TMT/IRMS Review

April 2, 2012

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ICRR, University of Tokyo

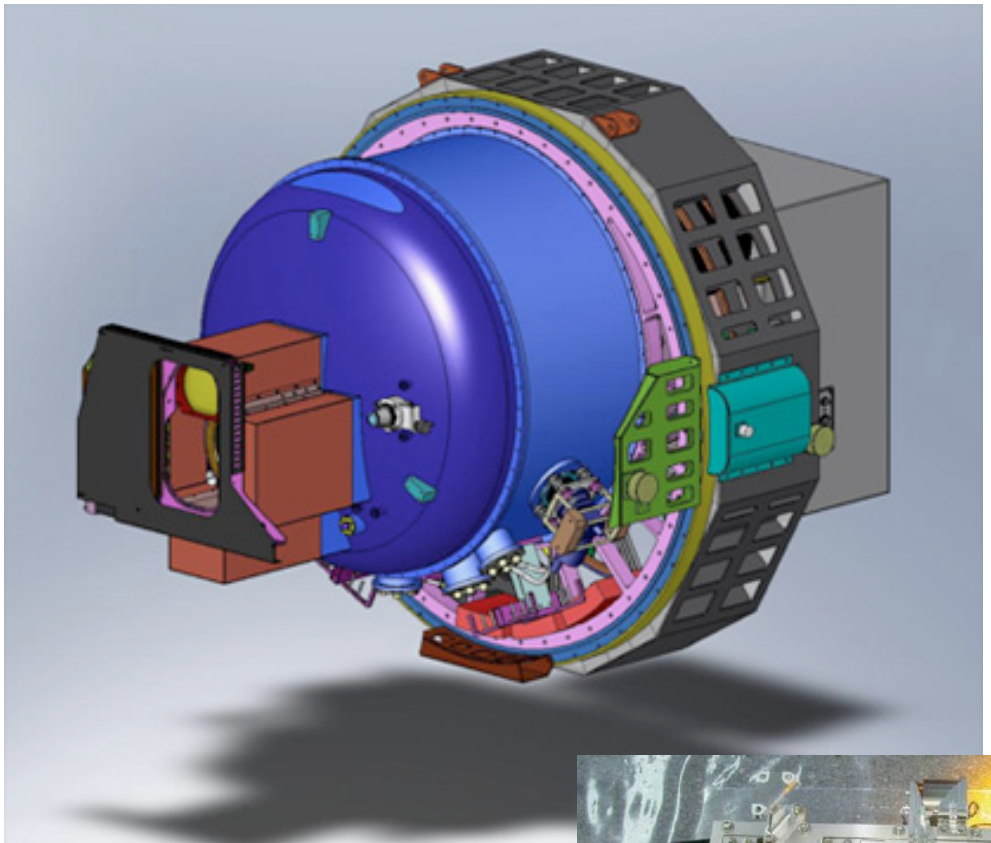
- MOSFIRE Status
- IRMS Status
- Tokoku’s Contribute to IRMS
- Tokoku’s Recent Works

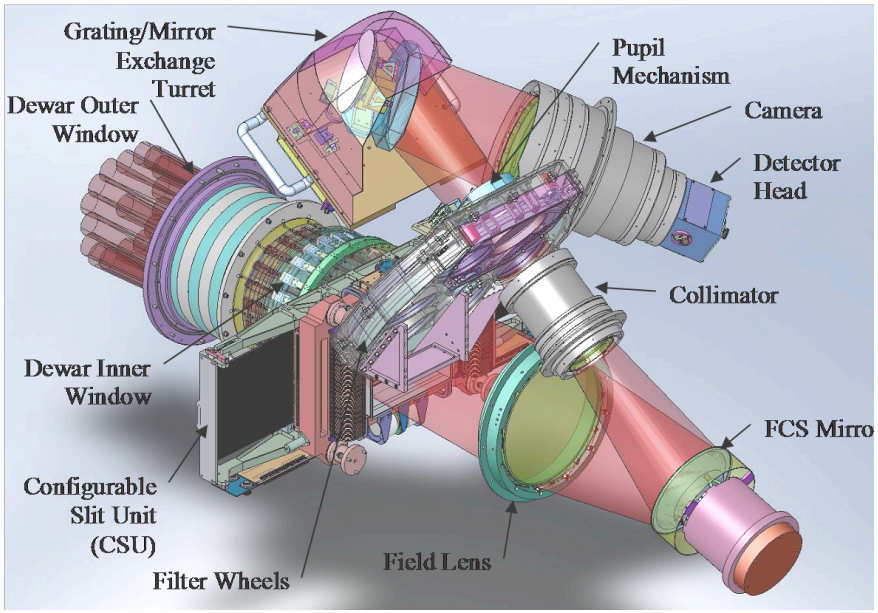
MOSFIRE Status

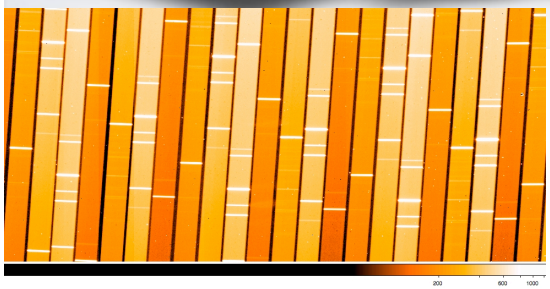
- MOSFIRE was delivered to Hawaii on Feb. 2012.
- Engineering Obs will be started on April 2012.
- Science Obs will be started on August 2012.

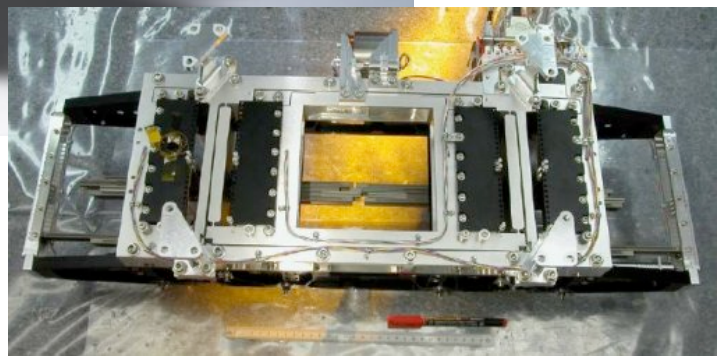
  (Shared Risk Mode during 2012B.)

