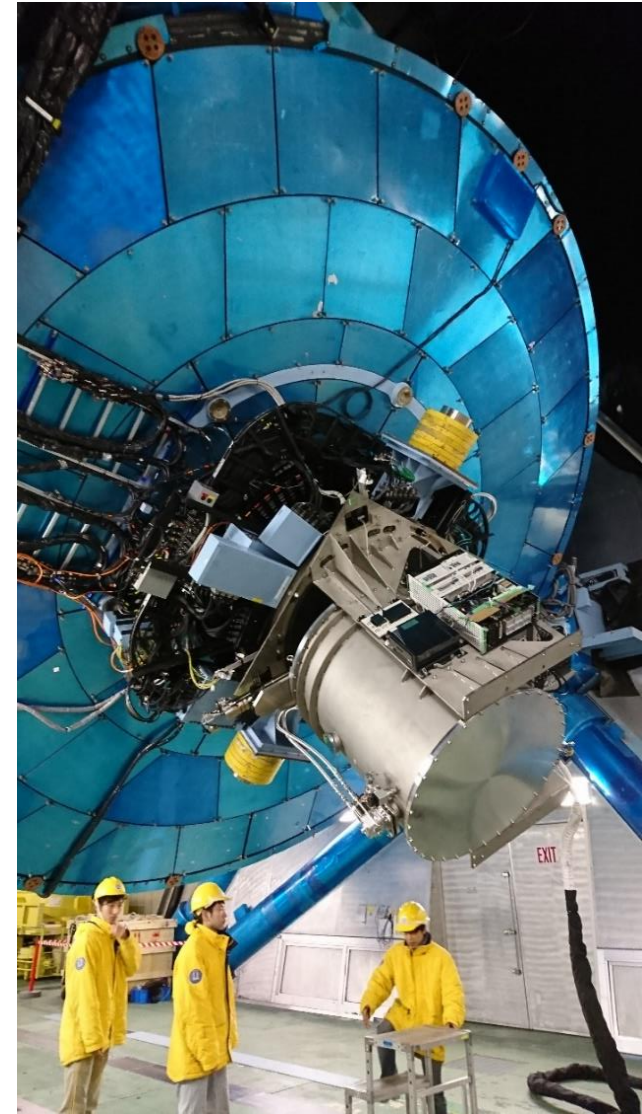


SWIMS: status report on the first open-use observations

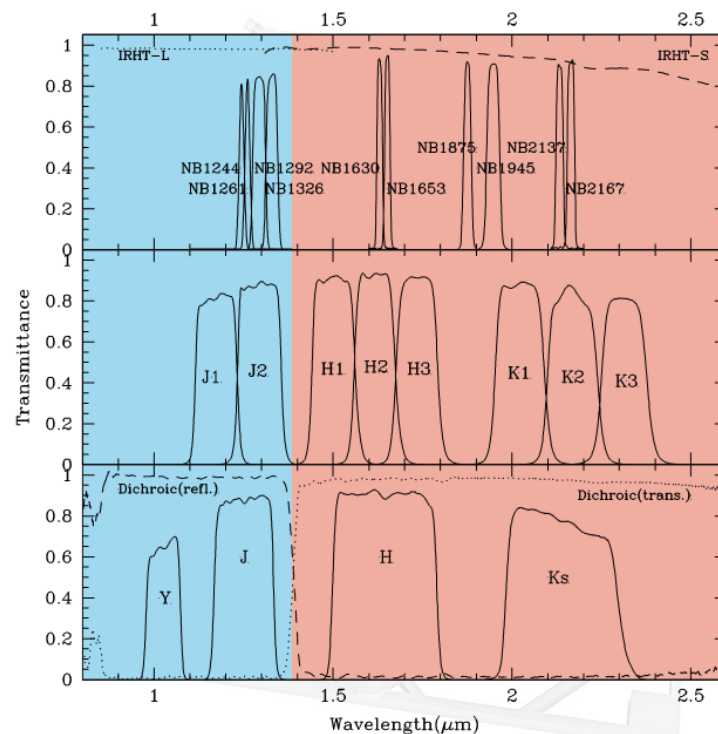
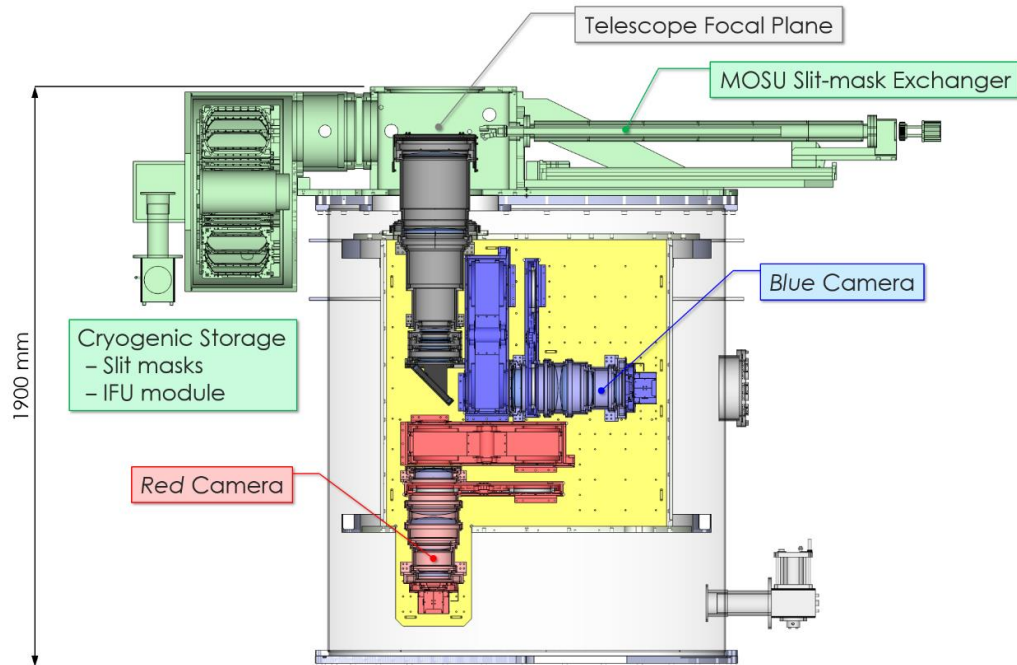
Masahiro Konishi (UTokyo)

Kentaro Motohara (UTokyo, NAOJ), Hidenori Takahashi, Shuhei Koyama, Natsuko M. Kato, Kousuke Kushibiki, Nuo Chen, Shogo Homan (UTokyo), Yuzuru Yoshii (UTokyo, UA), Mamoru Doi, Kotaro Kohno, Takashi Miyata, Masuo Tanaka, Takeo Minezaki, Toshihiko Tanabe, Shigeyuki Sako, Tomoki Morokuma, Bunyo Hatsukade, Takafumi Kamizuka, Tsutomu Aoki, Takao Soyano, Ken'ichi Tarusawa, Ryou Ohsawa, Hiroaki Sameshima, Kentaro Asano, Atsushi Nishimura, Kengo Tachibana, Tsubasa Michifuji, Hirokazu Iida (UTokyo), Yoichi Tamura (Nagoya U), Ken-ichi Tadaki, Hirofumi Okita, Shintaro Koshida (NAOJ), Tadayuki Kodama, Kazuki Daikuhara, Riho Okazaki (Tohoku U), Toshihiro Handa (Kagoshima U), Shinobu Ozaki (NAOJ), Yutaka Yamagata, Takuya Hosobata, Masahiro Takeda (Riken), Shinya Morita (Tokyo Denki U)



