National Astronomical Institute of Thailand
(Public Organisation)
Ministry of Science and Technology

Progress and Plan for the Thai National Radio Observatory

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RANGD Project Manager

EVN CBD Seminar, SHAO

16/05/18

Radio Astronomy Network and Geodesy for Development (RANGD) 2017-2021

"Capacity Building Through Radio Astronomy"

- Thai National Radio Observatory (**TNRO**)
  - 40m Thai Radio Telescope (**TNRT**)
  - 13m VGOS Telescope
  - Visitor Centre
- Receiver and Electronics Laboratories

Human Expertise

- Workshops & Seminars
- Trainings & Staff exchange

Background of TNRT

- Multipurpose ~40m RT — with flexibility
- (preferably) Existing Design — limited experience
- Frequency ~ UHF - ~115 GHz — determined by Science area,
  Radio Frequency Interference,
  Weather conditions

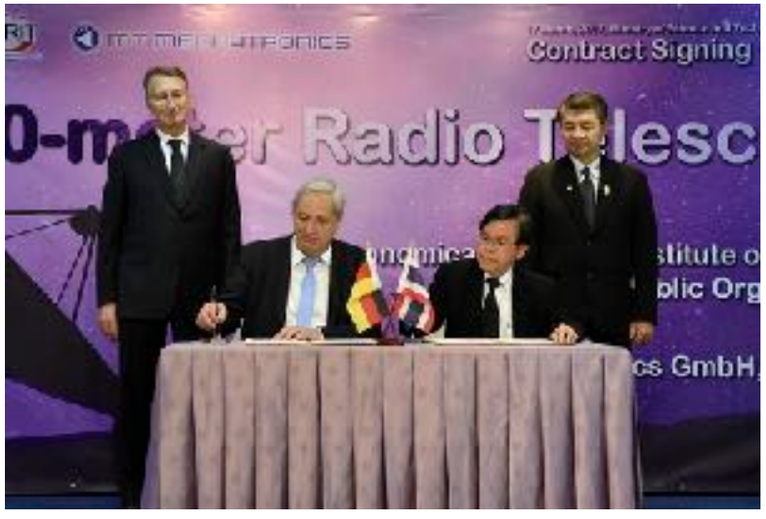
Key Science

- Extensive observing frequency : 300 MHz - 115 GHz
- Ideal latitude location : +18 N

Single Dish Applications focus on Time Domain astronomy, such as pulsars and radio transients and variability of masers and AGNs.

