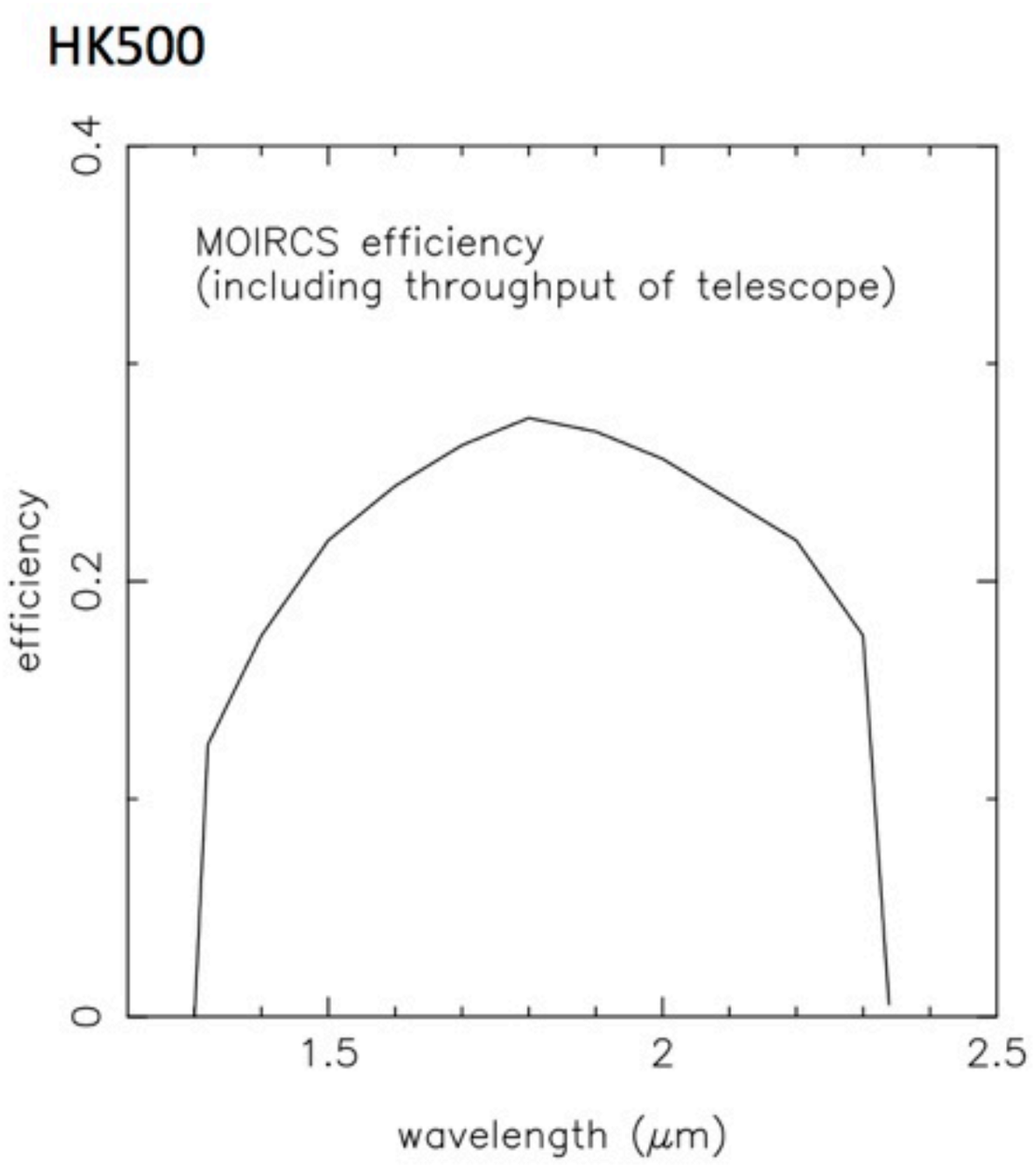
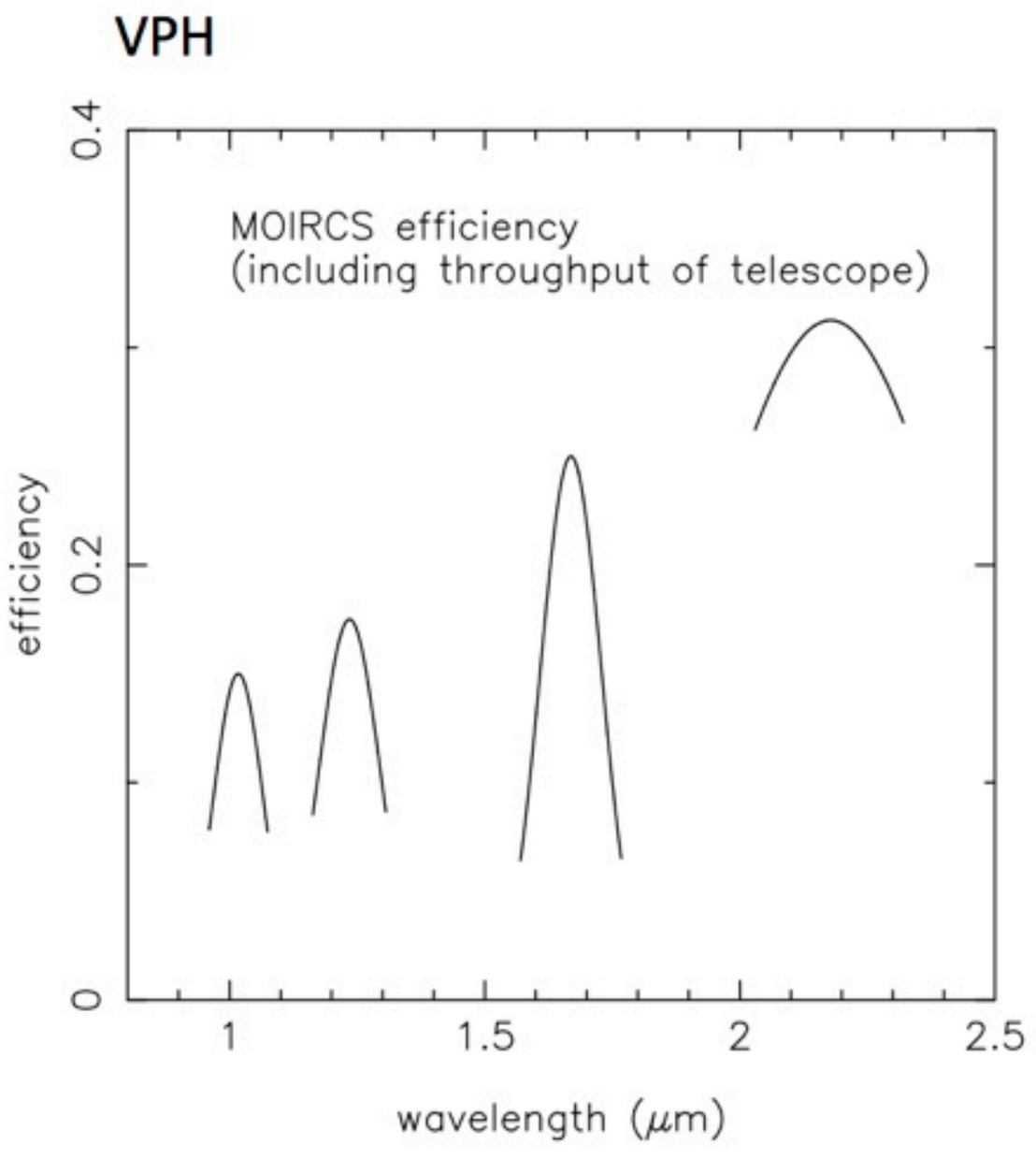
S/N Calculations

- Throughput including telescope and instrument optics:





