

Relocation of Iitate 60-cm Telescope to Haleakala Observatories

M. Kagitani^{1,2}, T. Sakanoi¹, T. Obara¹, S. Okano², Y. Kasaba¹ and H. Nakagawa¹
1: PPARC, Tohoku Univ (TU). 2: IfA, Univ. Hawaii (UH)



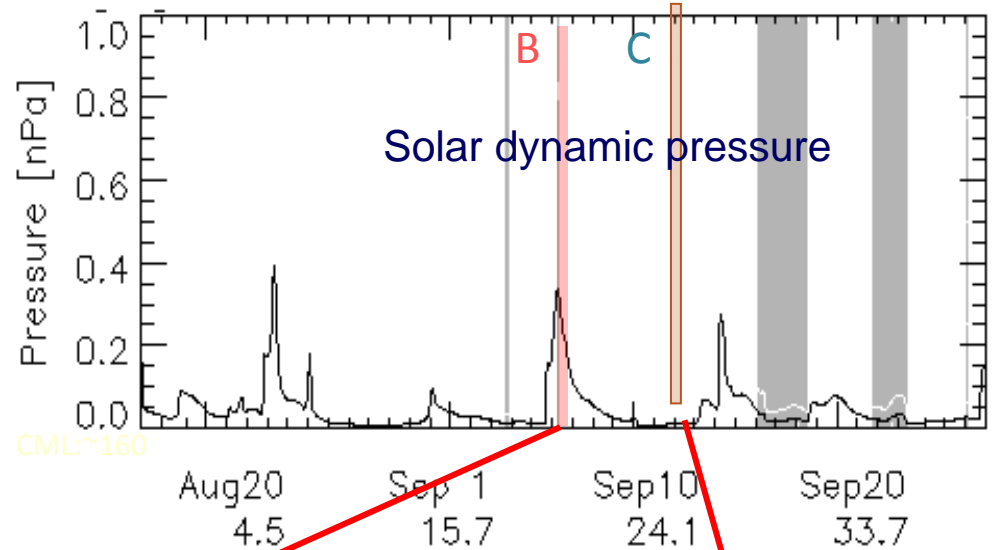
Continuous monitoring of Planetary plasma & neutral particles from the ground

TU has been made continuous observation at Haleakala observatory in Hawaii using 40cm telescope and high-resolution spectrograph in visible for the following targets,

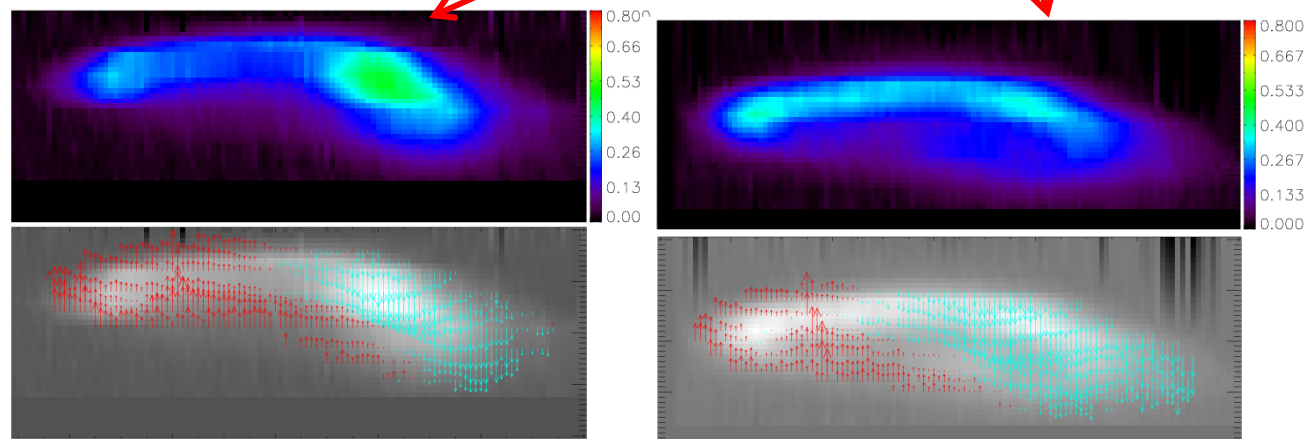
- Mercury sodium atmosphere
- Jupyter plasma torus & neutral sodium clouds
- Saturn's Enceladus torus

In IR & MIR wavelength

It is difficult to get long-term machine-time for middle/large class telescope (SUBARU, IRTF etc.)