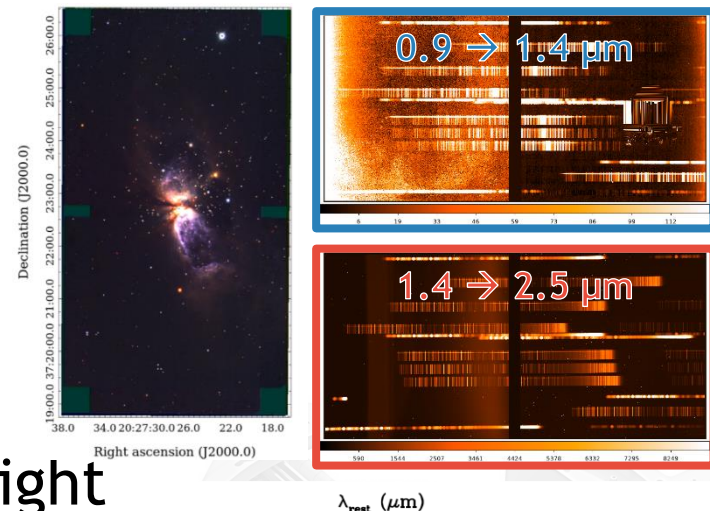
SWIMS

- 1st generation instrument for TAO 6.5m Telescope
- 2-color Simultaneous imaging/spectroscopy
 - 0.9–1.4 μm (Blue arm)
 - 1.4–2.5 μm (Red arm)
- Wide-field Imaging
 - 6.6' x 3.3' with 2K x 4K pixels @ Subaru
 - 0.095 "/pix @ Subaru
 - 22 filters
- Multi-object spectroscopy
 - ~30 objects
 - R~1000 w/ 0.5" slit width
 - 0.9–2.5 μm spectroscopy with a single exposure
- IFU under development



Main topics of Engineering Runs

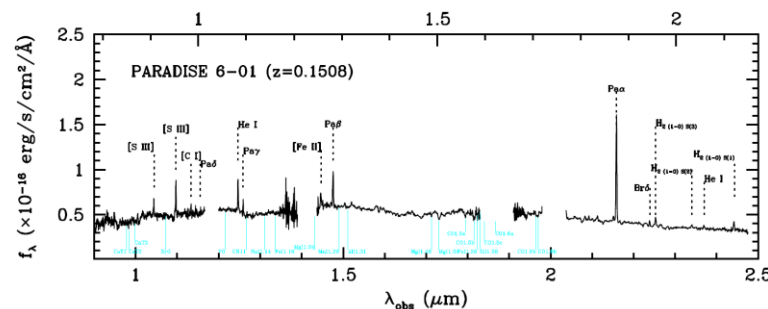
- S18A
 - Imaging First Light
 - Long-slit spectroscopy First Light
- S18B
 - Multi-object spectroscopy First Light



- (S20A: cancelled due to COVID-19)

- S20B

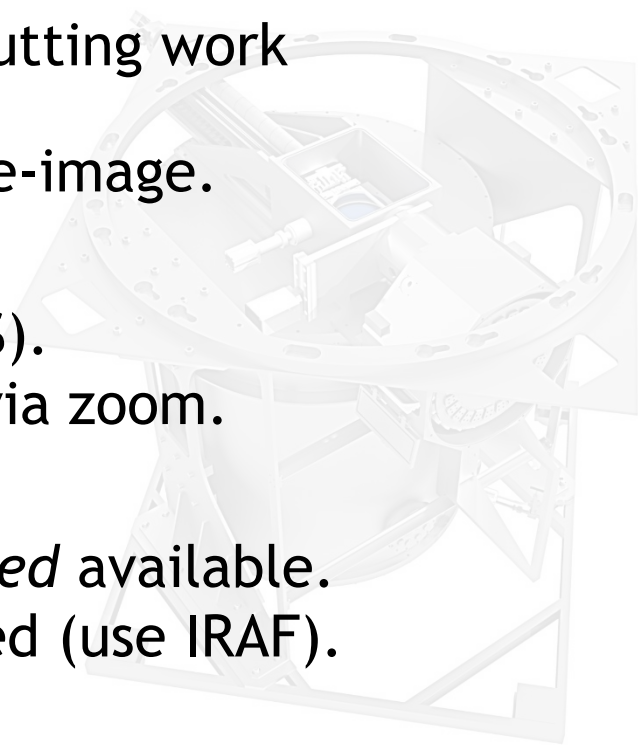
- Performance confirmation of new array #16321 (leased by Subaru)
- Approved for Open-use operation from S21A.