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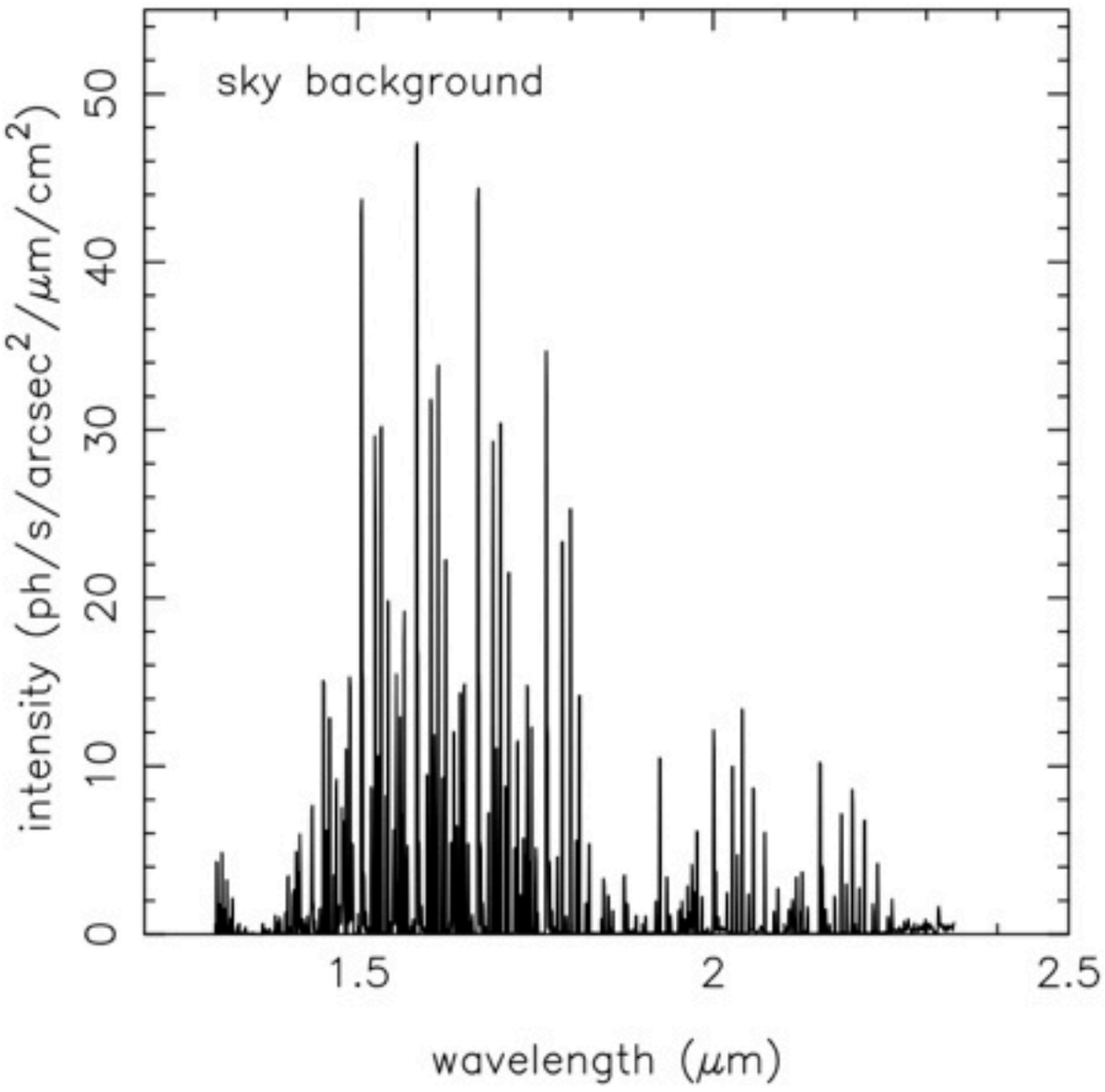
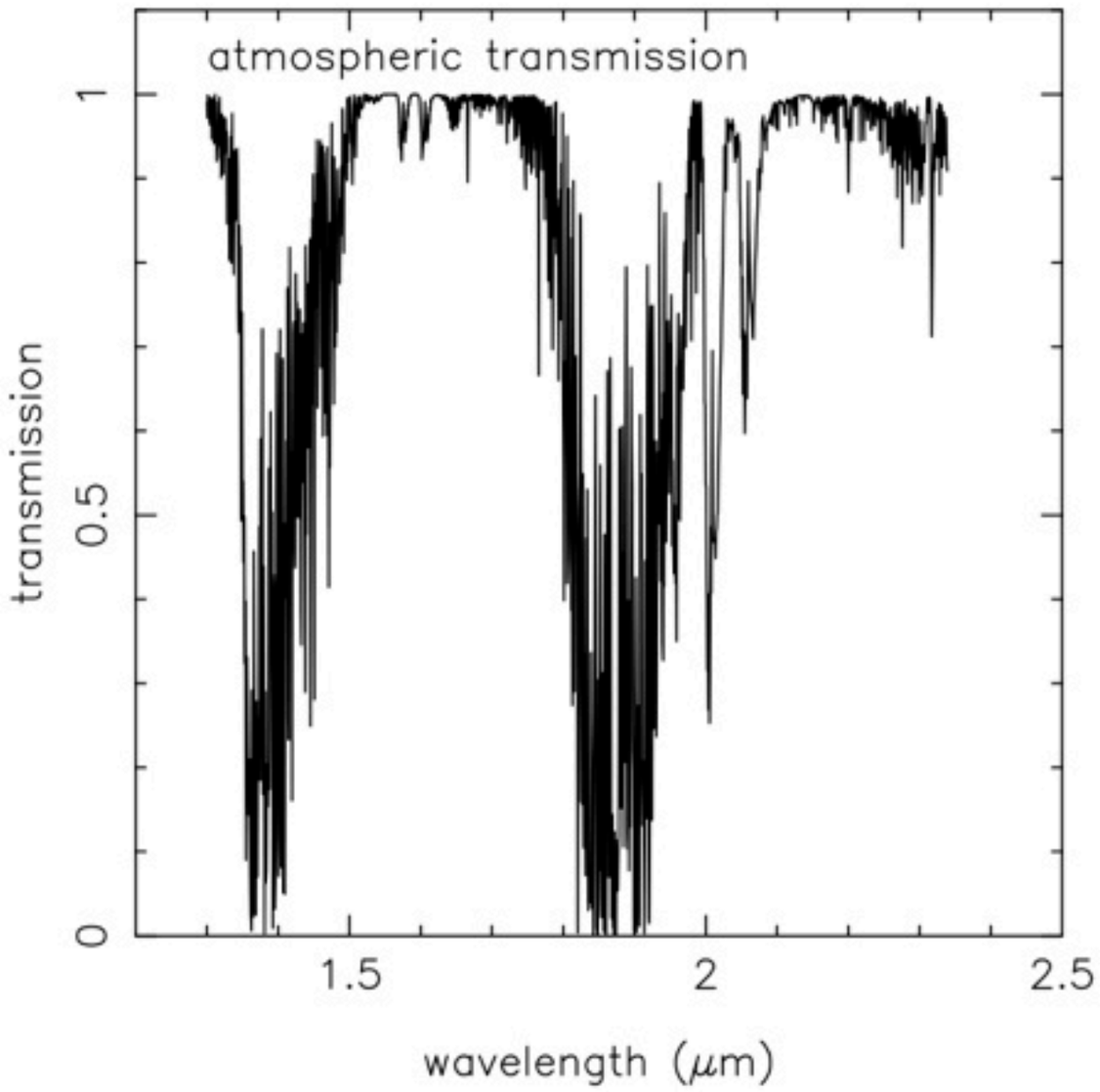
S/N Calculations

- Sky background and atmospheric transmission from Gemini web page:





