Activities of Optical-Infrared Astronomical Technology Group of KASI

Sungho Lee

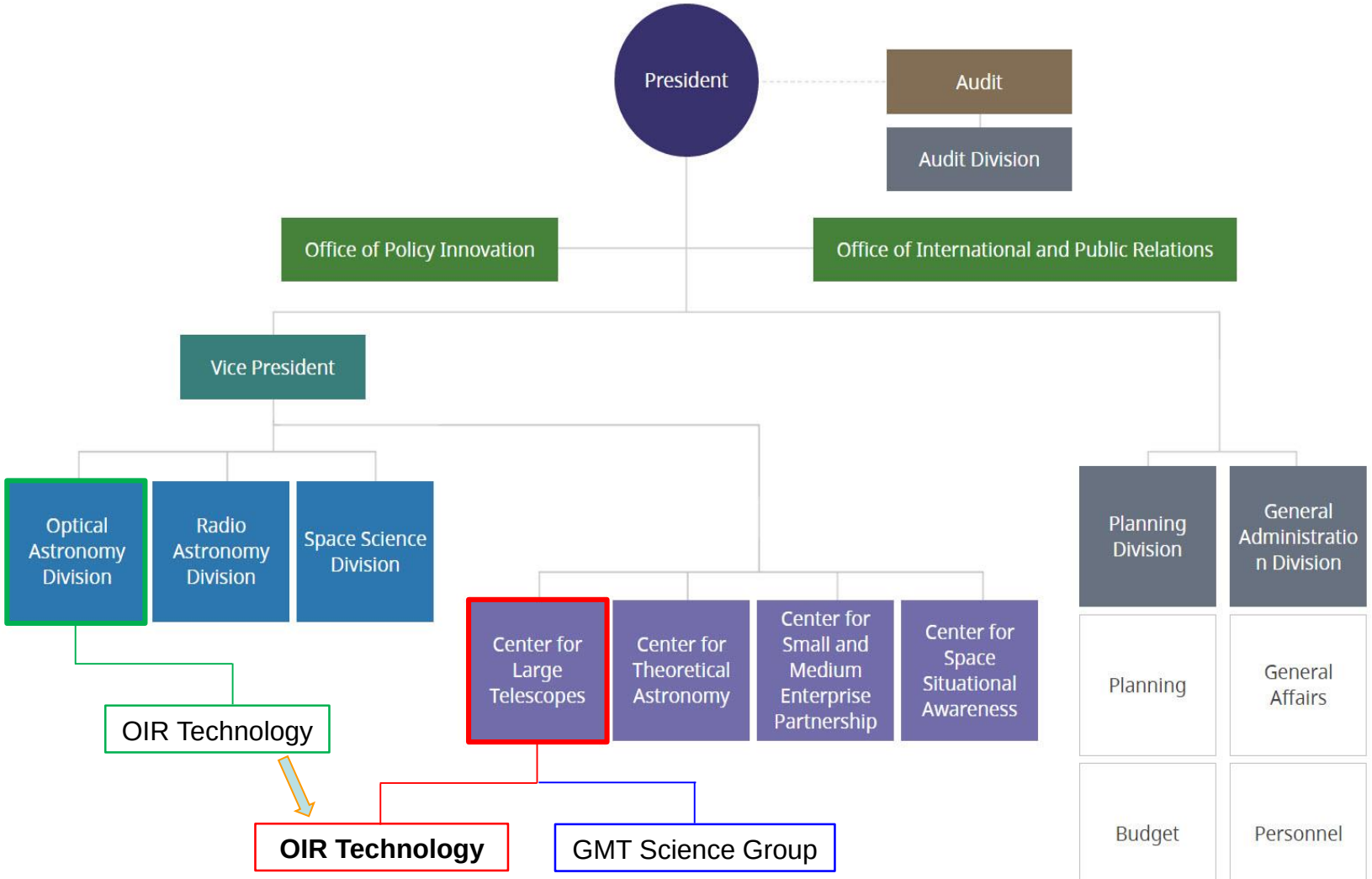
Korea Astronomy and Space Science Institute

@Subaru International Partnership Science and Instrumentation Workshop

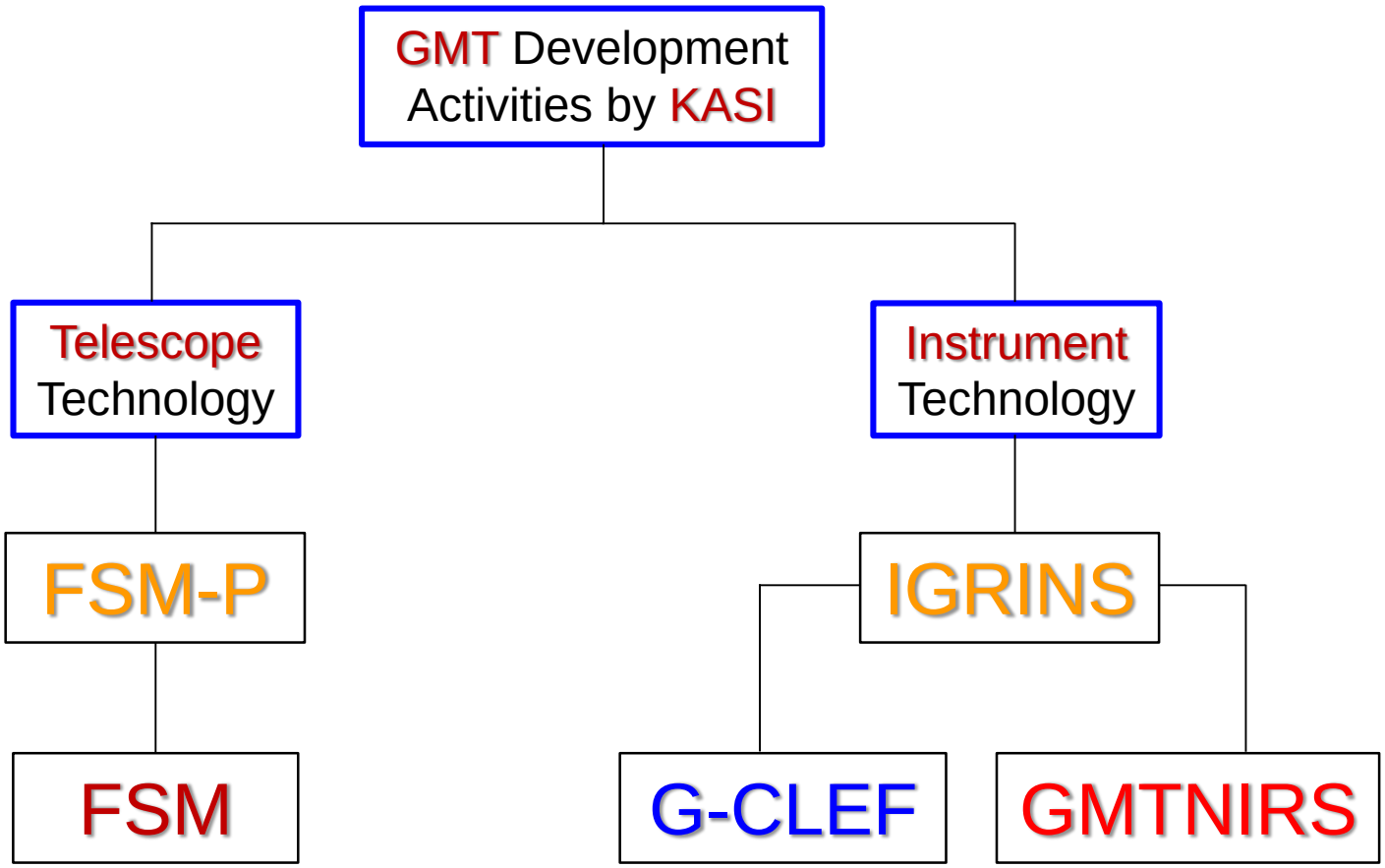
22 Mar 2017

KASI Korea Astronomy and Space Science Institute

KASI Organization



OIR Tech Group Activities



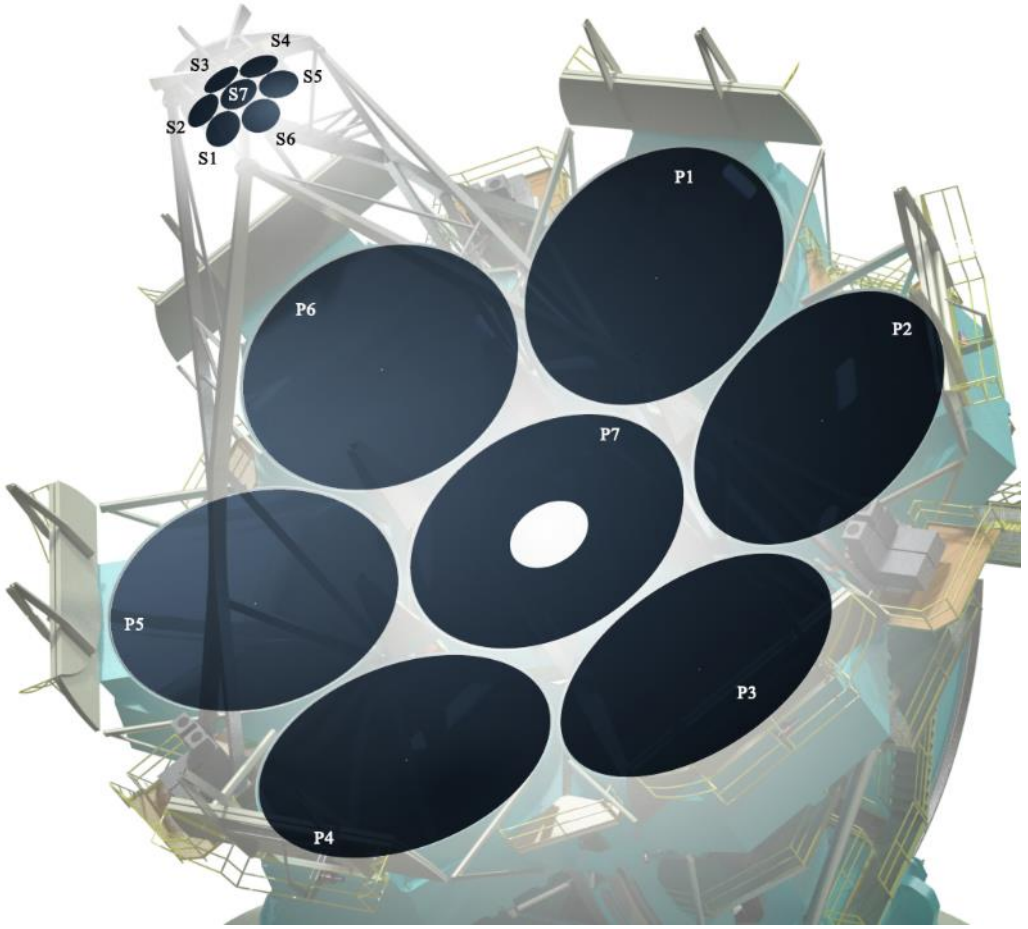
GMT Telescope Mirrors

Doubly segmented mirror sets

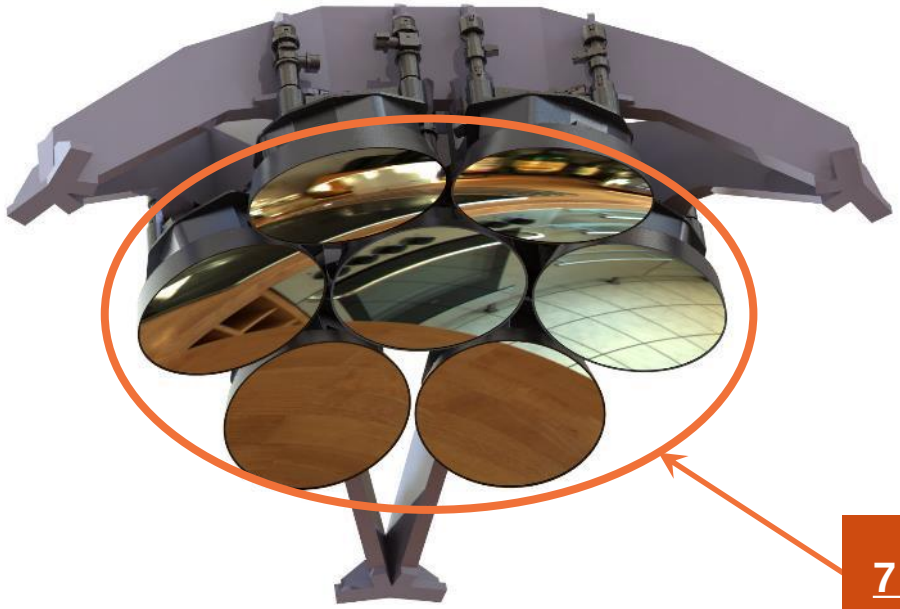
- *M1 - 8.36m 7 segments*
- *M2 - 1.06m 7 segments*
- *M1/M2 segments are conjugate*