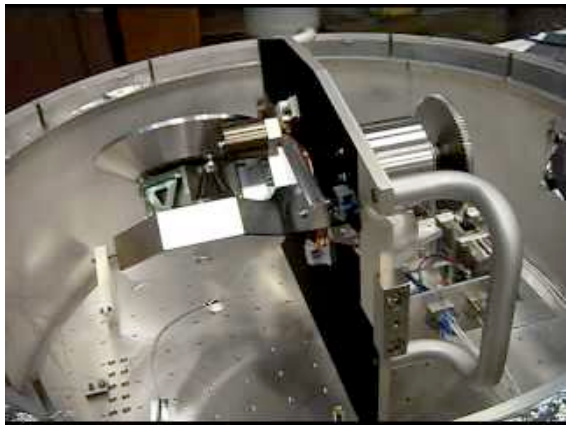
MOSFIRE on Keck







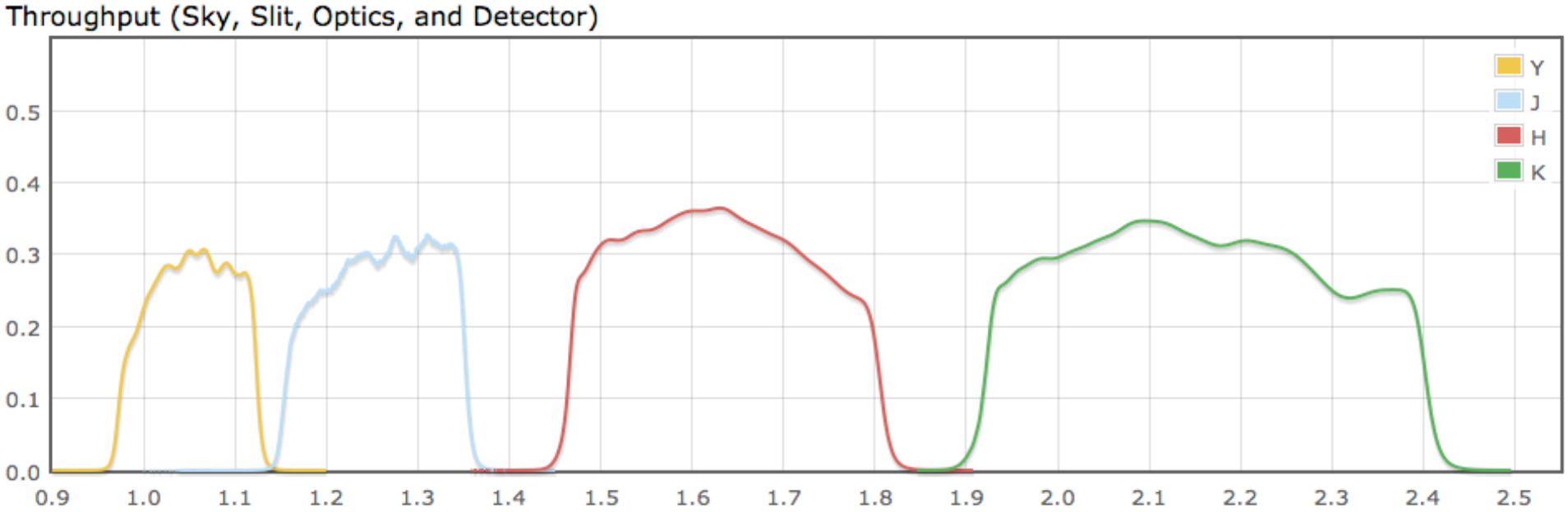


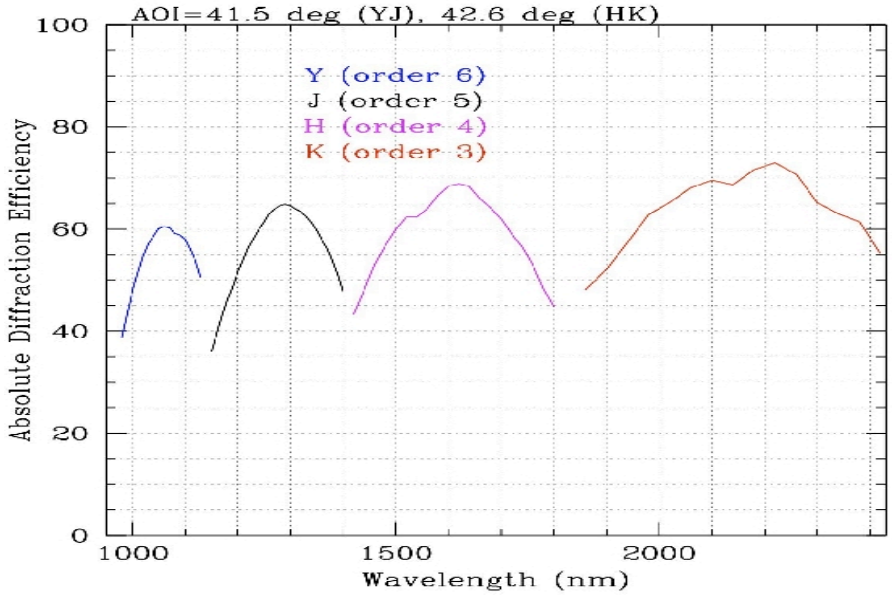


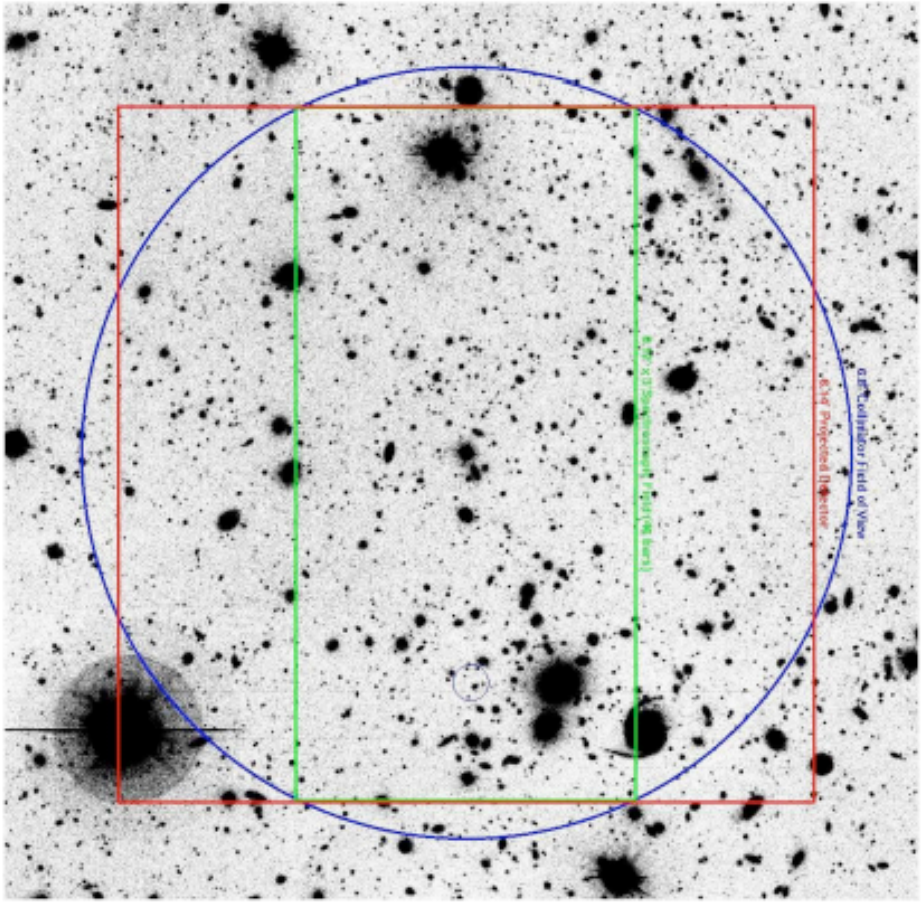
MOSFIRE Specifications

Wavelength	0.9 - 2.5 μm
Spectral Resolution	R=3270 w/0.7” slit (R=4770 w/0.48” slit)
AO	None
Pixel Scale	0.1798” in imaging mode
Field Size	6’.12 x 6’.12 (Imaging), 6’.12 x 3’ (Spectroscopy)
Multiplex	Cryogenic Configurable Slit Unit (CSU) ~45 remotely configurable slits. Length 7.3” Configuration Time ~300s (while slewing Tel.) (Detail time breakdown can be found at Pre Ship Review Report Page 175.)
Detector	One H2RG and ASIC (2k x 2k pixels)
First Light	April 2012

MOSFIRE Specifications



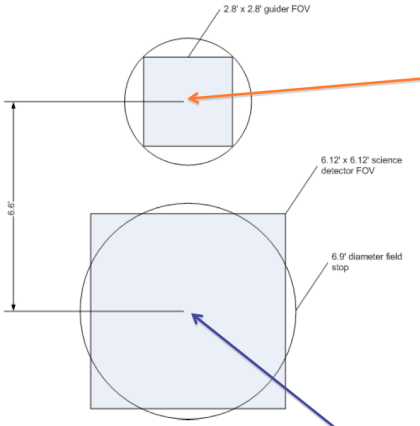




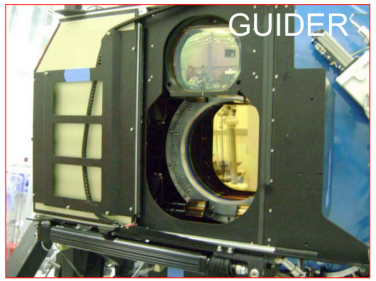
Blue: 6.8' diameter collimator field of view