IRTF



3
Jupiter H3+ aurora (away in red, toward in blue)

Science targets & Requirement for Instruments

Science Target	Planets	Wavelength [mm]	FOV	Instruments
Atmospheric Escape (Mars, Venus and Mercury)	Mars, Venus (O ₂ + 561nm, N ₂ + 391nm, CO ₂ + ~289nm, etc.)	VIS 0.4-0.95	8', ~20R _v , ~20R _j	<u>Spectroscopy</u> R > 50,000 (with image slicer) & Occultation mask
	Mercury (NaD 589nm, K 766nm)			
Magnetosphere & Atmosphere of Giant planets (Jupiter / Saturn)	Jupiter torus (SII 672nm, SIII 631nm / 953nm, OI 620nm etc.)			
	Saturn torus (OI 630nm)			
	Jupiter & Saturn: Aurora (H ₃ ⁺ 2.1 / 3.9 um, H ₂ 2.1um)	IR 2-4	<u>Spectroscopy</u> R > 50,000	
Atmospheric Minor Constituent & Dynamics (Mars , Venus)	Mars (H ₂ O ₂ , CH ₄ , etc.)	MIR 7-10	1' ~2R _j	<u>Spectroscopy</u> R > ~1,000,000
	Venus (CO ₂ , SO ₂ , etc.)			

Plan for groundbased observation on Haleakala

- (1) Continuous observation by remote and (semi) automatic control
- (2) using High-resolution spectroscopy in visible, IR and MIR.
- (3) with sufficient photon, for minor constitute.

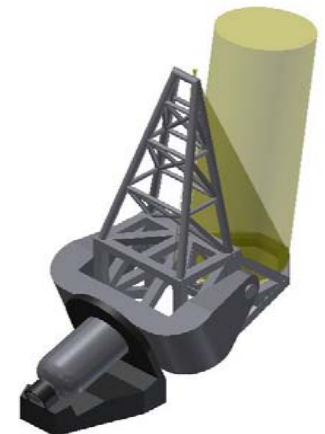
40cm, 2007-



60cm, 2013-



PLANETS 2m
2015- ???



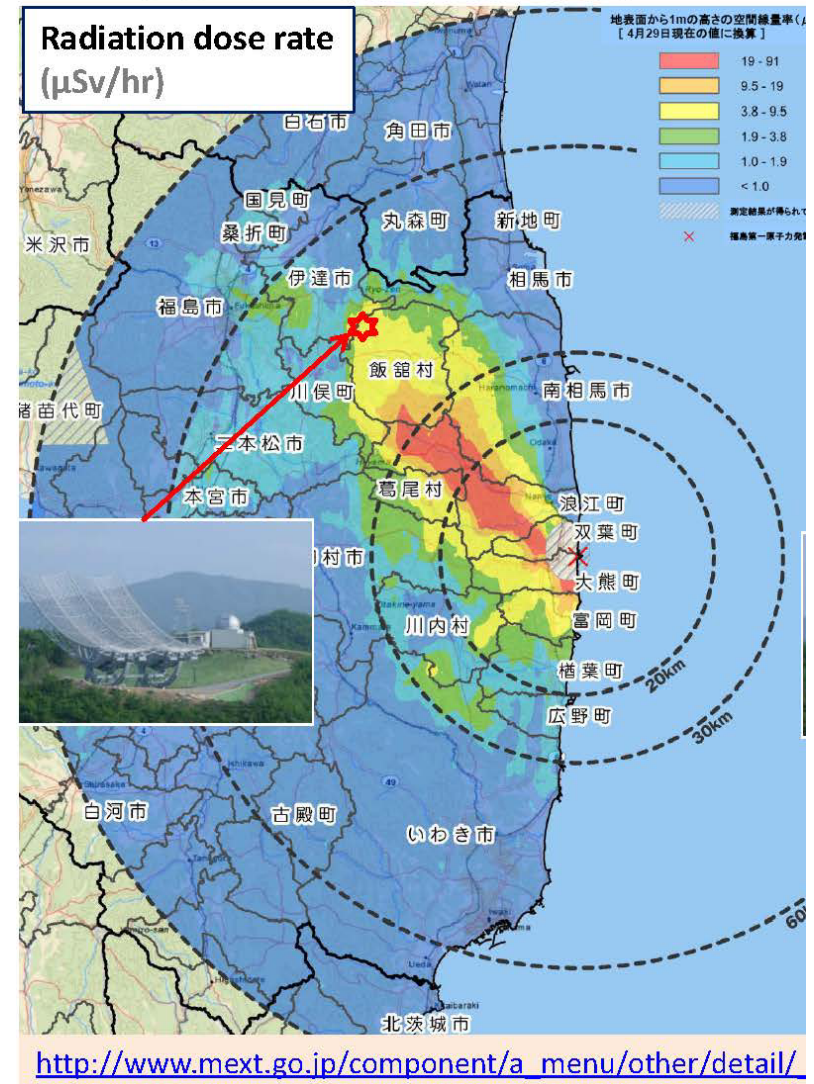
Pollution of Iitate Observatory

Radiation dose rate

- **Current value: $3.5\mu\text{Sv/hr} = \underline{30\text{mSv/yr}}$**
($5\mu\text{Sv/hr}$, 1 year ago)
- Inside a building: $0.2\ \mu\text{Sv/hr}$



Dr. Günther Hasinger, IfA Director accommodated a request for relocation of Iitate 60cm telescope on Nov. 2011 as a part of assistance for quake disaster.