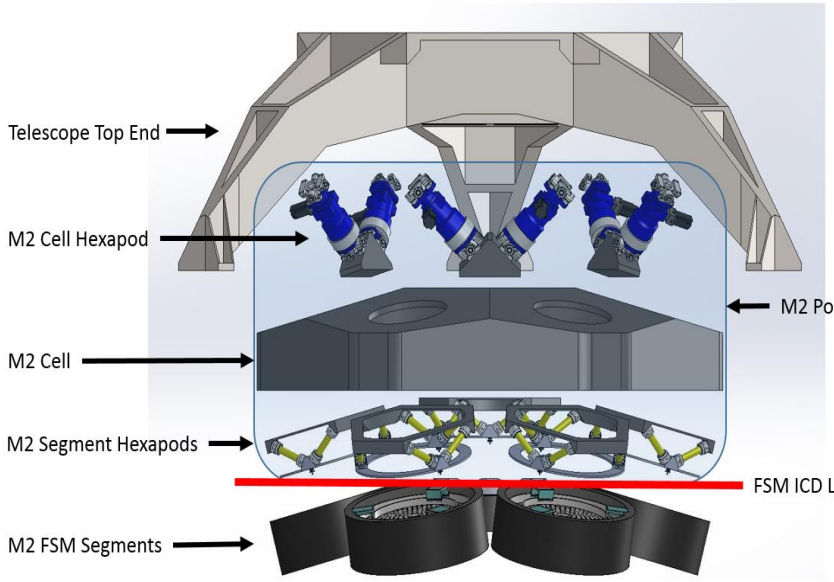
M2 segments of two types

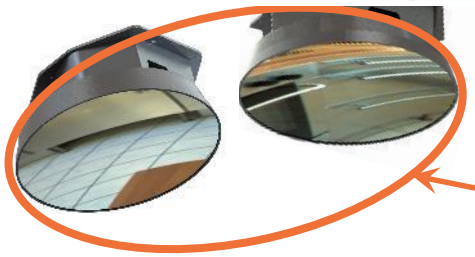
- *Fast-steering Secondary Mirrors (FSM, will support First light operation)*
- *Adaptive Secondary Mirrors (ASM, will provide AO capability to defeat atmospheric seeing)*



FSM Overview and Scope



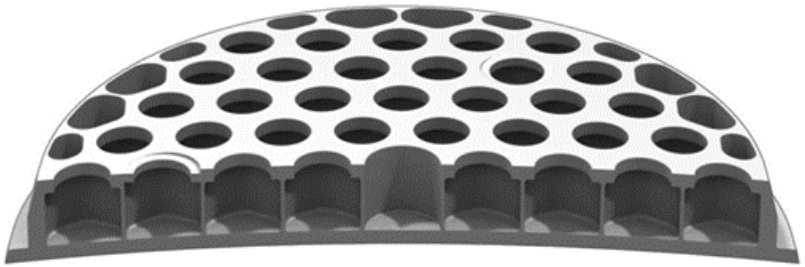


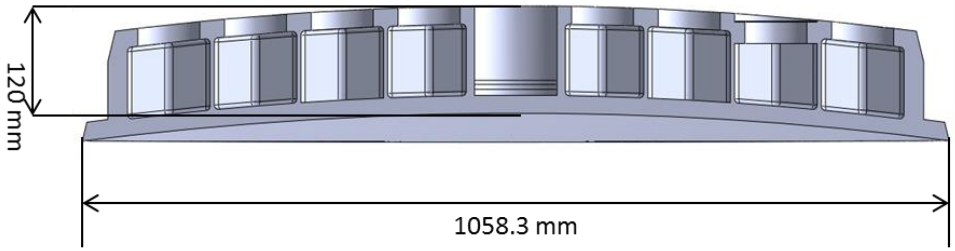


7 mirrors fabrication
- 1 mirror (on-axis)
- 6 mirrors (off-axis)

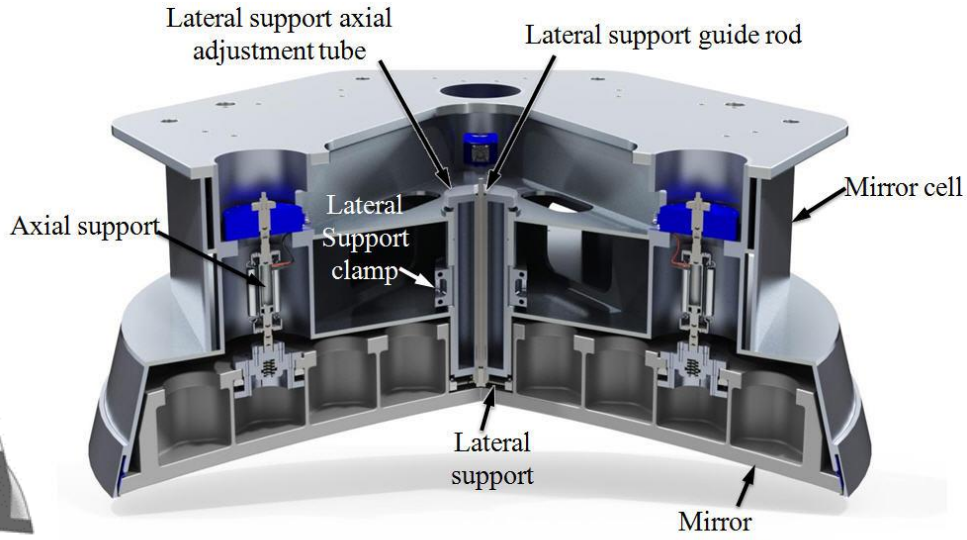
Spare: 2 mirrors fabrication (TBD)
- 1 mirror (on-axis)
- 1 mirror (off-axis)