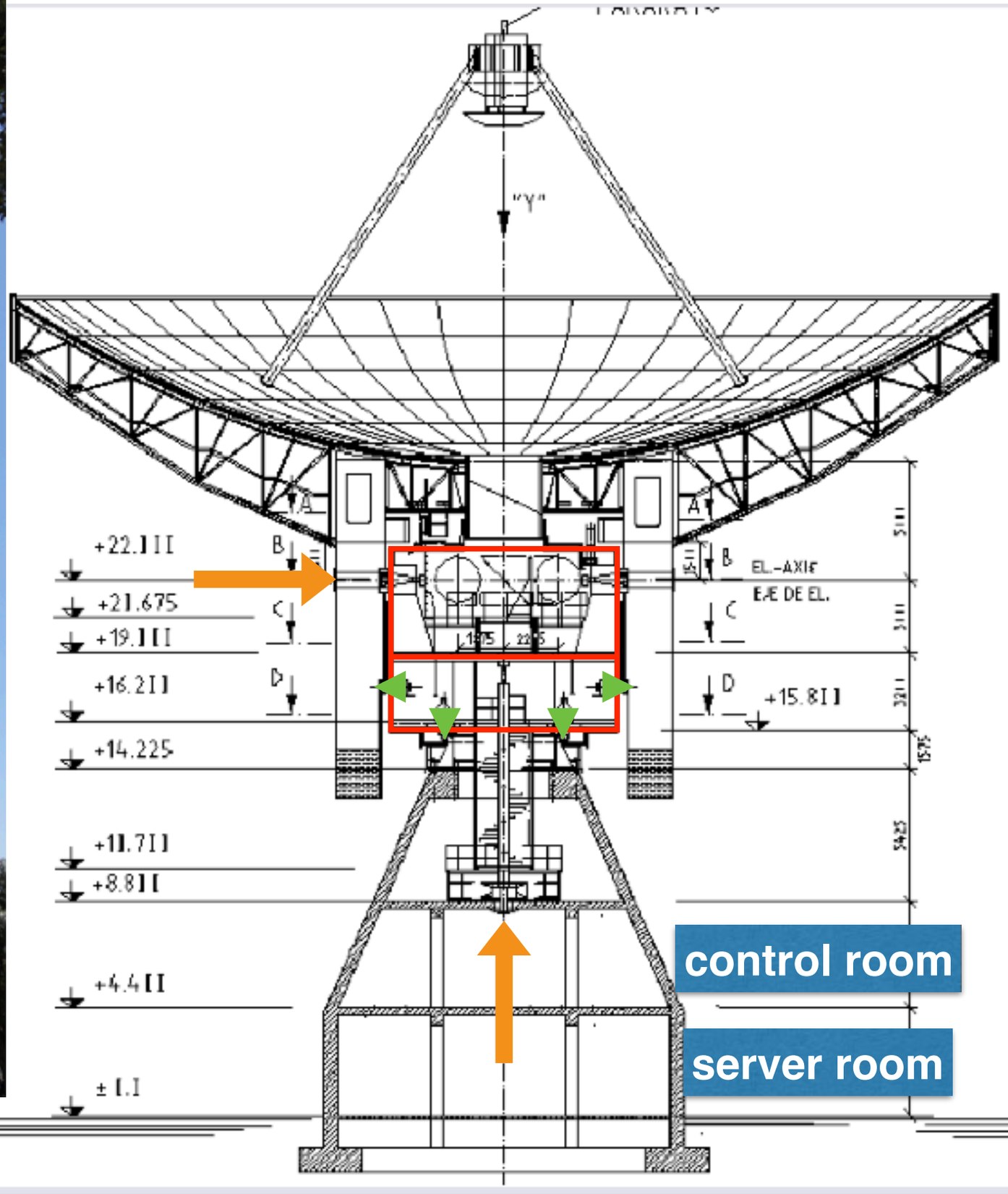
The 40m Thai National Radio Telescope

- `Updated' version of IGN's 40m Yebes Radio Telescope
- 40m Paraboloid Antenna, Cassegrain-Nasmyth optics
- 150 um (rms) total surface accuracy (@45EL)
- 300 MHz - 115 GHz
- Slew: Az 3 deg/s, EL 1 deg/s
- Pointing: 2" (no wind),
  6" (5 m/s wind)
- Tetrapod Head Unit (THU)