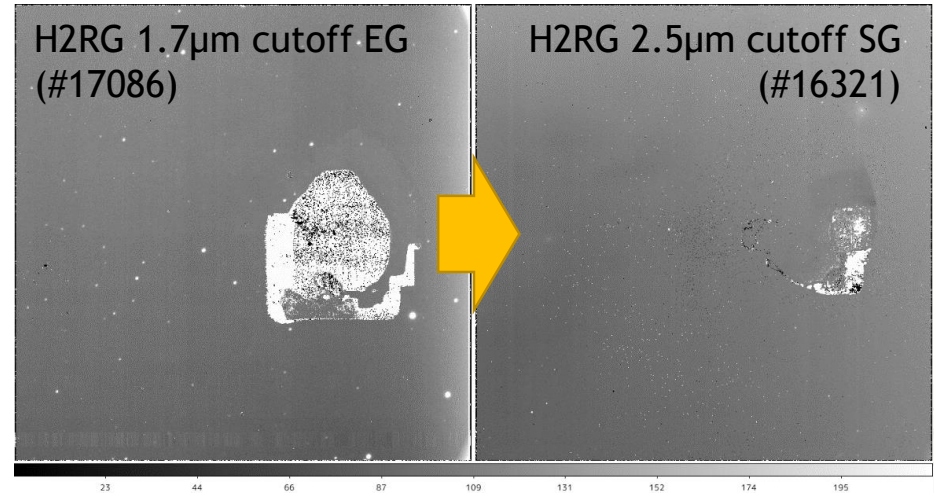
Open-use operation/support

- Preparation for OPE file
 - Imaging: by Observer (using a template)
 - Spectroscopy: by SWIMS team (for now)
- Preparation for MOS masks
 - Fully adopt the MOIRCS system for cutting work (Laser cutter, MCSMDP, etc.).
 - Use Pan-STARRS1 archival data as pre-image.
- Operation
 - One SWIMS member at summit (as SS).
 - A few SWIMS members at Mitaka or via zoom.
- Data Reduction
 - Imaging: python-based pipeline *swsred* available.
 - Spectroscopy: no special tools offered (use IRAF).



Updates from UM2020

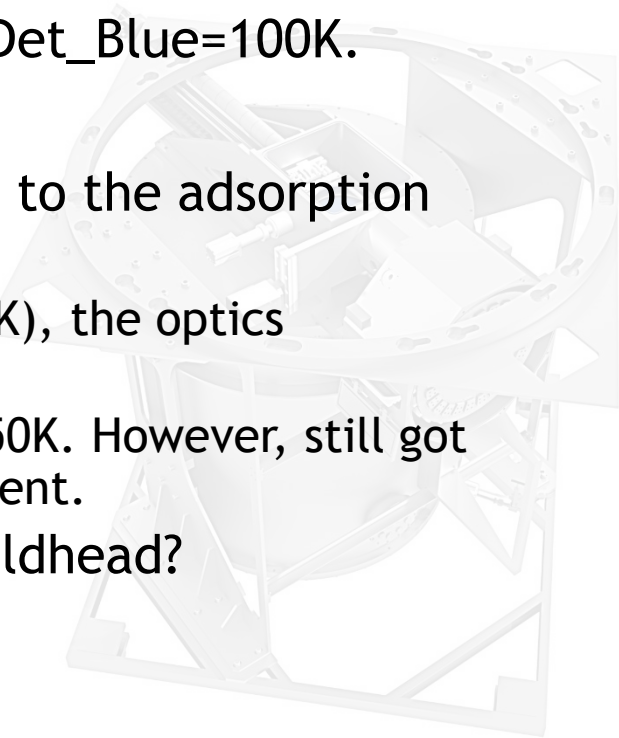
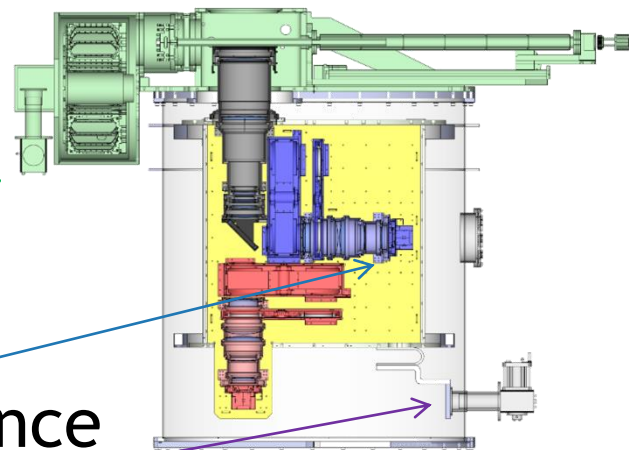
- Feb 2020:
 - Replaced one of the detectors on blue arm with one leased by Subaru.
- Apr 2021:
 - Changed He lines.
 - Served via telescope flange, instead from umbilical lines.