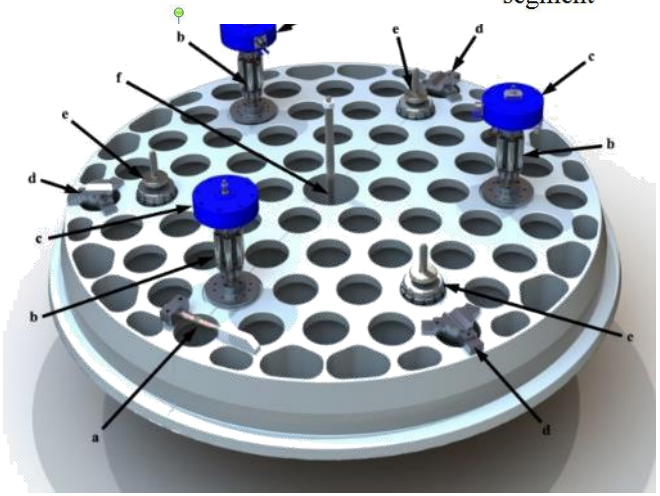
FSM Design - Mirror and Cell





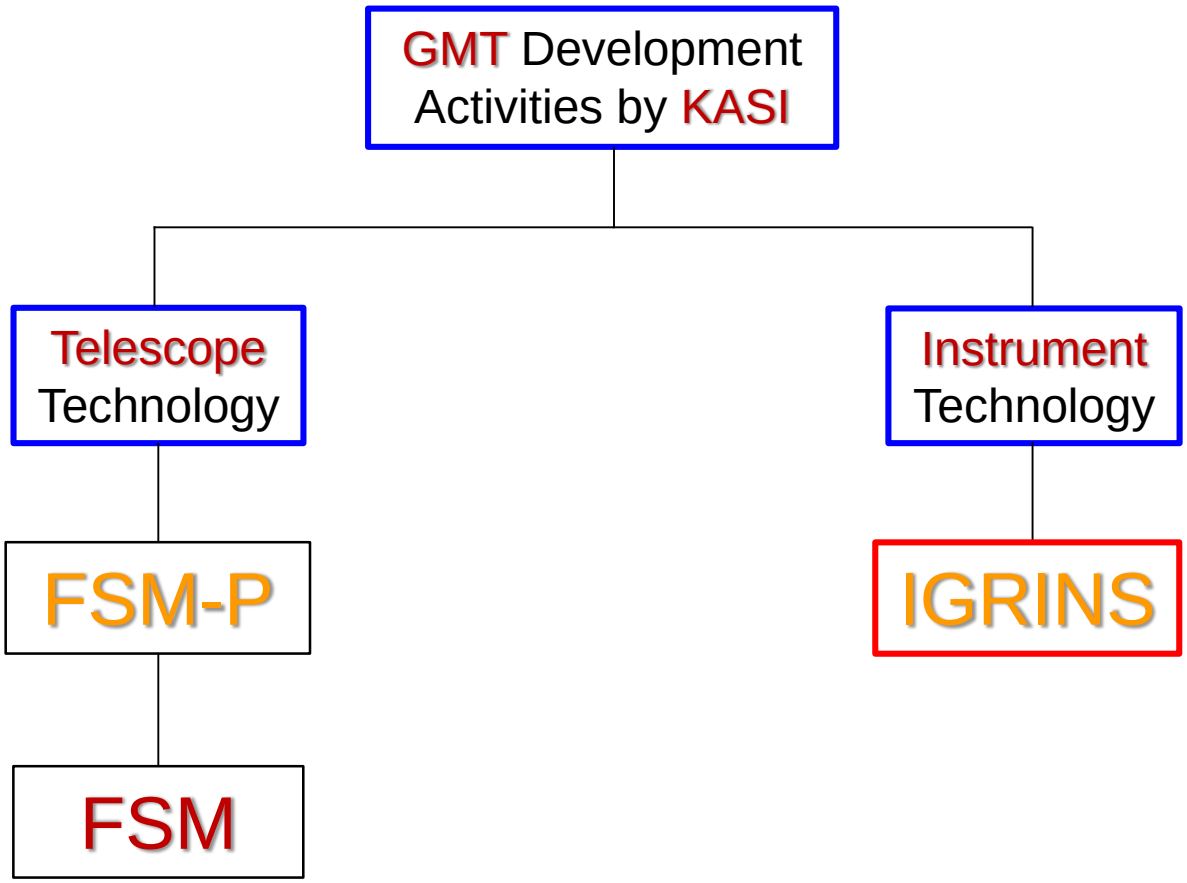
On-axis mirror





FSM Plan Review at GMTO

OIR Tech Group Activities

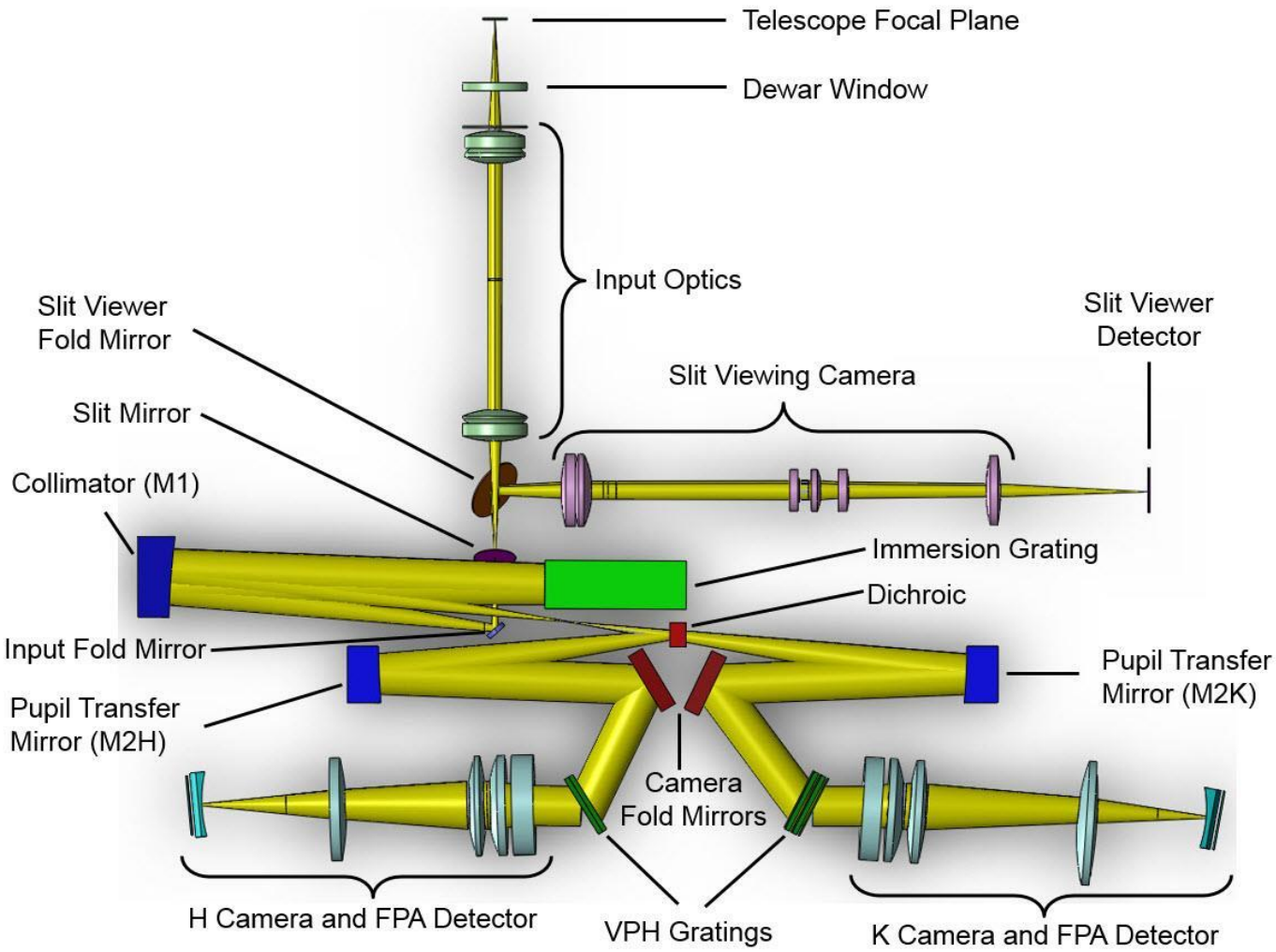


IGRINS Characteristic Feature

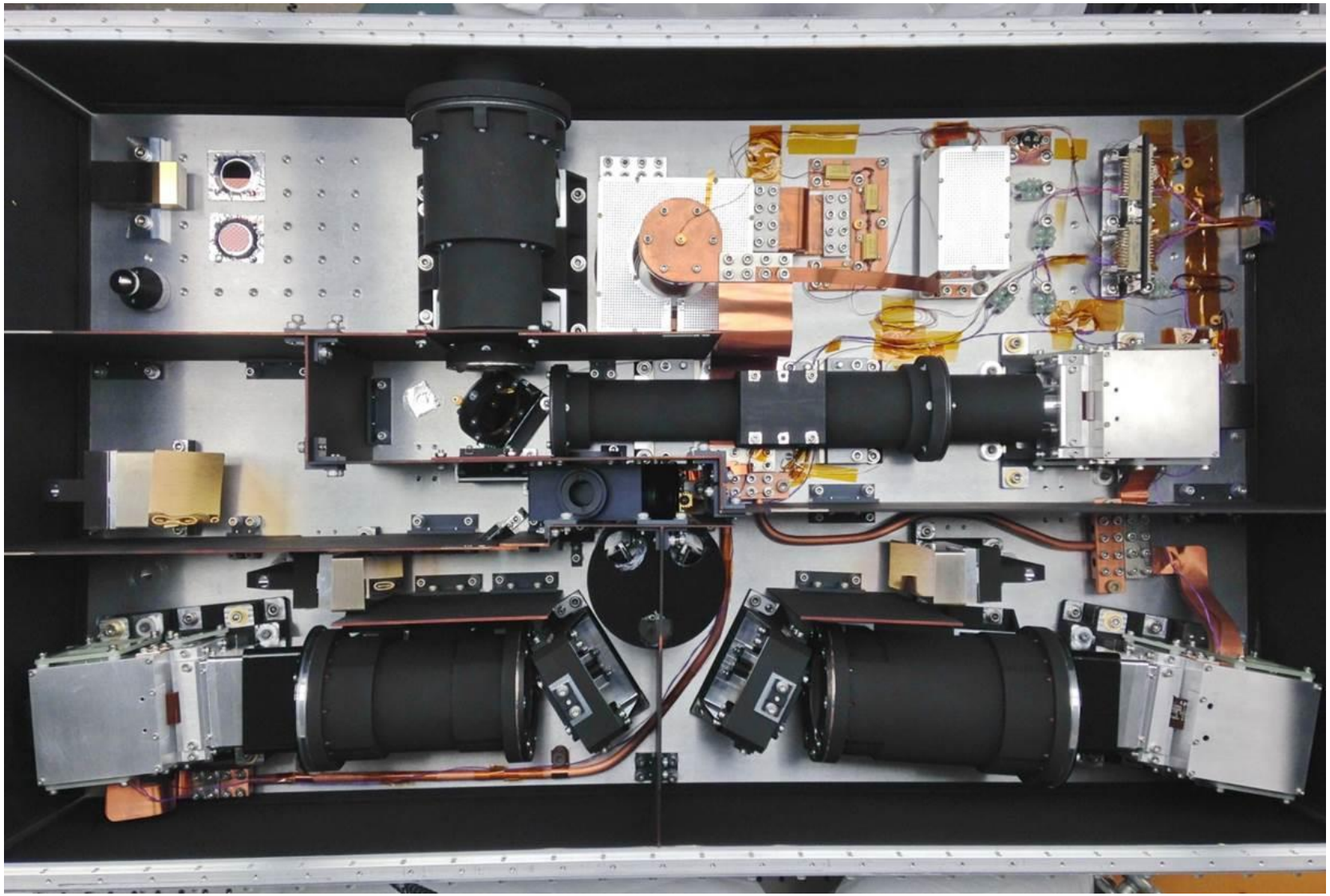
IGRINS Physical Size

VLT CRIRES Physical Size

IGRINS Optical Layout

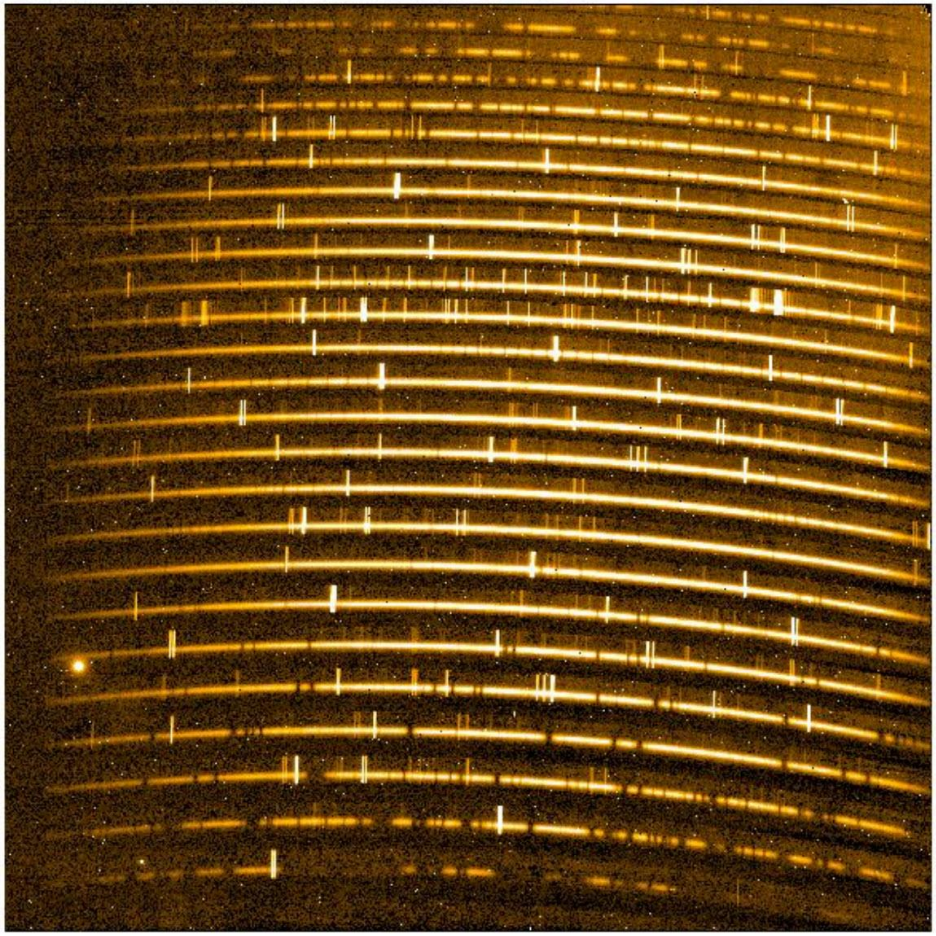


IGRINS Optical Bench Assembly



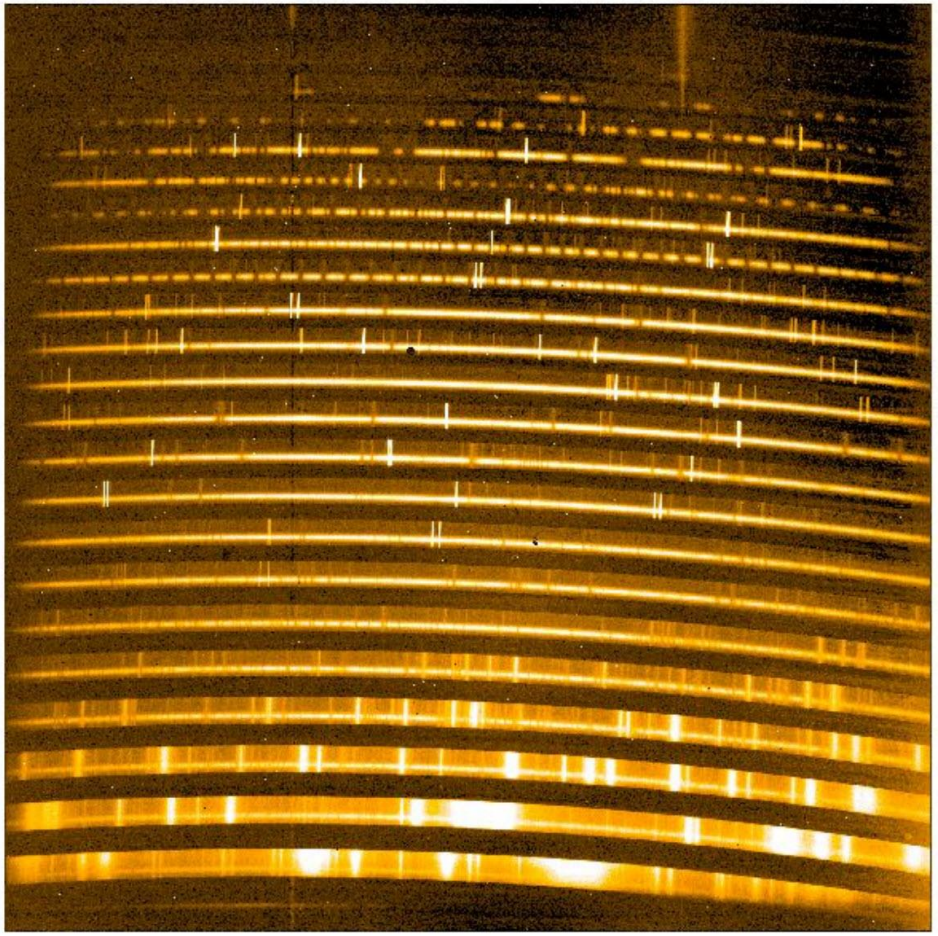
IGRINS at McDonald Observatory

- High resolution in a single exposure : R=45,000 full coverage of H & K bands
- At McDonald 2.7m Telescope : Mar 2014 ~ July 2016 total 374 nights operated



