IFU for Technology Verification (Tech. IFU)

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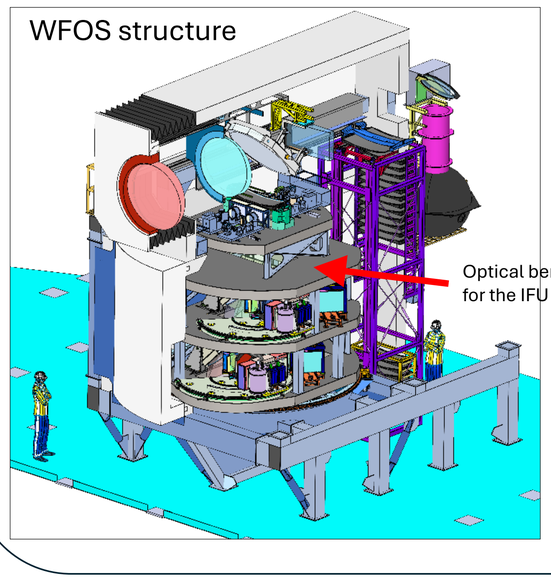
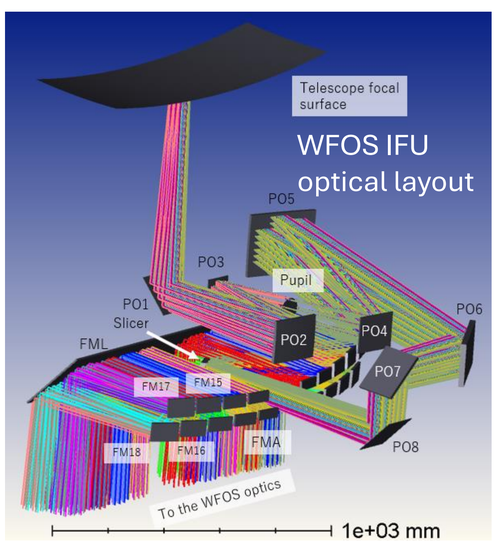
We are aiming to develop an IFU for Wide Field Optical Spectrograph (WFOS), one of the first-generation instruments of TMT, and now conducting some R&Ds on basic technologies for developing the IFU. To verify the technologies, we will develop an IFU (Tech. IFU) installed in Faint Object Camera and Spectrograph (FOCAS). In this presentation, we introduce Tech.IFU and its current status.

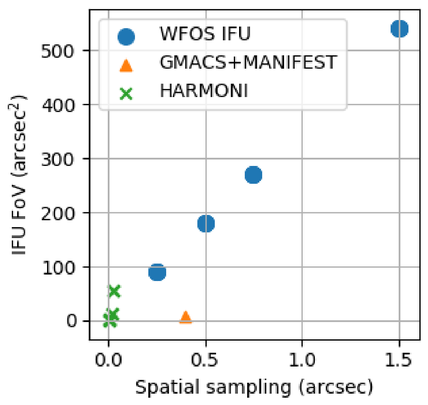
WFOS IFU

WFOS IFU is not a baseline feature of WFOS. However, considering its scientific benefit, we are aiming to develop the IFU as an upgrade. For the upgrade, the current WFOS structure has an optical bench dedicated for the IFU.





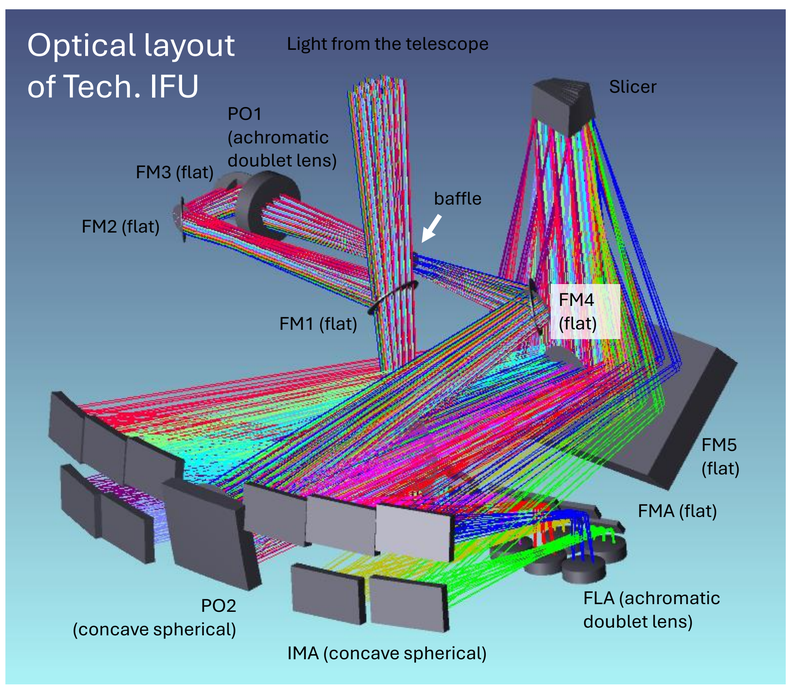
Number of slices	18			
Slice length (arcsec)	20			
Slice width (arcsec)	1.5	0.75	0.5	0.25
FoV (arcsec x arcsec)	20 x 27	20 x 13.5	20 x 9	20 x 4.5
Spectral resolution (R) for each grating in the IFU mode				
R=1500 grating	682	1364	2046	4092
R=3500 grating	1591	3182	4773	9546
R=5000 grating (goal)	2273	4545	6819	13635