（図はHK500に波長範囲や分解能を合わせたもの）

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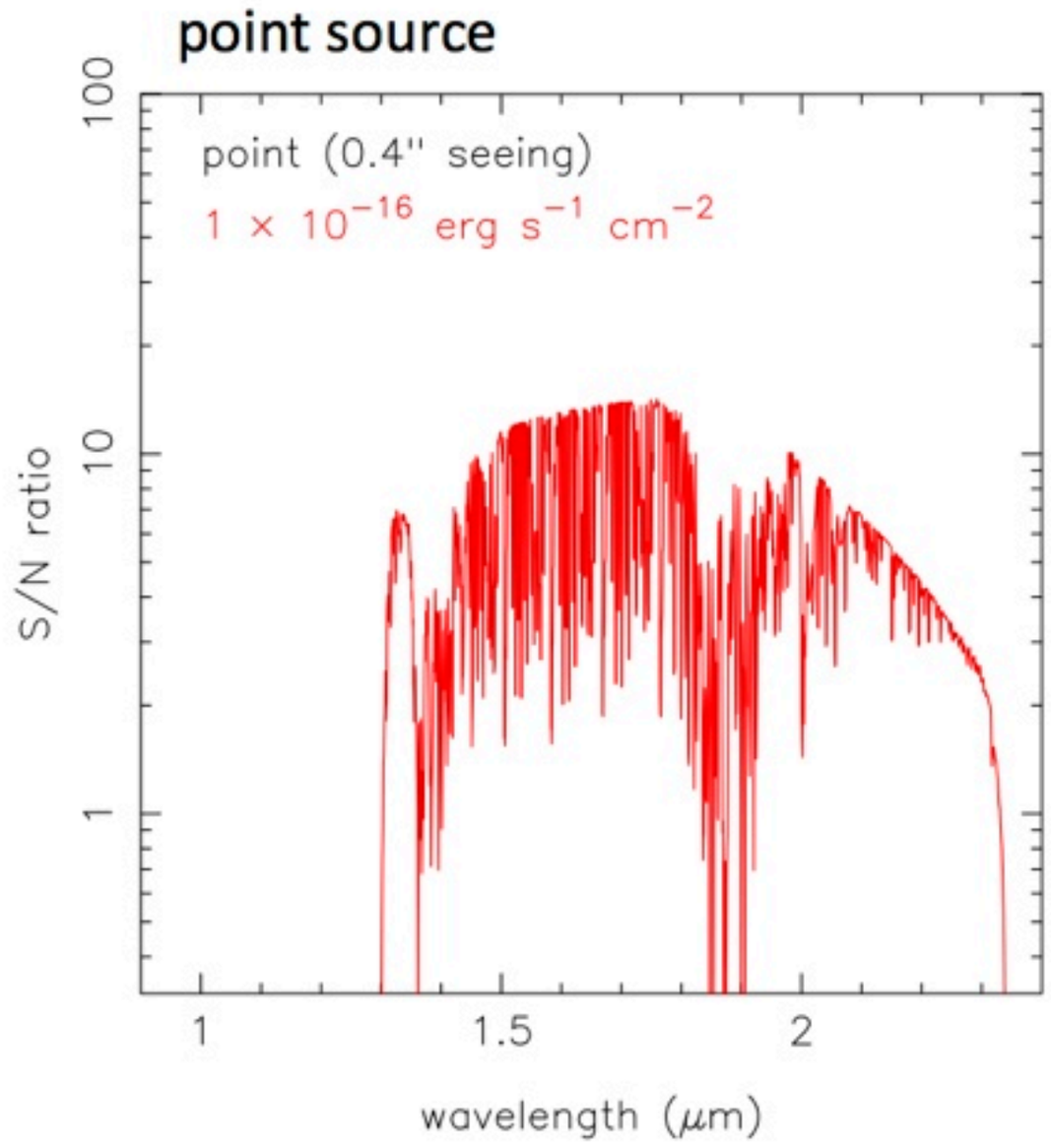
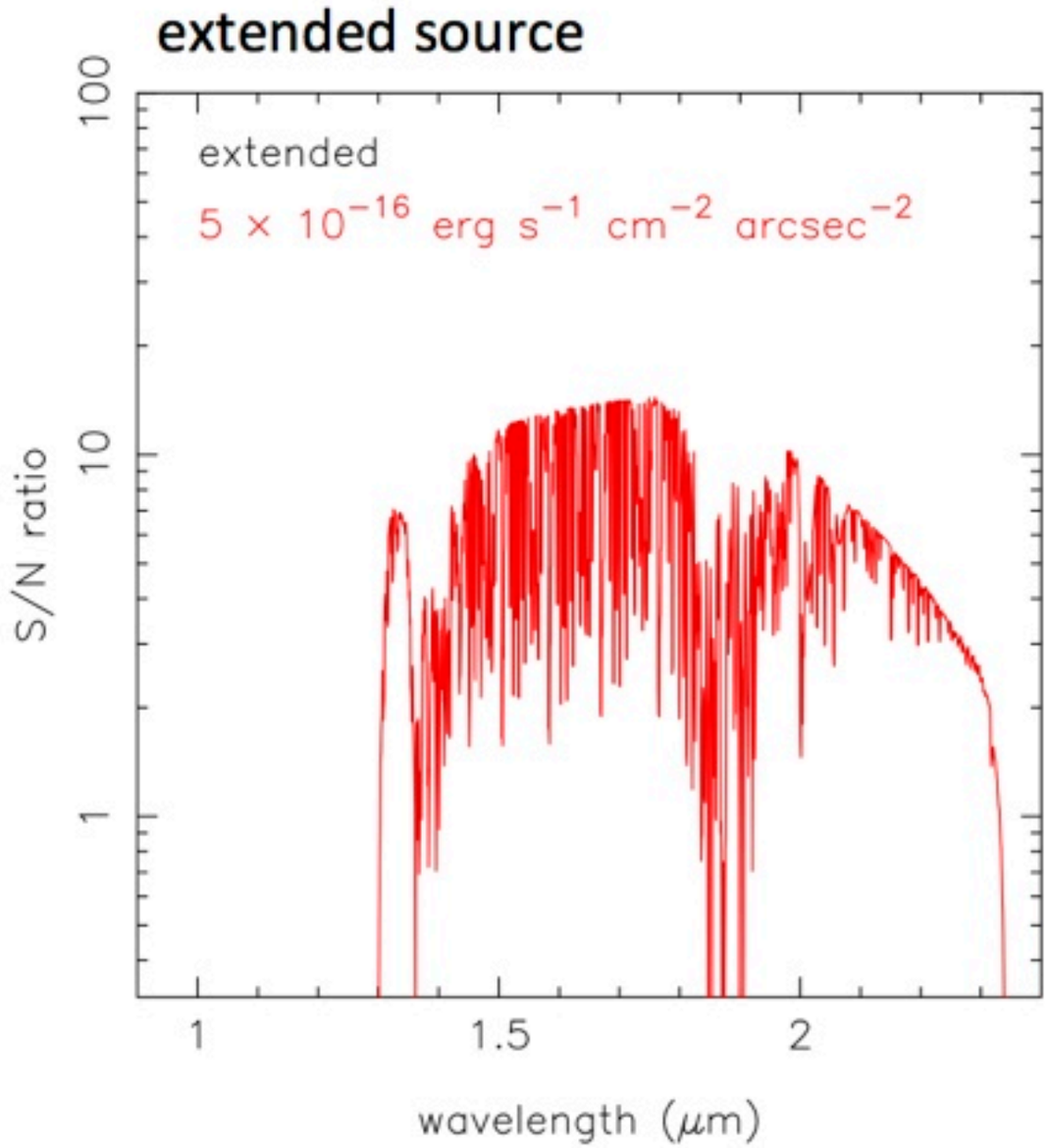
Expected S/N for Hα Emission with 2 Hrs Integration