▲ H band 25 orders

TW Hydrae



▲ K band 22 orders

IGRINS at McDonald Observatory

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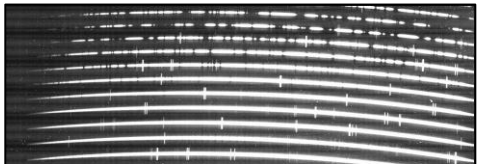
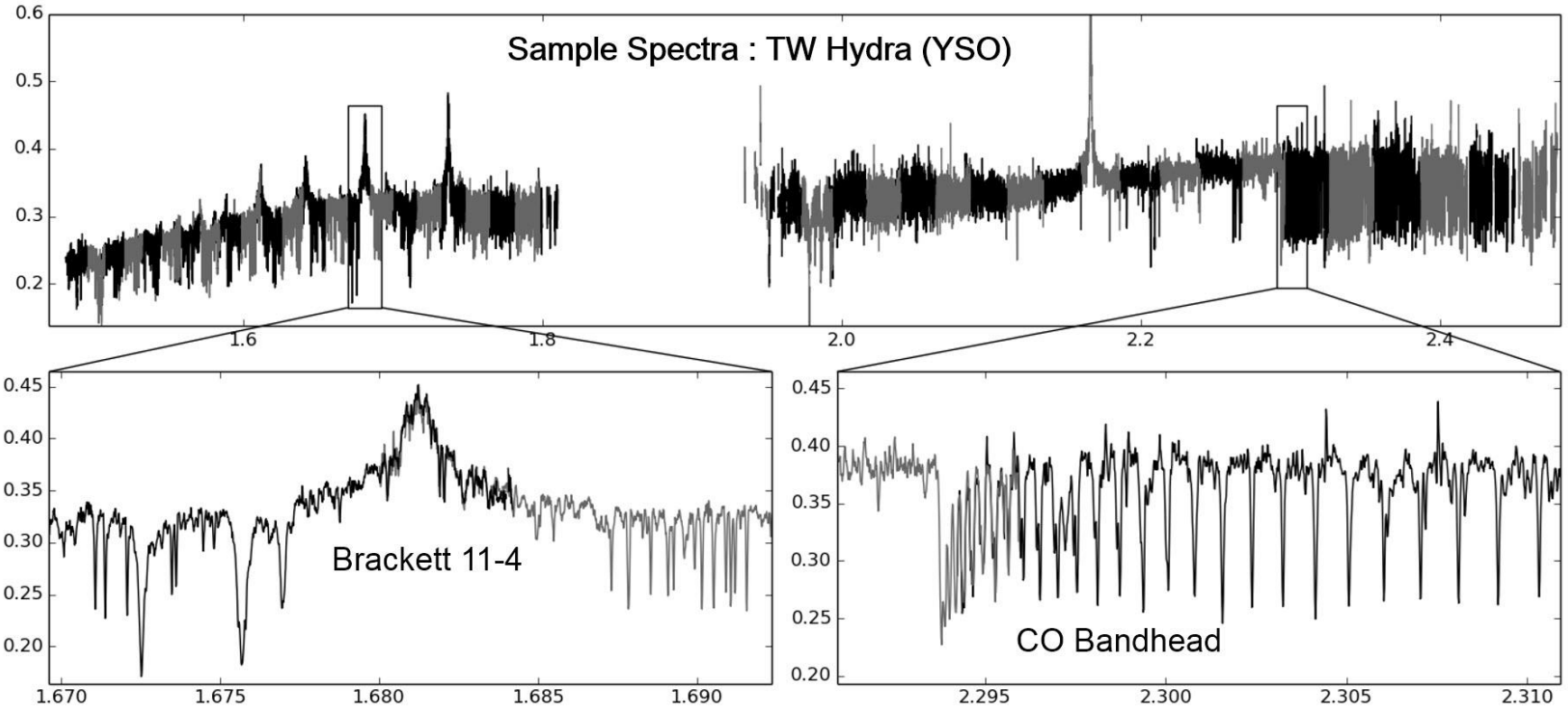
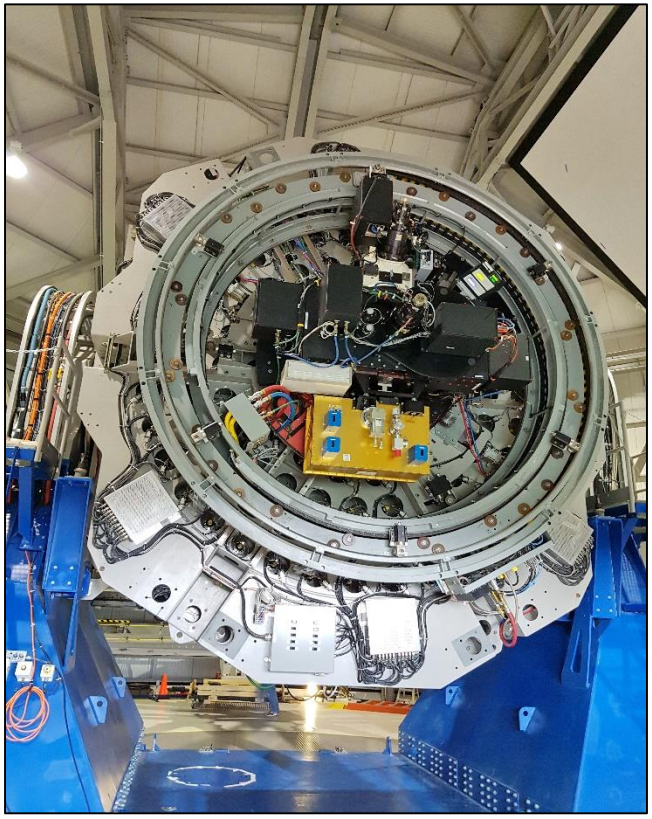


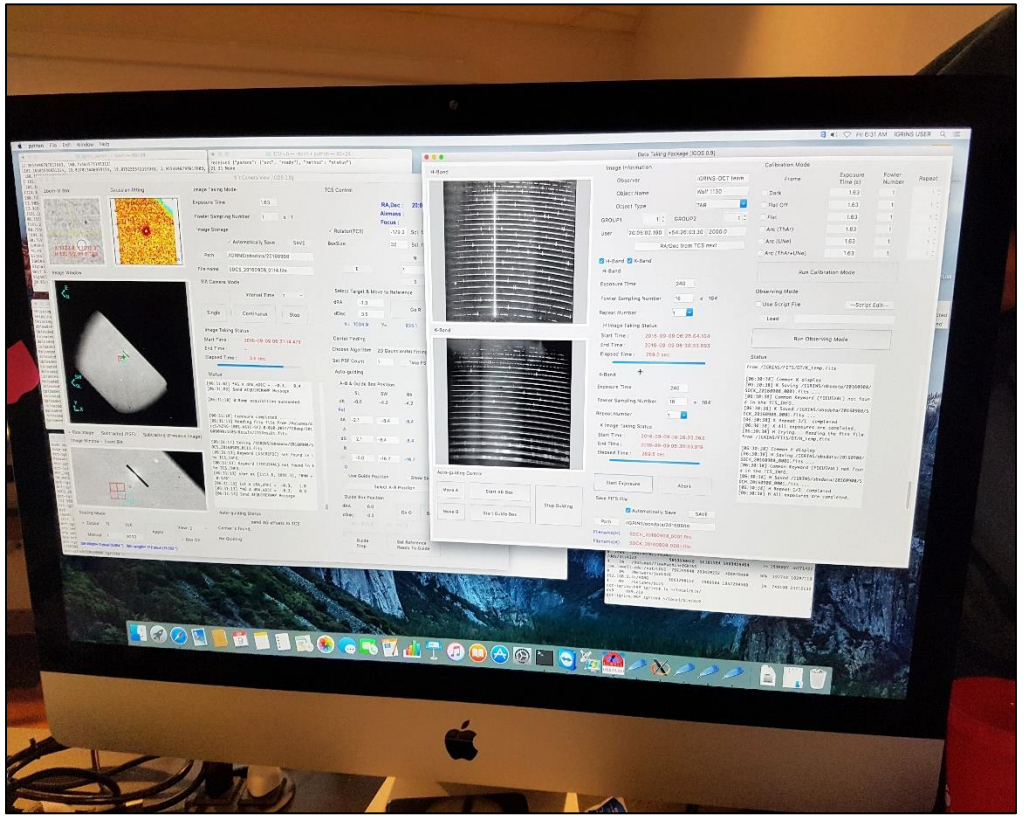


IGRINS at DCT 4m Telescope

- Discovery Channel Telescope run by Lowell Observatory Flagstaff AZ
- DCT schedule : Oct 2016 ~ Feb 2017 : >50% nights assigned for IGRINS
- 8m Gemini South Commissioning scheduled in March 2018

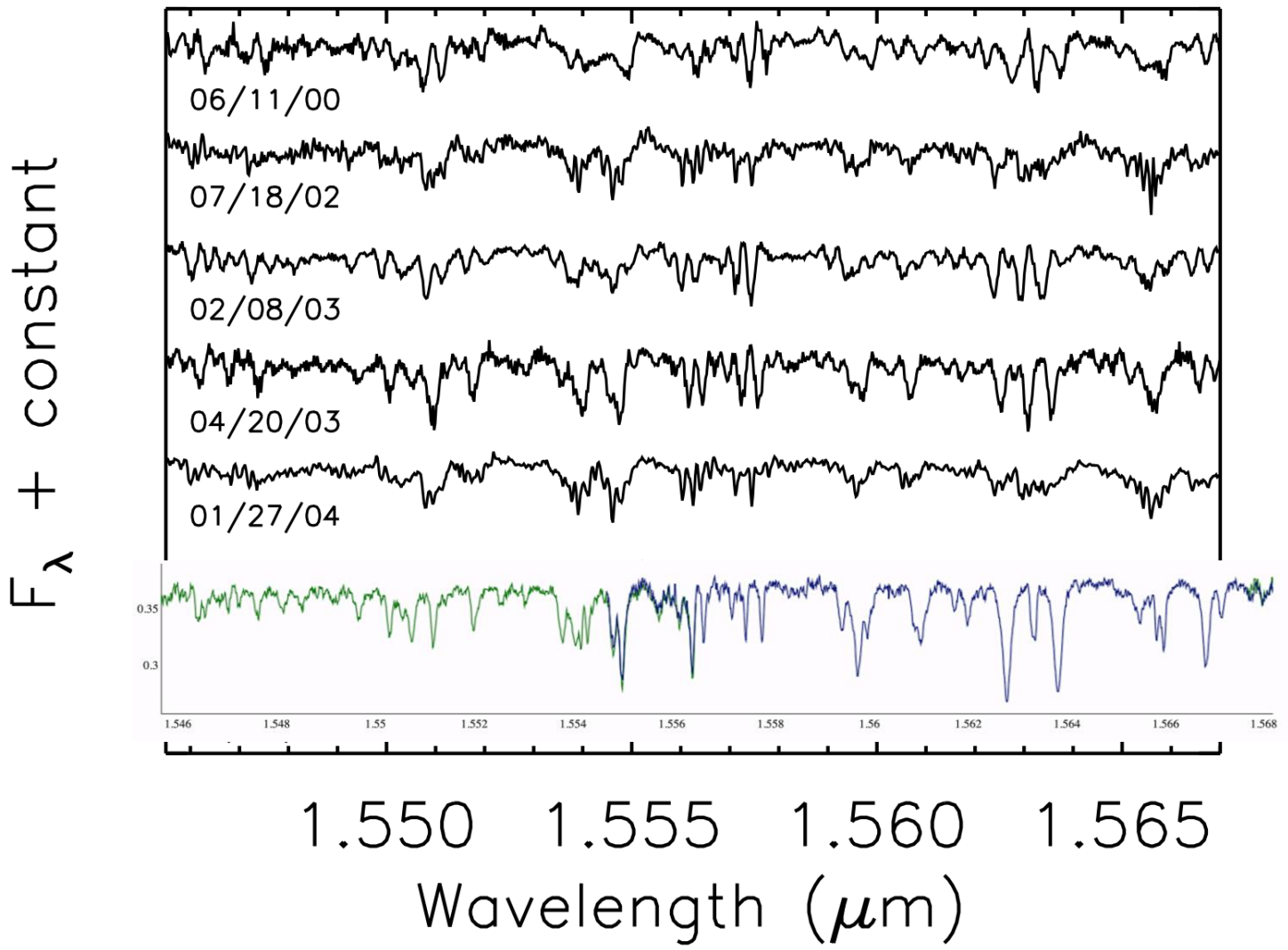


▲ IGRINS installed at DCT



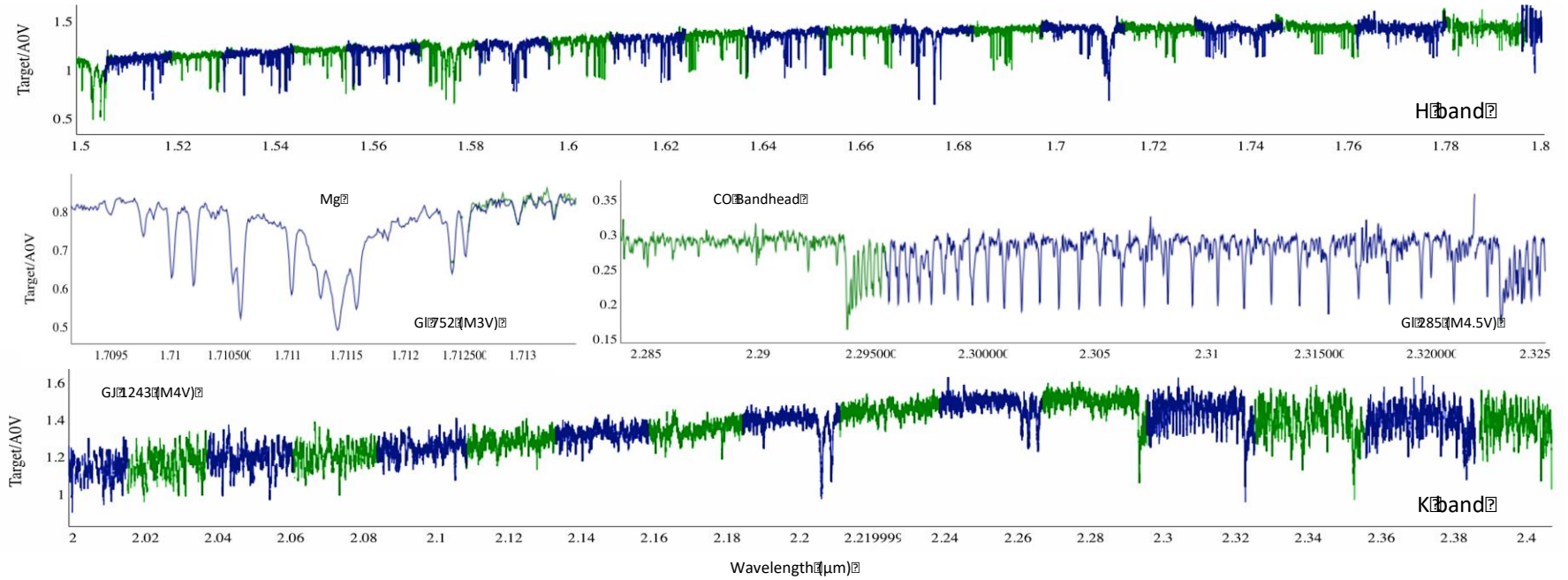
▲ First Light Slit-viewer and H & K band Spectra

