RAFCAP meeting
15 May 2025

Center for Radio Astronomy and Engineering at NARIT

NARIT: National Astronomical Research Institute of Thailand (Public Organization),
MHESI: Ministry of Higher Education, Science, Research and Innovation, Thailand

Bannawit Pimpanuwat, Postdoc / TNRO Commissioning Scientist

On behalf of: Koichiro, Sugiyama, Nobuyuki Sakai, Phrudth Jaroenjittichai, Apichat Leckngam, Wiphu Rujopakarn, Boonrucksar Soonthornthum, Saran Poshyachinda (NARIT), Busaba H. Kramer (MPIfR/NARIT), and all the CRAE/TNRO members.

National Astronomical Research Institute of Thailand (Public Organization)

Since July 2024 ~

Center for Radio Astronomy and Engineering

Thai National Radio Astronomy Observatory

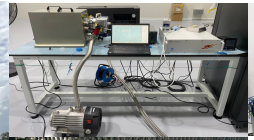
Thai National Radio Telescope (TNRT) 40-m

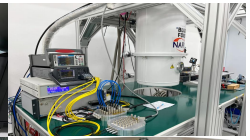
VGOS telescopes

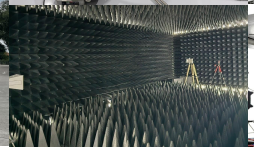
VLBA DiFX correlator
Credit: W. Brisken (NRAO)

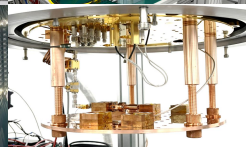
Advanced Radio Frequency Laboratory

@NARIT-HQ









Other Centers/Divisions/GPs

NARIT (Public Organization)

Executive Director: Saran Poshyachinda
Deputy Director: Wiphu Rujopakarn
Founder and ex-Director: Boonrucksar Soonthornthum
Expert for CRAE: Busaba H. Kramer

Center for Radio Astronomy and Engineering

Nobuyuki Sakai
Bannawit Pimpanuwat

(Acting Manager: Koichiro Sugiyama)

Centre of Observatory Operations and Engineering

(Manager: Apichat Leckngam)

Operation

Frontend team

Head: Dan Singwong

Members:
Settasak Naewchan
Chayanin Lakaew
Pichate Pakham
Adirake Ekwan
Siritida Duangbuppa

Backend team

Head: Teep Chairin

Members:
Naphat Yawiloeng
Warakorn Noisapung
Thita Dilokthanakun
Kritsada Angkaew

PAF / RFI team

Head: Songklod Punyawarin

Members:
Kamorn Bandudej
Attapon Bunwong
Wichitra Paithakam
Panupan Dumkham
Pathorn Sathapornwajana
Nattawut Chaiyawongwan

VGOS team

Head: Apichat Leckngam

Members:

Nattawit Chanwiset
Thodsawat Chaichana

Construction

Division of Observatory Operations

Head: Nikom Prasert

Members:
Pratchayaphan Jiraya
Pathit Chatuphot
Haseng Sani
Chalunthon Noochue
Saharat Sathipchan

Division of Maintenance Services

Head: Kitipoom Kanjana

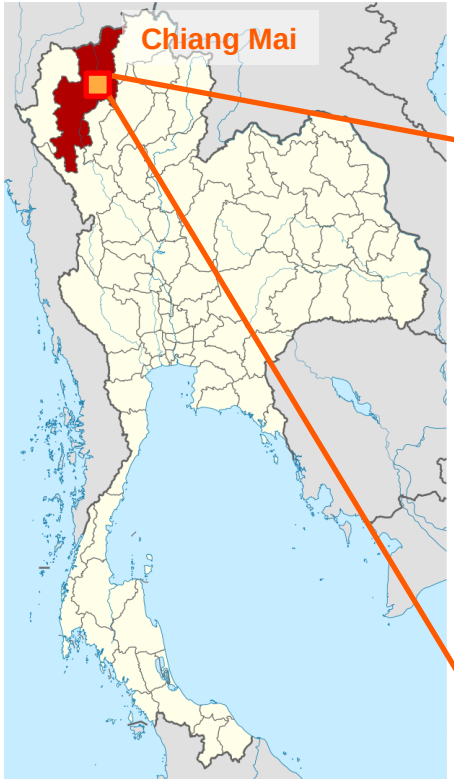
Members:
Anya Punnawat

Outline

1. Thai National Radio Astronomy Observatory (TNRO)
    1. The 40-m Thai National Radio Telescope (TNRT)
    2. VLBI Experiments
    3. VGOS Radio Telescopes
2. Advanced Radio Frequency Lab
3. Vision for the Future of CRAE in Thailand/SE Asia

Image credit: D. Singwong, N. Thoonsaengngam, & NARIT / TNRO / CROE.

Thai National Radio Astronomy Observatory



Thailand © NordNordWest in Wikipedia

- 40 km away toward NE from NARIT headquarters
- Site is a part of Huai Hong Khrai Royal Development Study Center
- Radio Quiet Zone: less RFI, & Relatively lower water vapor area

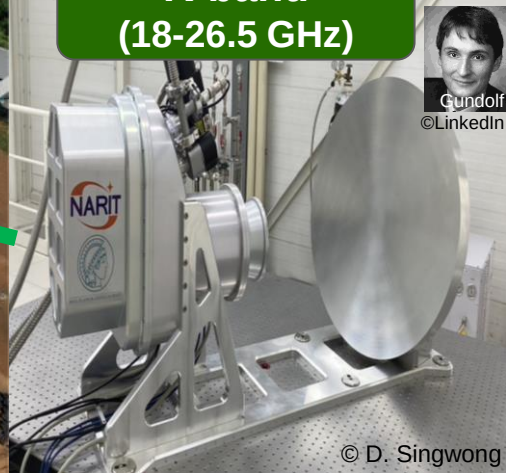
Image credit: P. Jaroenjittichai & TNRO/CROE members (NARIT)

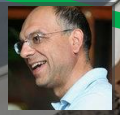
The 40 m Thai National Radio Telescope (TNRT)

since 2022~

L-band
(1.0-1.8 GHz)

K-band
(18-26.5 GHz)





Gundolf
©LinkedIn

"Upgraded" version of IGN's Yebes 40-m Radio Telescope

With Prime-Focus Tetrapod Head Unit (THU)