Red: 6.12' x 6.12' projected detector

Green: typical 6.12' x 3' spectroscopic field

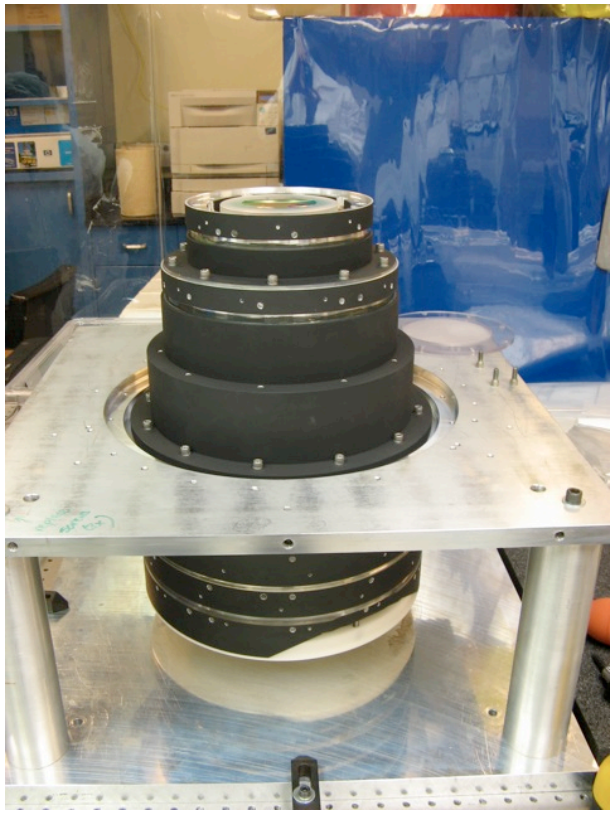


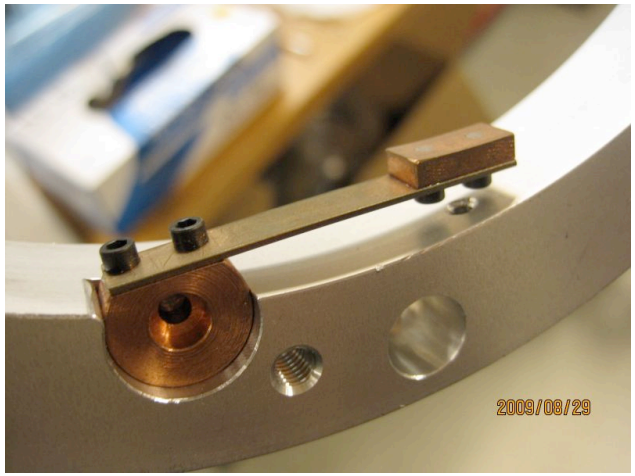
Optical (RG780) guider field centered 6.6' from telescope optical axis

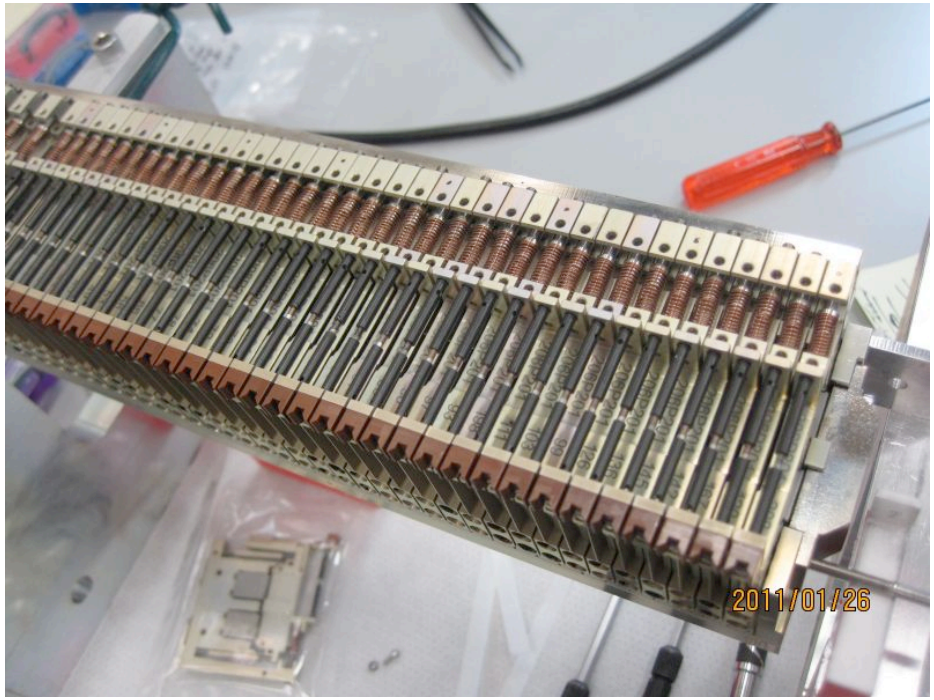


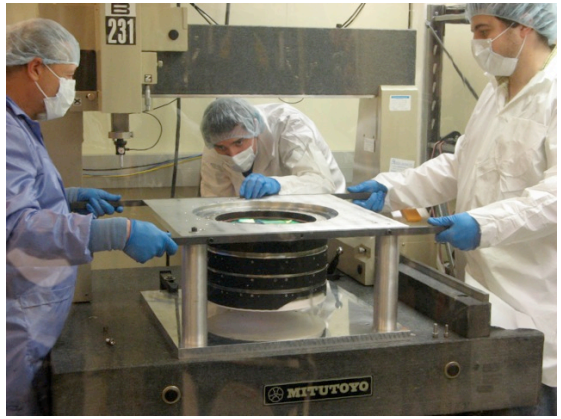
Science field centered on the telescope optical axis

MOSFIRE Pictures

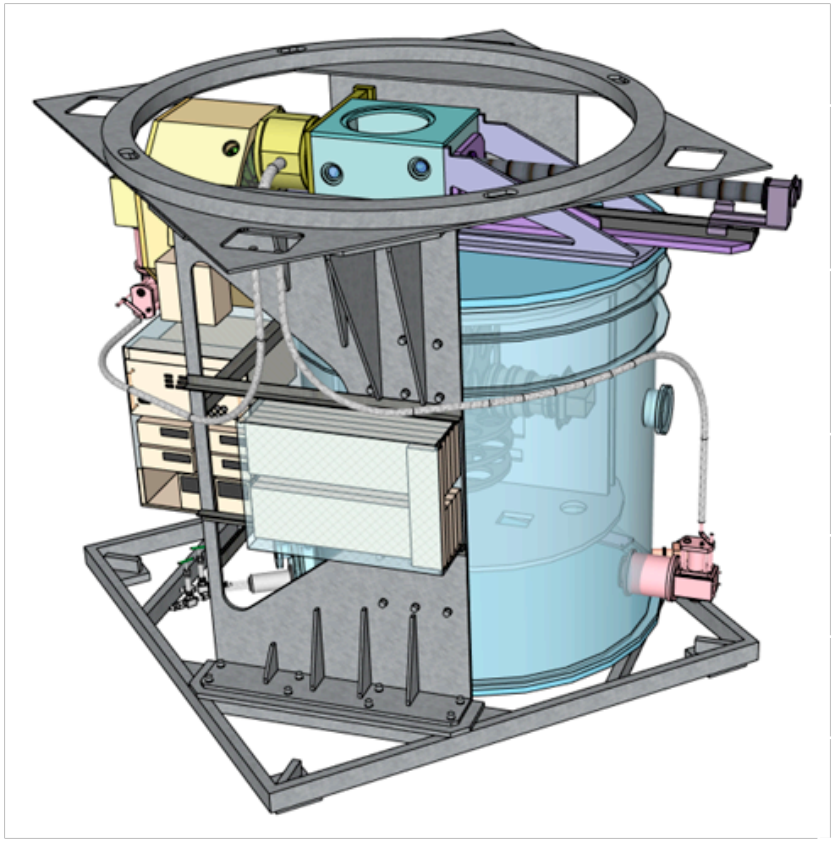








Another new IR-MOS for Subaru



SWIMS

Field Size	ϕ7.2’ for imaging 7.2’x4.5’ for MOS
Spectral Resolution	R=700-1000 for 0.9-1.4um R=500-900 for 1.4-2.5um
AO	None
Pixel Scale	0.096”
Detector	H2RGx8 (4 for each fov)
Multiplicity	~30