Keck NIRSPEC vs. IGRINS



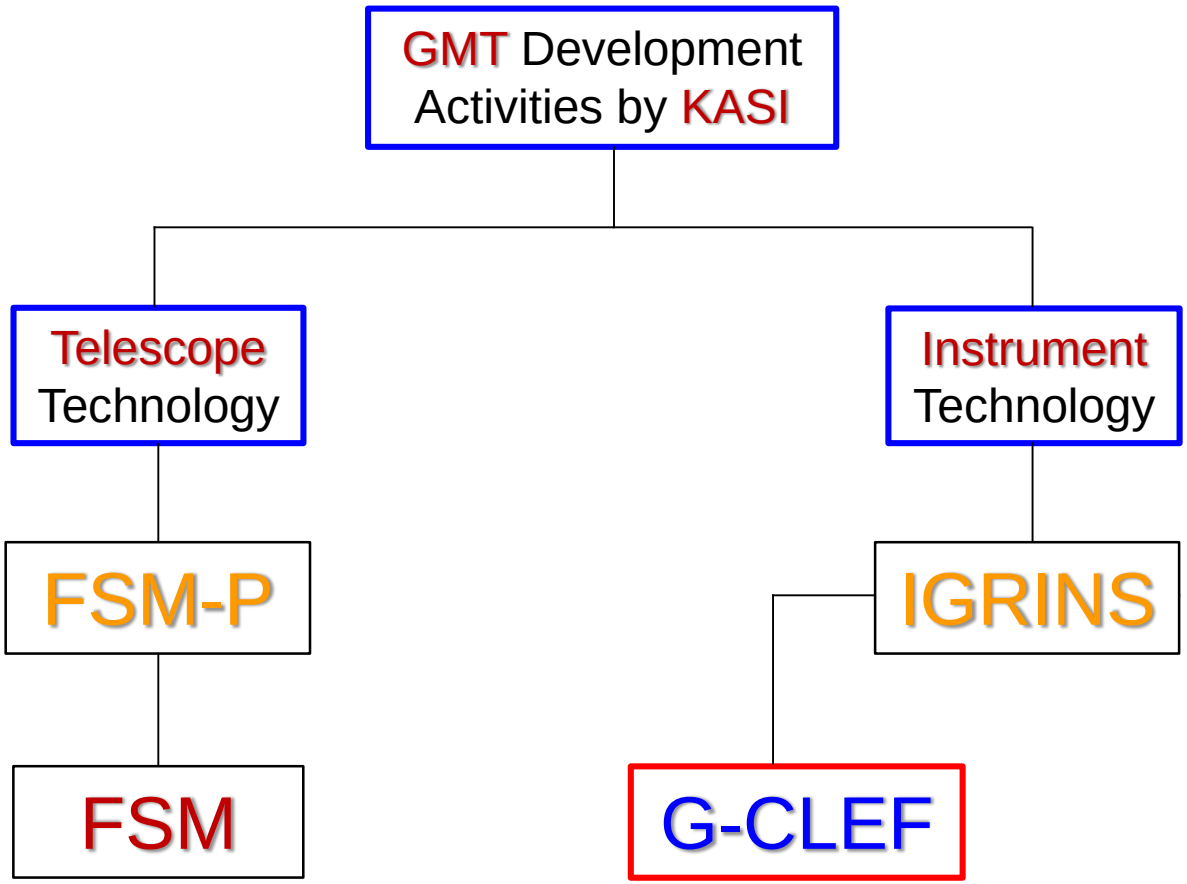
Mace et al. 2012

Unmatched Spectral Grasp of IGRINS



Dr. Jae-Joon Lee (KASI) - https://github.com/igrins/plp

OIR Tech Group Activities



G-CLEF Instrument Overview

The GMT-Consortium Large Earth Finder (G-CLEF) properties:

- Fiber-fed optical echelle spectrograph
- General purpose instrument
- Precision radial velocity (PRV) capable
- The first light science instrument for the GMT
- Passband is 3500Å – 9000Å (Spec) / 9500Å (Goal)
- Operates in 4 resolution modes
- Has an interface to MANIFEST for MOS operation

Mode	PRV	NS-PRV	MR	HT	MOS
Resolution	108,000	108,000	35,000	19,000	35,000

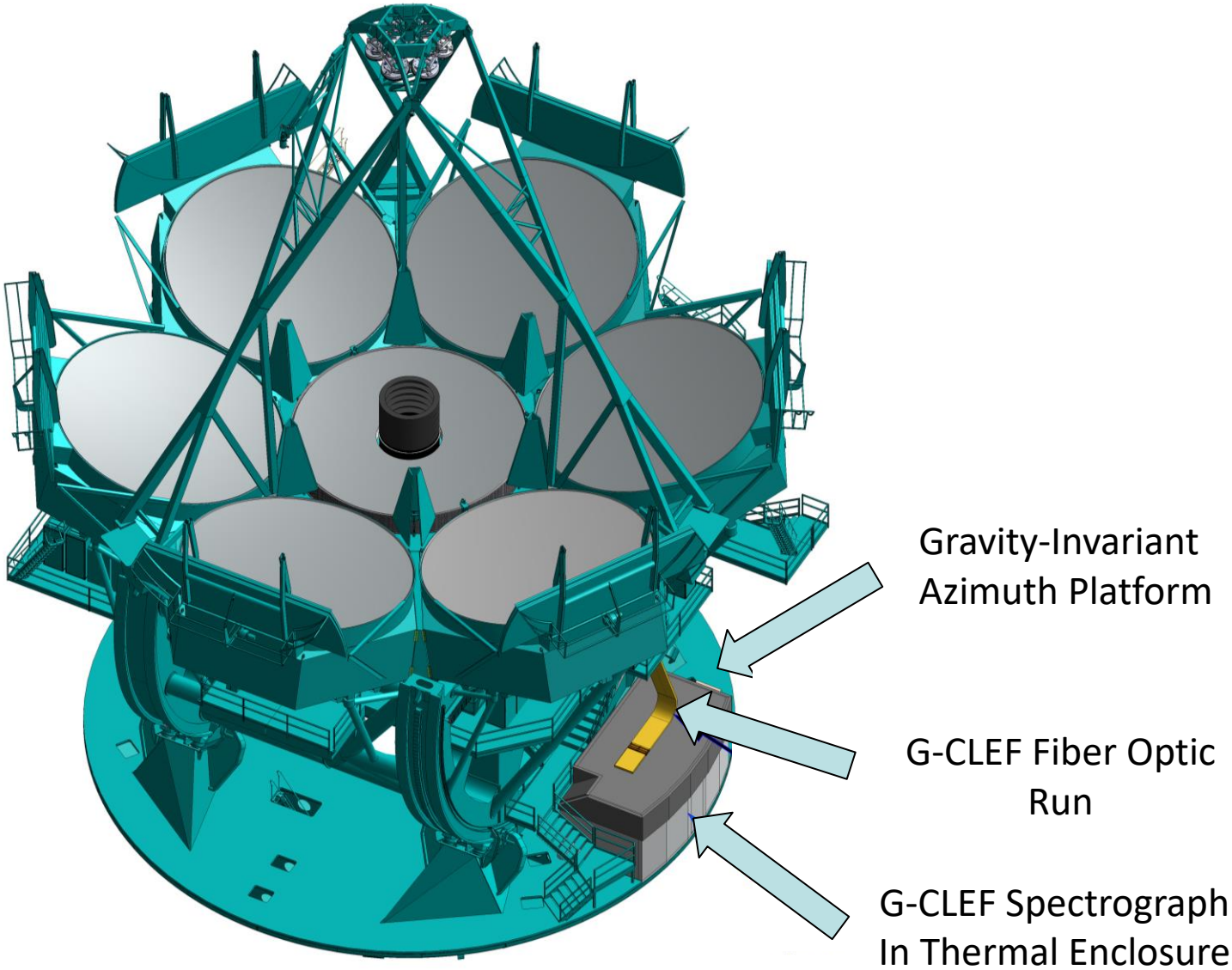
PRV: Precision Radial Velocity Mode
NS-PRV: Non-scrambled PRV Mode
MR: Medium Resolution Mode
HT: High Throughput Mode

G-CLEF Collaboration

Andrew Szentgyorgyi, PI
Daniel Baldwin
Stuart Barnes
Jacob Bean
Sagi Ben-Ami
Patricia Brennan
Jamie Budynkiewicz
Moo-Yung Chun
Charlie Conroy
Jeffrey D. Crane
Harland Epps
Ian Evans
Janet Evans
Jeff Foster
Anna Frebel
Sungho Lee
Thomas Gauron
Dani Guzman
Tyson Hare
Bi-Ho Jang
Jeong-Gyun Jang
Andres Jordan
Jihun Kim
Kang-Min Kim
Claudia Mendes de Oliveira
Mercedes Lopez-Morales
Kenneth McCracken
Stuart McMuldroch
Joseph Miller
Mark Mueller
Jae Sok Oh
Sanghyuk Kim
Cem Onyuksel
Mark Ordway
Byeong-Gon Park
Chan Park
Sung-Joon Park
Charles Paxson
David Phillips
David Plummer
William Podgorski
Andreas Seifahr
Daniel Stark
Joao Steiner
Alan Uomoto
Ronald Walsworth
Young Sam Yu

