

The 11th East-Asian Meeting on Astronomy, Oral PR-4C
December 8-12, 2025 @TOKI MESSE, Niigata, Japan

Development of Radio Astronomy Infrastructure in Thailand: The Thai National Radio Telescope and Beyond

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

Koichiro Sugiyama **Manager of Center for Radio Astronomy and Engineering (CRAE)**

On behalf of: N. Sakai, B. Pimpanuwat, P. Jaroenjittichai, A. Leckngam, W. Rujopakarn, B. Soonthornthum, S. Poshyachinda (NARIT), B. H. Kramer (MPIfR/NARIT), G. Wieching, E. Barr (MPIfR), P. de Vicente (IGN), Z.-Q. Shen, J.-L. Li (SHAO), T. Hidayat (ITB), Z. Z. Abidin (UM), P. N. Diep (VNSC), and CRAE members at NARIT.

National Astronomical Research Institute of Thailand (Public Organization)

AA-6I, by W. Rujopakarn

Since July 2024 ~

Center for Radio Astronomy and Engineering

Thai National Radio Astronomy Observatory

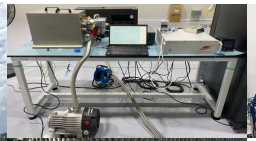

Thai National Radio Telescope (TNRT) 40-m

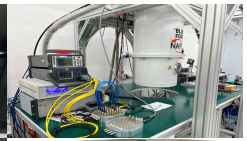

VGOS telescopes


VLBA DiFX correlator
Credit: W. Brisken (NRAO)

Advanced Radio Frequency Laboratory


@NARIT-HQ









Other Centers/Divisions/GPs

OE-2I, PO-3C, PO-24P

Thai National Radio Astronomy Observatory



Thailand © NordNordWest in Wikipedia

- 40 km away toward NE from NARIT head quarters
- 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)



"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
Pointing: 2" (no wind), 6" (5 m/s wind)
Beam size: 13.4 arcsec – 1.43 degree
Slew: AZ 3 deg/s, EL 1 deg/s

© D. Singwong

The 2nd Call for Proposals with TNRT, Cycle 1

- Deadline: **7th February 2025, 16:00 UT**
- **Received 14, and Accepted 11 Proposals**
- What's new?
  - Upgraded spec. : Perfection of dynamic pointing tuning, & Mitigation of RFI impacts
  - Frequency range : 1.63 − 1.67 GHz → **1.0 − 1.8 GHz**, full band in L-band
  - Polarizations : V → **V & H** (* NOT "full-stokes of polarimetry" mode yet)
  - Observation modes : OH maser lines, Continuum, **+ 21-cm HI line** emissions
- Open-use hours : Up to **1,000 hrs/semester**
- Note.: Still in Resident Shared Risk Observing for a part of obs. mode
- **Privilege for students**, encouraging sciece proposals from youth!

Webpage:

TNRT Cometary DataBase project

N. Sakai, et al. 2025, Planetary Science Journal (Q1), 6, 11, 261

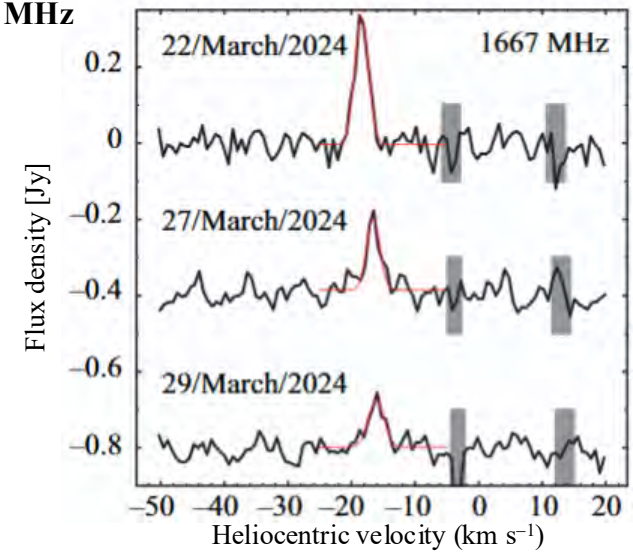


Slide Credit: N. Sakai

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



OH radical (maser) both at 1665 & 1667 MHz



- 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)**

C/2023 A3 (Tsuchinshan–ATLAS)



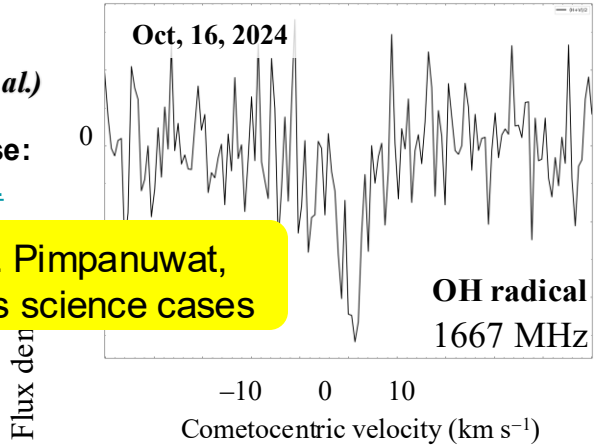
TNRT proposals:

NRTDDT_001 & 002

(Sakai, N., Poshyachinda, S., Sugiyama, K., Rujopakarn, W., Pimpanuwat, B., et al.)