40m RT Contract Signing March '17

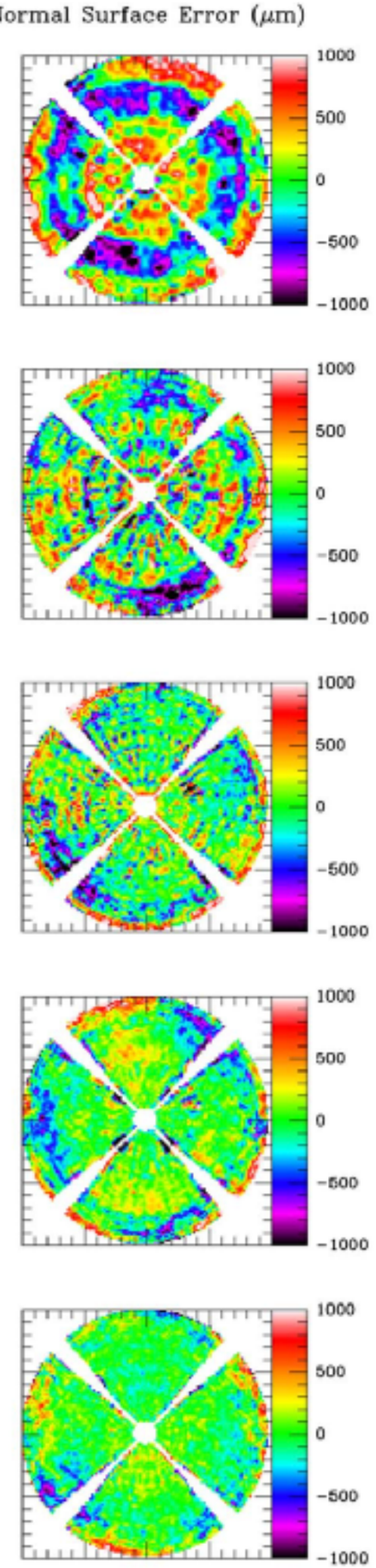
The 40m Thai National Radio Telescope

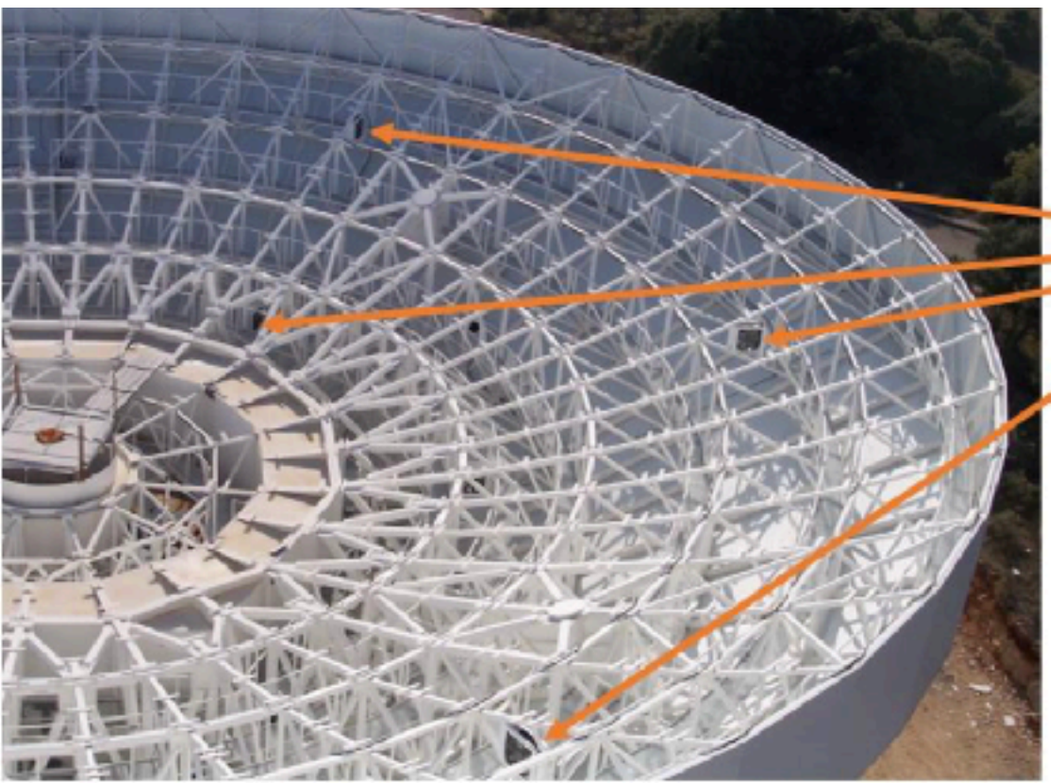


MINISTERIO DE FOMENTO
DIRECCIÓN GENERAL DEL INSTITUTO GEOGRÁFICO NACIONAL