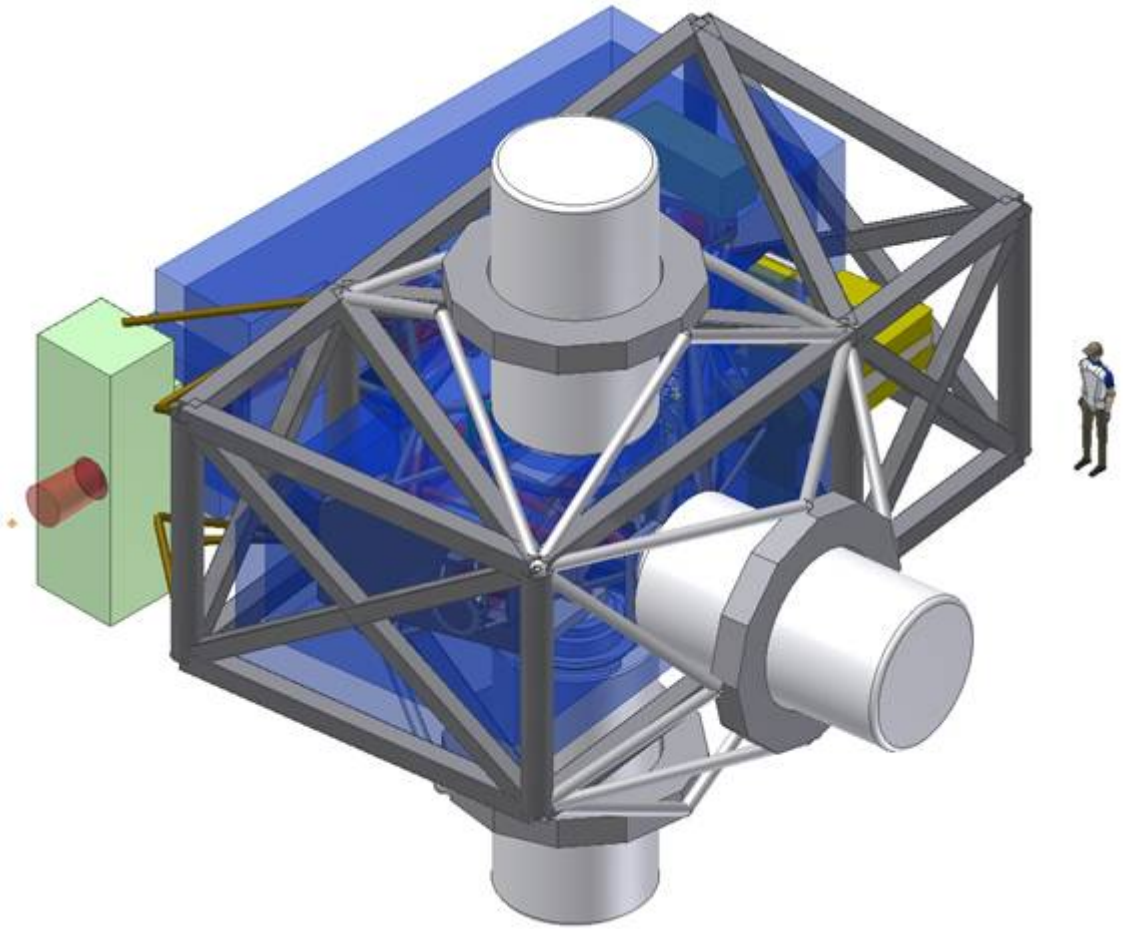
IRMS Status

- ?
- Depend on MOSFIRE Commissioning.

MOSFIRE to IRMS

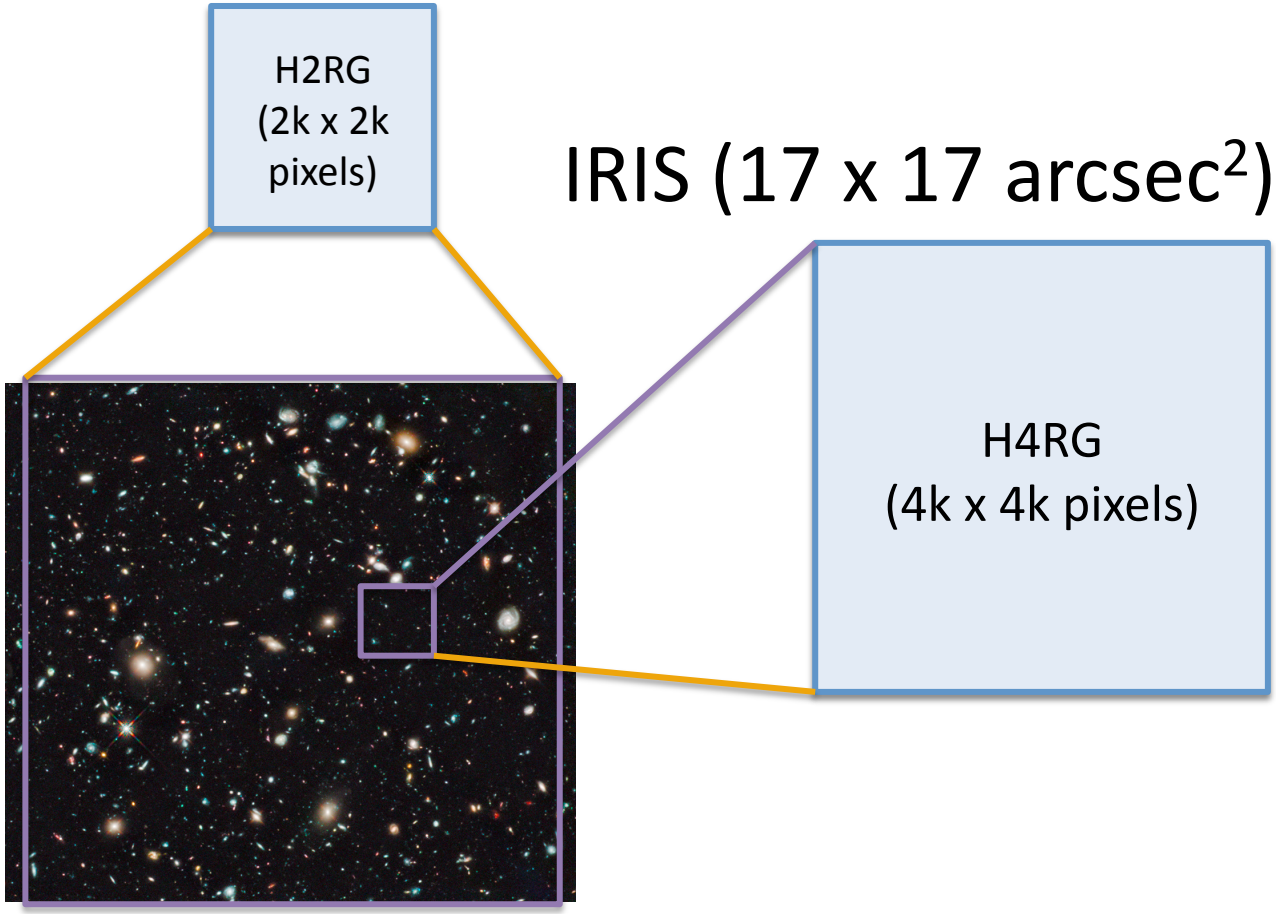
	MOSFIRE	**IRMS**
Telescope Aperture	10m Keck, Cassegrain	30m TMT, Nasmyth
Telescope F-ratio	f/14.5	f/15
FOV	6.8 x 6.8 arcmin	2 x 2 arcmin
Sampling	0.18”	0.06” (60 mas)
Plate Scale of Telescope	1.38 arcsec/mm 300 mm for 6.8 arcmin 507 um for 0.7” slit	0.45 arcsec/mm 267 mm for 2 arcmin 355 um for 160 mas slit
AO	None	NFIRAOS
OIWFS	None	Required
Atmospheric Dispersion Corrector (ADC)	None (On-Telescope Tip-tilt)	Required (On-Instrument)
Instrument Rotator	None	Required