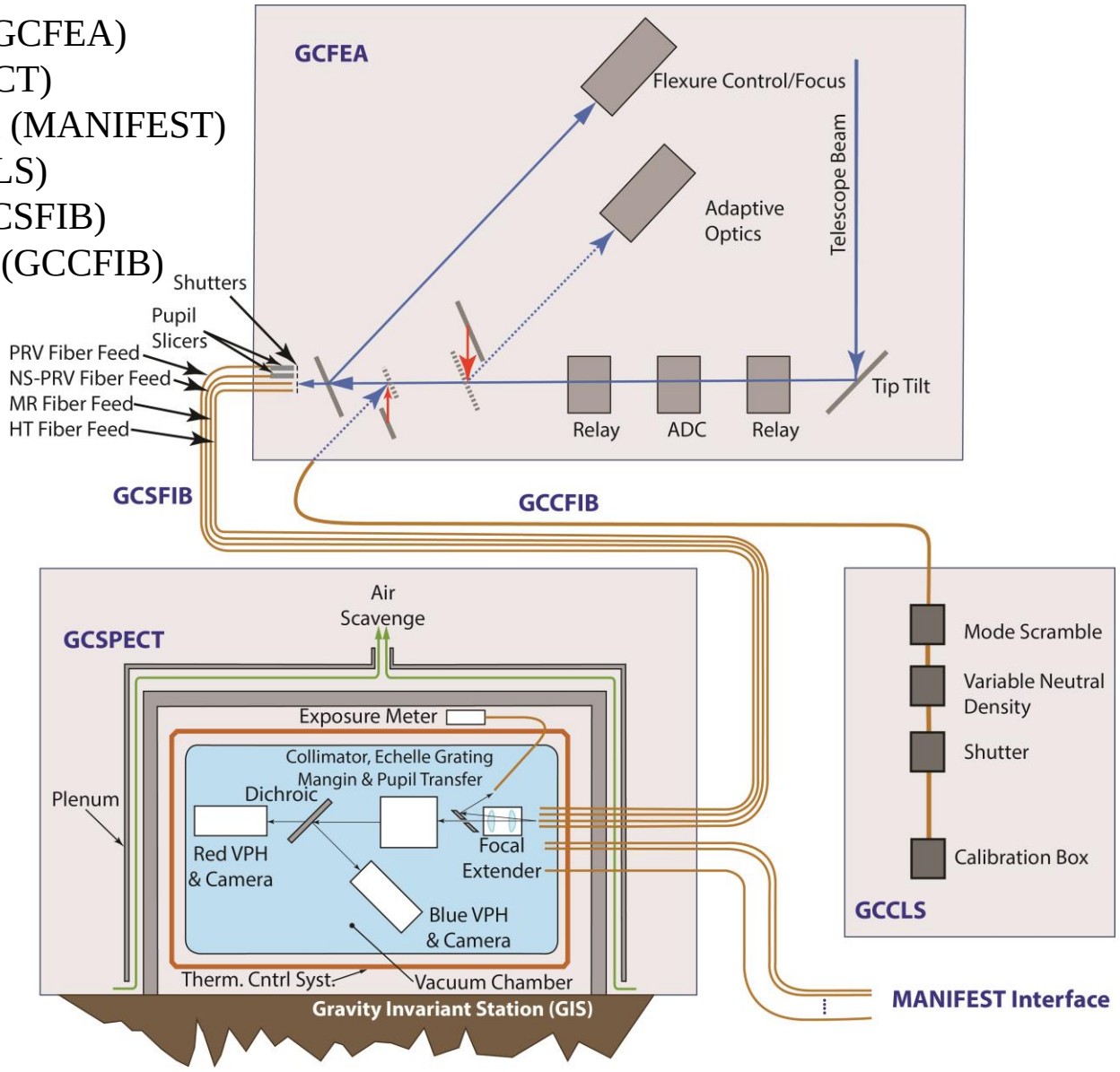
Harvard-Smithsonian Center for Astrophysics
Steward Observatory, University of Arizona
The Observatories of the Carnegie
Pontificia Universidad Catolica de Chile
University of Chicago
Korea Astronomy and Space Science Institute
Massachusetts Institute of Technology
UCO/Lick Observatory, University of California
Universidade de São Paolo

G-CLEF Location on GMT

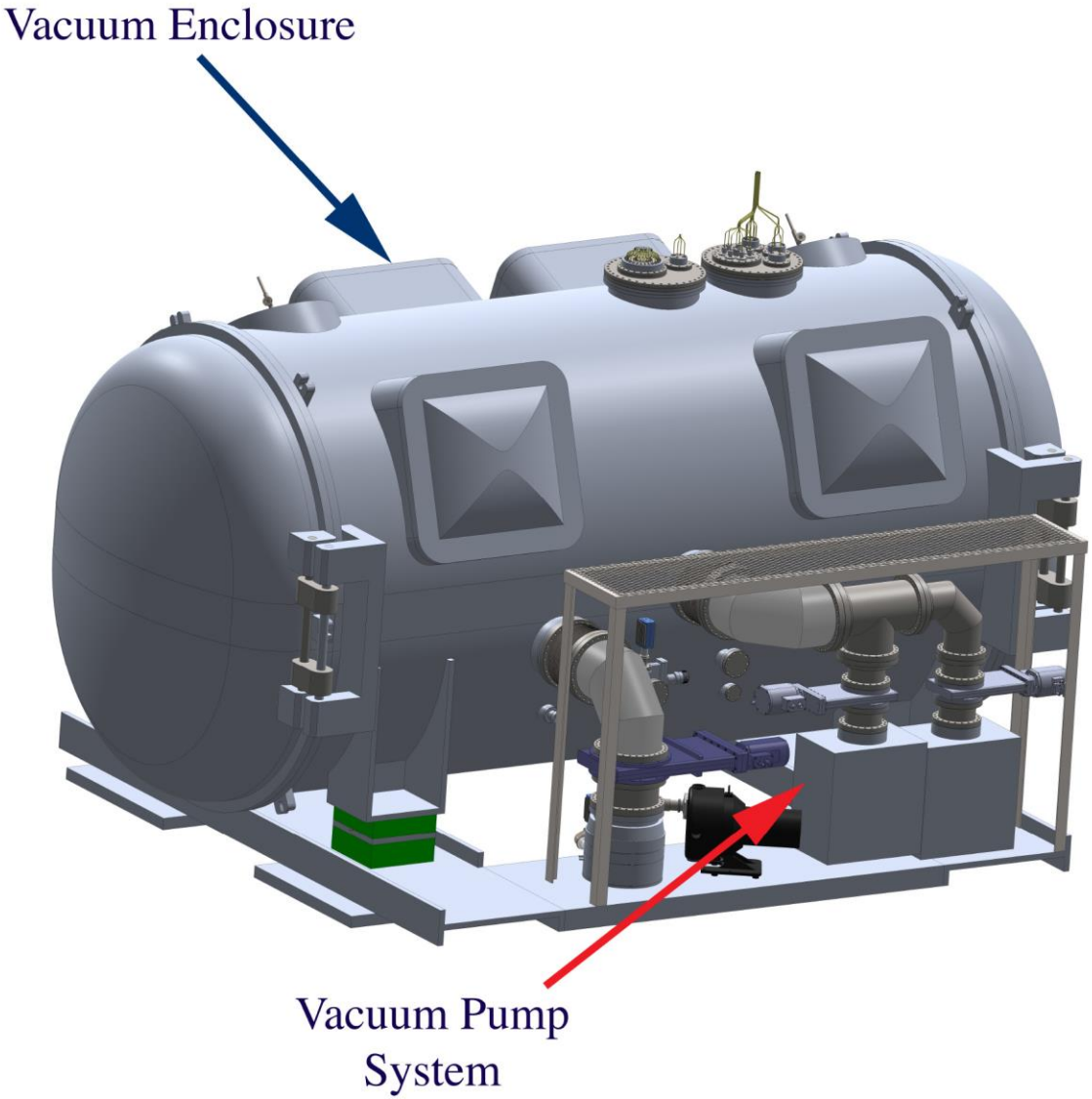


G-CLEF System Design

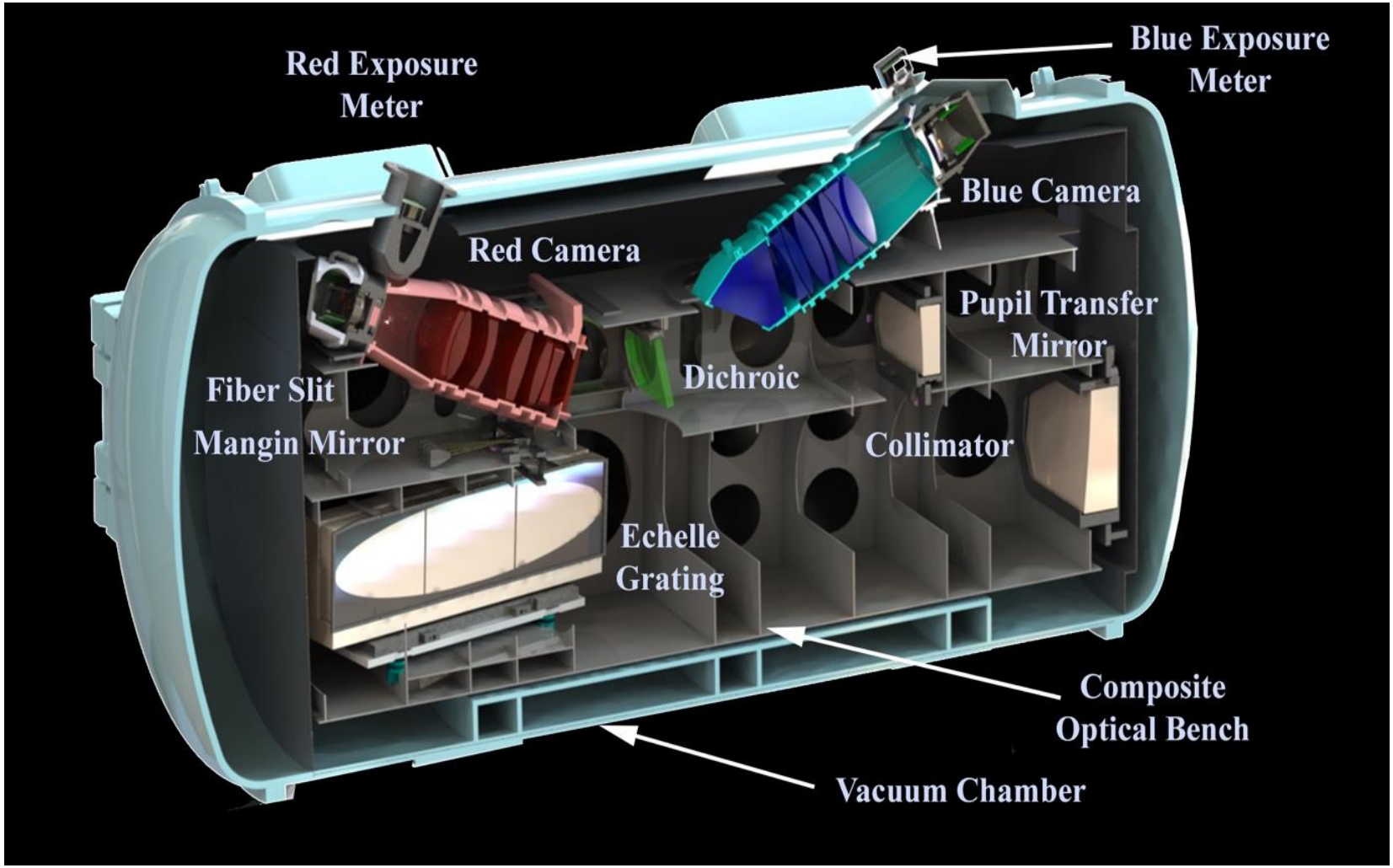
G-CLEF Front End Assembly (GCFEA)
G-CLEF spectrograph (GCSPECT)
Multi-Object Spectroscopy feed (MANIFEST)
Calibration Light Source (GCCLS)
Science fiber feed assembly (GCSFIB)
Calibration fiber feed assembly (GCCFIB)



Spectrograph Vacuum Enclosure

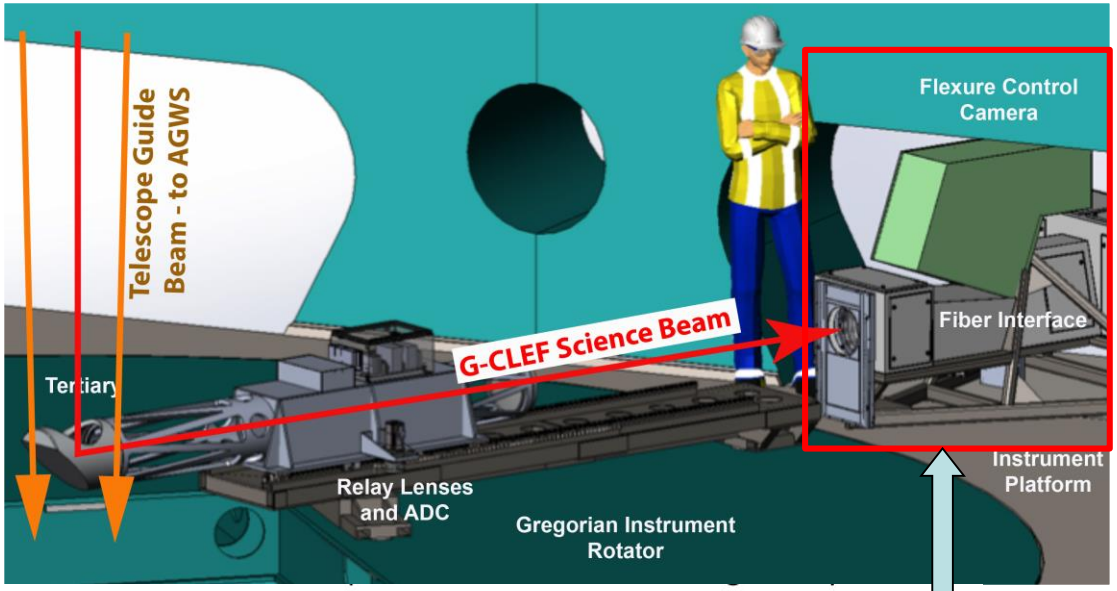


Spectrograph Mounted in Vacuum Vessel



G-CLEF is vacuum enclosed to insulate the spectrograph thermally and stabilize the index of refraction of the immersing medium to maximize radial velocity measurement precision. Vessel is made of aluminum.