0.3 − 115 GHz : **P/L/C/X/Ku/K/Q/W**-bands

150 um (rms) total surface accuracy

Beam size: 13.4 arcsec – 1.43 degree

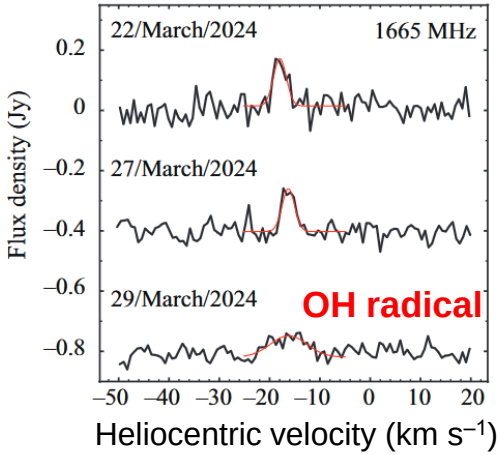
Pointing: 2" (no wind), 6" (5 m/s wind)

Slew: AZ 3 deg/s, EL 1 deg/s

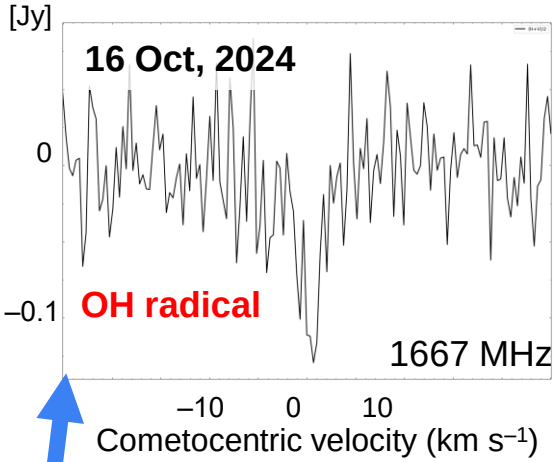
NARIT Cometary Database project since 2024

Slide Credit: Nobuyuki Sakai

12P/Pons-Brooks (a Halley-type comet)



C/2023 A3 (Tsuchinshan–ATLAS)



- Comets retain the information of solar system formation
- 1.6-GHz OH-radical observations of comets determine
  - OH/Water production rate [s^{-1}] ($Q_{H_2O} \propto Q_{OH}$)
  - Expansion velocity of comet's atmosphere (coma)

Optical telescope credit: Joseph Maldonado

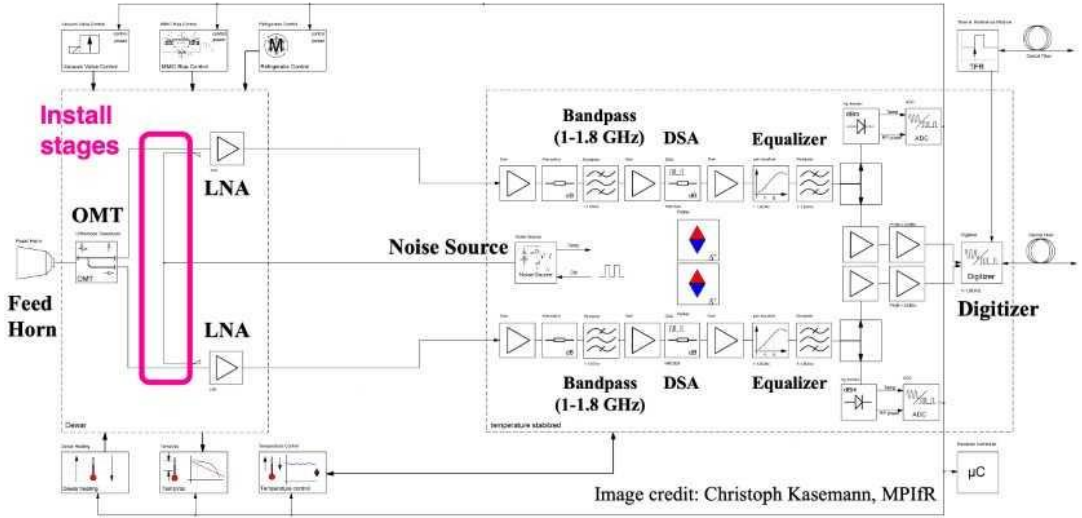
TNRT proposal ID:

- ***TNRTDDT_001***
- ***TNRTDDT_002***

Upgraded the L-band system, No. 1

Installation of high-/low-pass filters with MPIfR

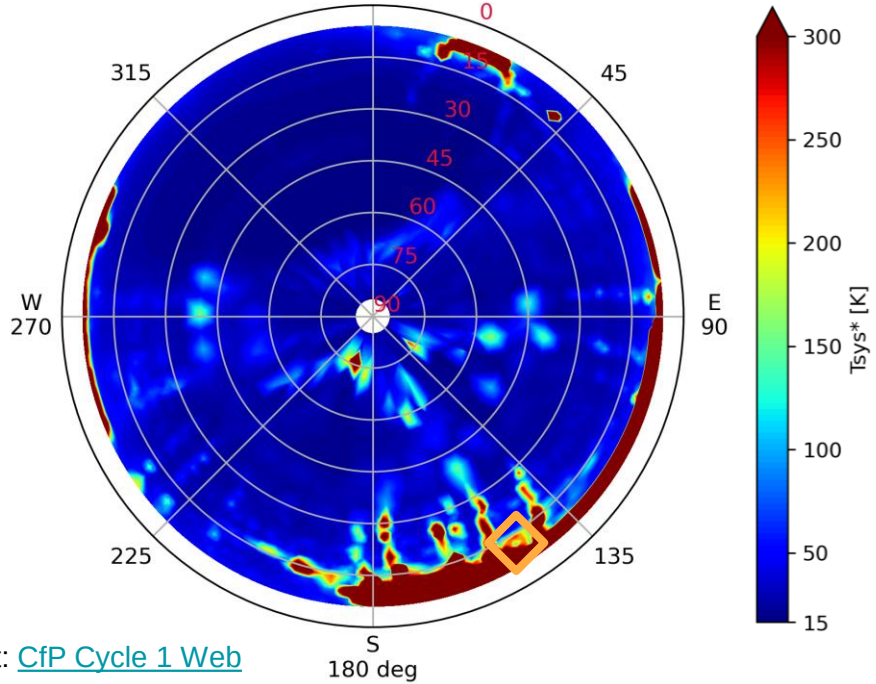
- Gundolf Wieching, Christoph Kasemann, et al. (MPIfR) produced high-/low-pass filters for TNRT: 30 dB attenuation at 1.75-1.85 GHz, & 80 dB attenuation at max
  - Mitigate the RFI monster (1.805–1.845 GHz), & Cancel intermodulation due to RFI from out-band
- Completed installation in mid-Nov 2023, with Christoph & Rafael (MPIfR)