IRMS on TMT



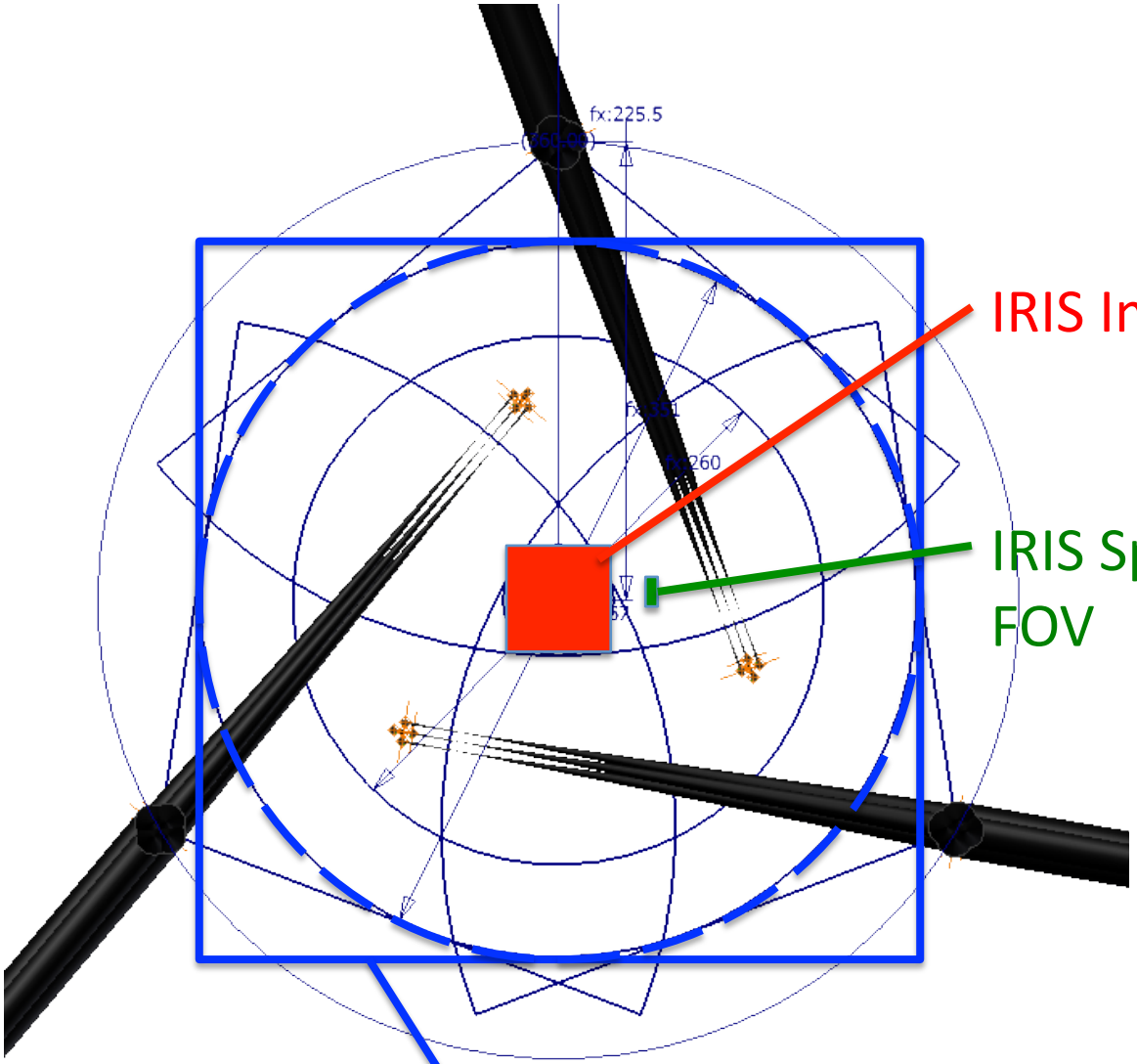
IRMS on TMT

IRMS (2 x 2 arcmin^2)



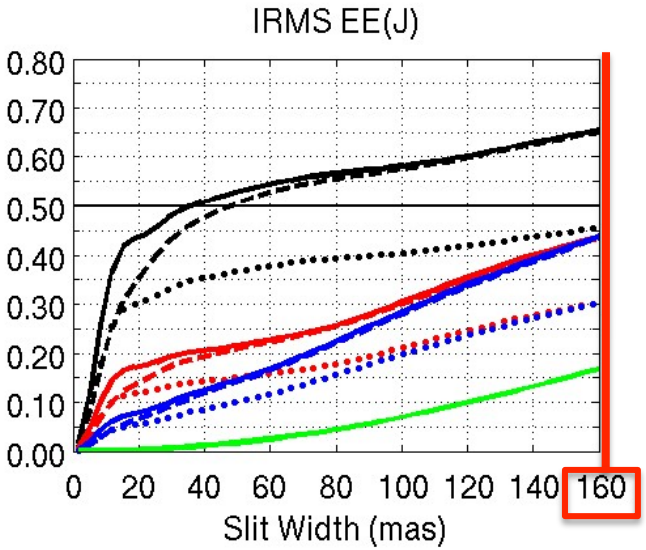
Sky image by HST/WFC3/IR/HUDF 2.2x2.2 arcmin^2

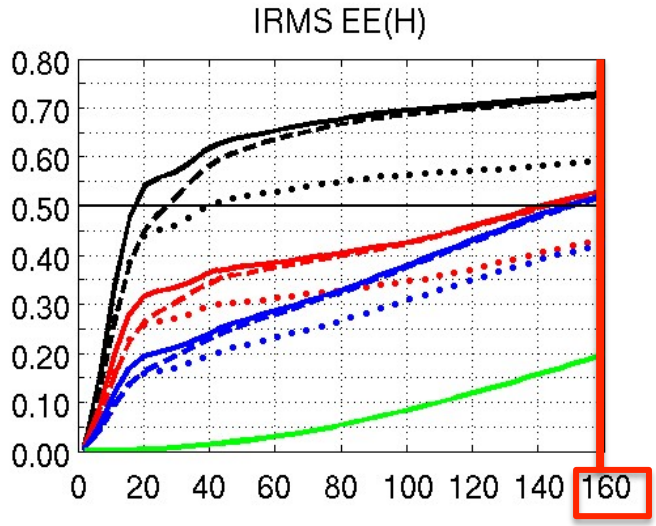
IRMS Field of View



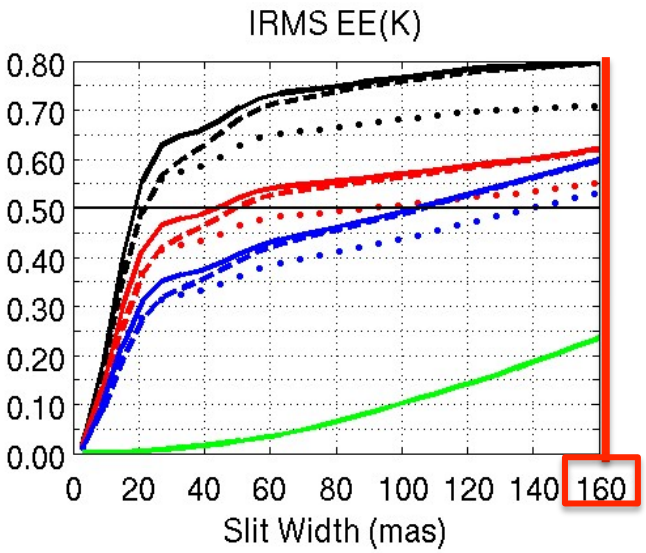
IRMS Sensitivity

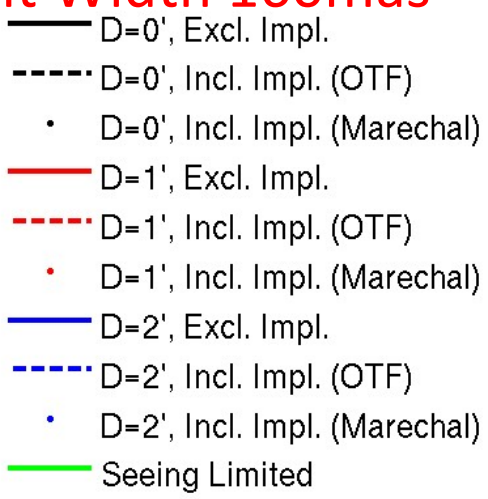
NFIRAOS Wide-field Mode (~2')





Slit Width 160mas





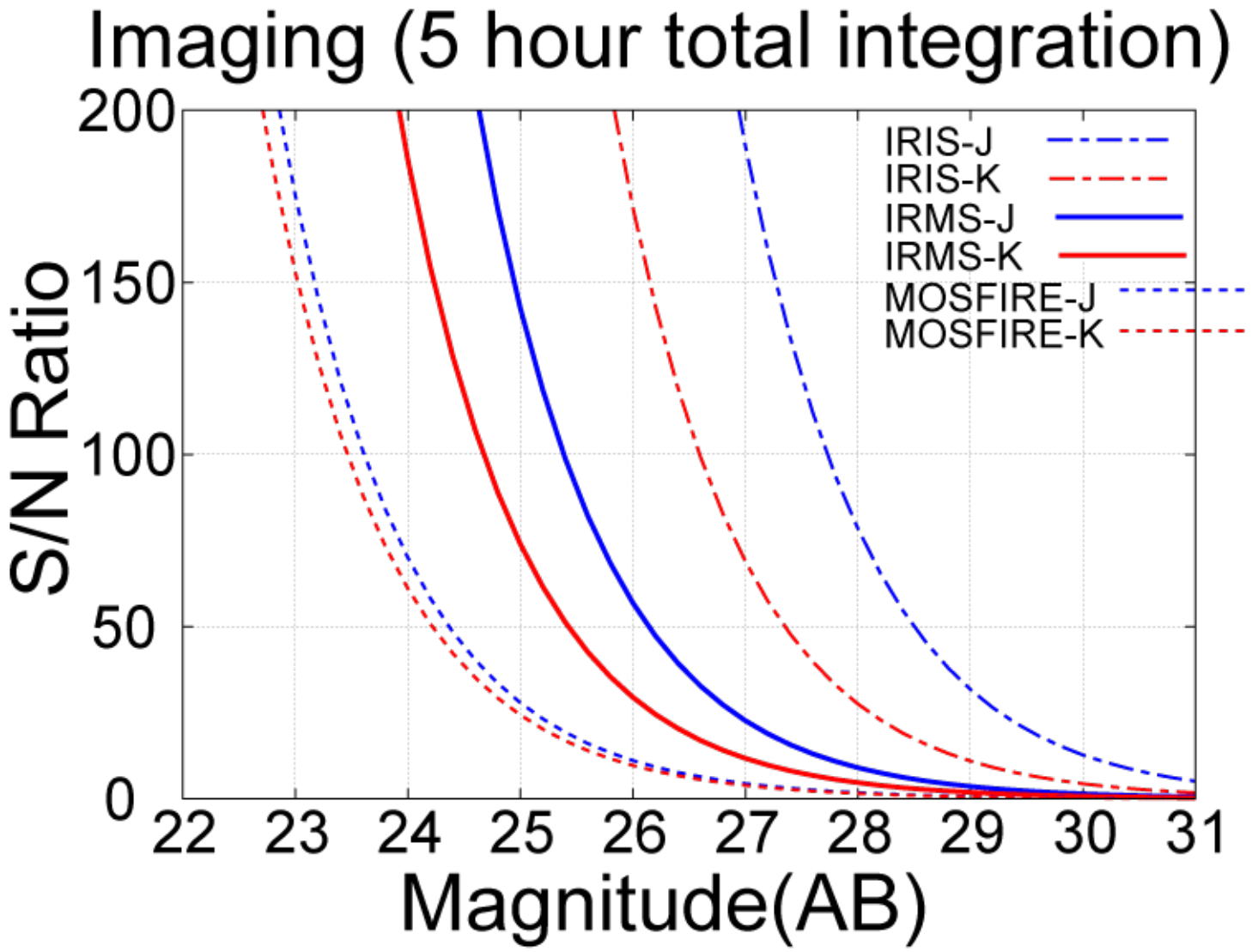
Edge of 1'