Press web-release:
Eng ver.; Thai ver.

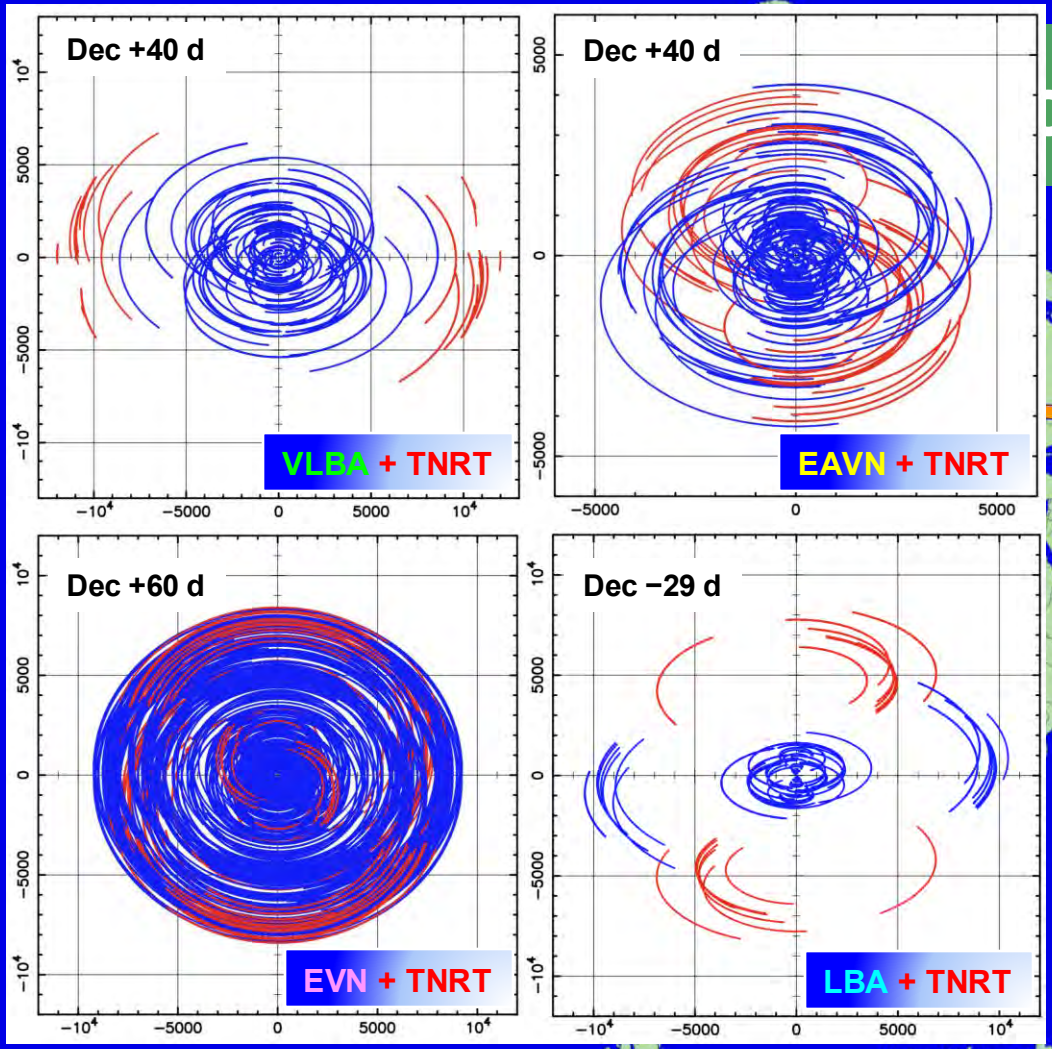
AS-4C, by B. Pimpanuwat, for AGB stars science cases