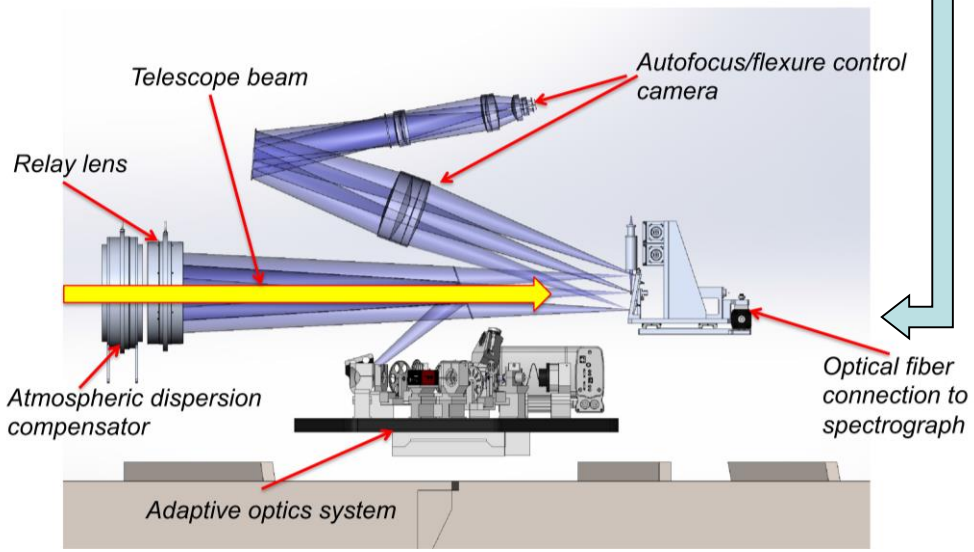
Front End Telescope Interface



The GMT guide itself exquisitely (< 0.2 arcsec over the observable sky)

The telescope guide systems (AGWS) & G-CLEF fiber interface are not co-located

Telescope flexure requires that G-CLEF has a dedicated Flexure Control System

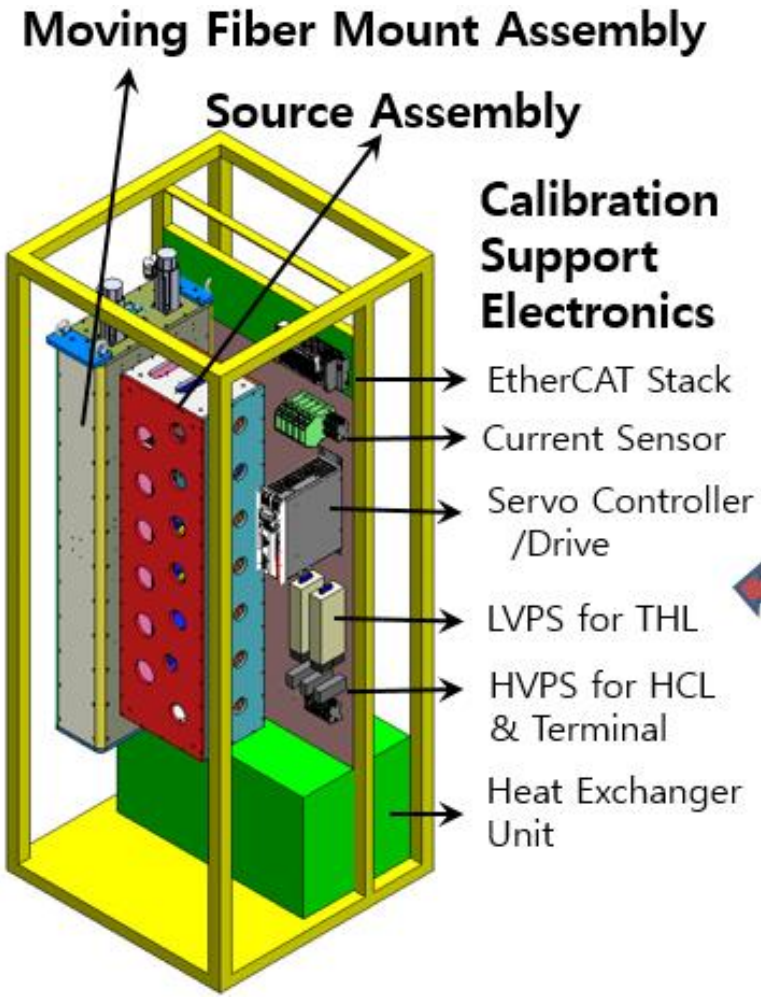


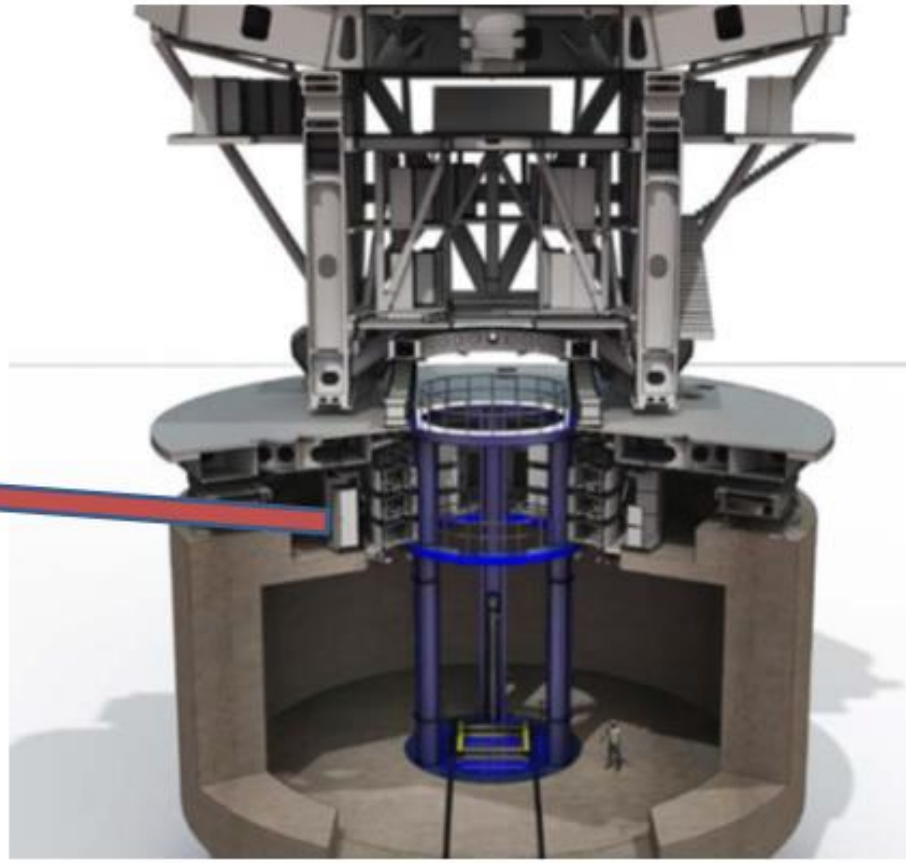
Fiber feed and flexure control system follows last relay optic in the front end

Flexure Control Camera subsystem guides out telescope flexure

Capability to accommodate wafefront sensor for adaptive optics control

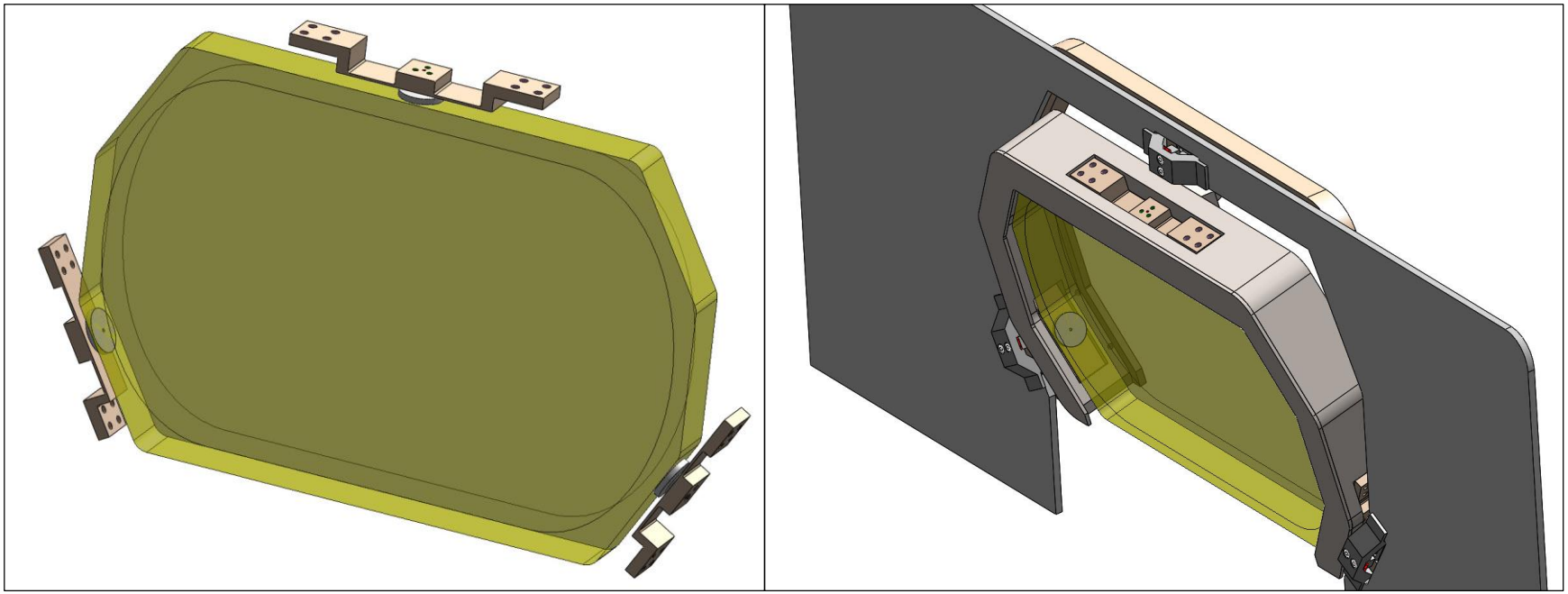
Calibration Light Subsystem at Azimuth Platform