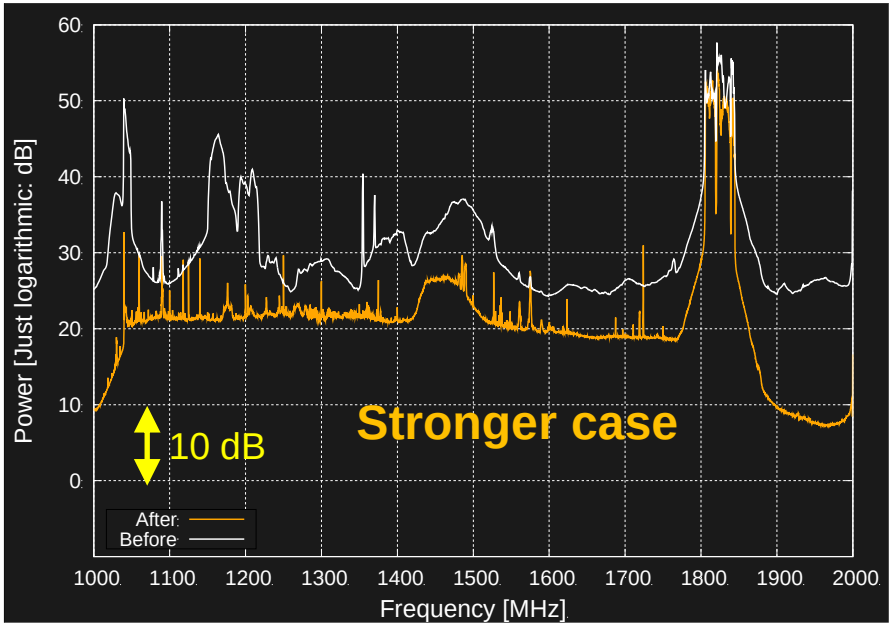
Upgraded the L-band system, No. 1

Installation of high-/low-pass filters with MPIfR

Before: April 2023, 1.63-1.67 GHz



On November 23rd, 2023



Credit: CfP Cycle 1 Web

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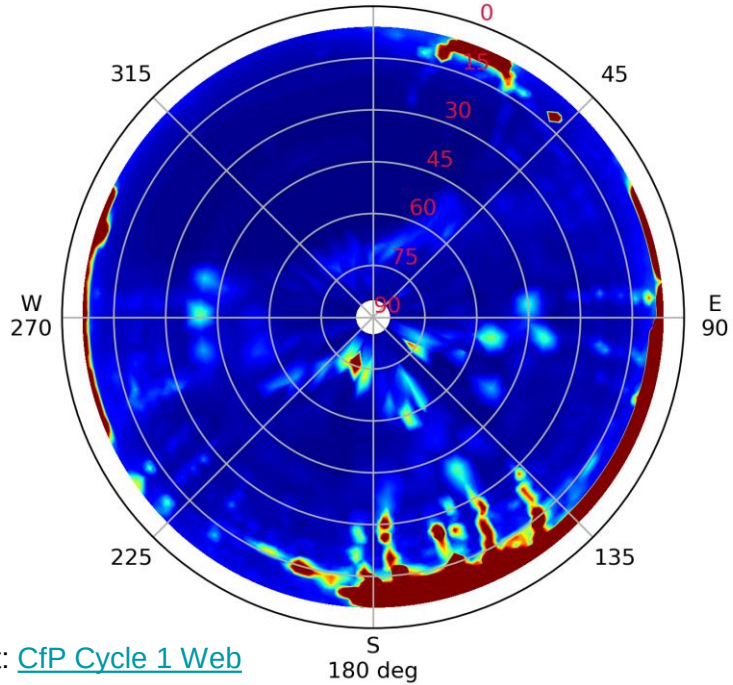
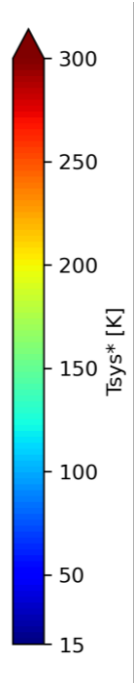
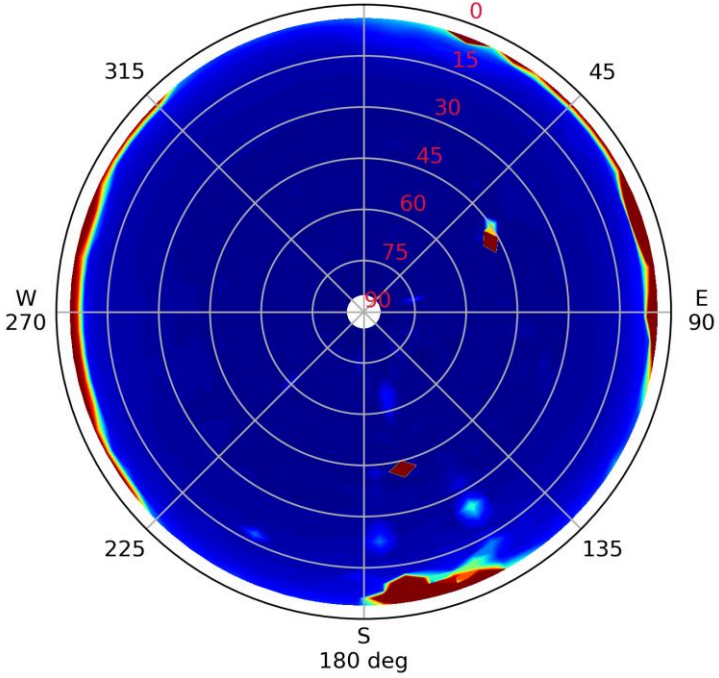




After: March 2024 (this Cycle 1)