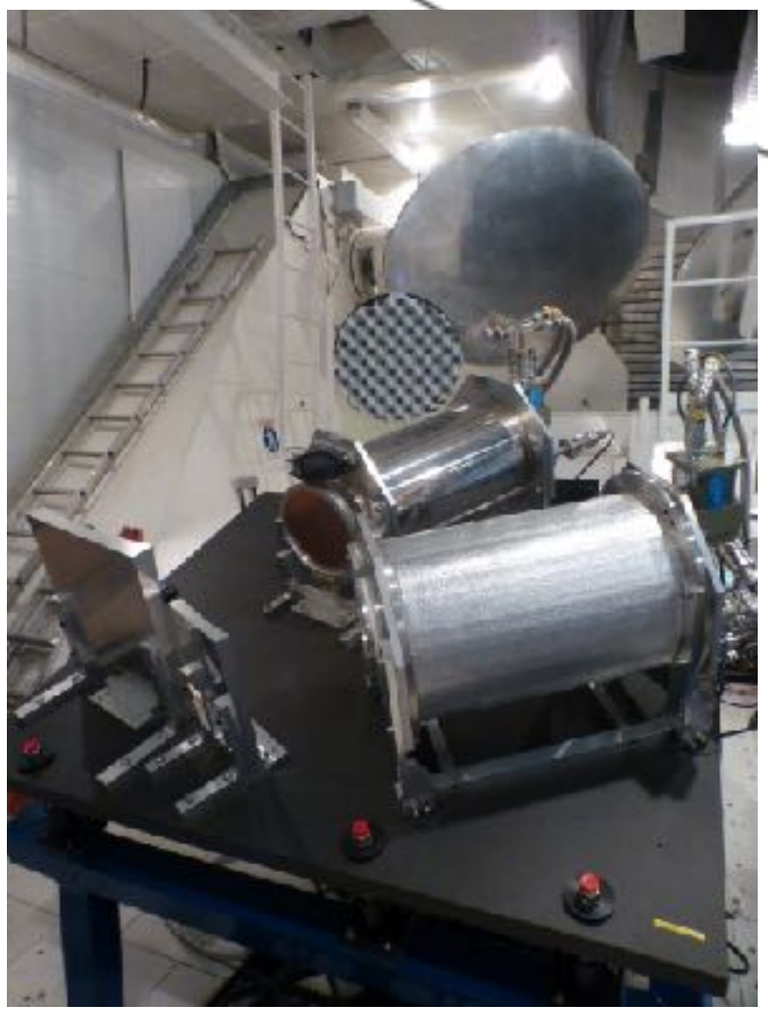
Main Reflector

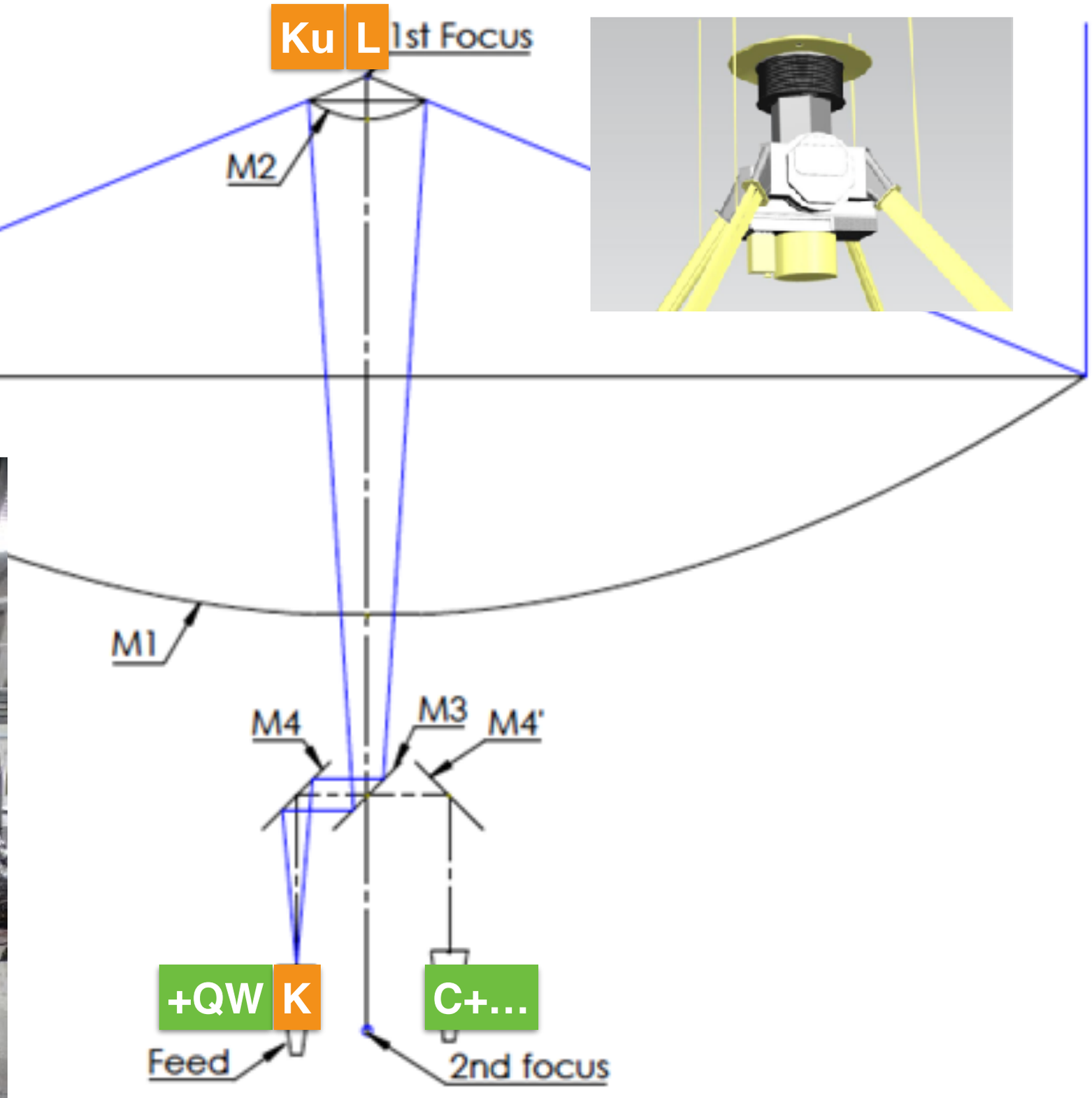
- 420 80um (rms) panels
- total passive surface
  150 um (rms) @50 deg
  180 um (rms) @20,70 deg
- fully cladded
- upgradable to active surface
- Ku microwave holography