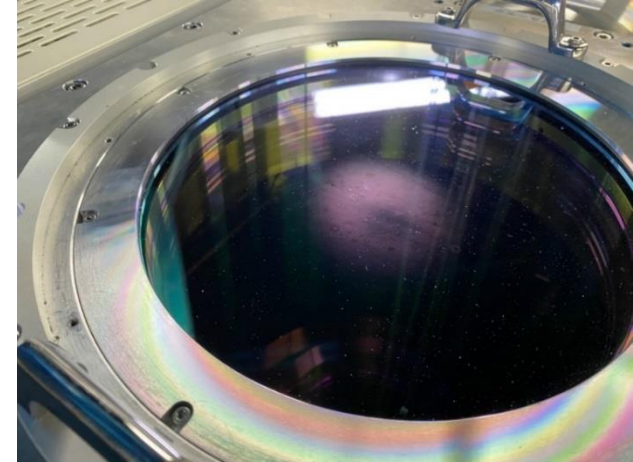
Troubles

1. Degradation of cooling performance

- After stopping MOSU cooling, temperatures of detectors and coldhead for the optics gradually increased from Nov 2020.
 - Apr 2021 observations conducted at Det_Blue=100K.
- Possible causes:
 - Decrease in the emissivity of MLI due to the adsorption of outgas?
 - By degassing (warming SWIMS to 250K), the optics improved below 90K.
 - The coldhead also cooled down to ~50K. However, still got warm by tilting/rotating the instrument.
 - malfunction/contamination of the coldhead?
 - Coldhead replaced in Nov 2021. (as of writing, coldhead ~ 40K)



Troubles



2. Loss in throughput

- The window (vacuum-side) surface is fogged, which causes higher background and lower throughput.
- Comparison of background levels with S18B data
 - No significant change up to H-band.
 - Clear increase in 2 μm .
 - Twice at the edge of FoV in Ks.



Counts (ADU/s)	Y	J	J1	J2	H	Ks	K1	K2	K3
S18B Jan	20	110	40	90	680	270	140	140	140
S21A Apr	20	80	40	70	410	230	170	160	150
S21A May	-	150	50	90	770	370	190	180	190

- Possible Cause:

- Adsorption of the outgas?
 - Still visible after “degassing” done in Apr 2021.
 - Looks disappeared in Nov 2021.
 - need to confirm by image.

Background level at edge of FoV.