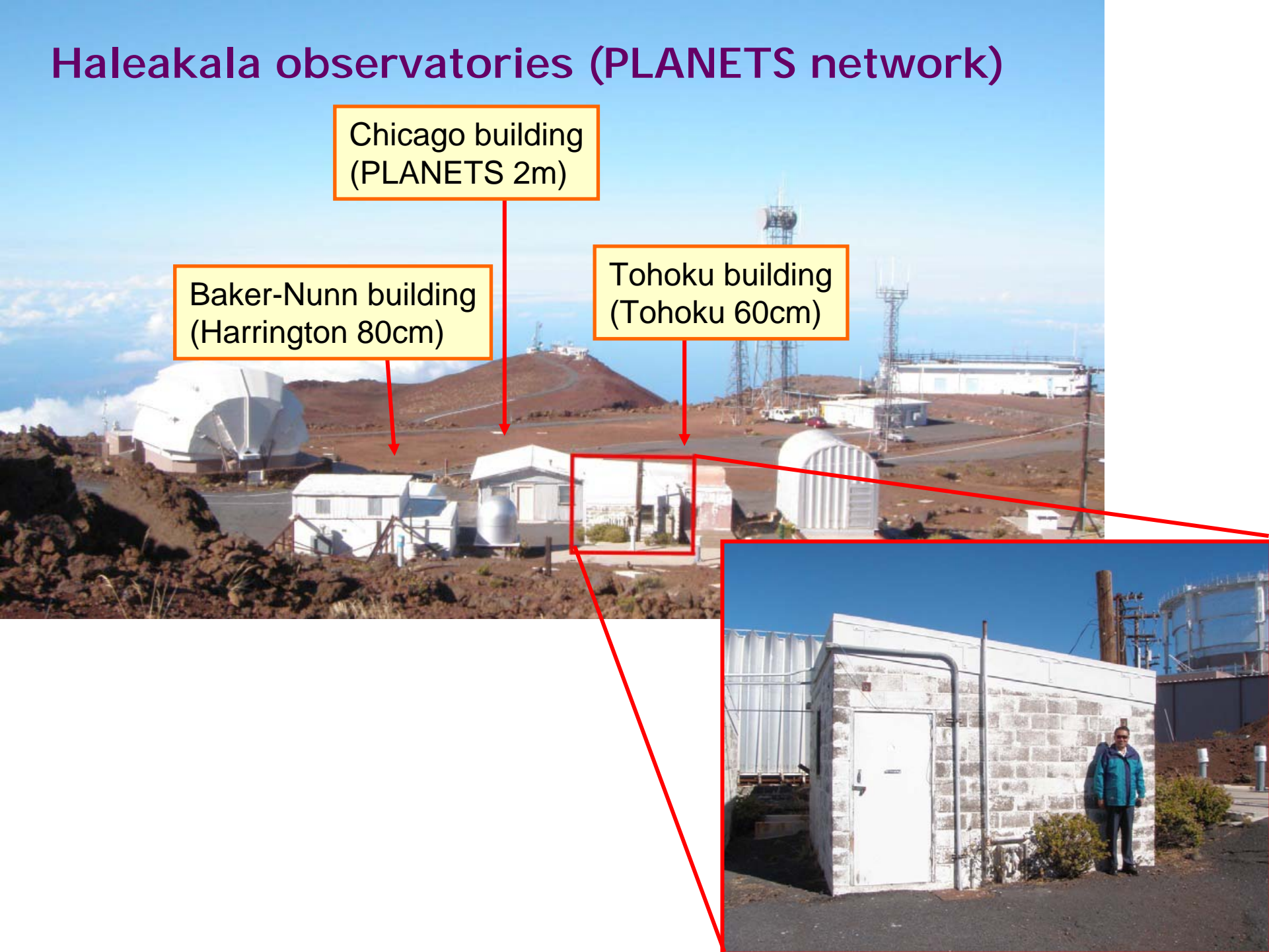


Haleakala observatories (PLANETS network)