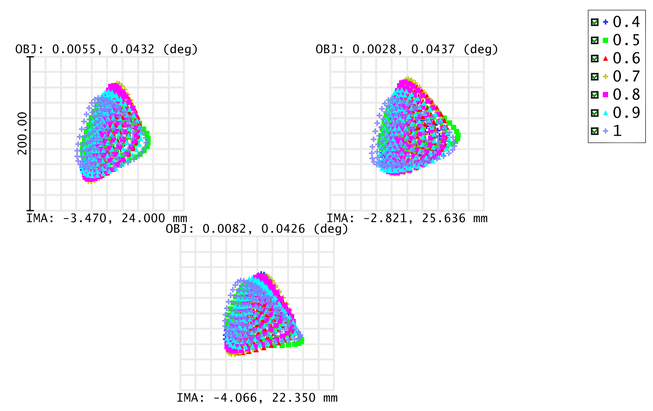
WFOS IFU has 4 slicers which have different slice widths. The wider width modes have outstandingly wider field comparing other IFUs on extremely large telescopes. In the narrowest width mode, the spectral resolution reaches R=13,635 without slit loss.

Optical design of Tech. IFU

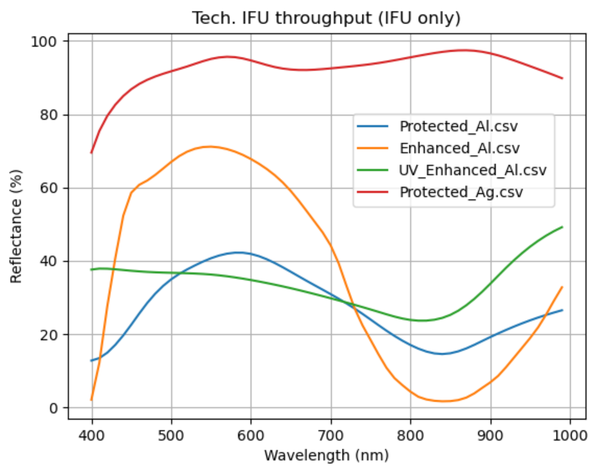
Tech. IFU focuses on the technology verification and uses as many ready-made products as possible for cost reduction.



Number of slices	10
Slice width	1.8 arcsec
Slice length	20 arcsec
FoV	20 x 18 arcsec^2
R@VPH680	1389



Worst case of the spot diagrams at the detector. The telescope, Tech. IFU, FOCAS are included in this estimation. The worst RMS diameter is 75.6 um corresponding to 0.43 arcsec. This is much less than the slice width (1.8 arcsec). As for the slice length direction, in the typical seeing condition of 0.6 arcsec, the spatial resolution is degraded to sqrt(0.6^2 + 0.43^2) ~ 0.74 arcsec.



Coating on the image slicer is highly reflective multilayer dielectric coating same as that for WFOS IFU. Its spectral reflectance is >98% over the WFOS wavelength coverage (310 – 1,000 nm) .

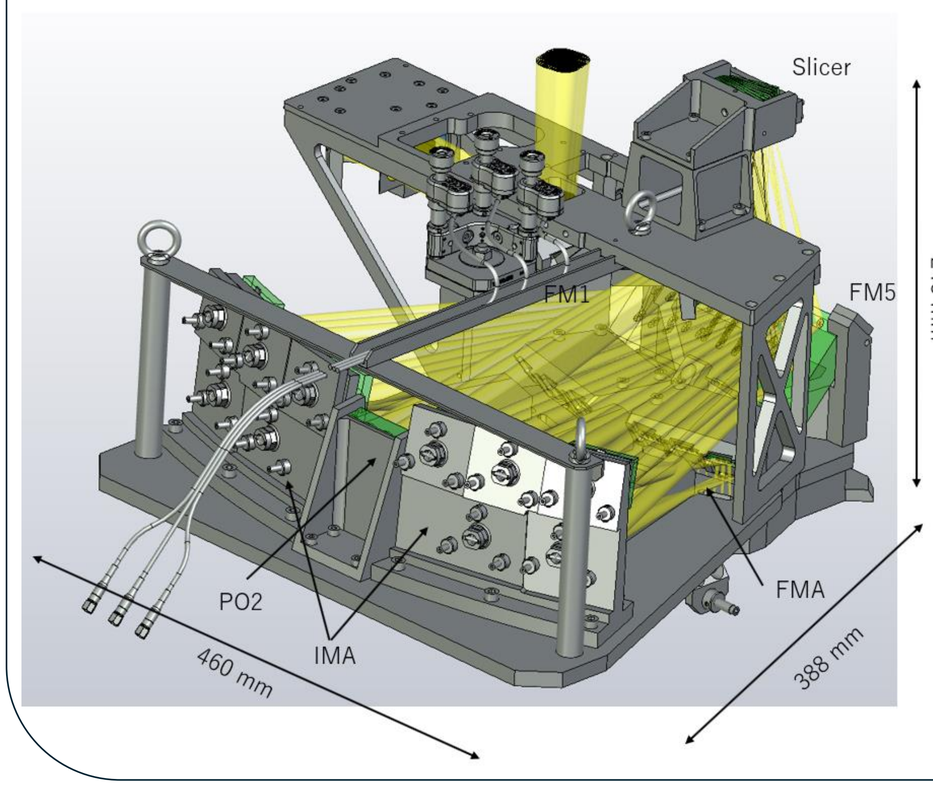
The achromatic lenses (PO1 and field lenses) are the off-the-shelf products with the VIS-NIR AR coating (Reflectance < 1.25% @ 400-870nm).