HK500





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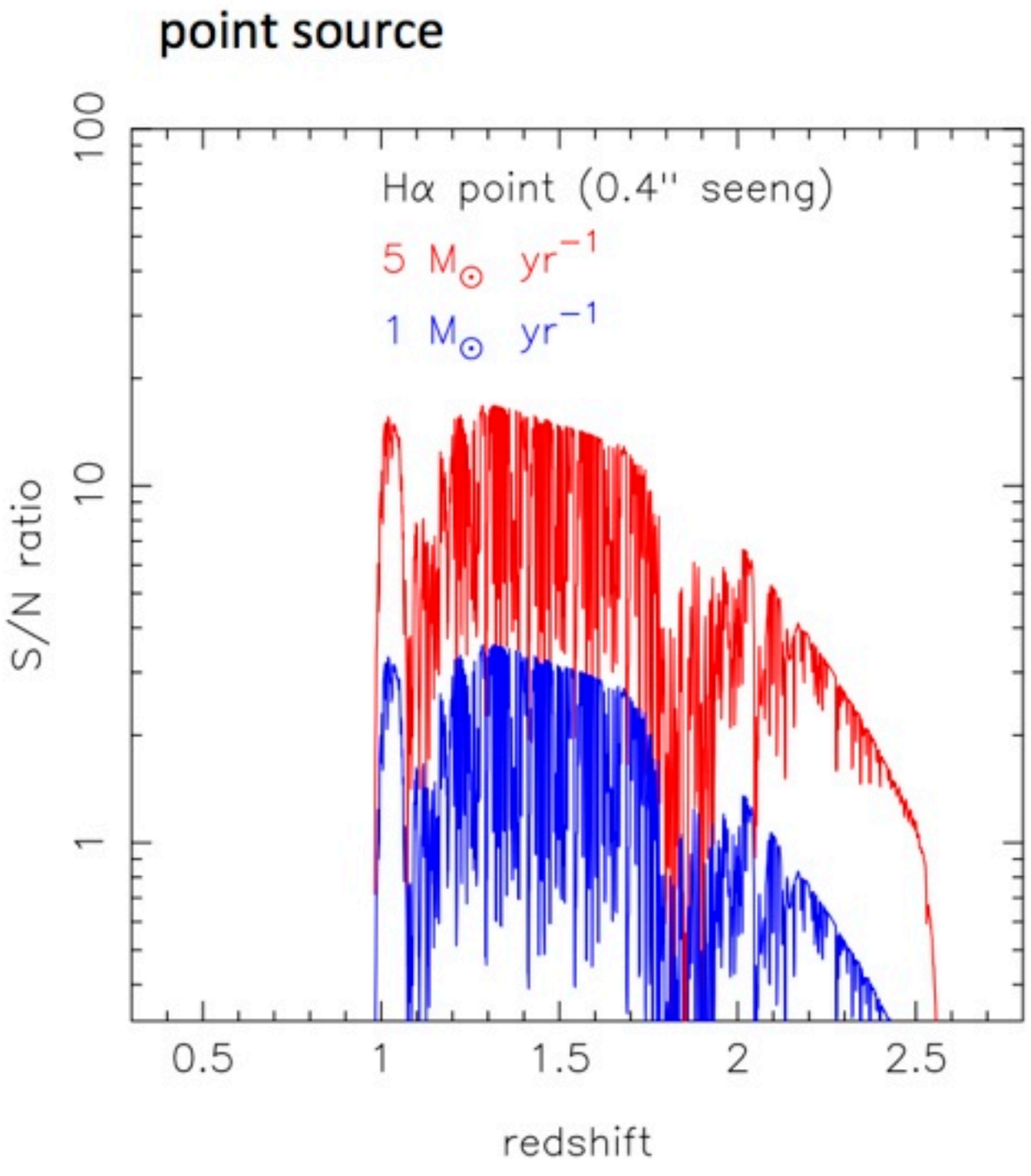
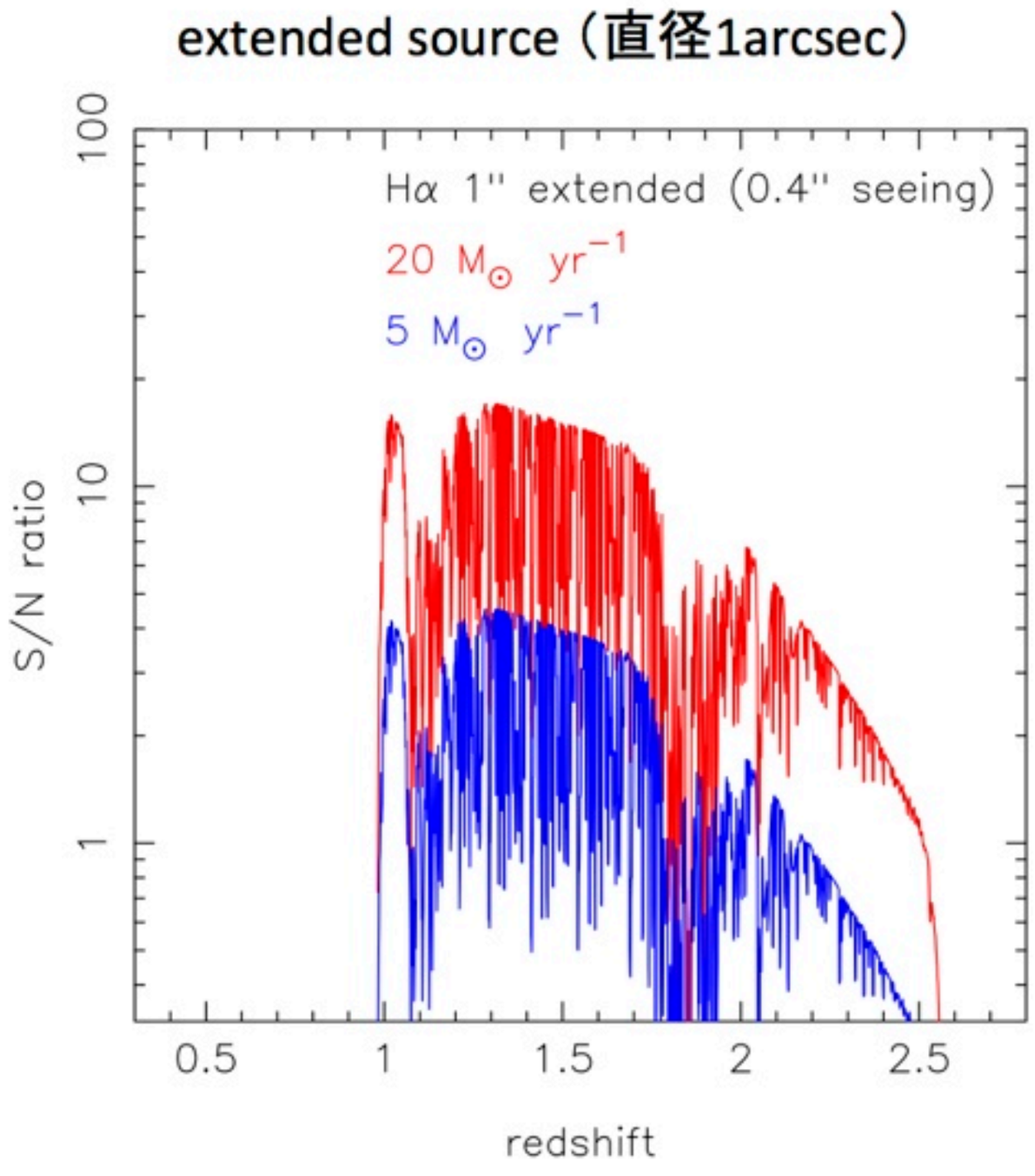
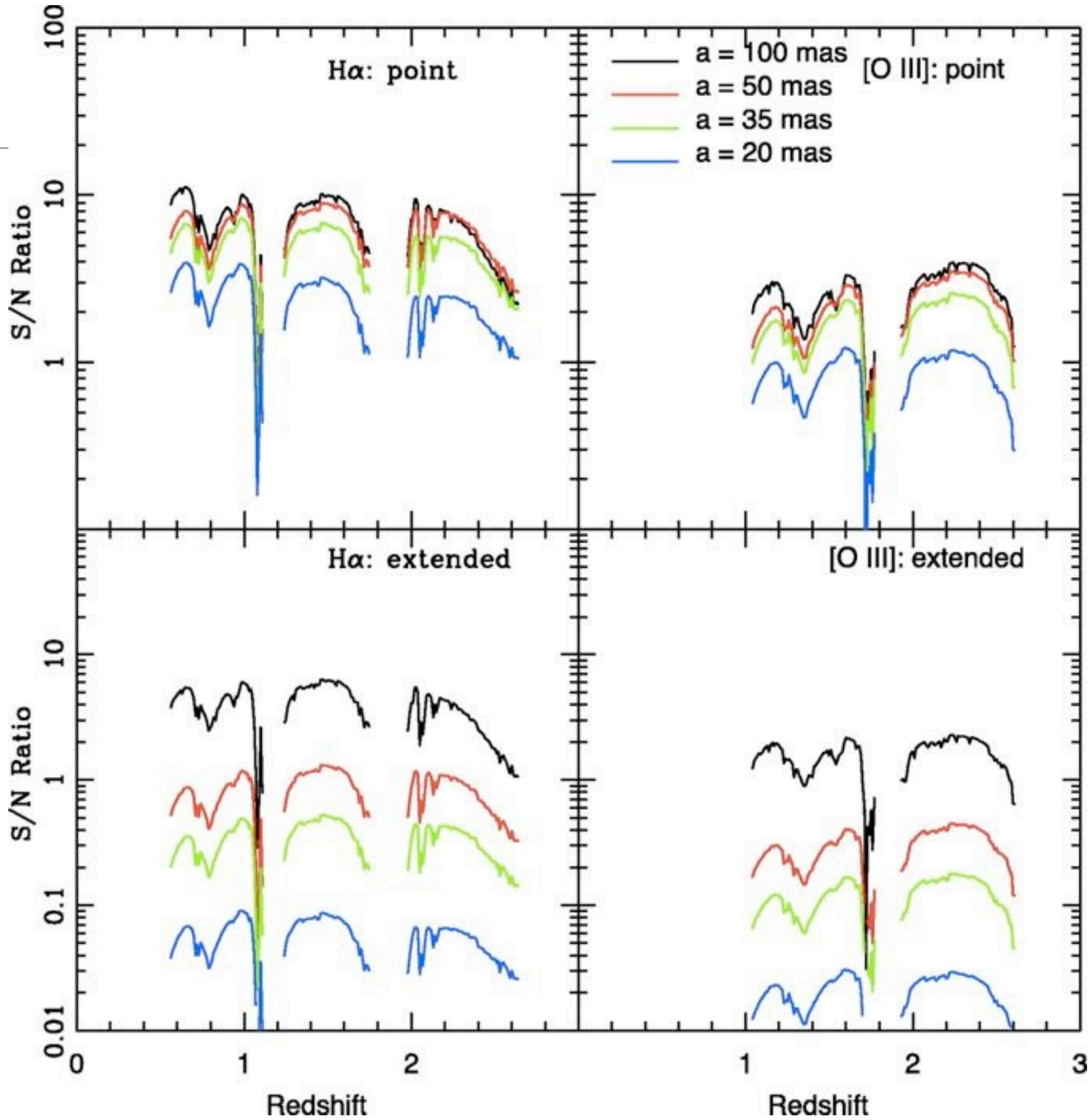
Expected S/N for Hα Emission with 2 Hrs Integration