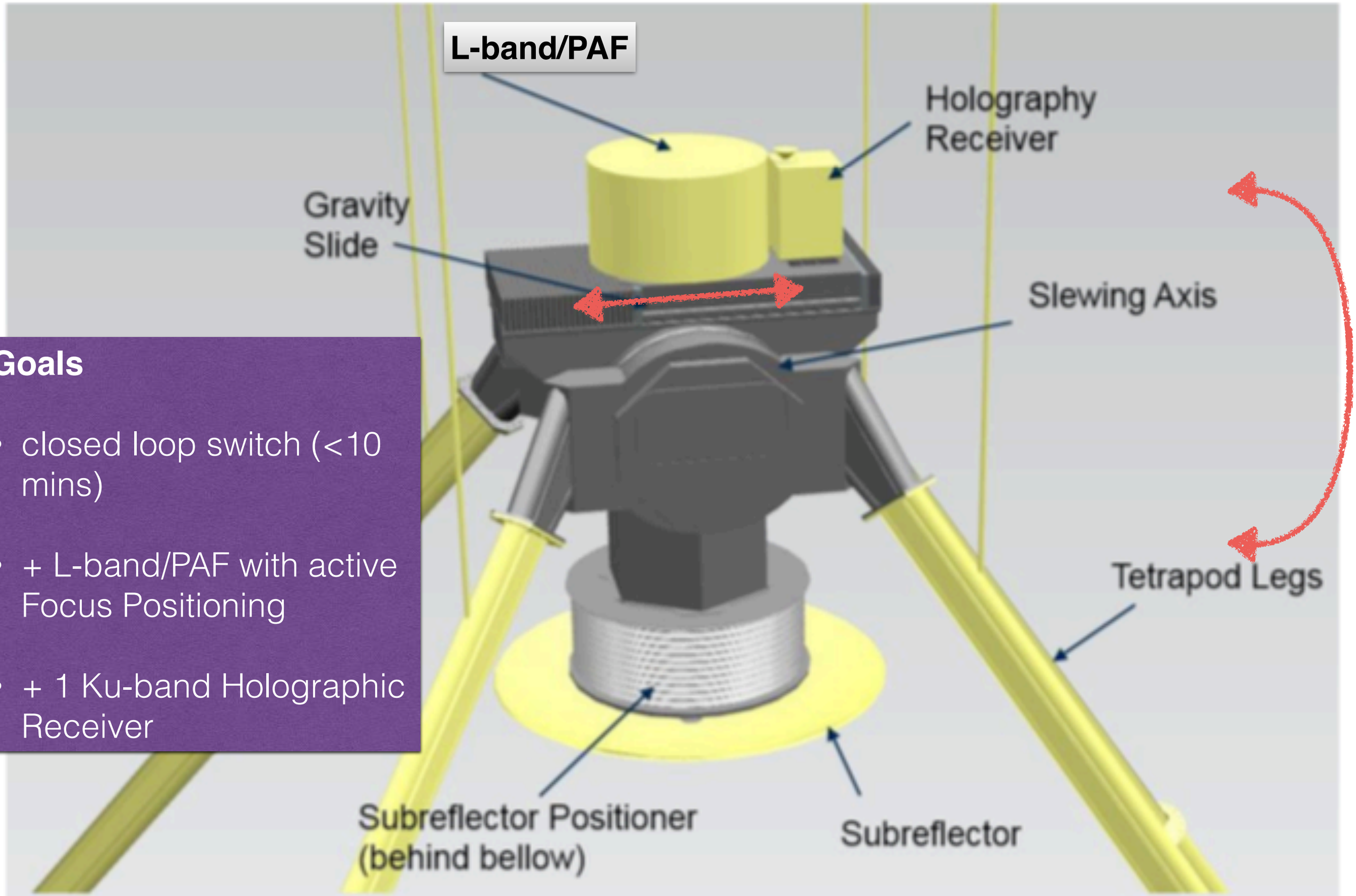


Optics





Tetrapod-Head Unit (THU)



Goals

- closed loop switch (<10 mins)
- + L-band/PAF with active Focus Positioning
- + 1 Ku-band Holographic Receiver

Concrete Tower (NARIT SOW)

	L-band	K-band
Location	Primary Focus	Nasmyth Focus
Frequency range (GHz)	**0.85-1.80**	**18.0-26.5**
Centre wavelength (cm)	21.4	1.36
Beam width (arcmin)	22	1.4
Polarisation	Linear	Circular
Cross polarisation	-25 dB	-25 dB
RF BW	**950 MHz**	8 GHz
sampler	3 Gsps	>4 Gsps
Packetizer BW	1.5 GHz	**>2 GHz**
digitisation bits	< 12 bit	< 12 bit
Digitizer Output	2 x 40 Gbps Ethernet, SPEAD	2 x 40 Gbps Ethernet, SPEAD
Total efficiency	0.7	0.5
Gain (K/Jy)	0.32	0.23
Trx	13	20
Tsky (K)	12	50
Tsys (K)	25	70
SEFD (Jy)	**78**	**304**

NARIT

Max-Planck-Institut für Radioastronomie

Primary/Nasmyth Cabins

L-band
0.85-1.8 GHz

Digitizers

K-band
18-26.5 GHz

Conversion

Digitizers

Fiber optics

Fiber optics

NARIT HQ

HPC

Data Archive

Packetizers

Ethernet Switch

BW 2pol x 2ghz

n x Backend Server

RFI mitigation

Stokes parameters

GPU

CPU

GPU

CPU

60s ring buffer

Onsite Server

filterbank data

VLBI vdif

Mark6 disks

Single pulse search (real time) CPU

100 dB EMC shielded Server Room

Observing Modes

Pulsar mode
dspsr
timing
search
transient
...