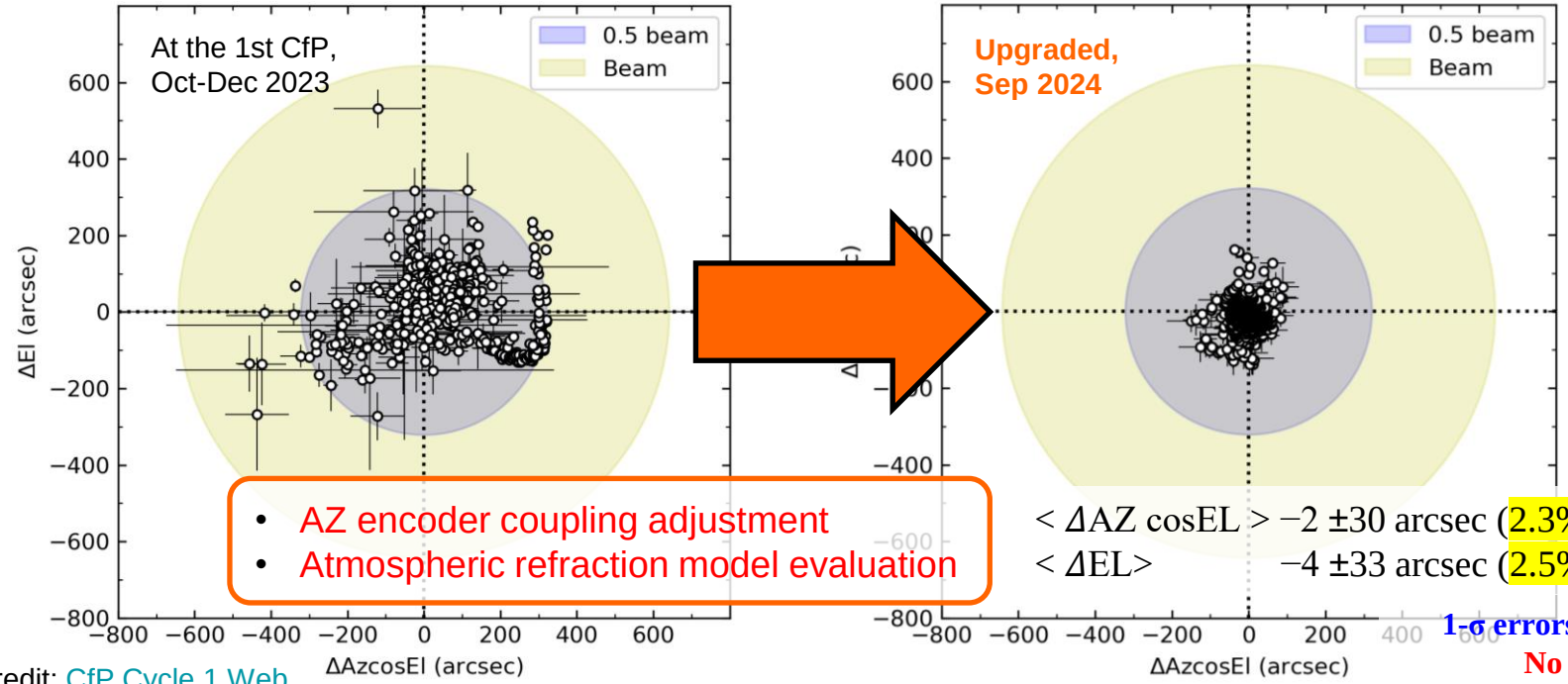
Credit: CfP Cycle 1 Web

Upgraded the L-band system, No. 2

Perfection of Dynamic Pointing Tuning in L-band

(led by Nobuyuki Sakai, Bannawit Pimpanuwat, et al.)

Plot Credits: N. Sakai



- AZ encoder coupling adjustment
- Atmospheric refraction model evaluation

< ΔAZ cosEL > −2 ±30 arcsec (2.3% beam size**)

< ΔEL> −4 ±33 arcsec (2.5% beam size**)

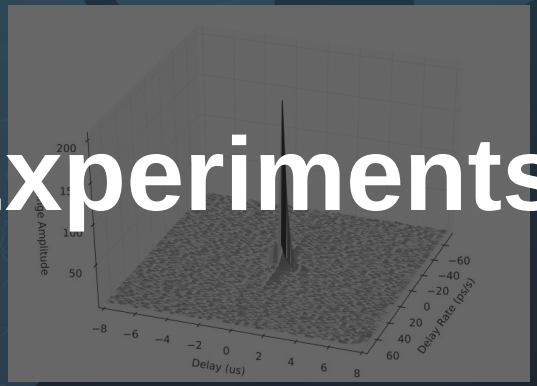
1-σ errors are OK (< 5%)

No systematic error

** Beam size In L-band ≈ 1,300 arcsec **

Credit: CfP Cycle 1 Web

TNRO: Thai National Radio Astronomy Observatory



1.2. VLBI Experiments with TNRT

Effelsberg Radio Telescope
(100-m)