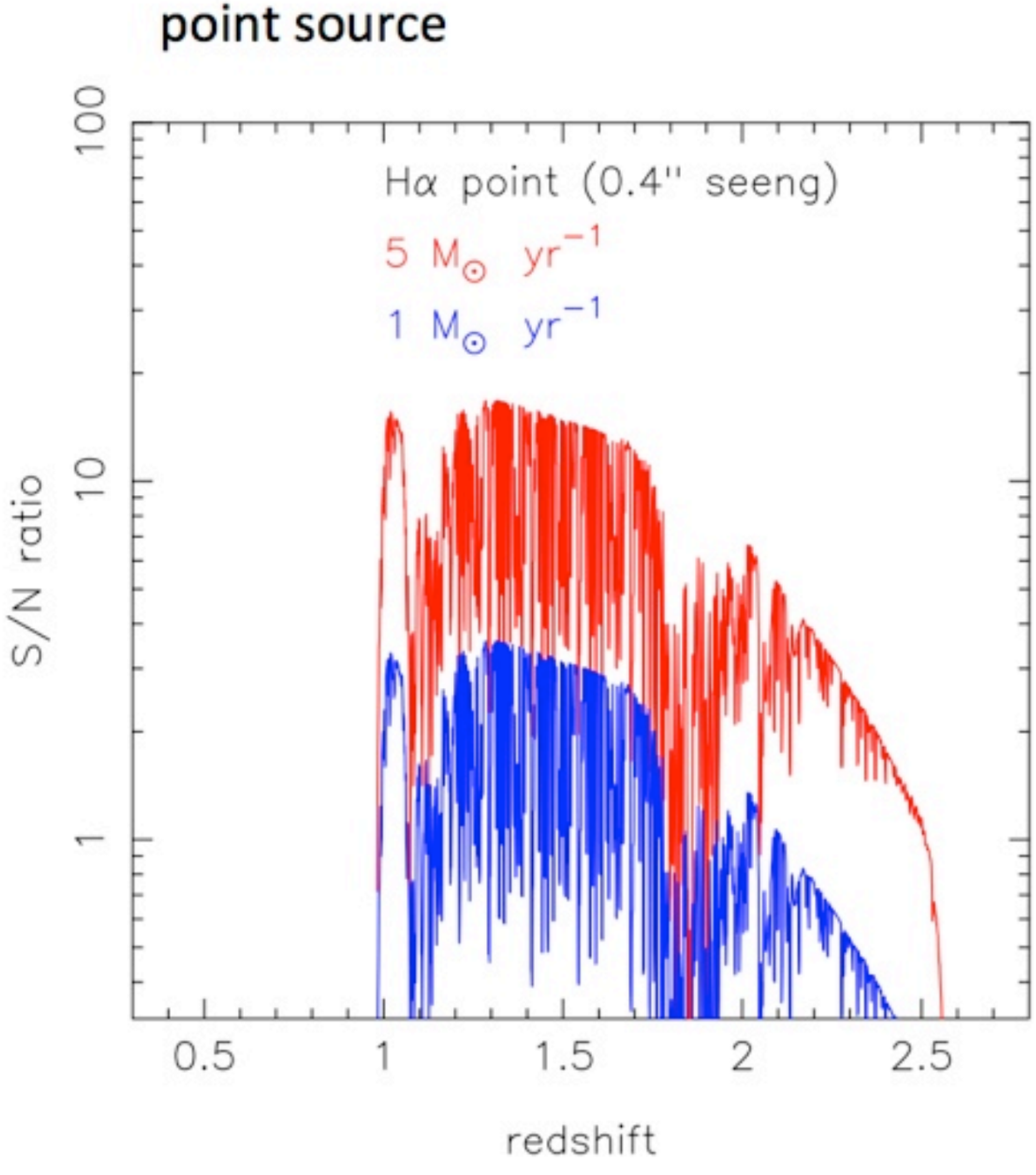
Keck/OSIRIS

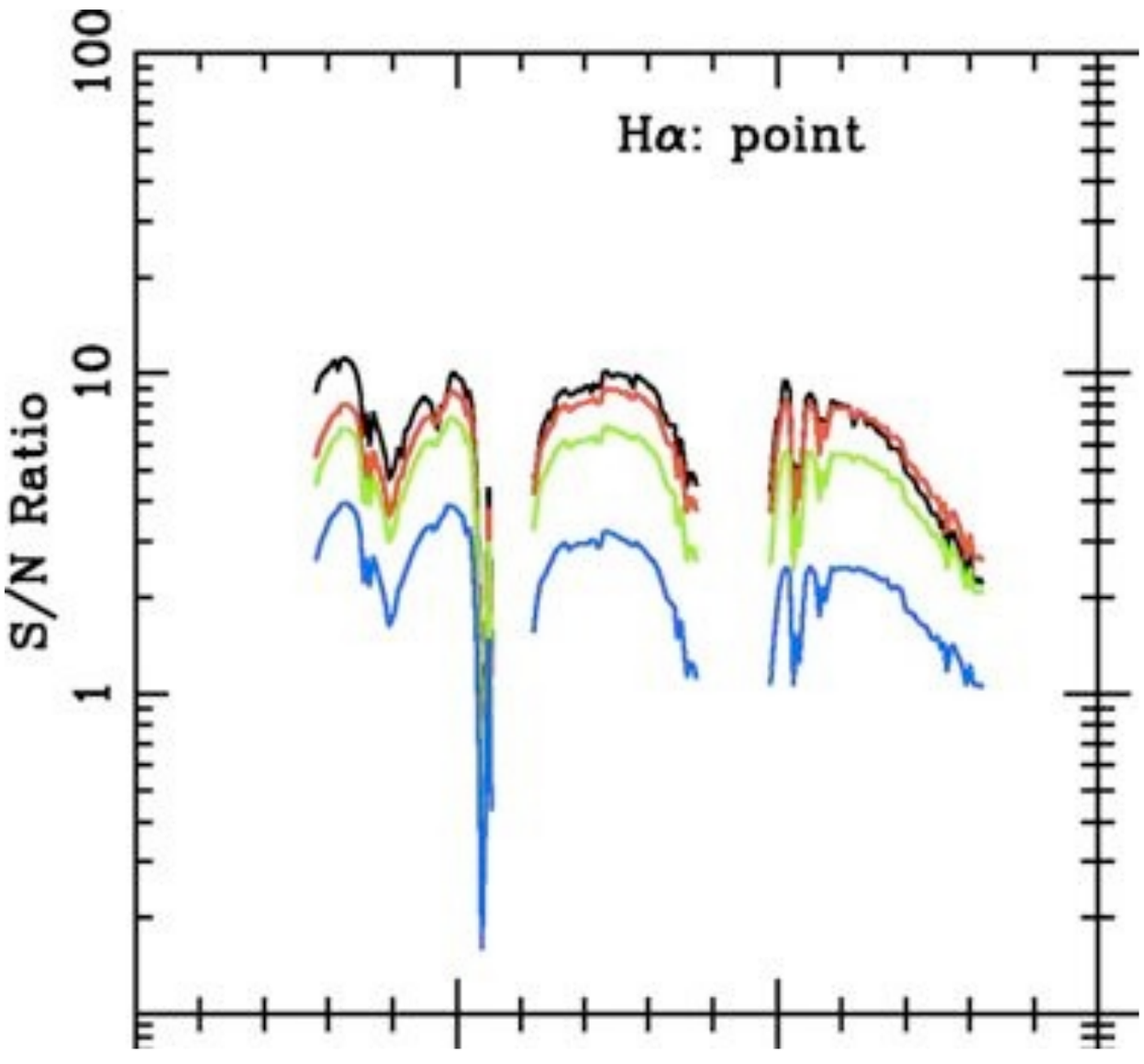
- 1 hour integration
- Different lenslet scales



Law et al. 2006

Comparison with Keck / OSIRIS





MOIRCS MLA-IFU / 2hrs

OSIRIS / 1hr

The difference would mainly come from read-out noise:
MOIRCS: 15e-, OSIRIS: 3e-, and smaller sky area.