Spectrometer mode
high resolution
filter
...

VLBI mode

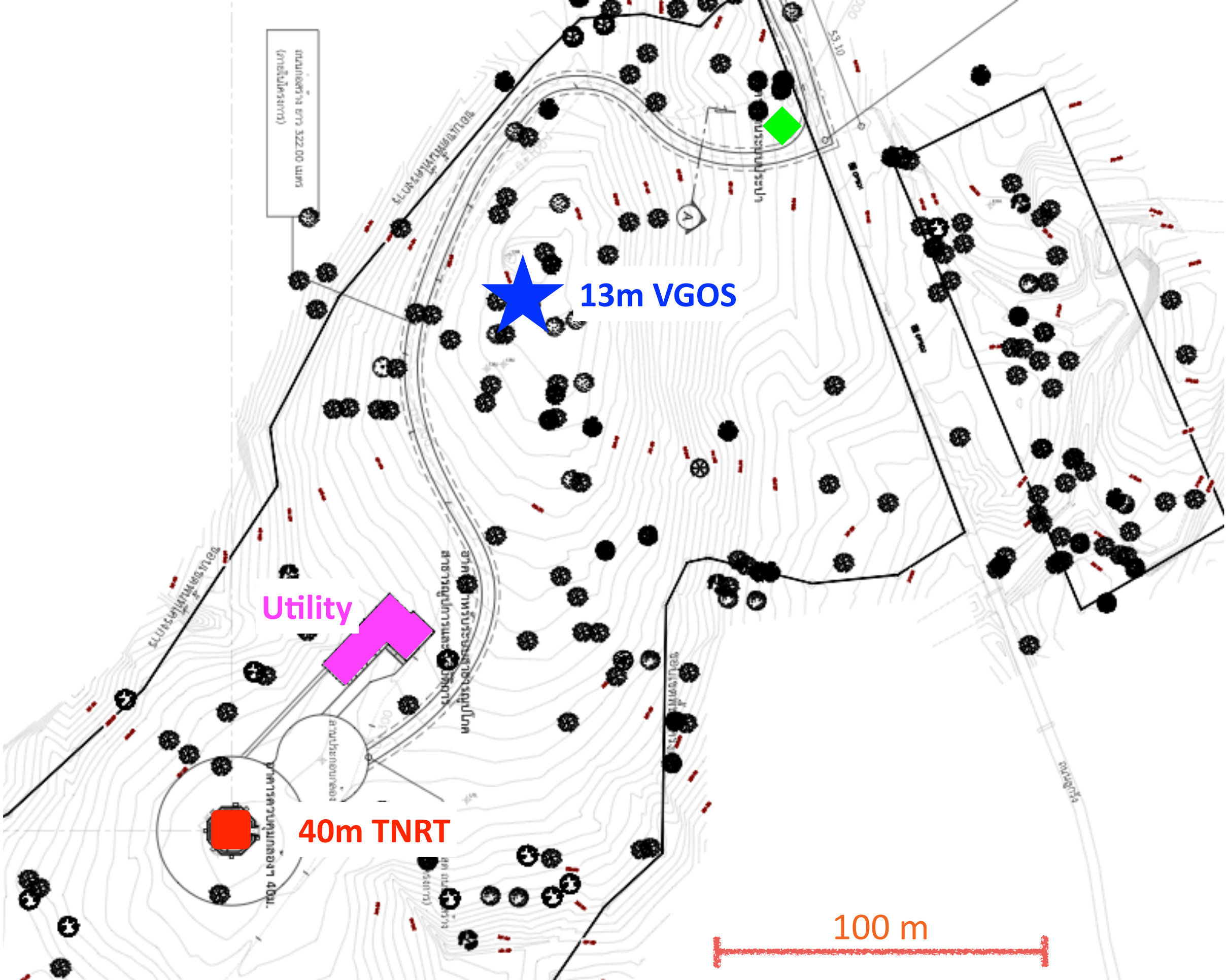
Band	UHF	L	S	C	X	Ku	K	Q	W	PAF	MB-CO
GHZ	0.3-1	1-2	2-4	4-8	8-12	12-18	18-27	36-46	75-110	0.7-2.1	115
Single dish											
Pulsar	PSR obs	PSR obs/ IPTA	PSR obs				GC search/ magnetars	GC search/ magnetars			
Maser & molecular lines		OH		CH3OH			H2O, NH3	Sio	Sio		
Continuum											
VLBI											
Geodetic VLBI			Legacy system		Legacy system						
			2-14 GHz 13m VGOS Telescope								
EAVN (Wajima et al 2015)											
KaVA											
EVN (evlbi.org)											
Aus LBA											
Global mm VLBA Array											
Space VLBI (radioastron)											

key	phase I Rx 2018	phase II Rx (TBC)