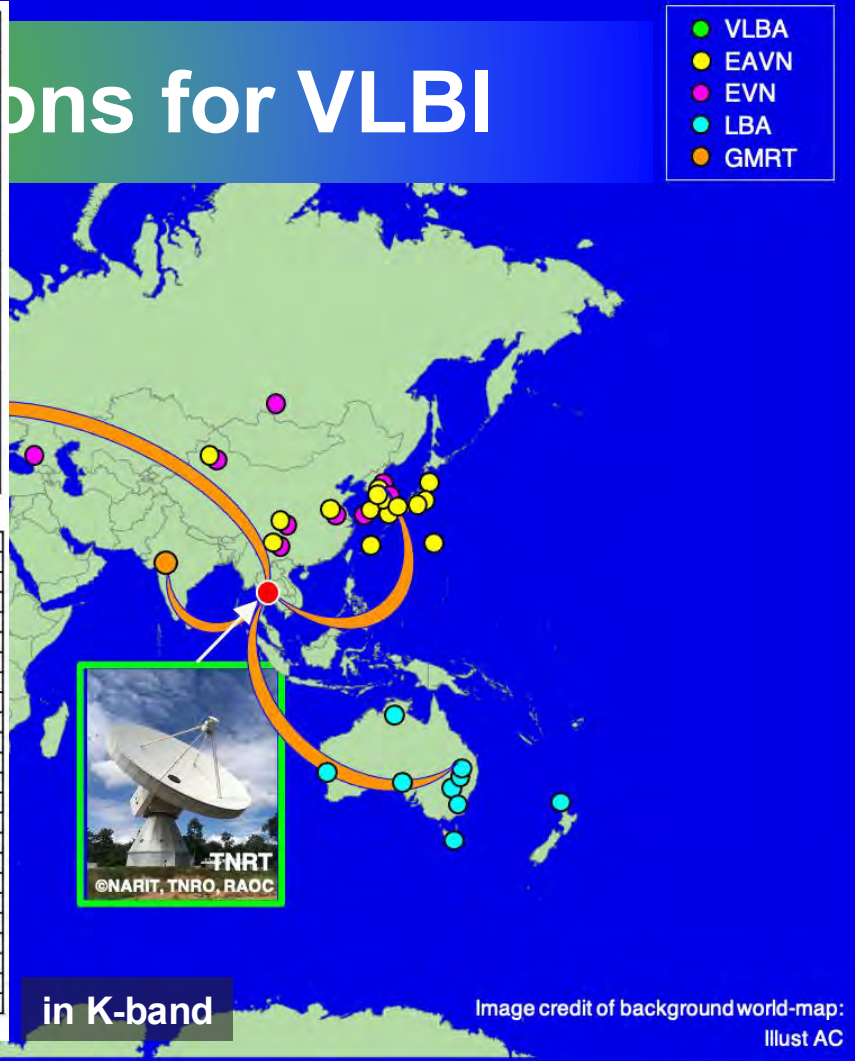


World-wide Collaborations for VLBI



ons for VLBI

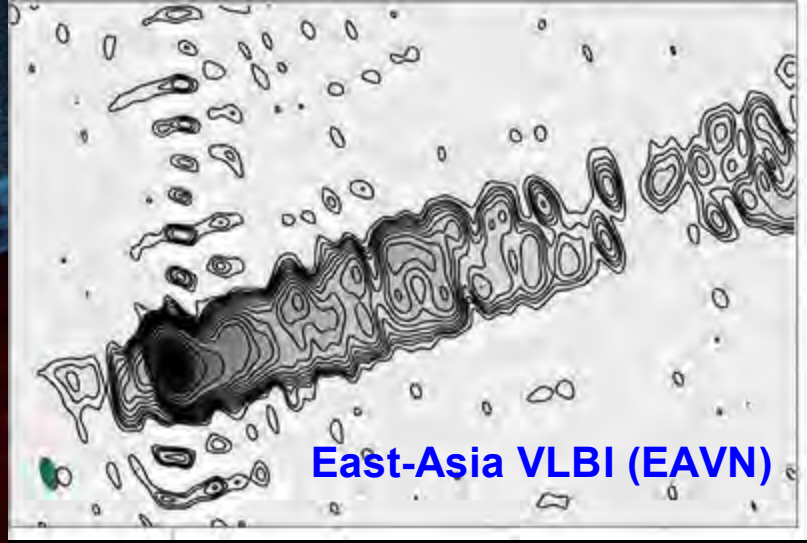




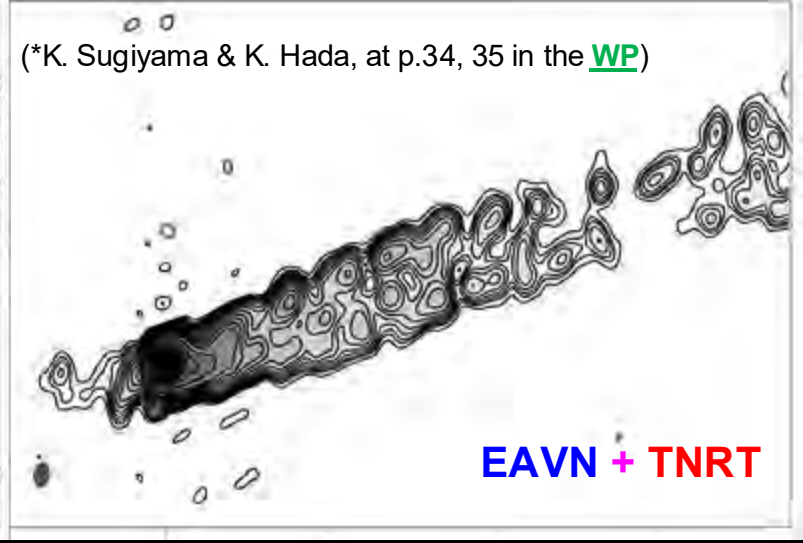
in K-band

Image credit of background world-map: Illust AC

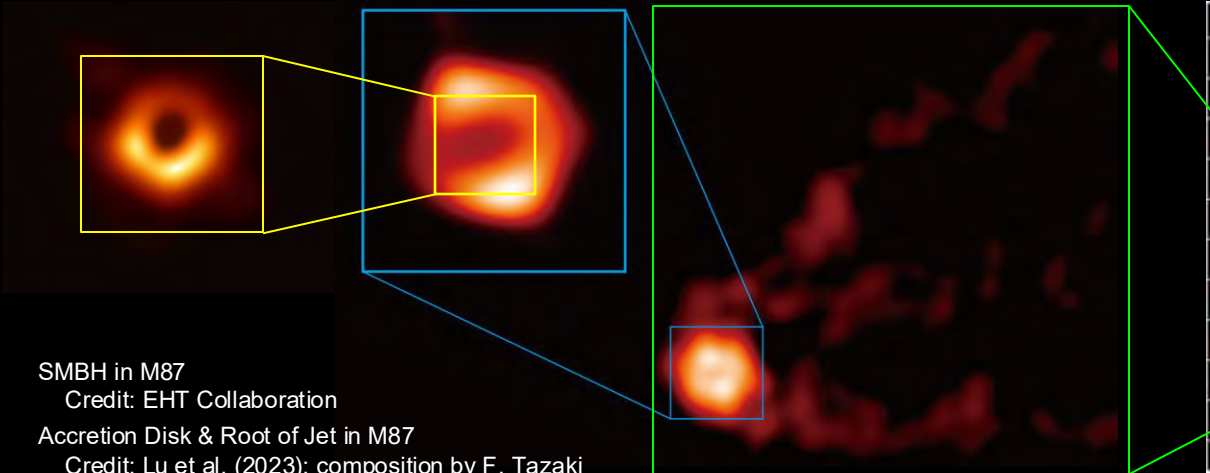




(*K. Sugiyama & K. Hada, at p.34, 35 in the WP)

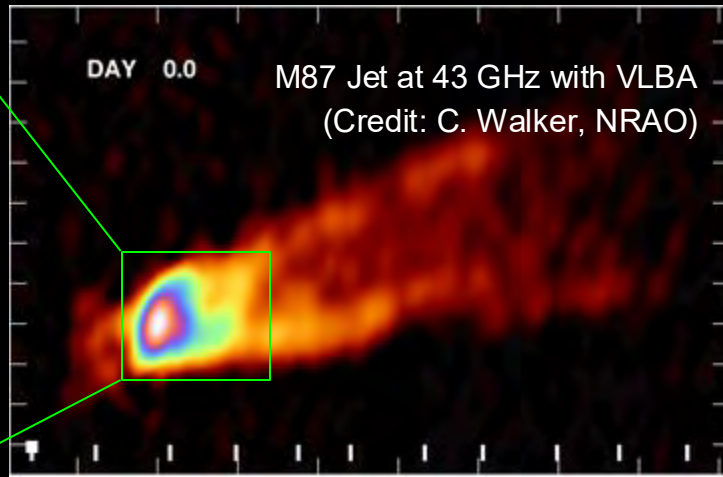


Simulated results of VLBI obs case towards Active Galactic Nucleus M87 at 22 GHz in K-band.



SMBH in M87
Credit: EHT Collaboration

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

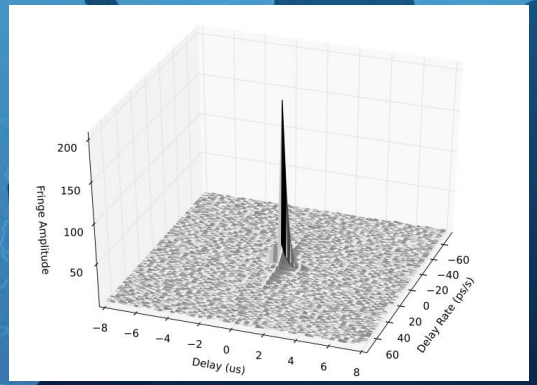


M87 Jet at 43 GHz with VLBA
(Credit: C. Walker, NRAO)

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

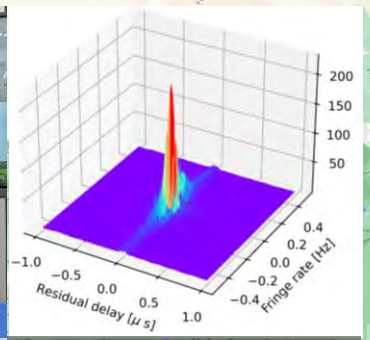
www.NARIT.or.th

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