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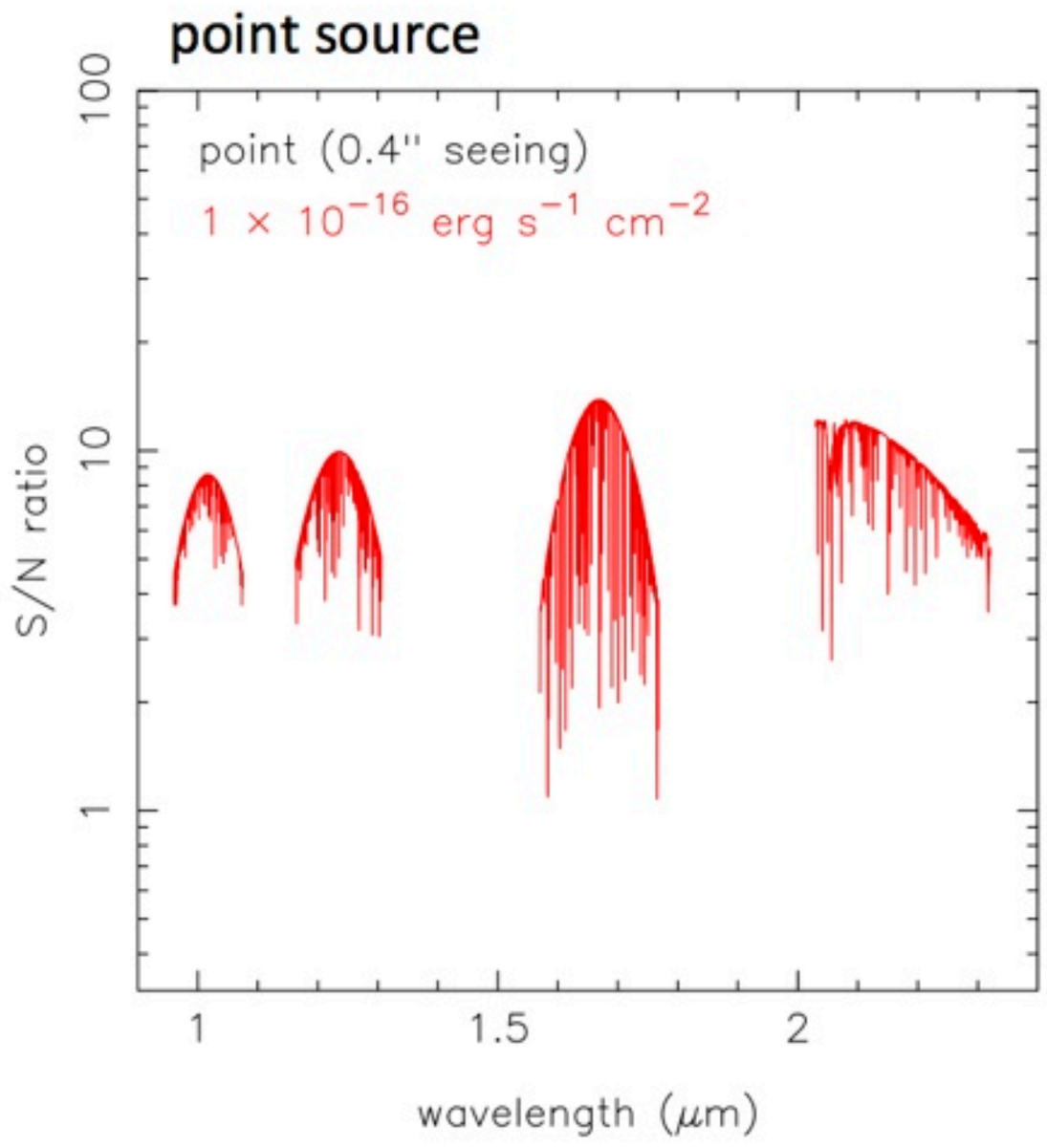
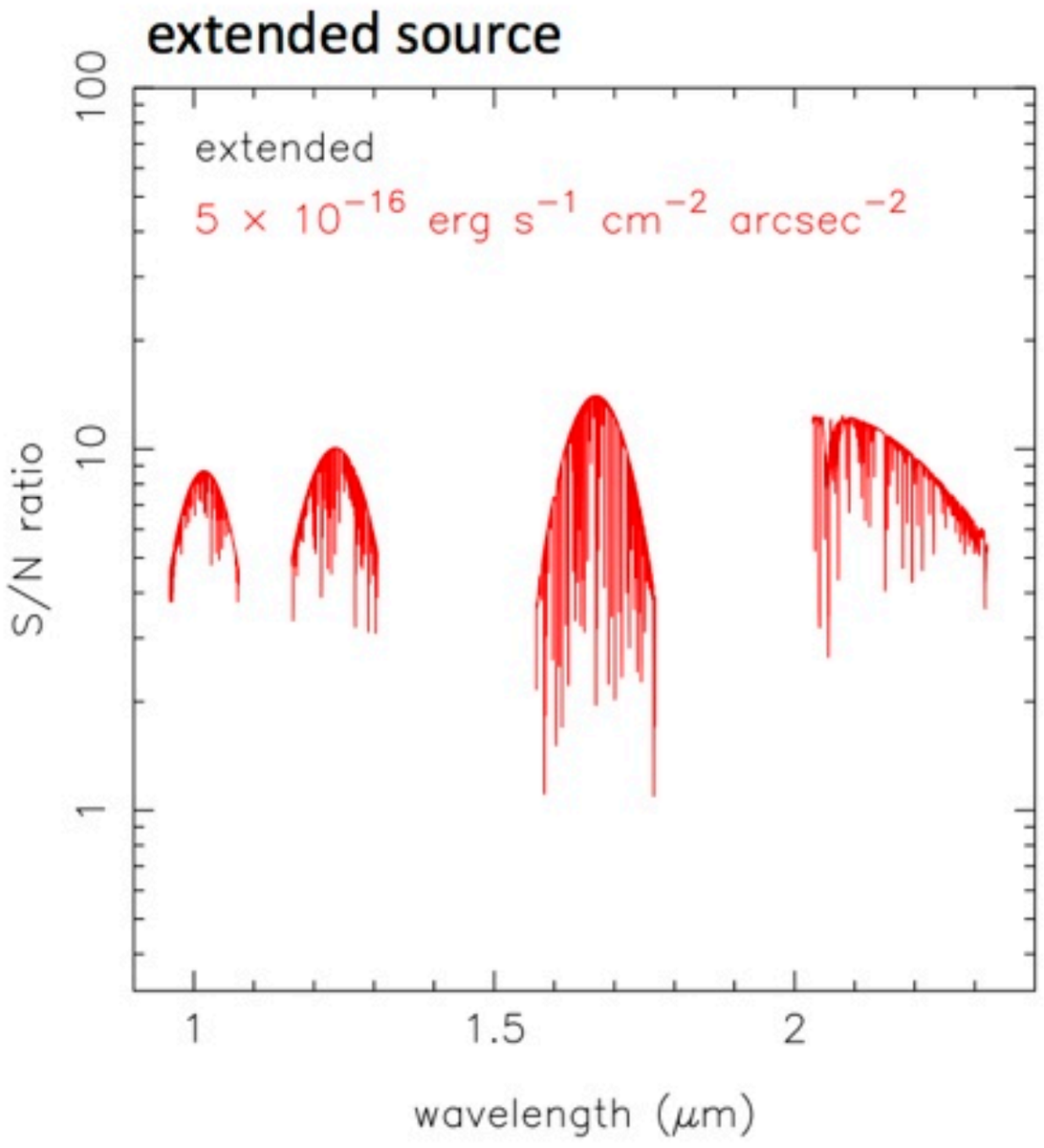
Expected S/N for Hα Emission with 2 Hrs Integration