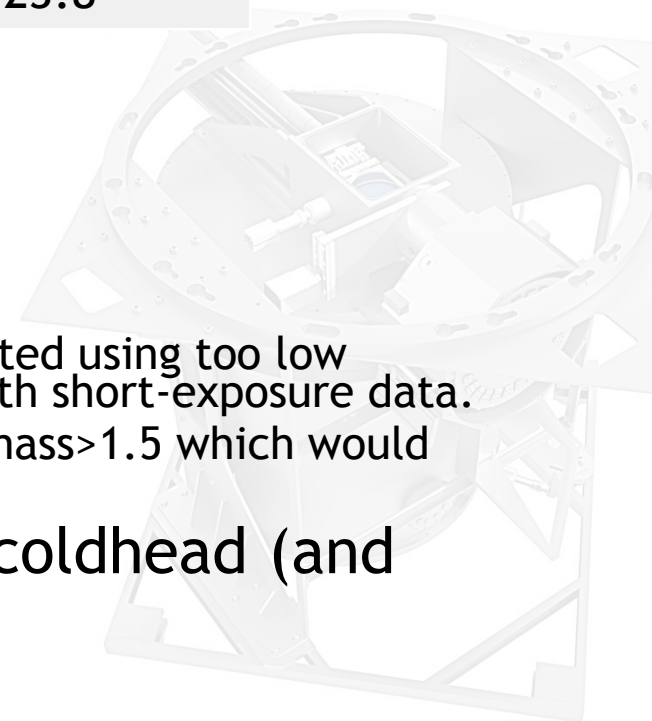


Troubles

- Impact on limiting magnitudes

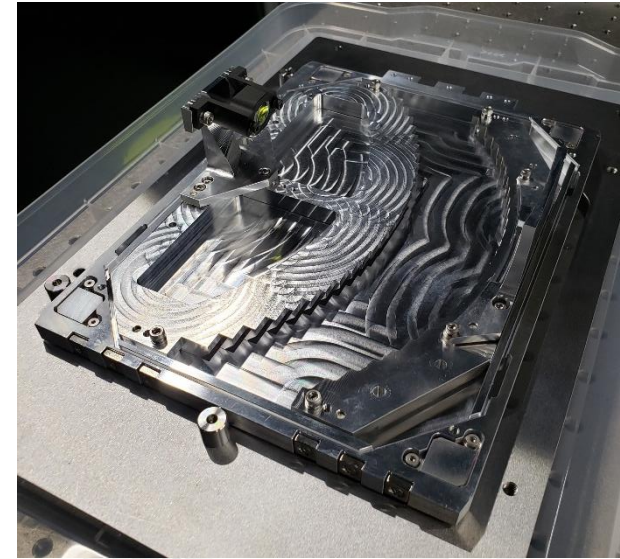
ABmag 1hr/5 σ /1" ϕ	J	Ks
S18B (expected)	24.9	24.4
S21A May (actual)	24.2	23.8

- Measurements can be explained by:
 - Loss in throughput ($\sim 10\%$) $\rightarrow 0.05\text{mag}$
 - Increase in background
 - Ks: 2X $\rightarrow 0.4\text{mag}$
 - J: 3X $\rightarrow 0.6\text{mag}$
 - ❖ Note that the expected value was calculated using too low background level which was estimated with short-exposure data.
 - ❖ Note that S21A data was taken below airmass > 1.5 which would lead to shallower result.
- We expect improvements with new coldhead (and degassing).

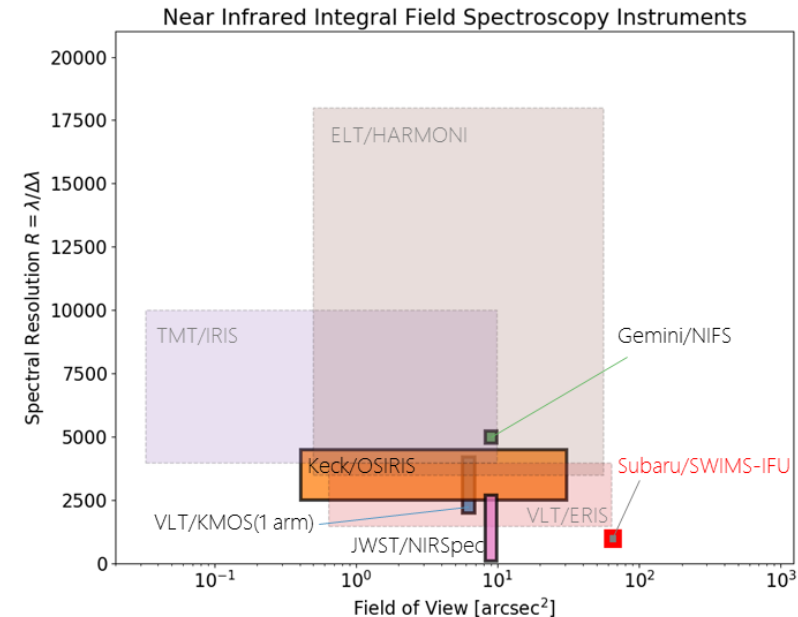


SWIMS-IFU: overview

- “Handy-size” IFU to be installed into the MOS exchanger unit.
- Image-slicer optics.
- Large FOV and wide wavelength coverage.