VLBI experiments / success of TNRT with Chinese telescopes, Jun-Aug 2024



on 22 August 2567



Credit: Wu Jiang (SHAO)



Credit: NARIT Facebook



TNRT

FAST



China

Tianma 65-m



1,500 km

1,100 km

2,600 km

Tajikistan

Pakistan

Myanmar (Burma)

Thailand

Vietnam

Cambodia

Laos

Taiwan

Hong Kong 香港

Bangkok

Hanoi

Manila

South China Sea

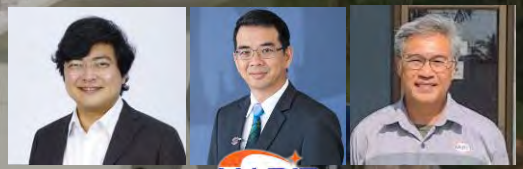
Gulf of Thailand

Ho Chi Minh City

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

VGOS Radio Telescopes






Grand Opening of VLBI Global Observing System (VGOS) telescope in Chiang Mai, on **16 May 2025!!**



Apichat Leckngam

In collaboration with **Shanghai Astronomical Observatory, Chinese Academy of Sciences, China**

Credit:
Facebook of NARIT,
and Web-page

Big Lift of VGOS in Nakhon Si Thammarat, on 22 Sep 2025!!