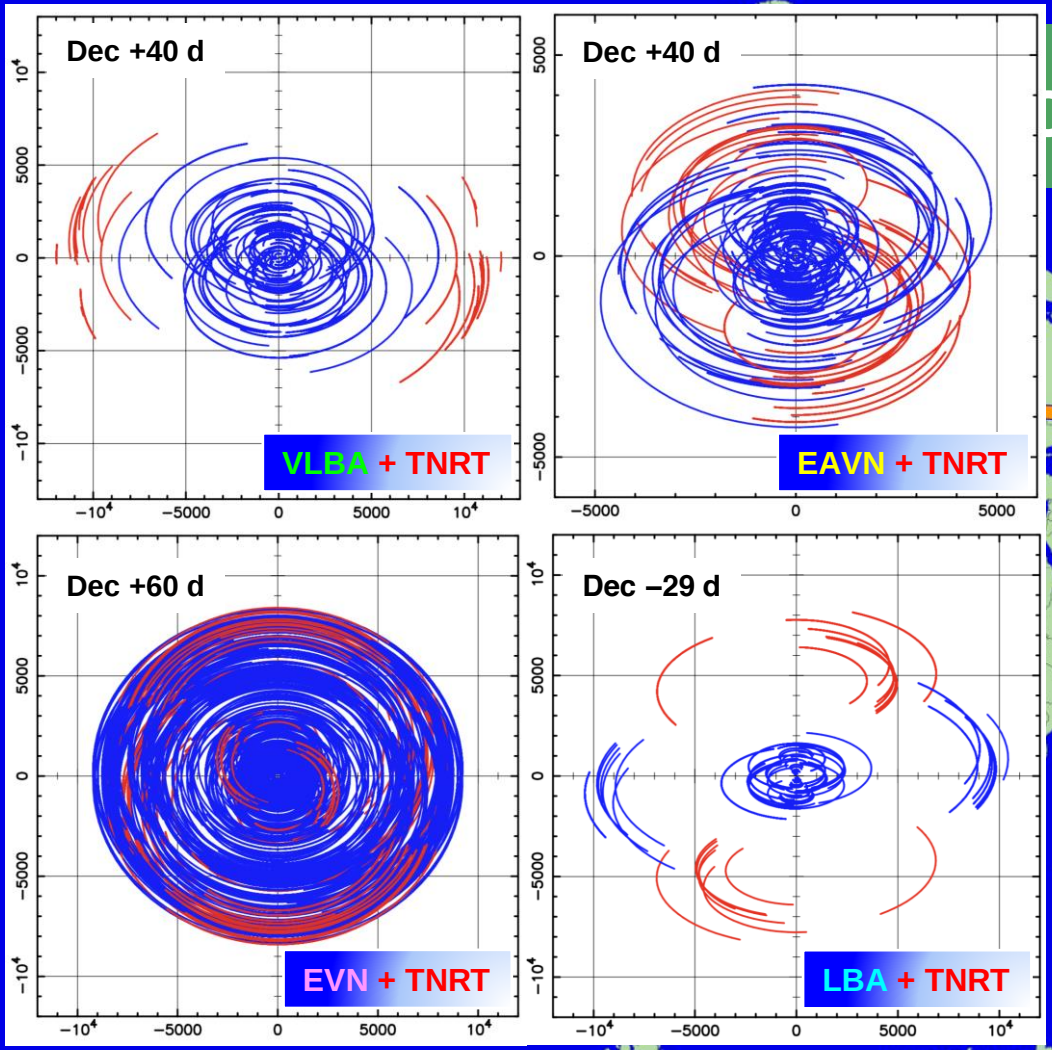
Thai National Radio Telescope
(40-m)

ก้าวไปอีกขั้น! กล้องโทรทรรศน์วิทยุแห่งชาติ
เชื่อมต่อกับกล้องของเยอรมนีด้วยเทคนิค VLBI
สำเร็จเป็นครั้งแรก

www.NARIT.or.th

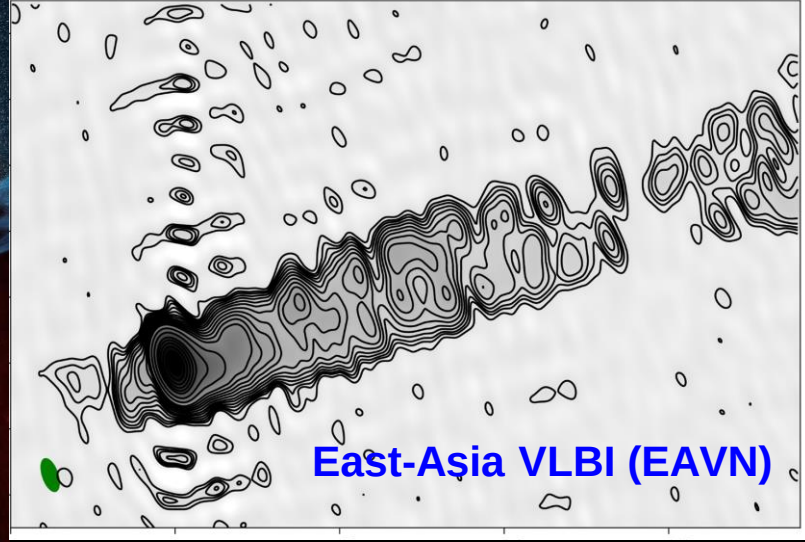
World-wide Collaborations for VLBI

ons for VLBI

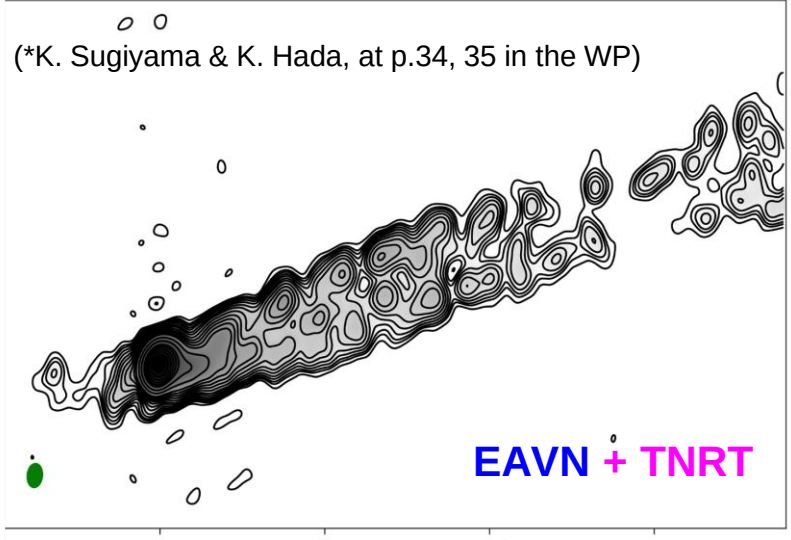


in K-band

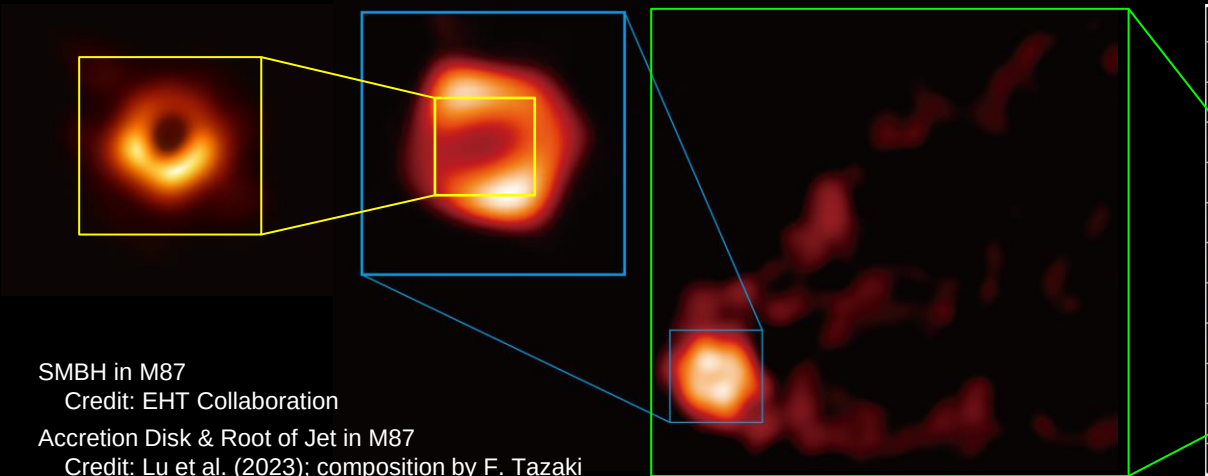
Image credit of background world-map:
Illust AC