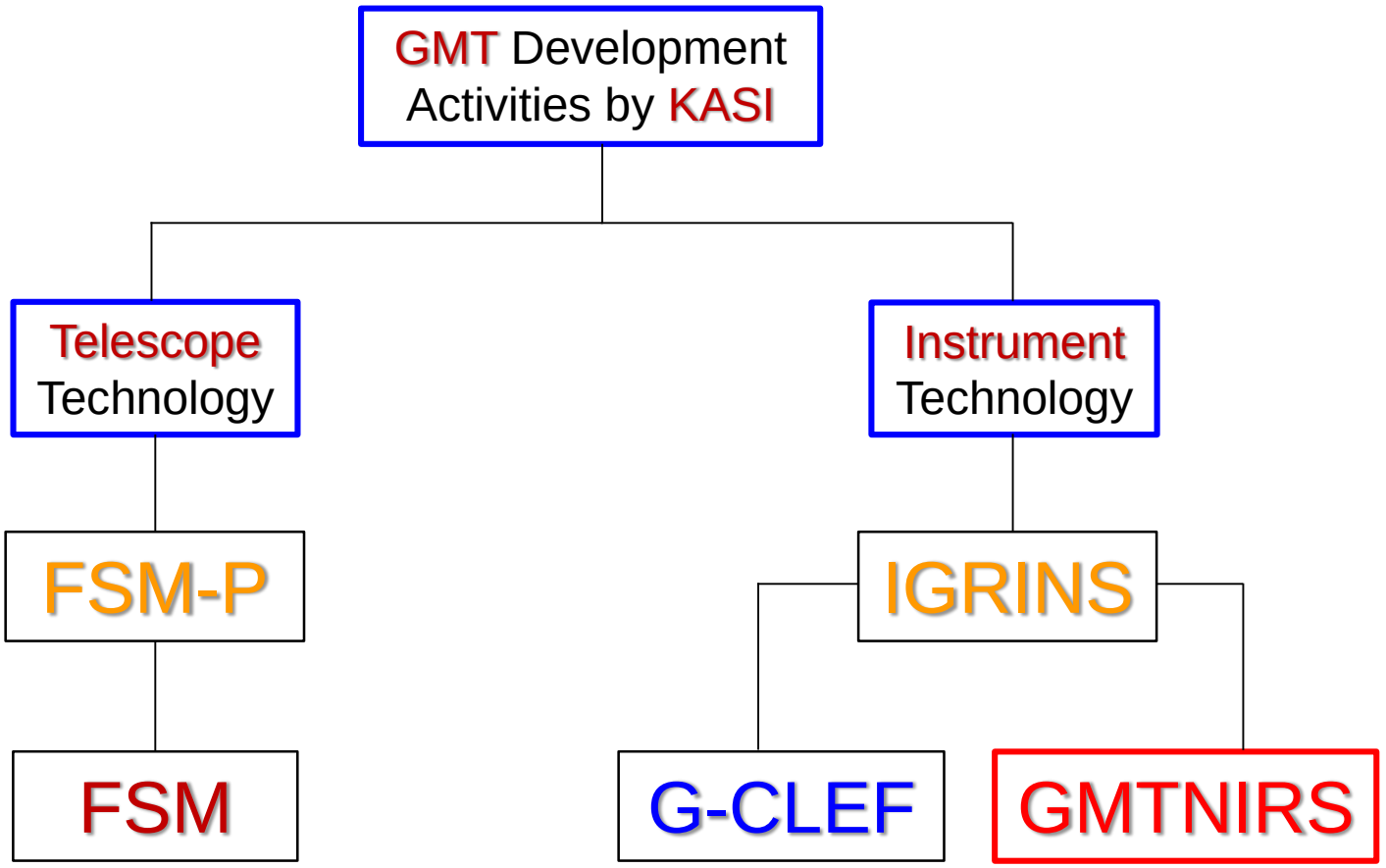


Dichroic Mirror Mount Assembly

Double blade flexures, mount bezel, tip-tilt for alignment



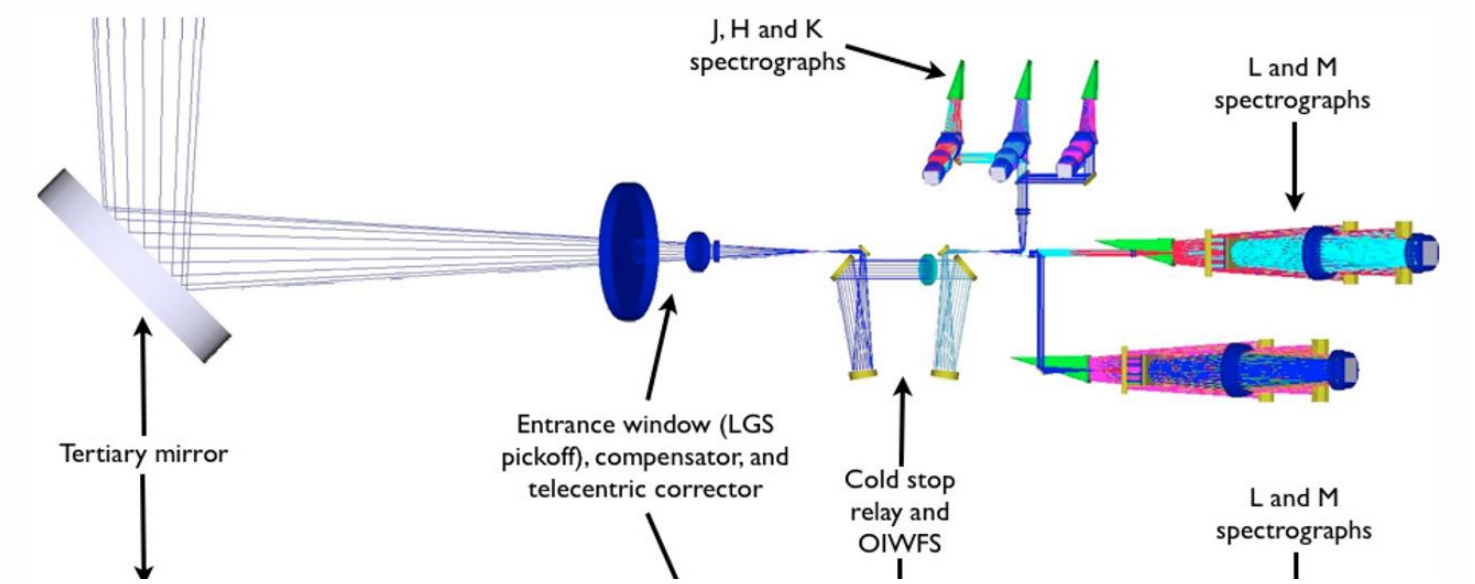
OIR Tech Group Activities



GMTNIRS Design Concept

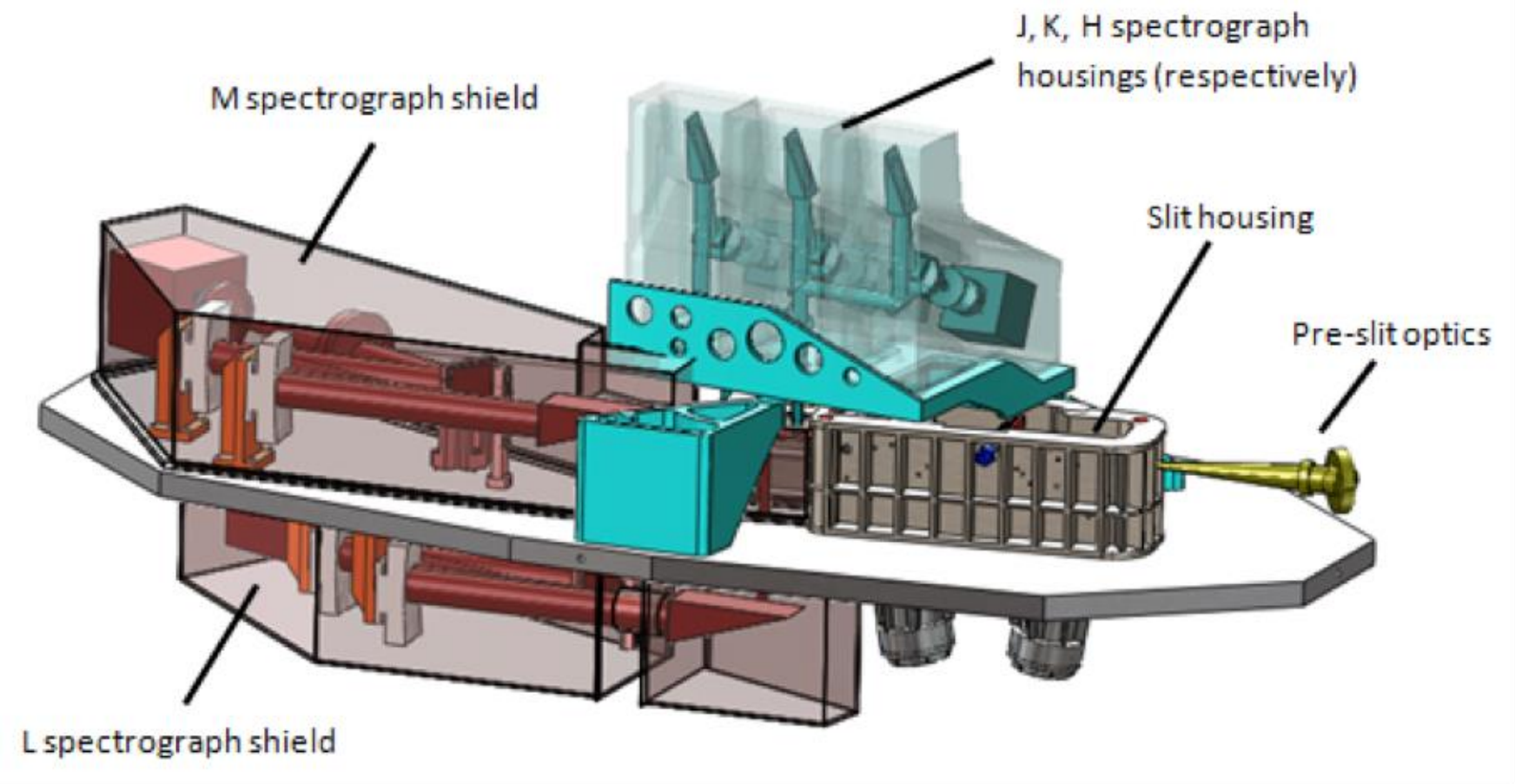
GMTNIRS is a high resolution AO-fed spectrograph for the infrared covers all of the 1.12-5.3 micron range in a single exposure through an 85 mas slit with 4 pixel sampling. R= 50,000 at JHK and 90,000 at LM

- J: 1.12 μm < λ < 1.35 μm, (limited at the short wavelength and by the transmission of silicon)
- H: 1.45 μm < λ < 1.80 μm,
- K: 2.00 μm < λ < 2.45 μm,
- L: 2.90 μm < λ < 4.15 μm, and
- M: 4.50 μm < λ < 5.30 μm.

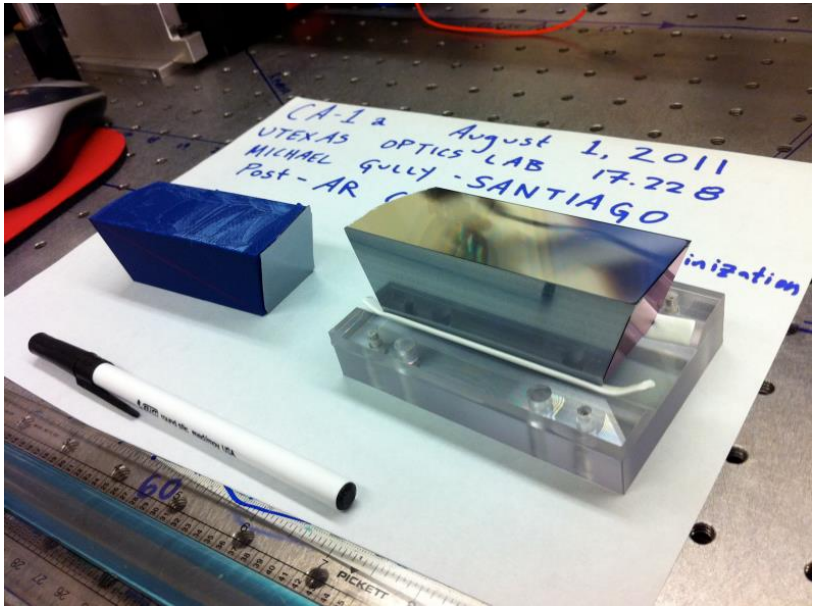


GMTNIRS Design Concept

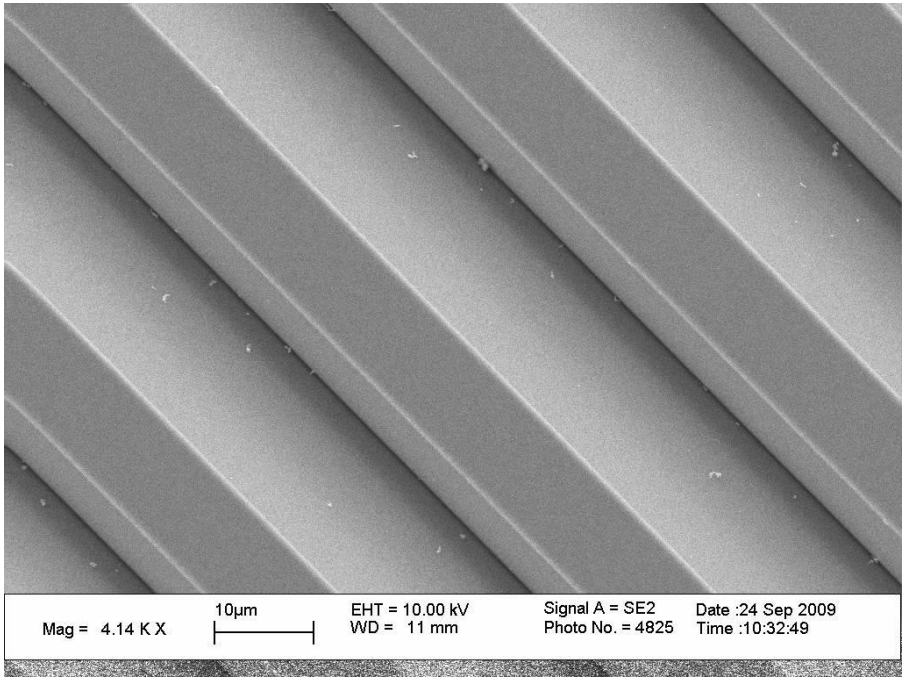
- International collaboration similar to IGRINS: KASI-UT (Carnegie-KHU)
- JHKLM five modular design - one spectrograph per band
- Subunits packaged separately for easier alignment and thermal management



Immersion Grating Fabrication



An immersion grating for IGRINS



감사합니다

Thank You