President of Walailak Univ.
Prof. Dr. Sombat Thamrongthanyawong

Executive Director of NARIT
Dr. Wiphu Rujopakarn



Credit: Facebook of Walailak University and NARIT, & Web-page

แผนดำเนินการติดตั้งกล้องโทรทรรศน์วิทยุแบบวีกอสในประเทศไทย

Thai National VLBI Array (TVA), Phase 1

กล้องโทรทรรศน์วิทยุแห่งชาติ

Thai National Radio Telescope (TNRT)

ขนาดเส้นผ่านศูนย์กลาง 40 เมตร

รับสัญญาณได้ในช่วงความถี่ 0.3 – 115 GHz

Operation since 2023



กล้องโทรทรรศน์วิทยุแบบวีกอส

VLBI Geodetic Observing System Radio Telescope (VGOS)

ขนาดเส้นผ่านศูนย์กลาง 13 เมตร

รับสัญญาณได้ในช่วงความถี่ 2 – 14 GHz

VGOS telescopes



Operation since 2025





เชียงใหม่ **Chiang Mai**

ที่ตั้ง: หอสังเกตการณ์ดาราศาสตร์วิทยุแห่งชาติ
ภายในศูนย์ศึกษาการพัฒนาห้วยฮ่องไคร้
อันเนื่องมาจากพระราชดำริ
อ. ดอยสะเก็ด จ. เชียงใหม่

Big lift on 22 Sep 2025

Nakhon Si Thammarat

นครศรีธรรมราช

ที่ตั้ง: มหาวิทยาลัยวลัยลักษณ์
ต. ไทยบุรี อ. ท่าศาลา จ. นครศรีธรรมราช

Songkhla

สงขลา On-going building

ที่ตั้ง: หอดูดาวเฉลิมพระเกียรติ
7 รอบ พระชนมพรรษา สงขลา
ต. เขารูปช้าง อ. เมืองสงขลา จ. สงขลา
มีกำหนดติดตั้งกล้องในเดือนธันวาคม 2568

Slide Credit: Division of Public Relations, NARIT.

Thai Space Consortium

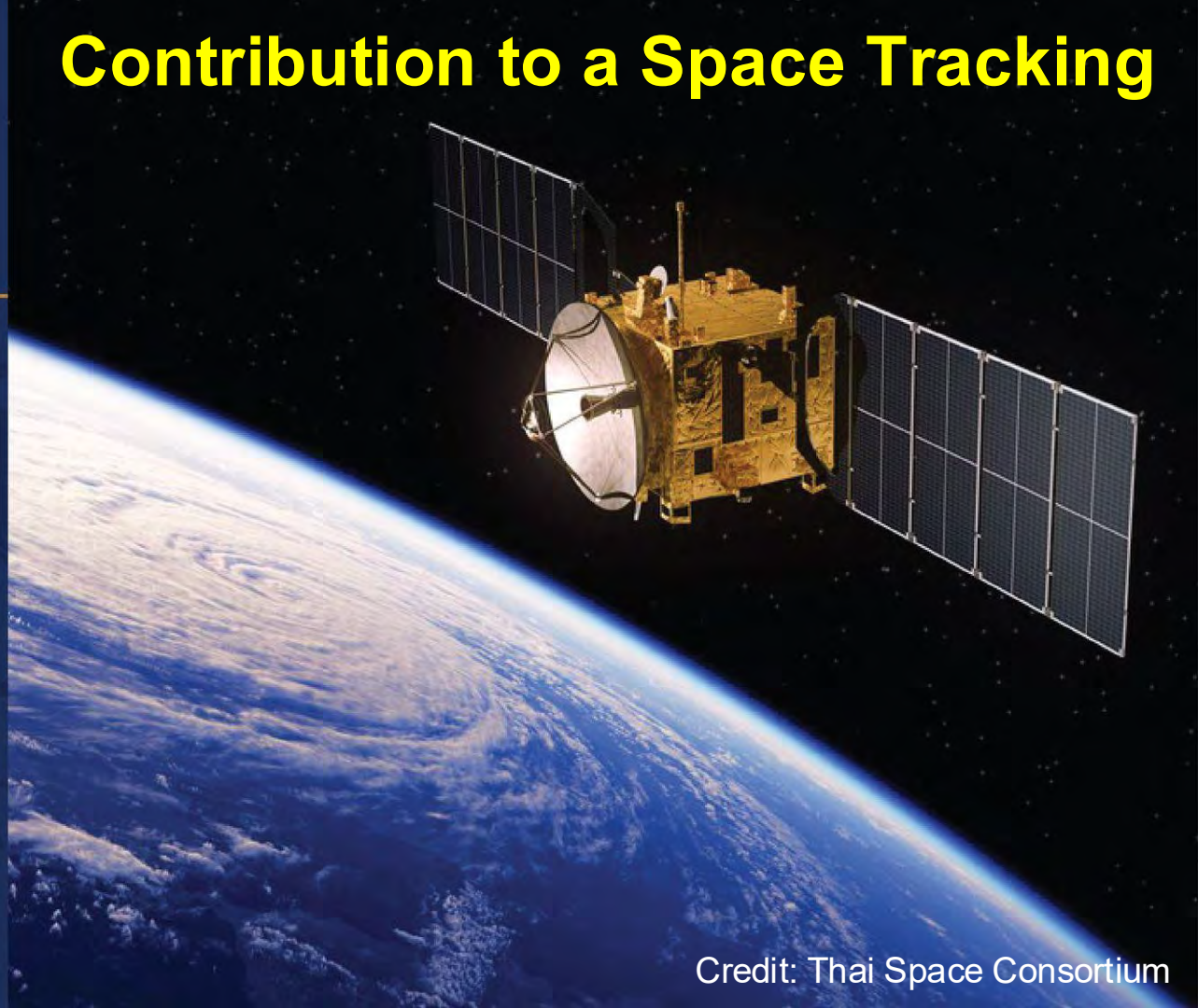
National Astronomical Research Institute of Thailand (Public Organization)