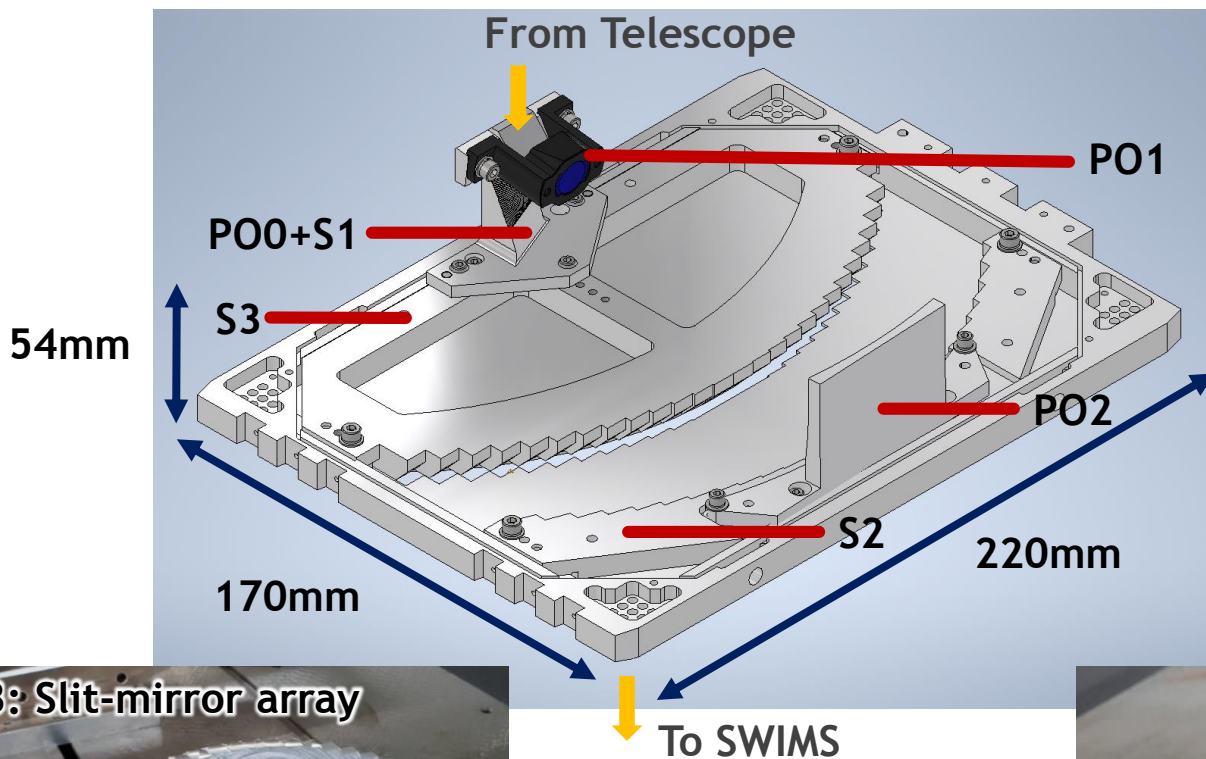


Wavelength Coverage (Same as SWIMS)	0.9 - 1.45 μm (Blue) & 1.45 - 2.5 μm (Red)
Spectral Resolution (Same as SWIMS)	R~900-1400 (Blue) & R~700-1200 (Red)
Field of View	13.5" x 4.8"
Pixel Scale	0.095 "/pix
Slice Width	0.4"
Number of Slices	12 (CH-6 ~ CH+6)
Expected Throughput of IFU	~70-75%