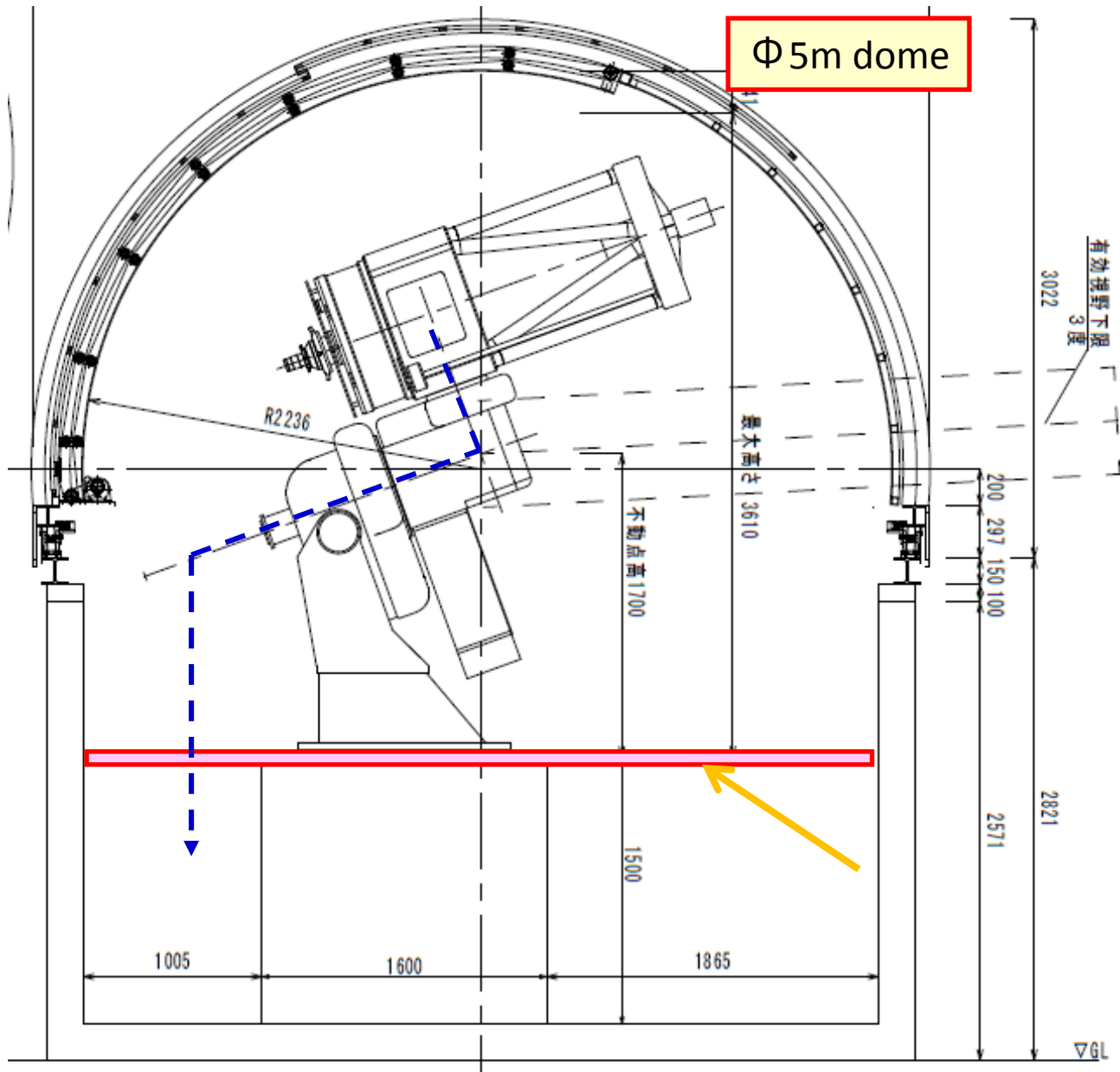
Chicago building
(PLANETS 2m)

Baker-Nunn building
(Harrington 80cm)

Tohoku building
(Tohoku 60cm)