NARIT

SYNCHROTRON THAILAND CENTRAL LAB

GISTDA

Contribution to a Space Tracking

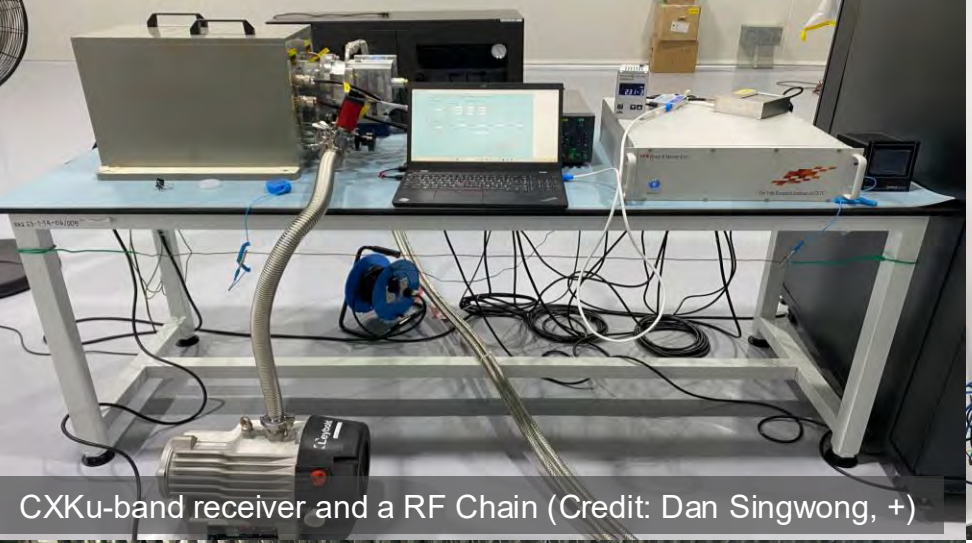


Credit: Thai Space Consortium

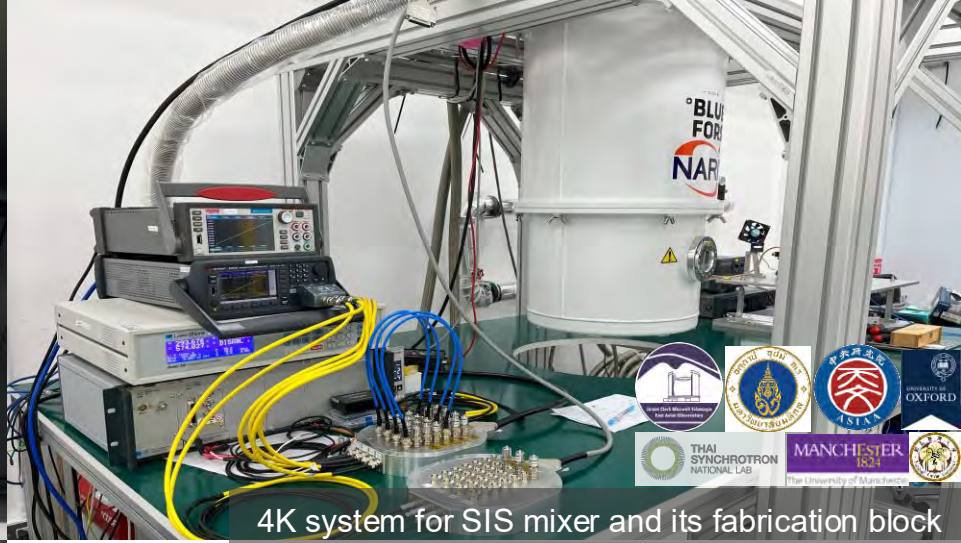


Advanced Radio Frequency Laboratory

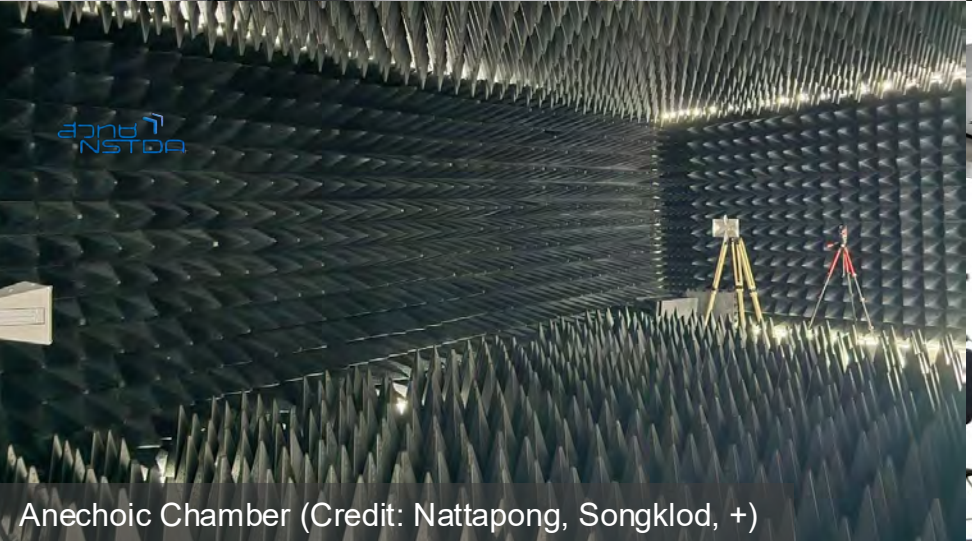
In the same building of Thai Space Consortium (TSC),
Collaborate with Centre of Observatory Operations and Engineering (COOE)



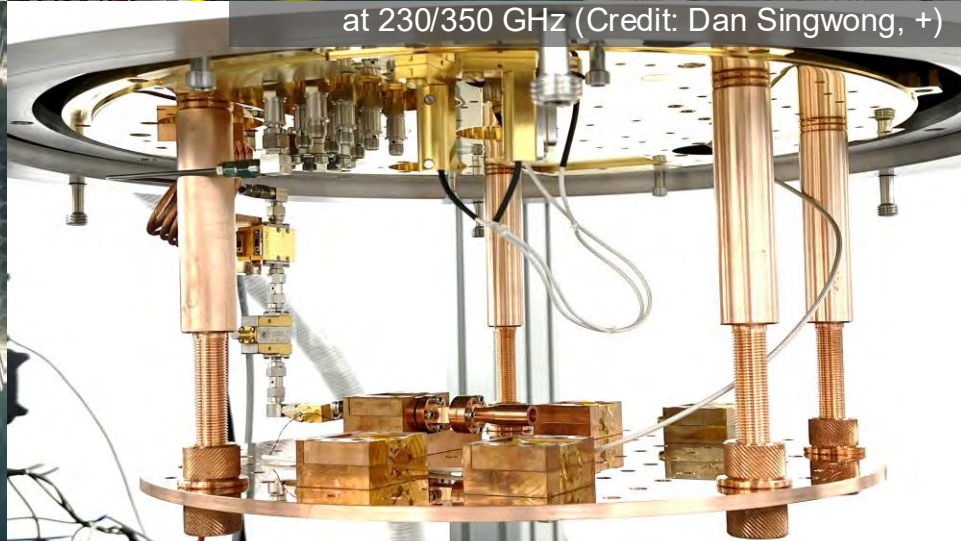
CXKu-band receiver and a RF Chain (Credit: Dan Singwong, +)



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



Anechoic Chamber (Credit: Nattapong, Songklod, +)



CXKu-band Development with CETC16−CAS & MPIfR

CETC16−CAS, China: Wideband low-noise CXKu-band receiver, 4.55-13.65 GHz

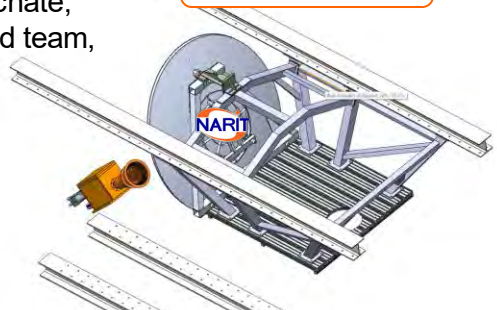
NARIT, Thailand: Colgate feedhorn and Mirror for CXKu-band system

MPIfR, Germany: Backend of D/C and EDD (Annex since Sep 2024 ~)