Edge of 2'

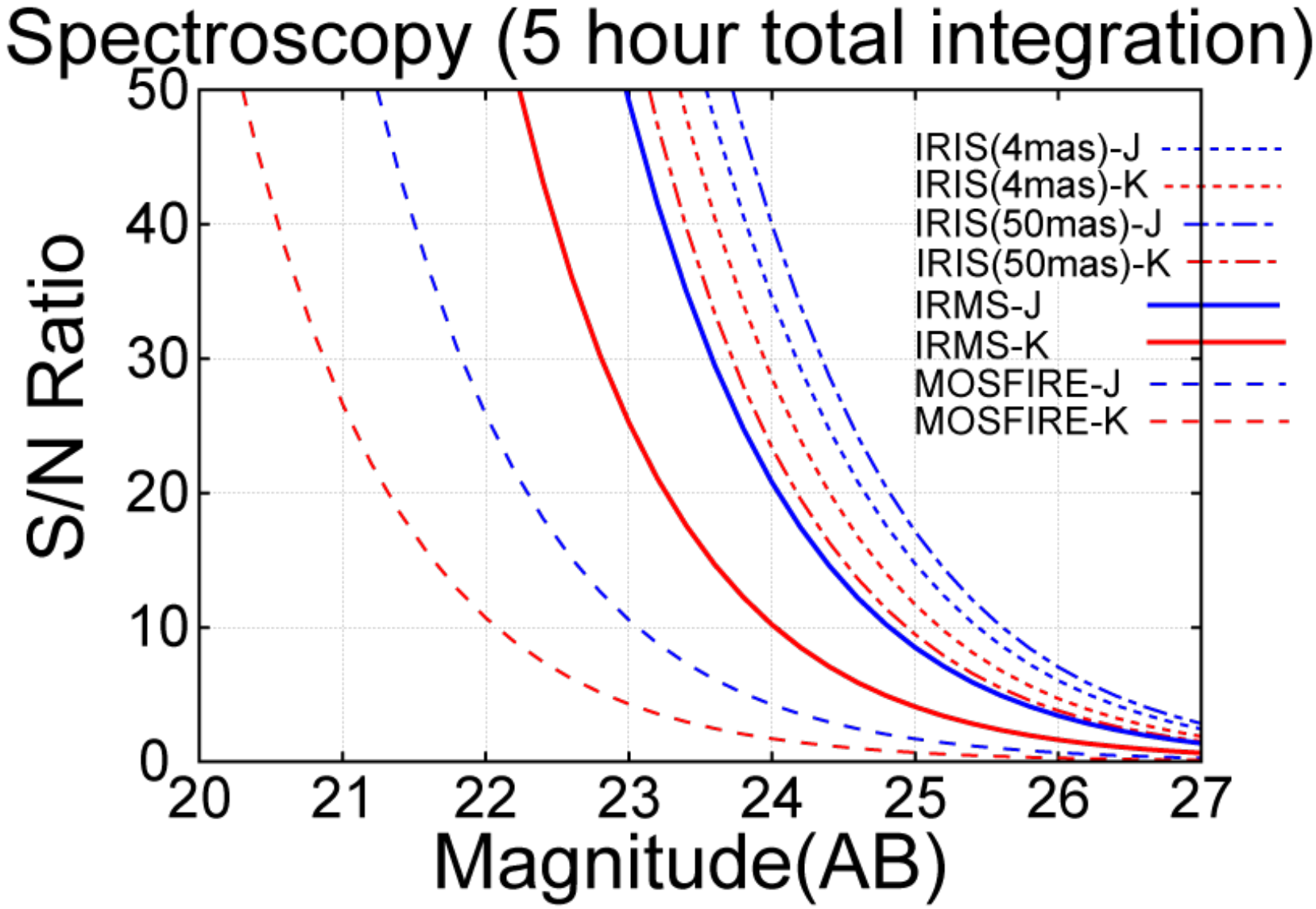
Seeing limited

Latest Simulation by Luc Gilles as of 3/2011

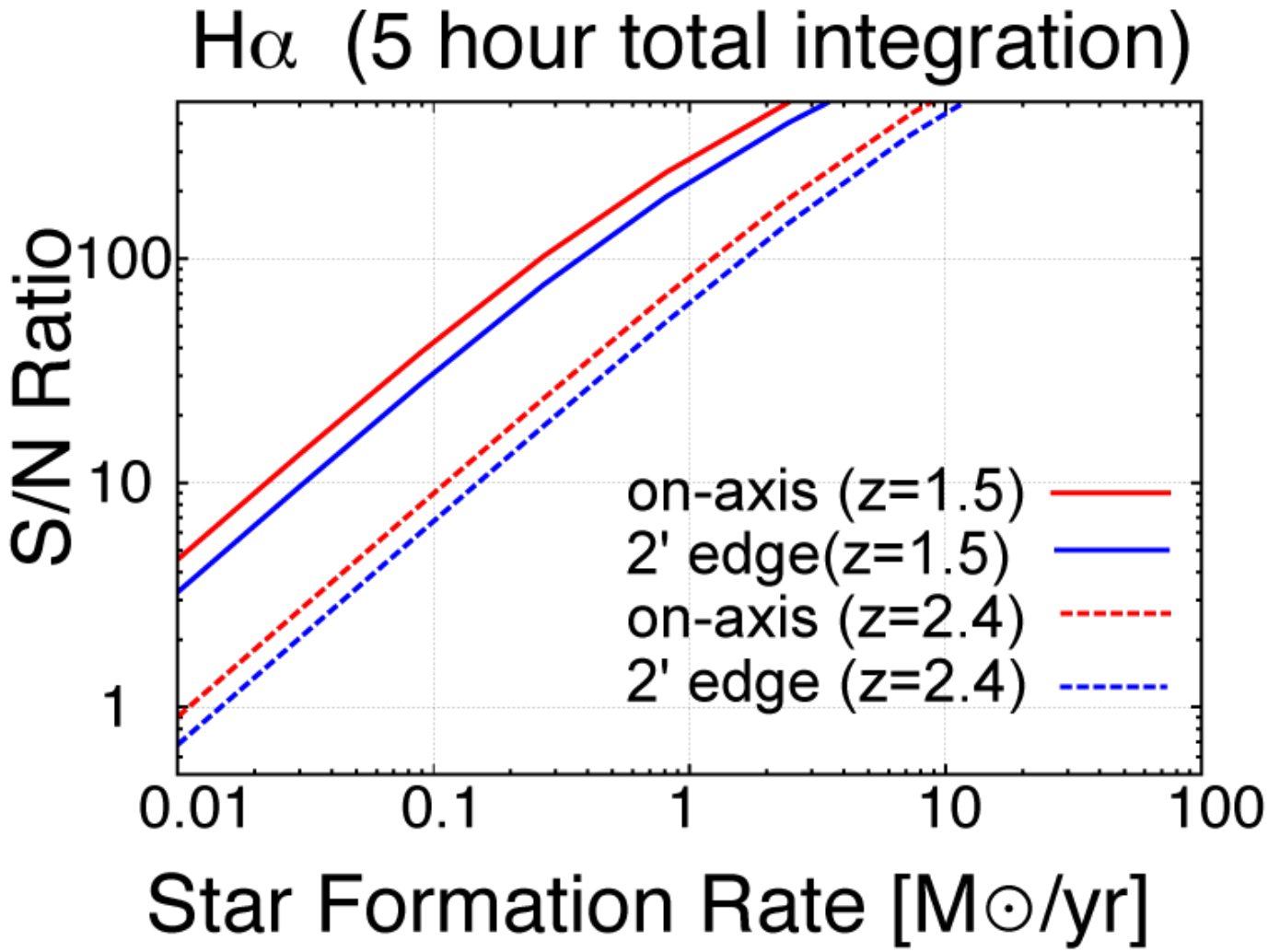
Imaging Sensitivity
Comparison with IRIS