VPH





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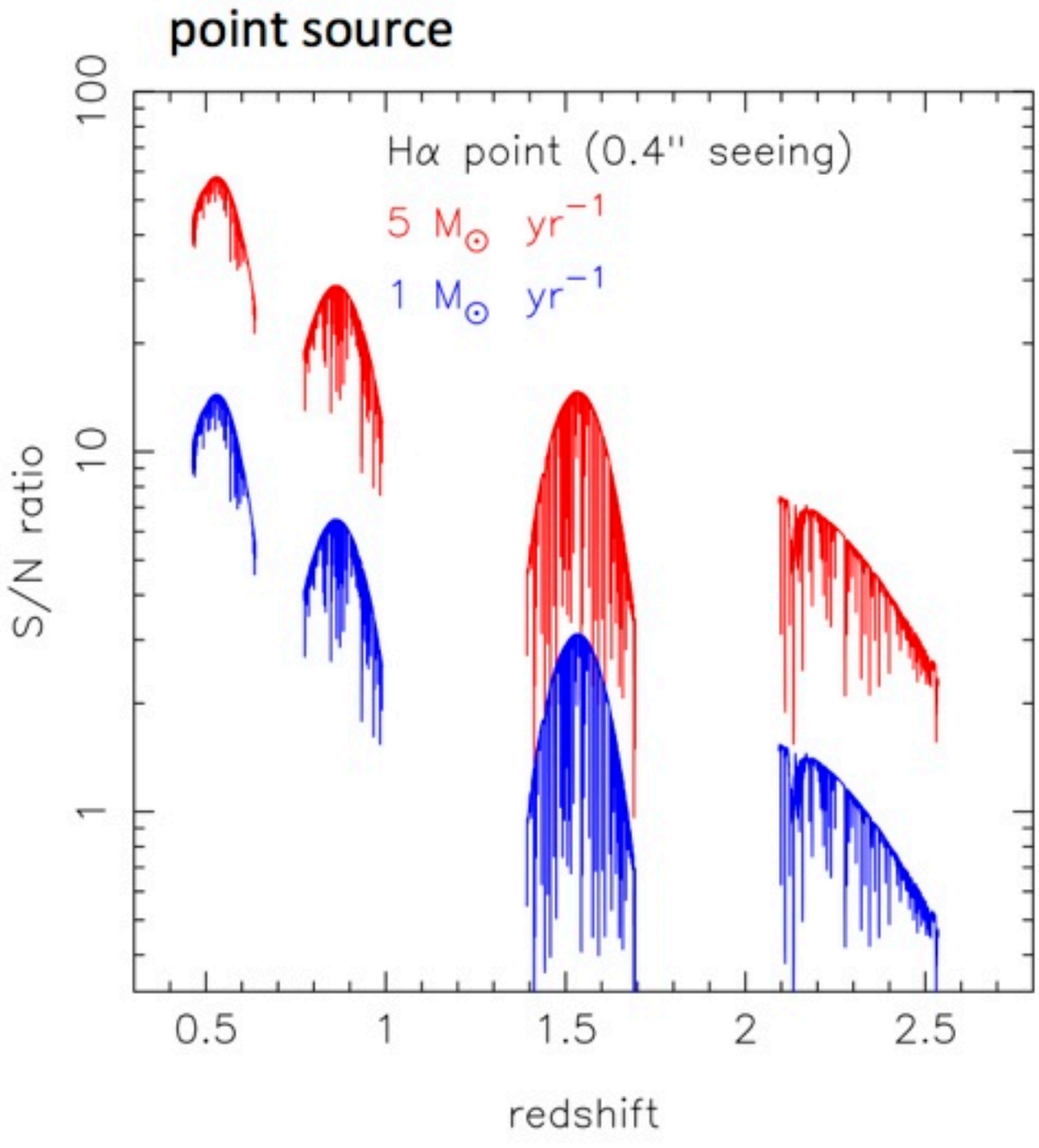
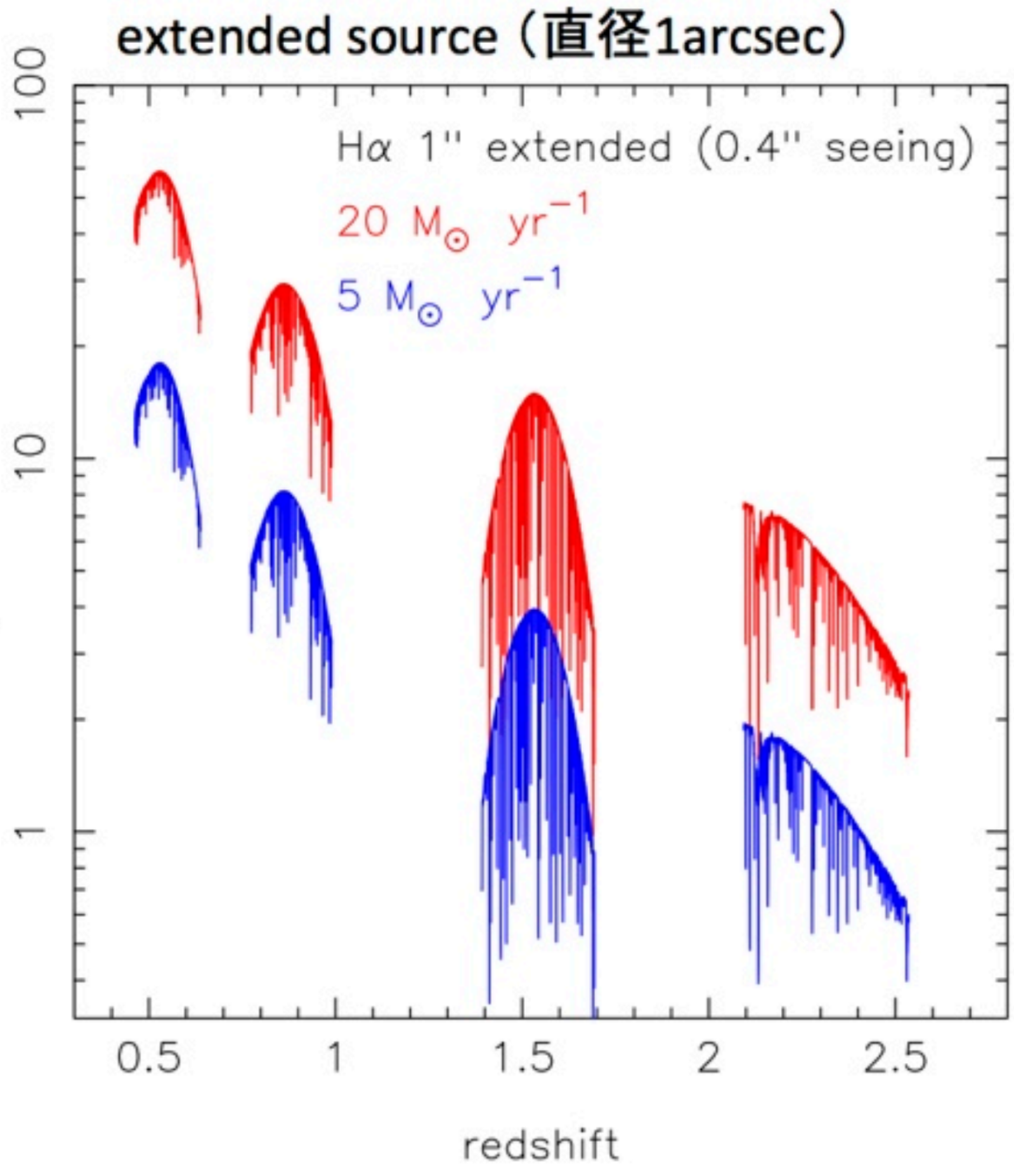
Expected S/N for Hα Emission with 2 Hrs Integration