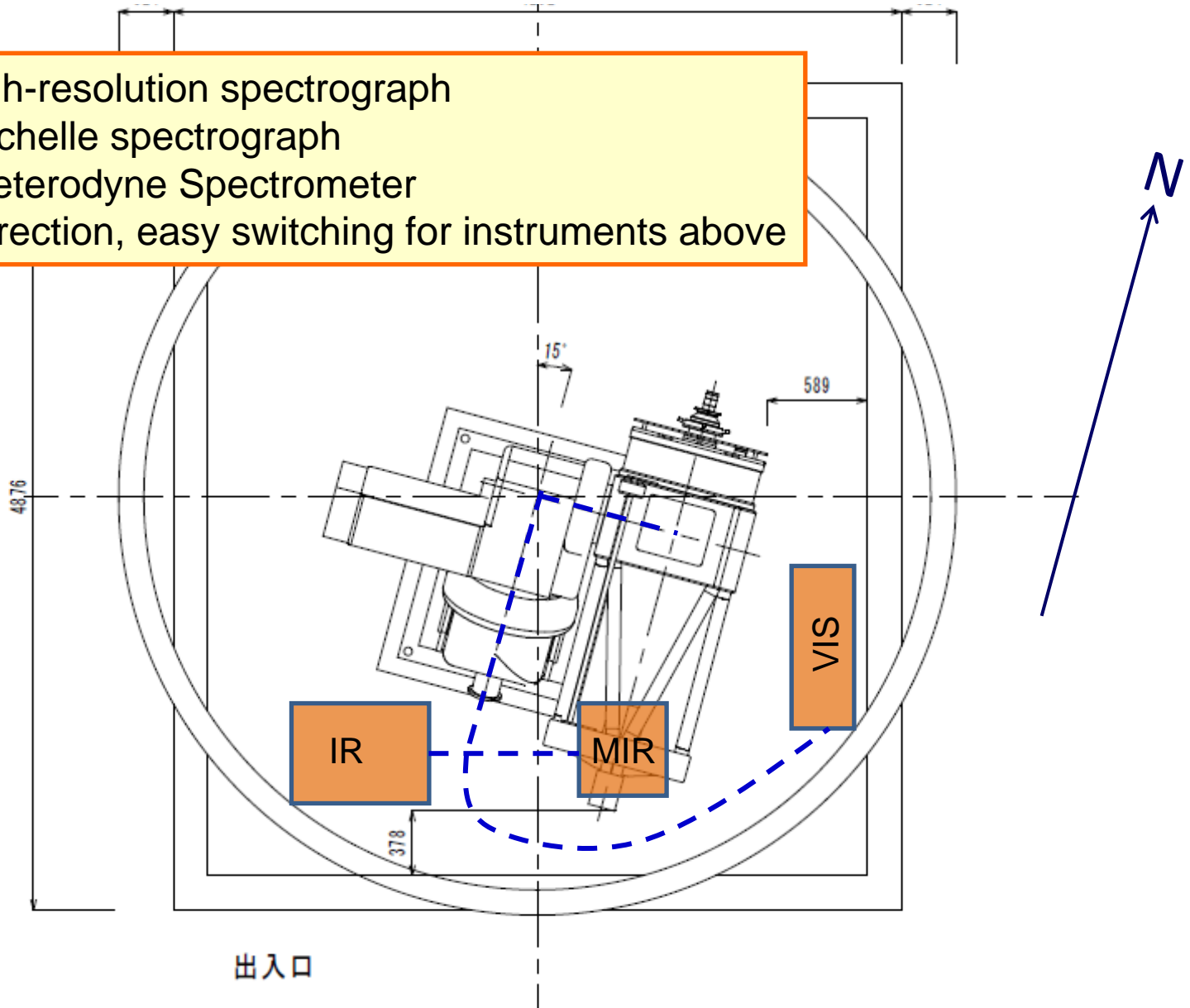


The building and a dome



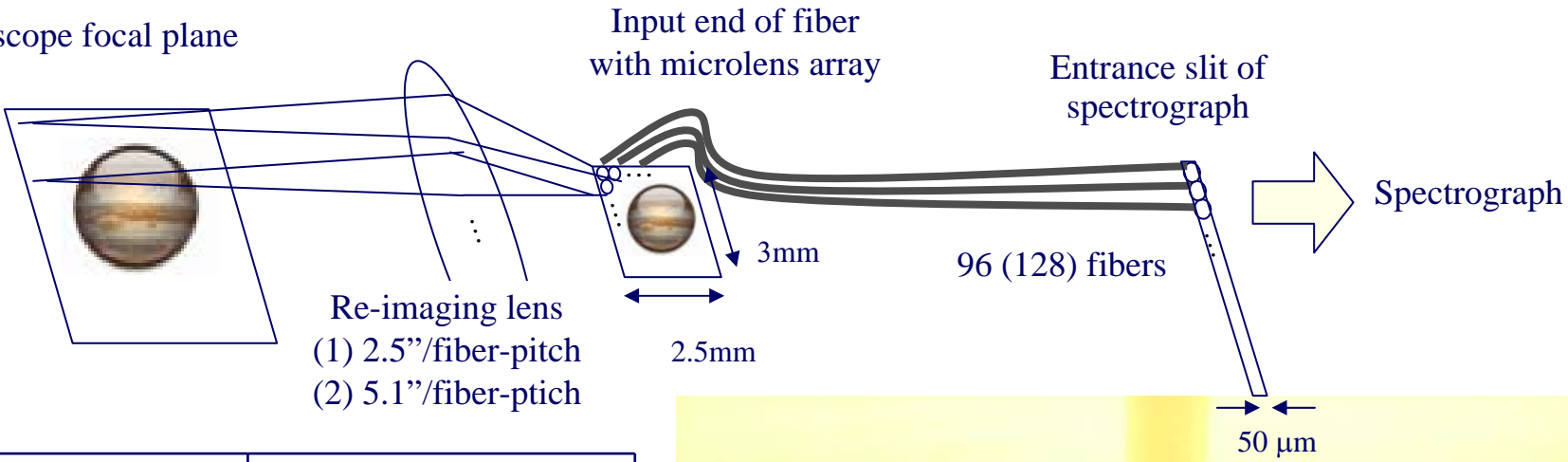
Instruments layout

- Visible high-resolution spectrograph
- Infrared Echelle spectrograph
- Infrared heterodyne Spectrometer
- Tip-tilt correction, easy switching for instruments above