MOS Sensitivity
Comparison with IRIS



MOS Sensitivity
Hα emission line



Hα@z=1.5 (H-band)
Hα@z=2.4 (K-band)

Dispersion 80 km/s
5 hour exposure

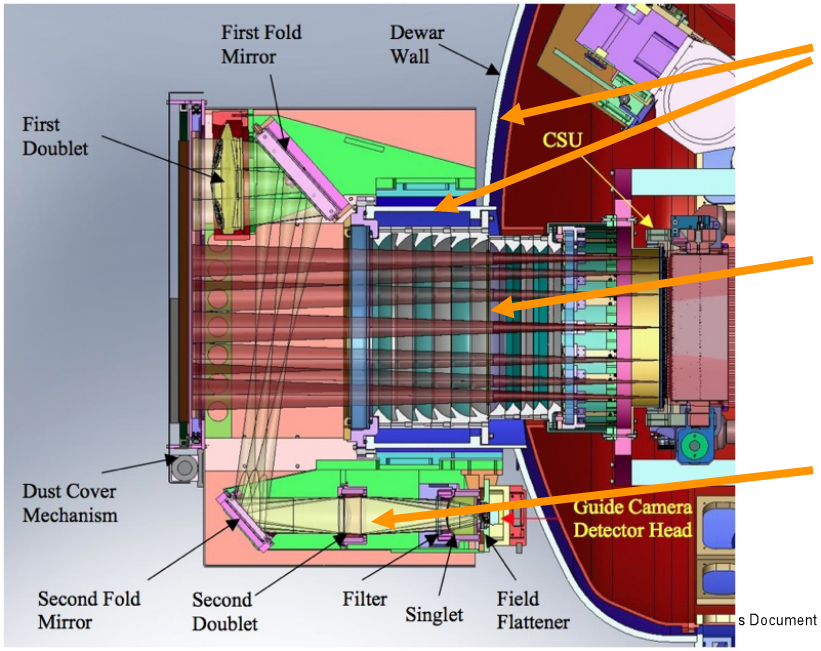
Challenges in Designing TMT/IRMS Observations (by Mobasher)

- What is the number density of interesting sources at 5<z<7 ?
- We are still limited by sky emission and bright sky-bg at near-IR wavelengths- integrated sky-bg in the 1-2.5 um is 250-1500 times brighter than that in the optical.
- The full 2.3 arcmin diameter of the IRMS allows observations of faint galaxies using 200 mas slits, providing a gain in sensitivity over a factor of 50 over the existing NIR spectrographs on 8-10m class telescopes.

IRMS mini meeting on 3/2011 at Victoria

- Richard Dekany, Keith Matthews, Luc Simard, Glen Herriot, Rick Murowinski, David Crampton, Brent Ellerbroek, Bahram Mobasher, and Tokoku
- About modification or redesign from MOSFIRE to IRMS. "Near" clone of MOSFIRE.
- Study has started since 2007.
- Interface to the instrument rotator. Buffle thermal redesign.
- Configuration of the guider probe near focal plane.
- Thermal treatment of the window.
- Focal plane distortion.
- Scalloping effect?
- Flexure correction system with the instrument hanging downward.
- Flexure control of the grism turret. (Grisms are heavy.)
- Slit transmission.
- Investigate the curvature of the focal plane and slit position.
- Vibration measurement. (CTI 150 single-stage is used in MOSFIRE).
- Nick Konidaris will work on the optical redesign.
- Procurement of window material. CaF2? 1640?
- Need lamp for wavelength calibration? K-band.
- Noise trade off with what? (I can't be heard.)
- Performance at the four corners of 2' x 2' FOV.
- Narrow-band filter (in J-band) study by Betsy Barton?

Needed IRMS Front-End Modifications

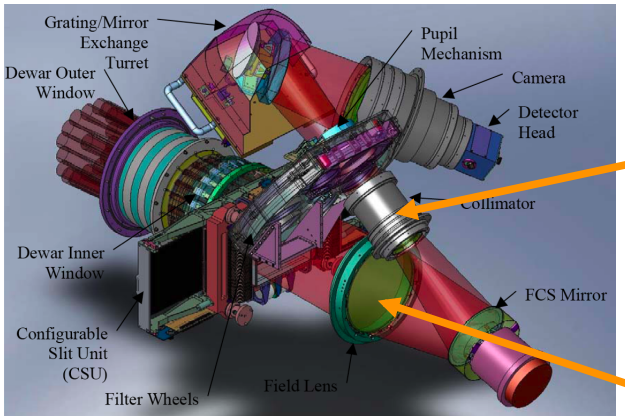


Cold paths including dewar

Entrance thermal baffle

Guiders and OIWFS

Needed IRMS Back-End Modifications



Collimator:
Some lenses might be different in prescription and location, but same overall mechanical envelope

Field lens:
Small changes in shape and position

Tokoku's Contribute to IRMS

- Tokoku had worked for the IRMS Science Team at UC Riverside during 10/2010-7/2011.
- Main work was to help Prof. Mobashar (Sci. PI) to prepare a science detail proposal.
- Prepare IRMS Science Team Homepage.

  http://faculty.ucr.edu/~mobasher/irms/
- Study about instrumentation of MOSFIRE and IRMS, and NFIRAOS.
- Attend some meeting at Caltech and TMT office. Great chance to meet related people and catch up on latest information.

IRMS Science Team Homepage
http://faculty.ucr.edu/~mobasher/irms/

but still in preparing…

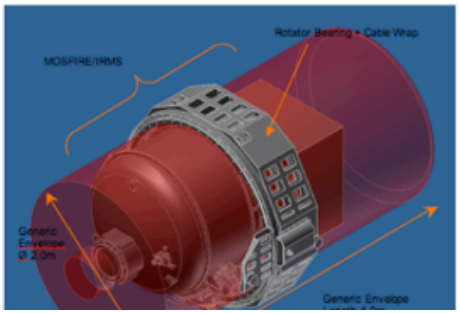
IRMS: Infrared Multi-Slit Spectrograph for Thirty Meter Telescope

- Home
- Instrument
- Adaptive Optics
- Sensitivity
- Science Case
- Documents
- Member
- Link
- Internal Site

Over View

IRMS is a near-diffraction-limited multislit near-infrared spectrometer and imager. It will operate behind NFIRAOS, over the 0.8 - 2.5 um wavelength range. Closely modeled after the Keck instrument MOSFIRE, IRMS will employ a cryogenic slit assembly with 46 individually-configurable slits. The slits can be positioned within a 2 arcmin field. The detector scale is 60 mas/pixel and the spectral resolution is about R = 5000 for a 160 mas slit width (lower with wider slits). The imager covers a 2.27 arcmin diameter FOV with 60 mas sampling. IRMS will be an early-light instrument on the TMT.

TMT
THIRTY METER TELESCOPE



Tokoku's Recent Works

- Moved to ICRR on July 2011.
- Norikura Observatory (2800m in altitude) operation/maintenance work during summer.
- Assigned KAGRA(LCGT) Project (until 2016).
- Development and Performance Test of UHV Large Cryostat.
- Working with KEK people (professionals of large UHV structure from Accelerator Research, and professionals of Cryogenic from Superconductivity Research.)