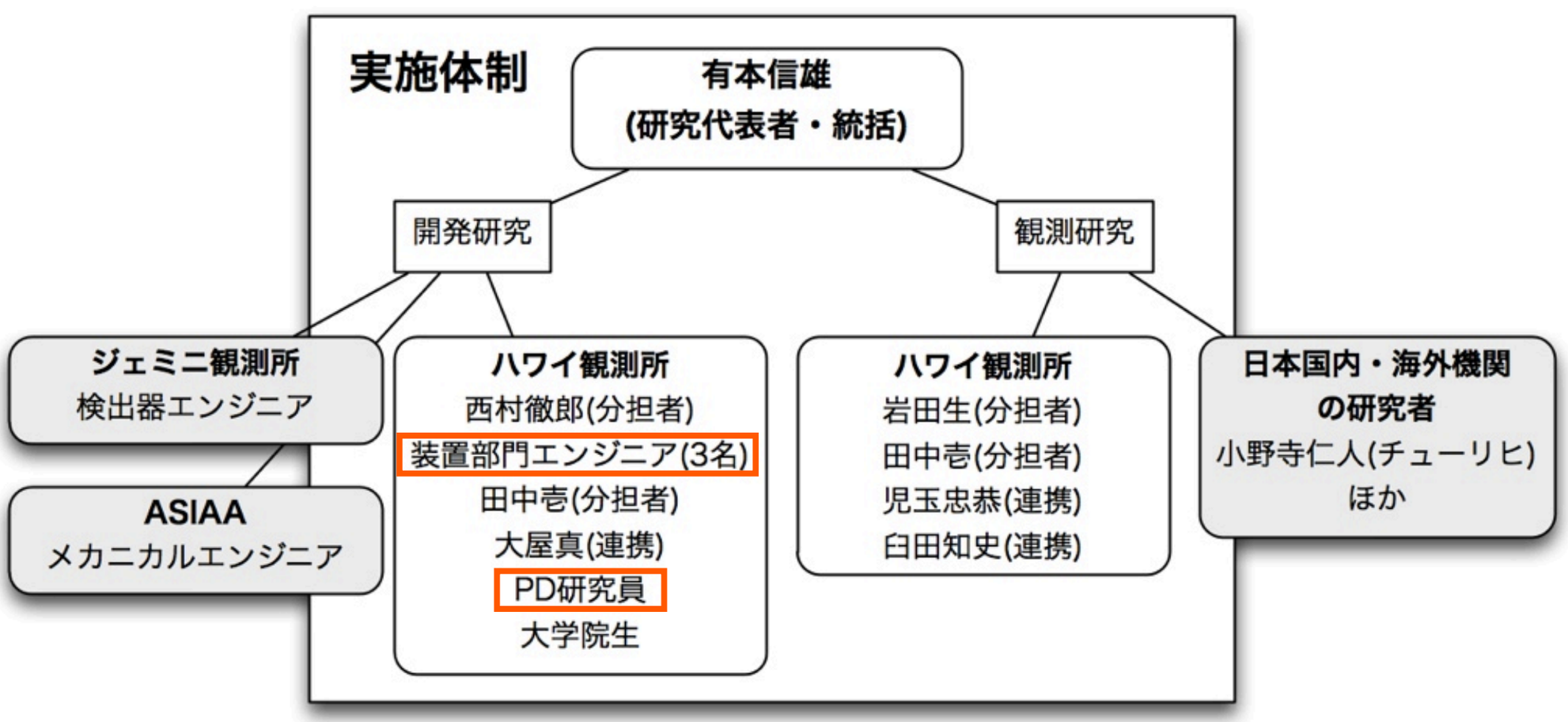
VPH





Resources and Schedule

- 科学研究費基盤研究(S) 「広視野多天体分光・面分光で探る銀河形態の起源」
  (PI: 有本信雄)
- FY2011-2014 (4 years)



Resources and Schedule

- Detector Replacement: GL Scientific, ASIAA, Iwata
- IFU
  - Fiber: Nishimura, STM
  - MLA-IFU: Ishigaki, Ozaki, Iwata
- Mechanical Design
  - Omata, Nishimura, STM
- Software
  - Omata, Yoshikawa (Niji-koubou), Tanaka
- Test and Performance Evaluation
  - Tanaka
- Science
  - Arimoto, Kodama, Ferré-Mateu, et al.

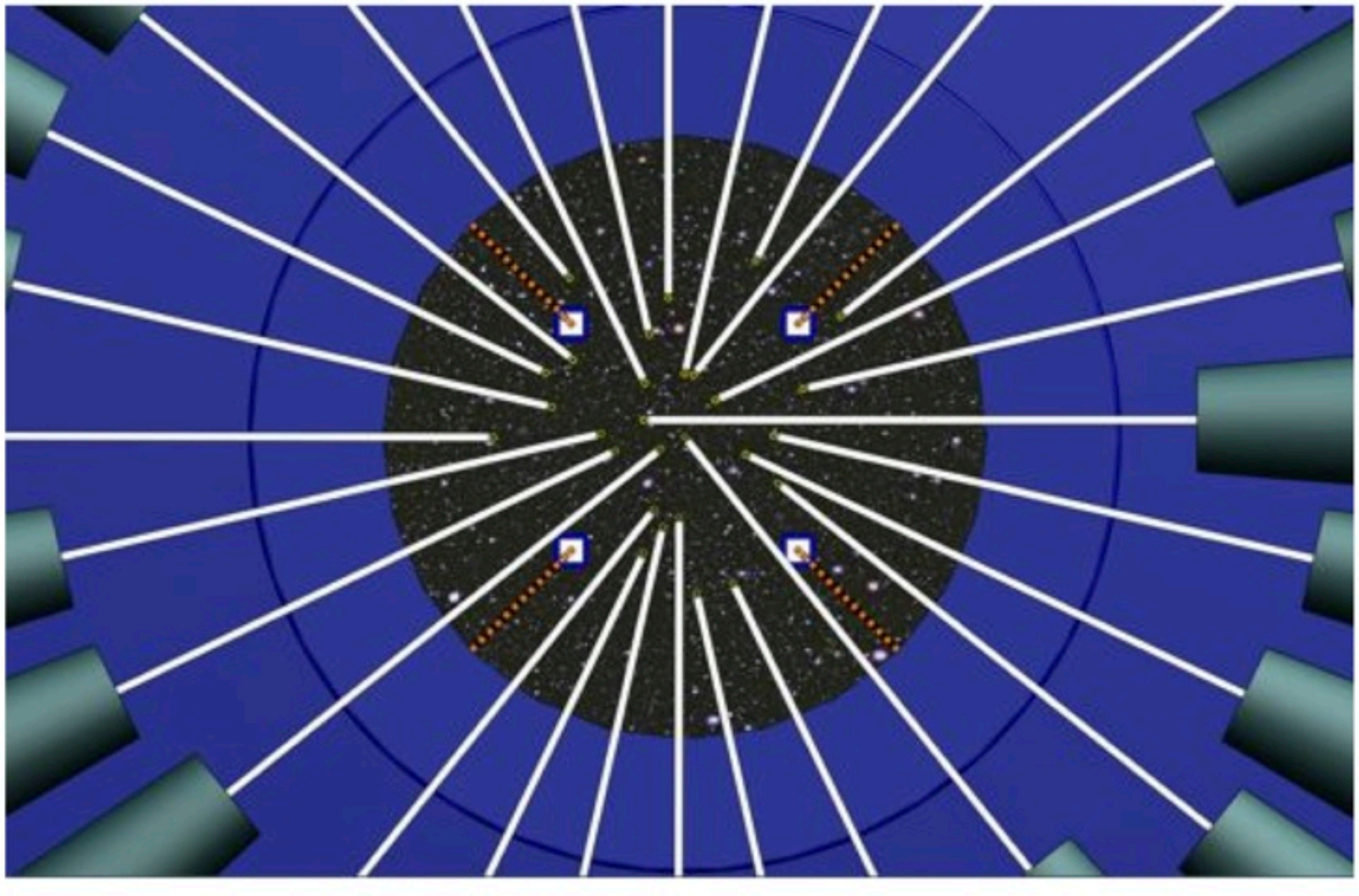
Resources and Schedule

- Detector Replacement
  - Hardware fabrication and software development (2013)
  - Jan. - March 2014 (TBD)
- MLA-IFU (Single Channel)
  - Initial Cooling Test (Now)
  - Fabrication of Optical Components (2013)
  - Test in Mitaka (First Half of 2013)
  - Assembly of Mechanical Parts and Test in Hilo (Summer 2013)
- *The earliest possible on-sky test of the first MLA-IFU would be in Early 2015.*

Slide by Nishimura-san in 2010

CIRMOS Plan?

- SIRMOS-14



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CIRMOS Plan?

- SIRMOS-14