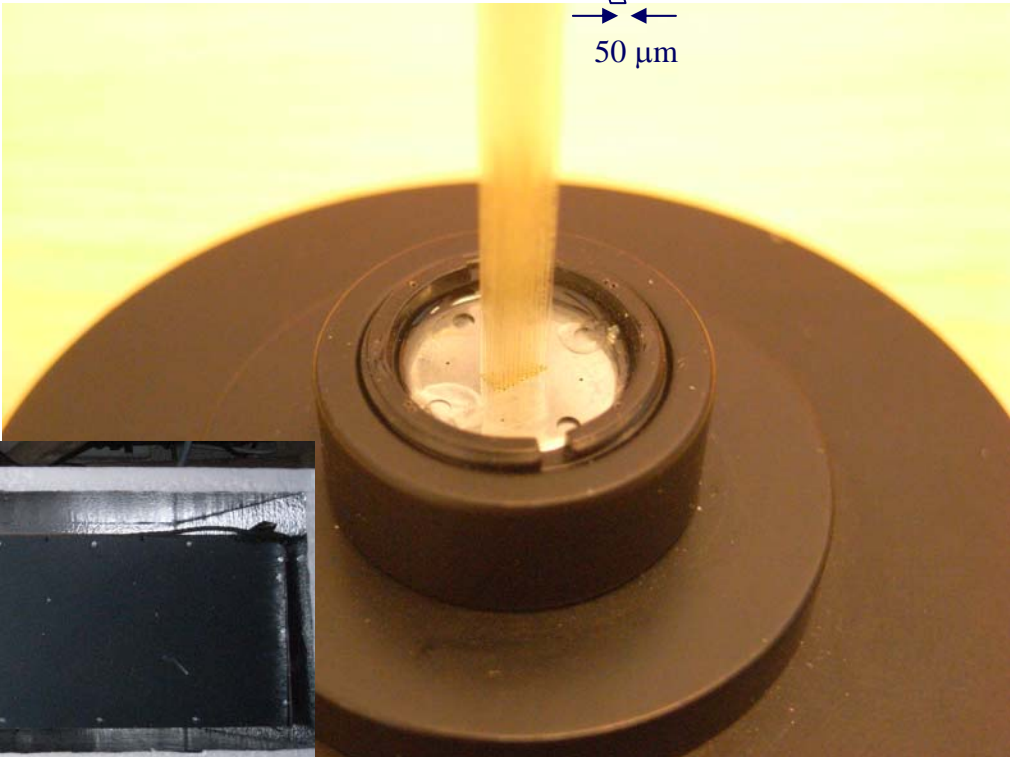


Visible high-resolution spectrograph with fiber array

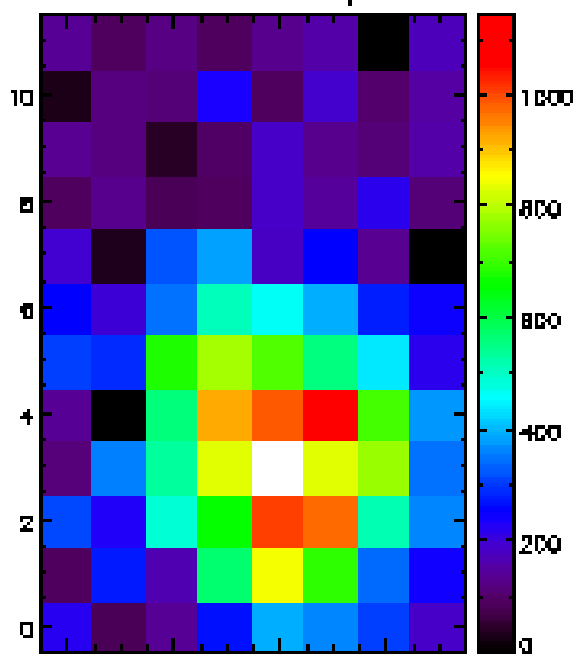
40cm telescope focal plane



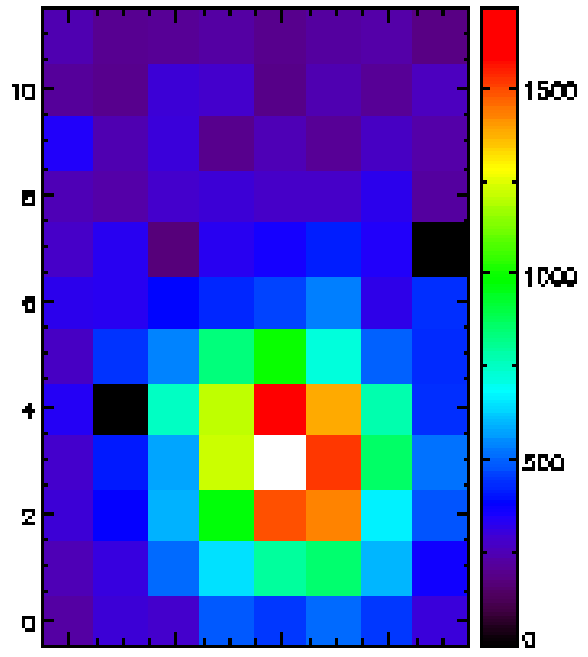
Spatial resolution (FOV)	2.5"/fiber (21x30") 5.1"/fiber (42x60")
Spectral resolution	50,000
Wavelength	550 – 900 nm
Pre-disperser	590,630,670,(770,900)
Observing target	Jupiter (SII, SIII), Mercury (Na, K), Saturn (OI), etc.



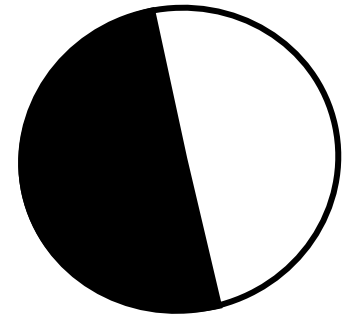