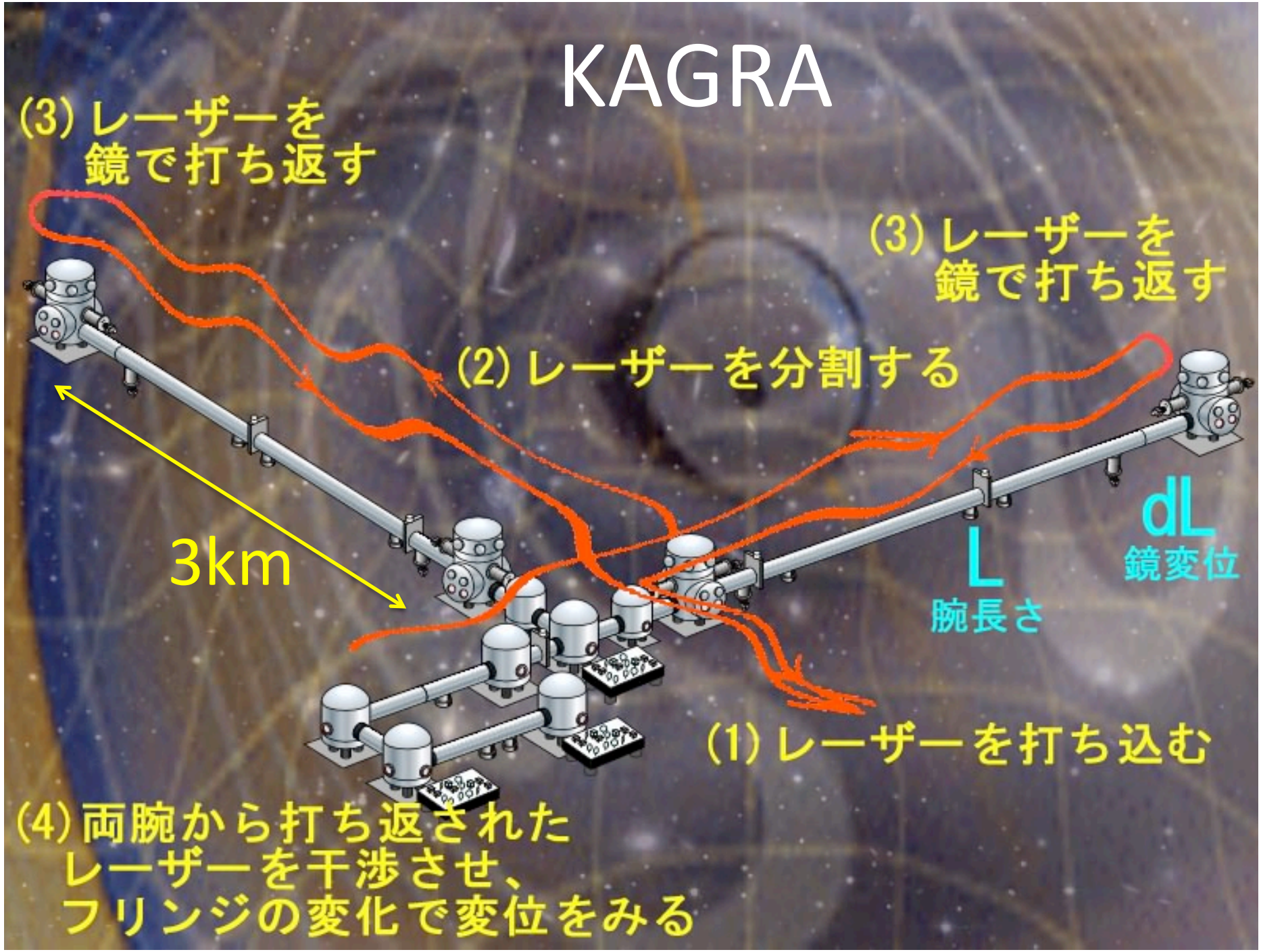
KAGRA

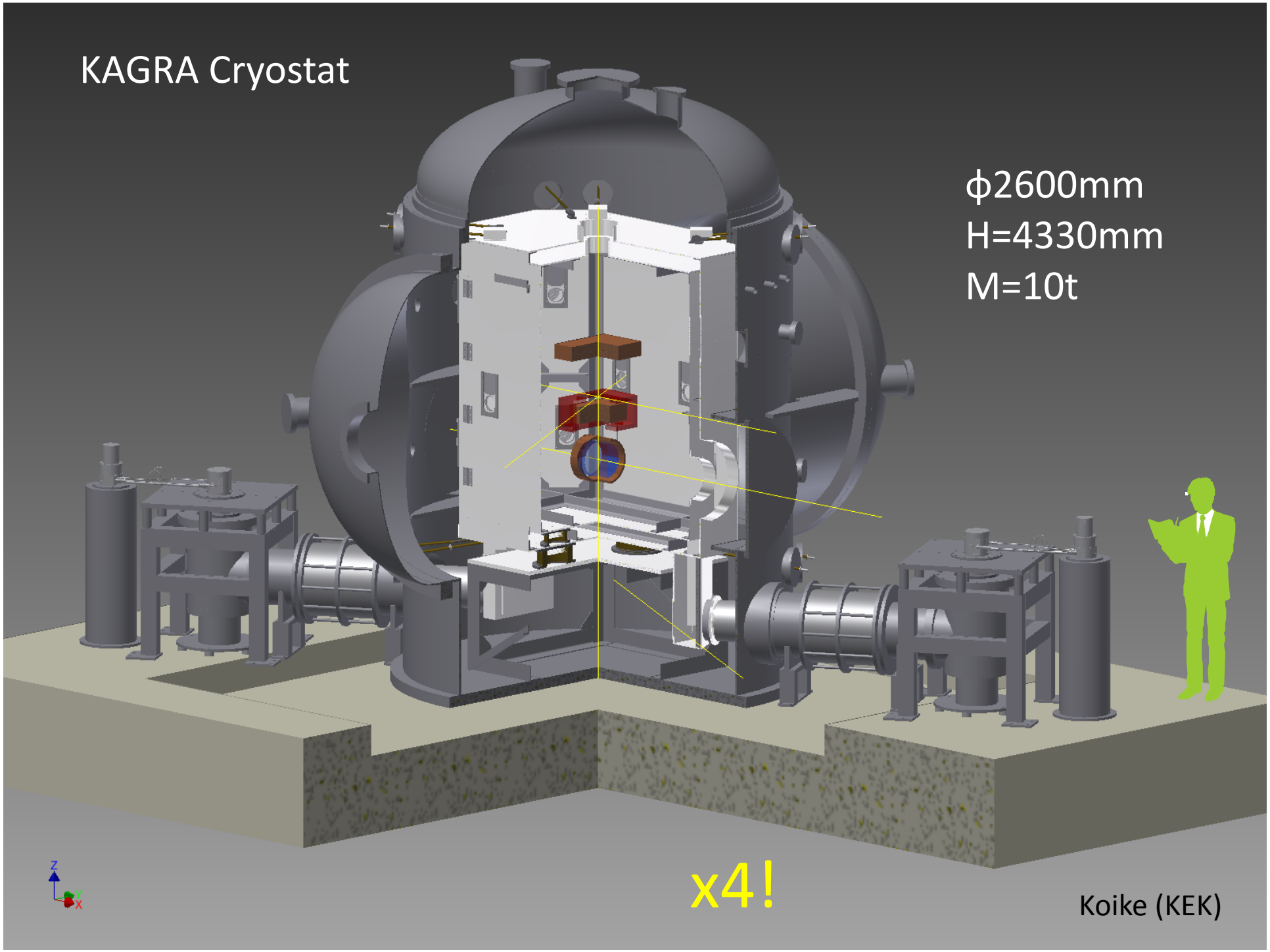
Kamioka Gravitational Wave Detector
Large-Scale Cryogenic Gravitational Wave Telescope

- Kamioka Site.
- First direct detection of gravitational waves.
- International Collaboration, >50 groups in Japan, >30 groups from foreign.
- 2012 : Start Construction

  2015 : Commissioning

  2018 : Science Observation


KAGRA
(3) レーザーを
鏡で打ち返す
(3) レーザーを
鏡で打ち返す
(2) レーザーを分割する
3km
L
腕長さ
dL
鏡変位
(1) レーザーを打ち込む
(4) 両腕から打ち返された
レーザーを干渉させ、
フリンジの変化で変位をみる


KAGRA Cryostat
ϕ2600mm
H=4330mm
M=10t
x4!
Koike (KEK)

Common Basic Knowledge for Huge Cryogenic Instrument

- Large Cryostat Design Process.
- Extremely low vibration structure.
- Technical know-how for UHV and cryogenic on huge instrument.
- Manufacturing and handling of large and high quality optics. (ex. Sapphire)
- Extremely clean environment (class~1-100), low static, low scattering, low outgas, ….

Future Works?

- (Collaborate on IRMS science proposal.)
- Contribute to IRIS from ICRR Ouchi group?