(*K. Sugiyama & K. Hada, at p.34, 35 in the WP)

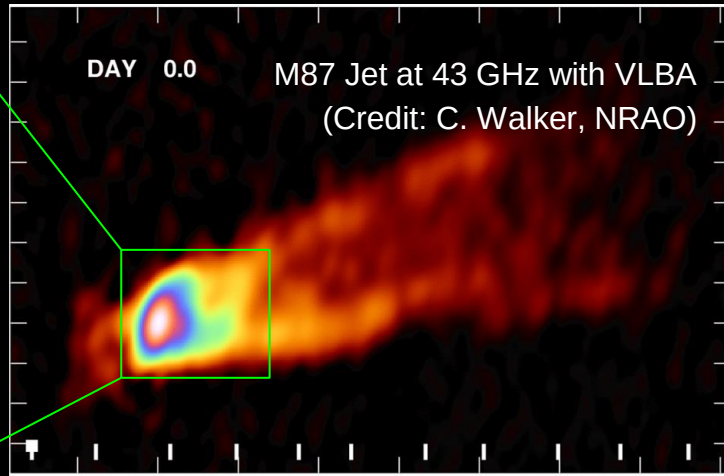


Simulated results of VLBI obs case towards Active Galactic Nucleus M87 at 22 GHz in K-band.



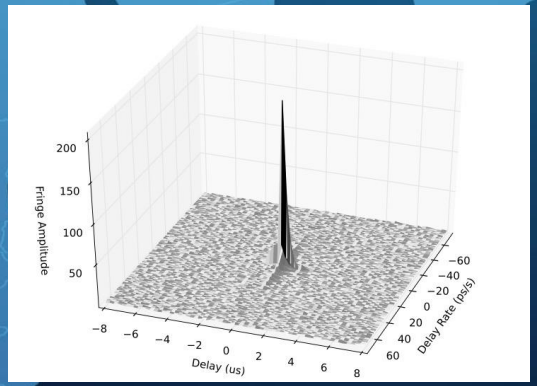
SMBH in M87
Credit: EHT Collaboration

Accretion Disk & Root of Jet in M87
Credit: Lu et al. (2023); composition by F. Tazaki



Milestone of the 1st VLBI Fringe Detection of TNRT with Effelsberg 100m in L-band, 16th May 2024

~8,500 km



Effelsberg Radio Telescope
(100-m)

Thai National Radio Telescope
(40-m)

ก้าวไปอีกขั้น! กล้องโทรทรรศน์วิทยุแห่งชาติ เชื่อมต่อกับกล้องของเยอรมนีด้วยเทคนิค VLBI สำเร็จเป็นครั้งแรก

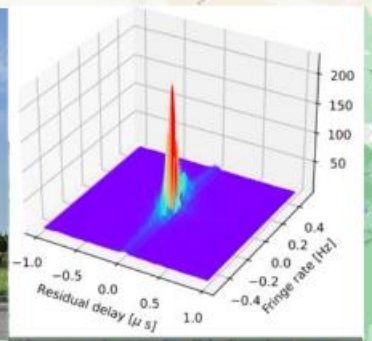
www.NARIT.or.th

NARIT: Eng ver., Thai ver., Facebook; *MPIfR*: Eng ver., German ver.

VLBI experiments / success of TNRT with Chinese telescopes

Credit: NARIT Facebook

on 22 August 2567



Credit: Wu Jiang (SHAO)