Preliminary result of Mercury Na atmosphere



Na D2 emission



Continuum



Angular diameter: 8"

Observation Mercury sodium atmosphere using the visible spectrograph was made on Nov. 2012 successfully.

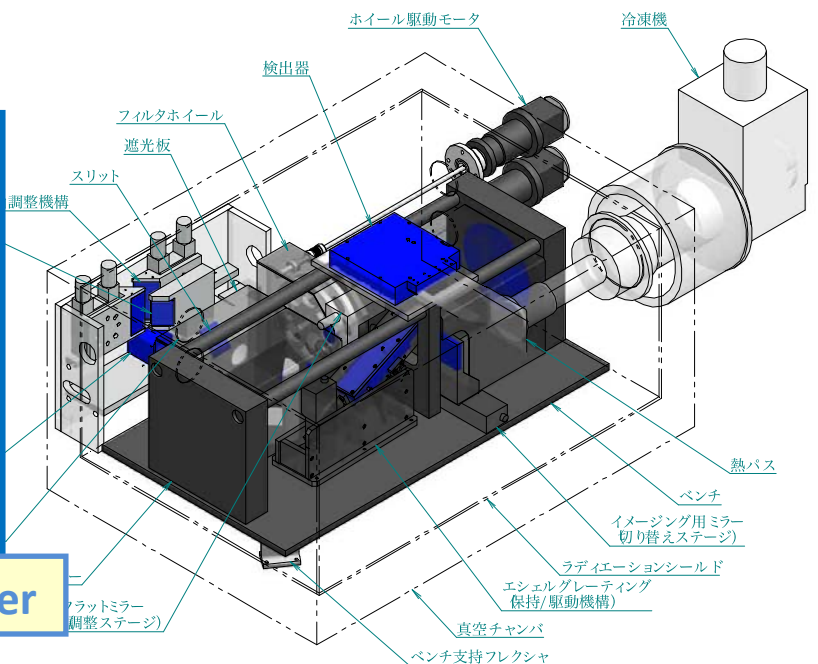
Infrared high-resolution echelle spectrograph

Slit length	50 arcsec
Spectral resolution	20,000
Wavelength	1 – 4 μm
Velocity resolution	0.5 km/several min integration (Jup. H_3^+)
Imaging mode	available
size	800x500x400 mm