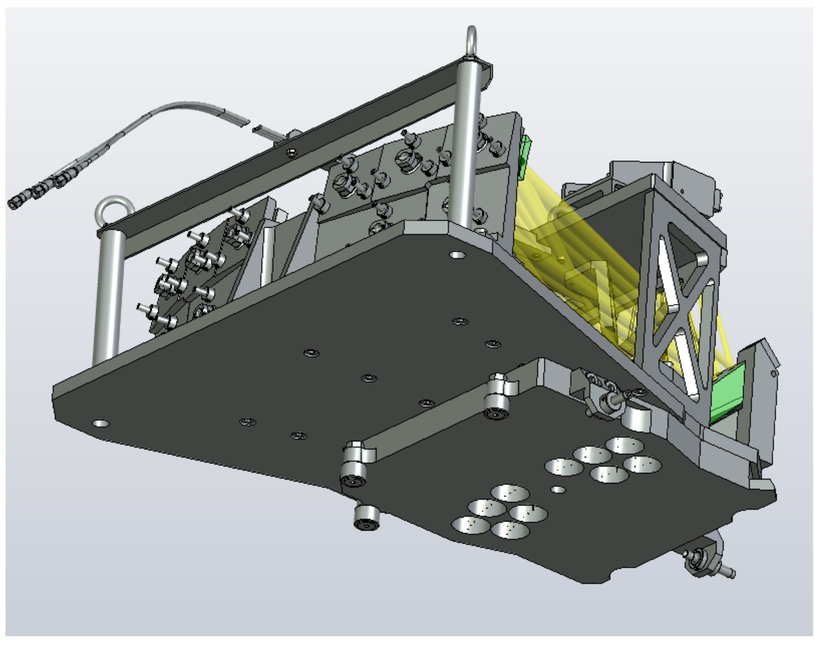
For other mirrors, we have not decided on the reflection coating yet. Current candidates are protected aluminum, enhanced aluminum, UV enhanced aluminum and protected silver.

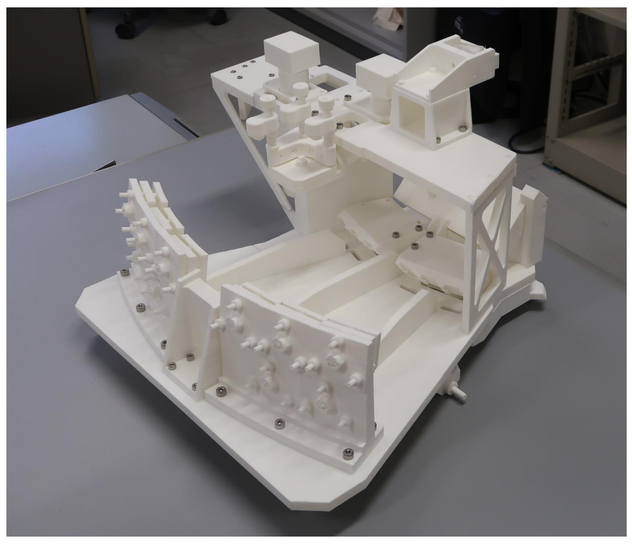
Including all of them, the throughput of Tech. IFU is shown in the left figure. For the technology verification purpose, the throughput is not important performance.

Mechanical design of Tech. IFU

The conceptual mechanical design was completed. PO1 has three actuators to align the telescope exit pupil image and the baffle in Tech. IFU. Each imaging mirror has three-axis adjusting mechanism to align the baffles in Tech. IFU and FOCAS.







The above figure shows 3D model made with a 3D printer in NAOJ ATC. This will be used to check interference with the FOCAS structures.

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