FAST

Tianma 65-m

1,500 km

1,100 km

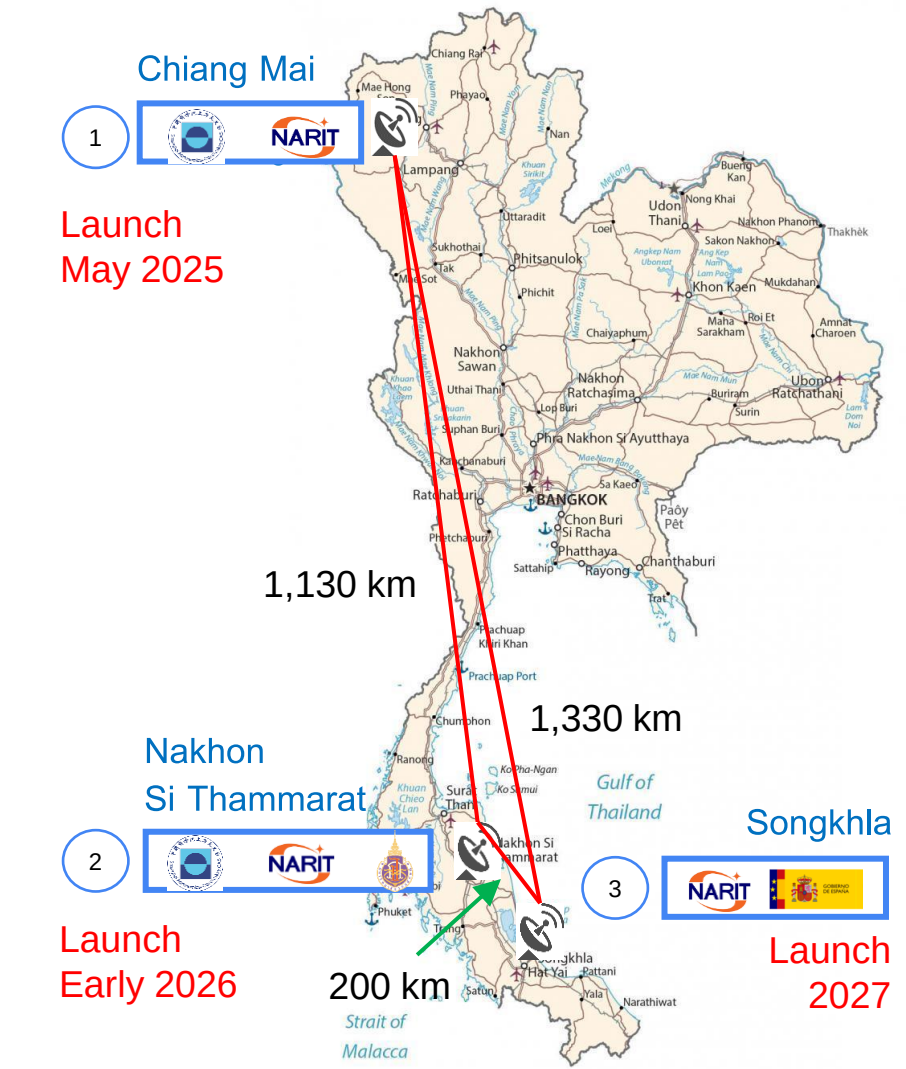
2,600 km

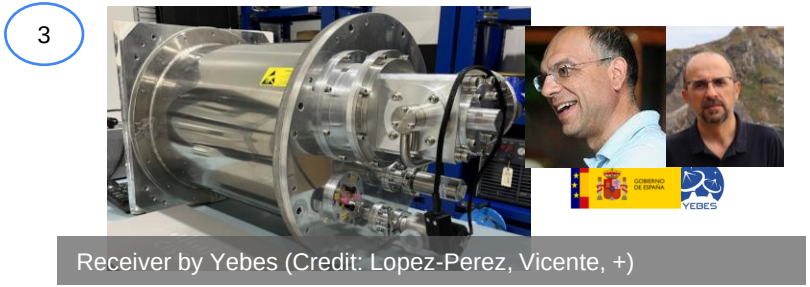
TNRT

Background Credit:
Yuwei Liu, + in SHAO-VGOS team

TNRO: Thai National Radio Astronomy Observatory

1.3. VGOS Radio Telescopes





Receiver by Yebes (Credit: Lopez-Perez, Vicente, +)

Address Two Unique Tectonic Plates

Chiang Mai

Nakorn Si Thammarat & Songkhla

Persia-Tibet-Burma Orogeny

Yangtze Plate

Eurasian Plate

Indian Plate

Philippine Sea Plate

Philippines Orogeny

Ninety East-Sumatra Orogeny

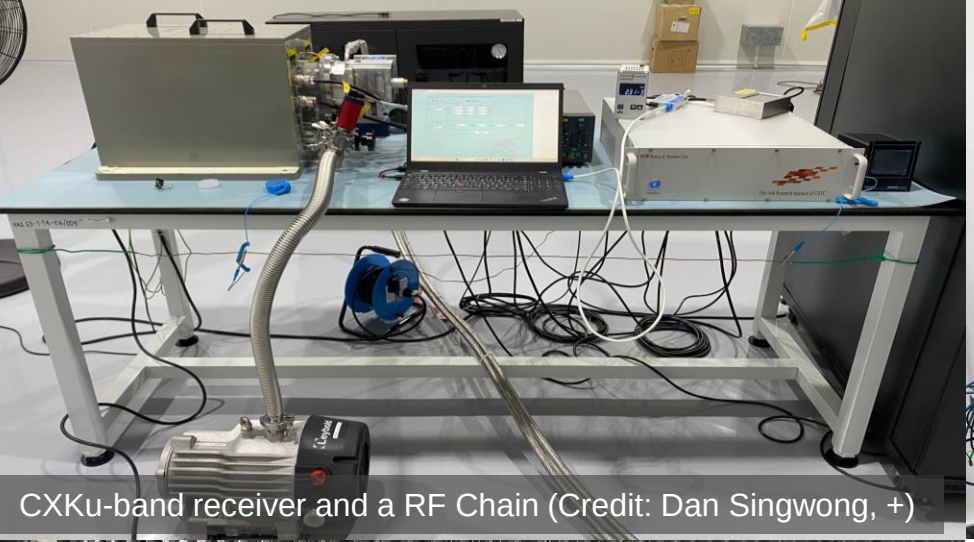
Australian Plate

36 15 54 71 17 84 92 70 57 11 15 44 70

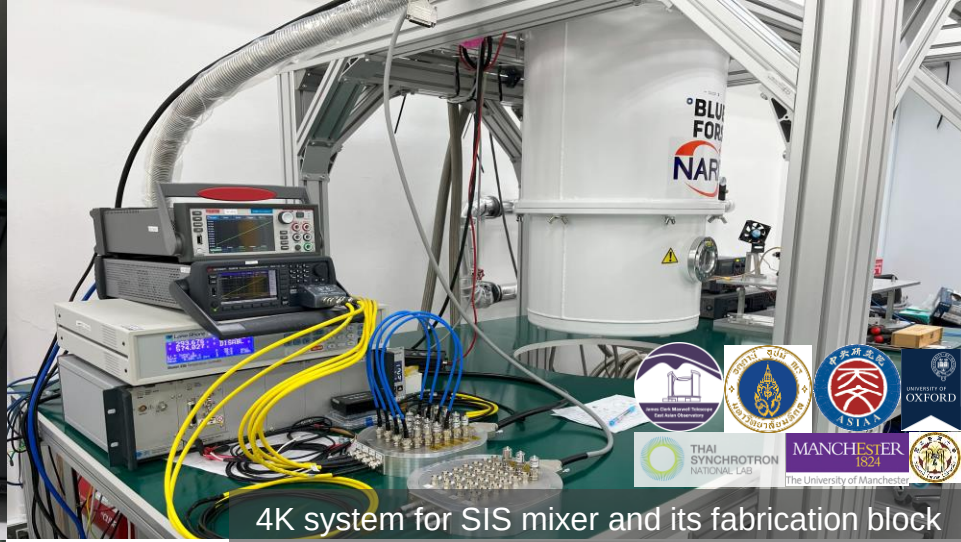
Background Credit: Alataristarion, Wikipedia