Huai Hongkhrai Royal Development Study Center

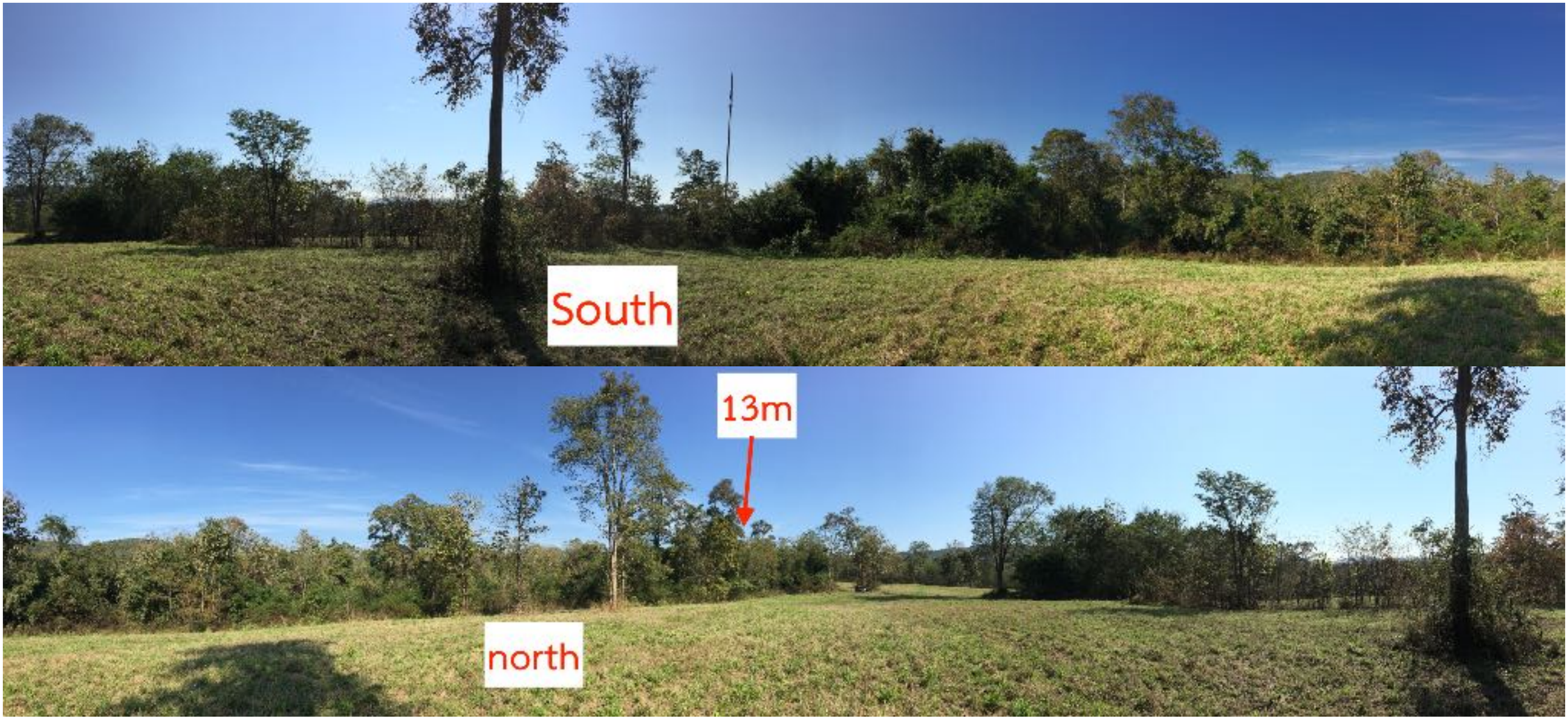
เชียงใหม่

เทศบาลนคร
เชียงใหม่

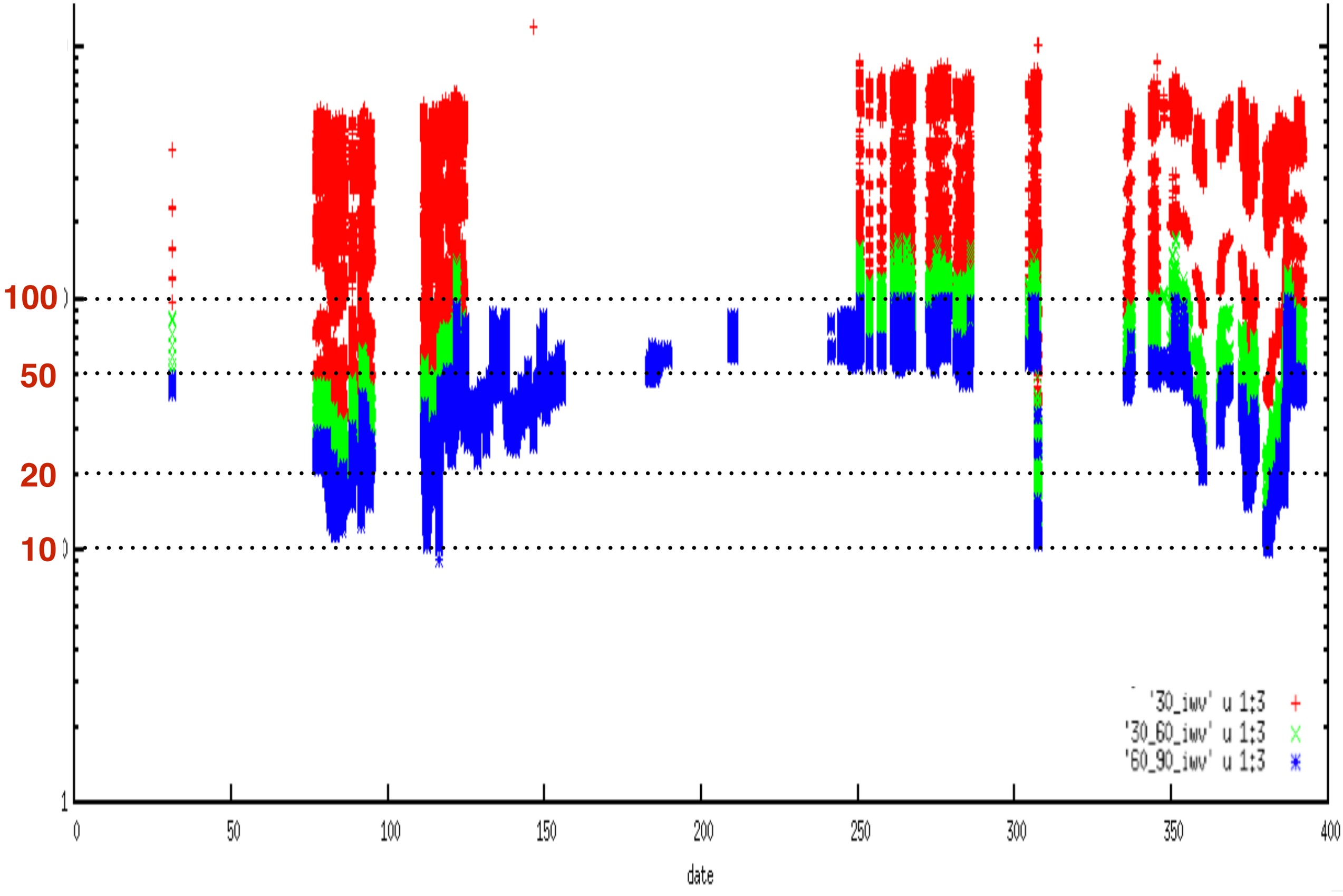

13m VGOS
Utility
40m TNRT
100 m


S

Horizon view@40m RT



Integrated Water Vapour (mm.)



Timeline	2017	2018	2019	2020	2021
Sitework					
Contract Signing					
CDR					
Installation					
L-band					
K-band					
Backends					
Auxiliary systems					
Phase I Commissioning					
Phase II receivers					
VGOS 13m (TBD)					
Receiver Lab					

The 7th International VLBI Technology Workshop 2018

Important dates:

30 Apr : Call for Abstracts
31 Aug : Abstract submission deadline
15 Sep : Registration Deadline/
Accommodation Booking

Background

The International VLBI Technology Workshops have evolved from the highly successful 10-year series of International e-VLBI workshops. The scope of the technology workshops aims to encompass all areas of hardware and software development relevant to VLBI.

The seventh workshop in this series will feature (but not be limited to) traditional VLBI topics, such as receivers, backends, recording equipment, and e-transport. One day will be dedicated to correlators, for which we will also invite a number of experts from non-VLBI fields.

Workshop date and venue

12-15 November 2018

Aonang Villa Resort, Krabi, Thailand

For more information

Website: www.narit.or.th/ivtw2018
Email: ivtw2018@narit.or.th
Fanpage : NARITpage / ITCAUNESCO

NARIT

ITCA

NARIT

Trip to AstroPark and TNRO site in Chiang Mai on Friday 9 November, 2018.

Summary

Scope of work

- 40m RT (exclude tower) — MT Mechatronics
- Tower + Site — NARIT

Collaborations

- Microwave Holography System + TCS + Trainings — Yebes Obs
- L-band + K-band + Universal Software Backend — MPIfR+Manchester
- 13m VGOS telescope — SHAO