Echelle grating drive mechanism



Image-spectrograph changer

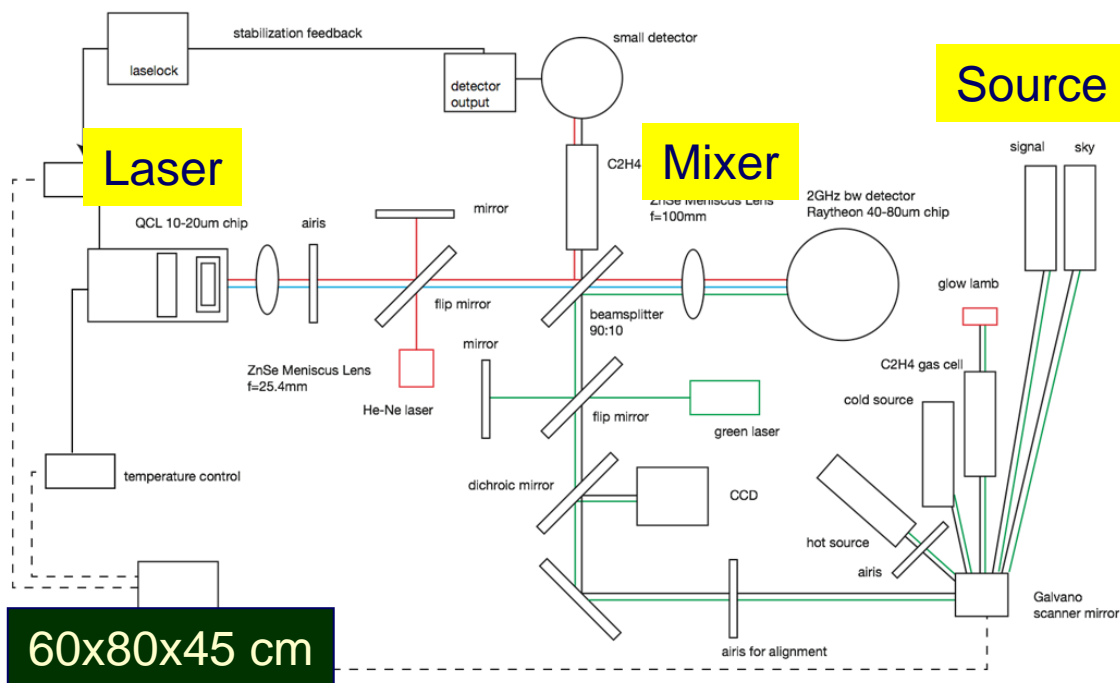


MIR ultra high-dispersion Heterodyne spectrograph

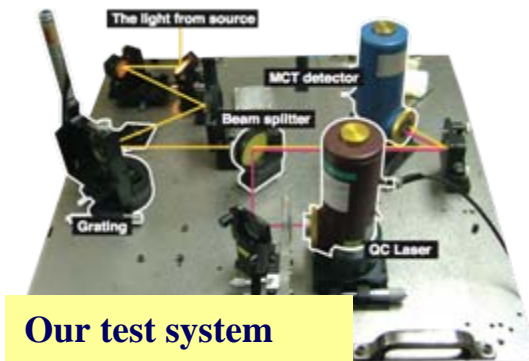
Highest spectral resolution in Medium IR (7-13 μm) with simple system

- $\lambda / \Delta \lambda > 10^{6-7}$ several 10s-100s m/s

~ similar scale to planetary atmospheric motions ~



60x80x45 cm



Our test system
[First light: 2011]



U3 Cologne's system (Obs @ Kitt Peak
2010 summer)



lead by H. Nakagawa (Tohoku Univ.)
with U. Cologne & NASA/GSFC

Schedule for Relocation of 60cm telescope

		2013											
		1	2	3	4	5	6	7	8	9	10	11	12
Dome & Building	Facility Use Agreement with Hawaii University	effective											
	Conservation District Use Application		reviewing										
	Foundation work, Pedestal, Wall Reinforcement												
	Dome												
Electricity													
Telescope	Carrying out from Iitate Observatory												
	Modification of mount												
	Shipping to Hawaii												
	Installation, Adjustment												
Instruments	Visible Spectrometer	making											
	Heterodyne Spectrometer												
	Near-infrared Echelle Spectrometer												

▲ Launch of EXCEED

→ EXCEED campaign

Summary

- 1.6m telescope will be relocated to Haleakala observatory by Oct. 2013 for the purpose of long-term monitoring of planets.
- Three instruments will be installed
 - Visible (0.55-0.9 micrometer) high-resolution spectrograph
 - IR (2-4 micrometer) high-resolution echelle spectrograph
 - MIR (7-10 micrometer) ultra high-dispersion Heterodyne spectrograph