2. Advanced Radio Frequency Laboratory

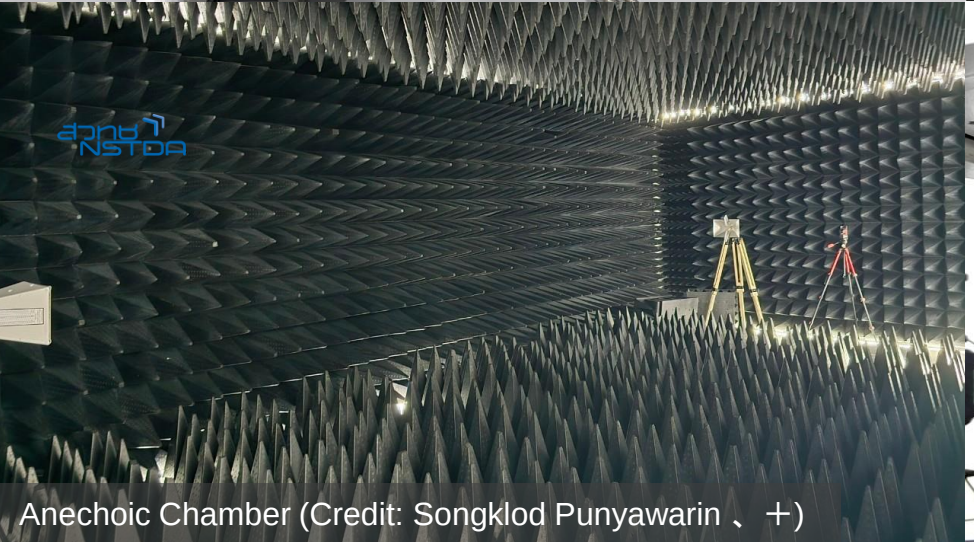
In the same building of Thai Space Consortium (TSC),
Collaborate with Centre of Observatory Operations and Engineering (COOE)



CXKu-band receiver and a RF Chain (Credit: Dan Singwong, +)



4K system for SIS mixer and its fabrication block at 230/350 GHz (Credit: Dan Singwong, +)

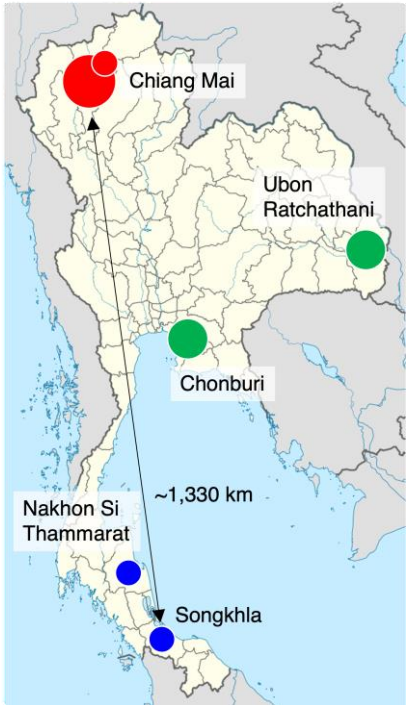


Anechoic Chamber (Credit: Songklod Punyawarin 、＋)

3. Vision for the Future of CRAE in Thailand and Southeast Asia

Vision for the Future: **Thai National VLBI Array (TVA)**

in C/X/Ku/K-bands, 2027 (?) ~



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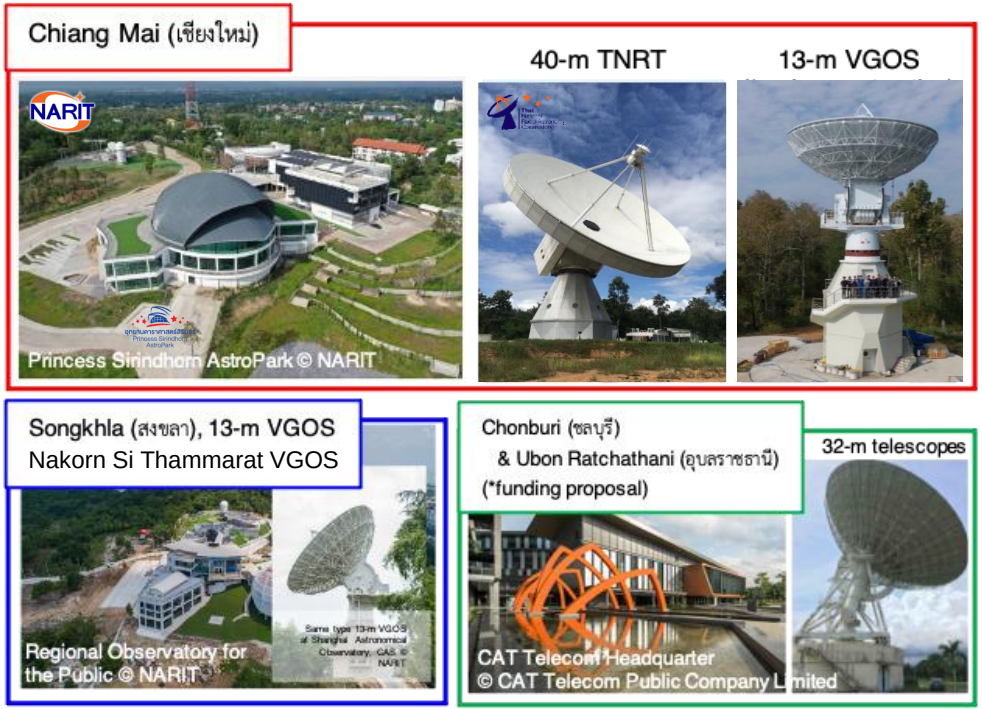
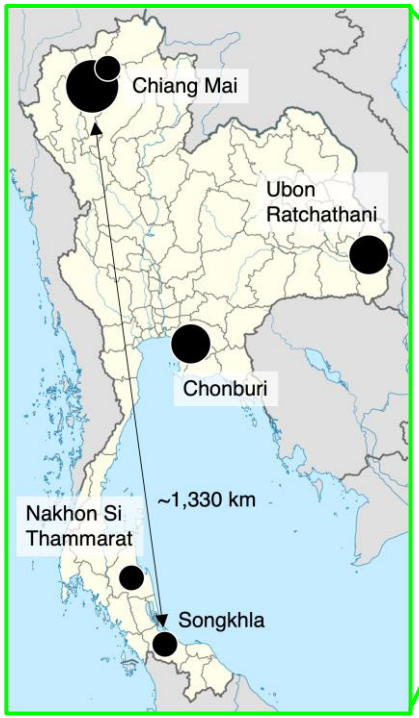


VLBA DiFX correlator
Credit: Walter Brisken (NRAO)

Antenna Conversion! **(see my another presen. later)**

Vision for the Future: **South-East Asian VLBI Network**

in C/X/Ku/K-bands, 2027-2028 (?) ~



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