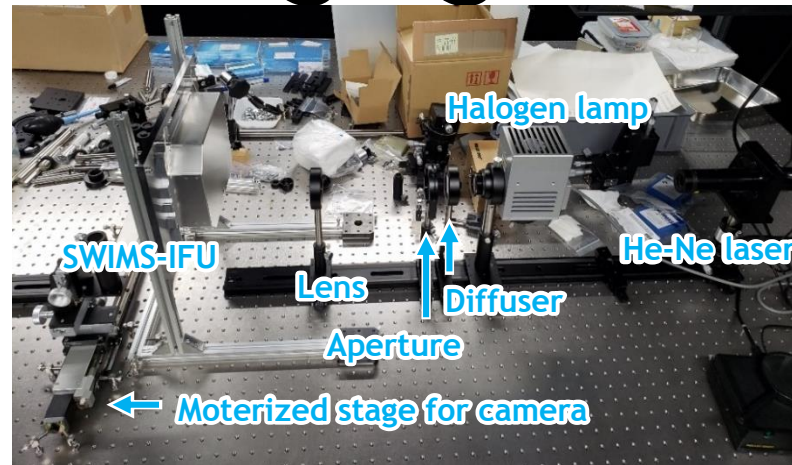


SWIMS-IFU: fabrication/assembly completed!

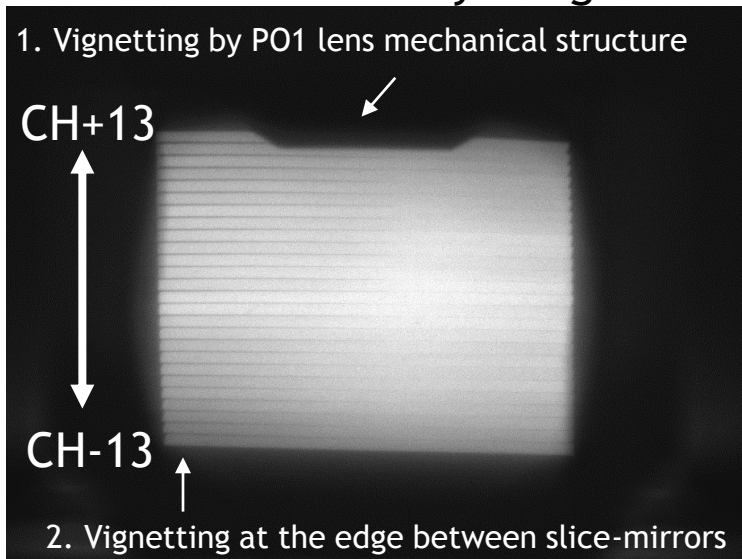
(by ultra-precision monolithic machining)



SWIMS-IFU: Imaging tests @ ATC lab



Slice-mirror array images



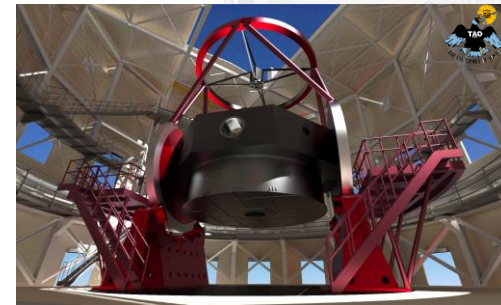
Pseudo-slit images



SWIMS-IFU is working with expected precision !!

Schedule (2022~)

- Feb
 - Transport IFU to Hilo.
- Mar
 - IFU work
 - Install into SWIMS.
 - Daytime tests
 - Mechanical test
 - Optical test using dome light
 - Engineering obs.
(TBD for IFU open-use operation.)
- End of FY2022 (after S22B)
 - Transport SWIMS to Japan
→ First light @ TAO in 2024.



Summary

- **SWIMS** is in operation from S21A as a PI-type instrument (until S22B).
 - S21A was succeeded w/o any serious incidents/accidents.
 - SWIMS will be transported to Japan after S22B run.
- Instrument Troubles
 - Gradual increase in temperatures.
 - Coldhead replaced in Nov 2021.
 - Loss in throughput and increase of background (possibly due to adsorption of outgas?)
 - ~0.5mag loss in limit mag.
 - Expect to see improvements in S21B.
- IFU
 - Engineering obs in Mar.