Preliminary

Credit: Dan, Pichate, with his frontend team, NARIT, MHESI





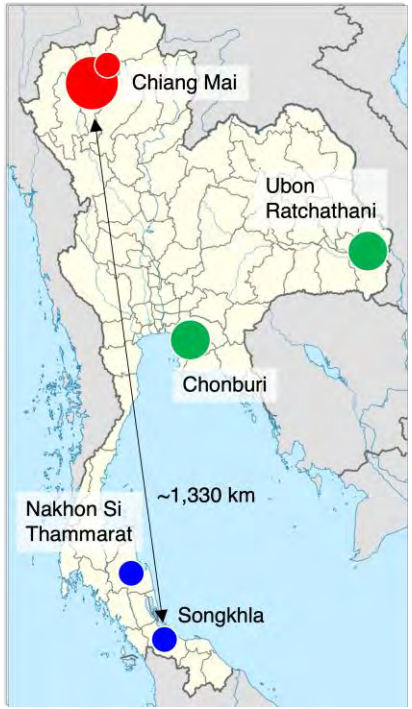
Credit: CETC16, CAS



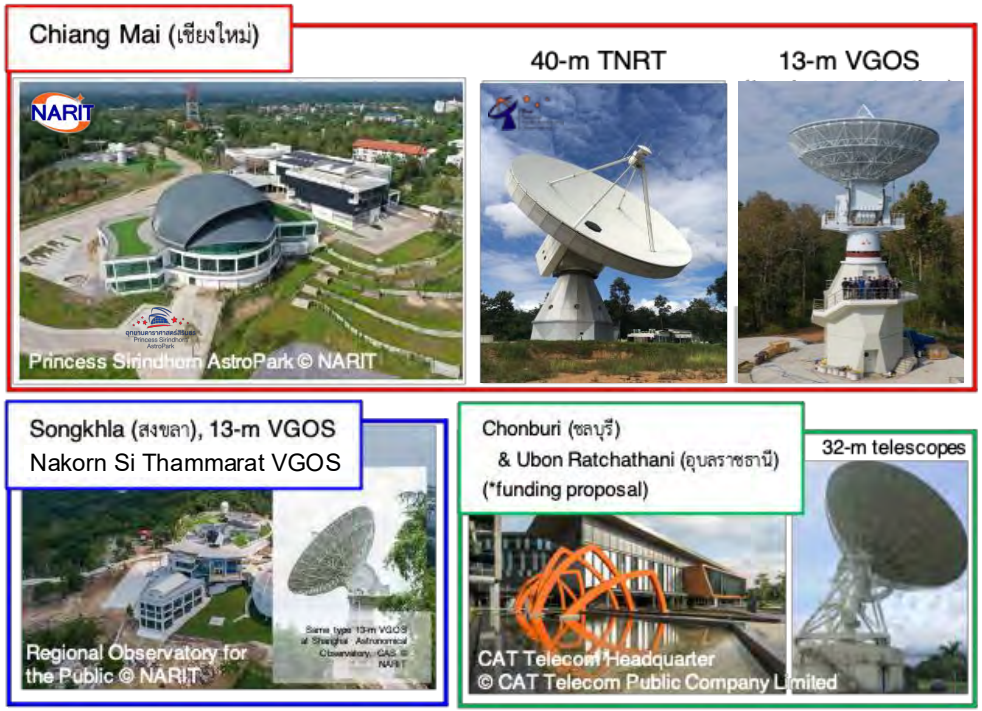
Short-term Vision for the Future of CRAE in Thailand, & SE Asia

Vision for the Future: TVA, Phase 2

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



Background © NordNordWest in Wikipedia



Antenna Conversion



SHAO DiFX Credit: Xuan He (Petrov et al. 2007, AJ, 133, 2487)

VLBI Data Correlation Center at Center for IT, NARIT





Installation Success on Aug 14, 2025.

Supported by
NARIT CIT, SimpleHPC company, and Director of NARIT Wiphu, & SHAO correlator GP leader (F. Shu)



Server Specifications

Compute	> 48 cores: Intel Xeon Gold CPU @2.80GHz
Memory	> 263 GB
Storage	> System: 446 GB - RAID1 > Data: 163 TB - RAID6
Networking	> Infiniband: 56 Gbps > Fiber Optic Bond Connection: 2x10 Gbps
System Softwares	> CentOS7 > DiFX, HOPS, nuSolve, SKED, PGPLOT

Slide Credit: Yu-An Chen (Victor)

Preliminary Correlation Result

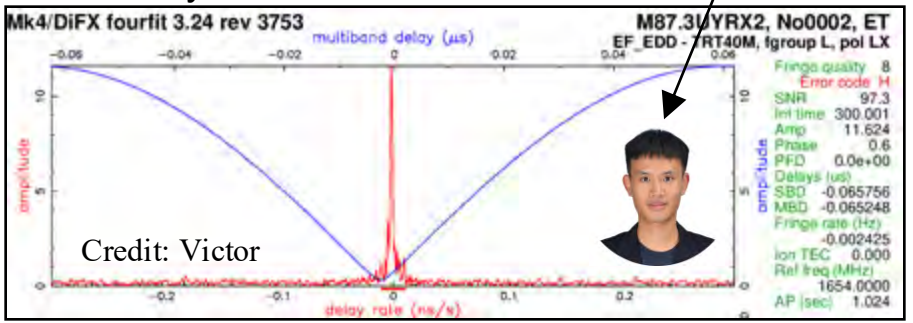


Figure 1. Fringe Detection Plot Generated from NARIT Correlator

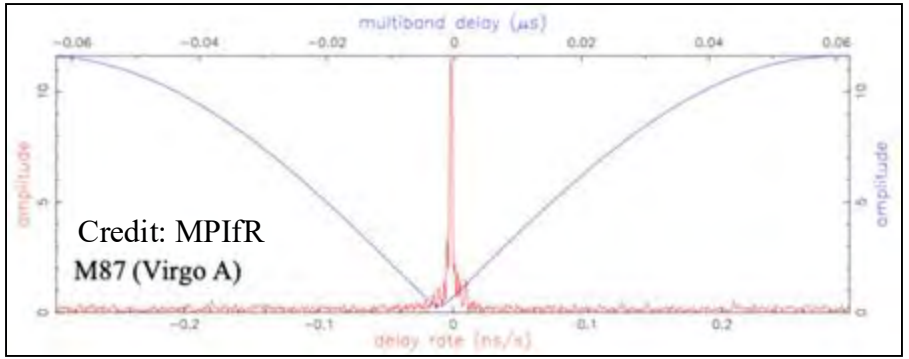


Figure 2. Fringe Detection Plot Generated at MPIfR in 2024

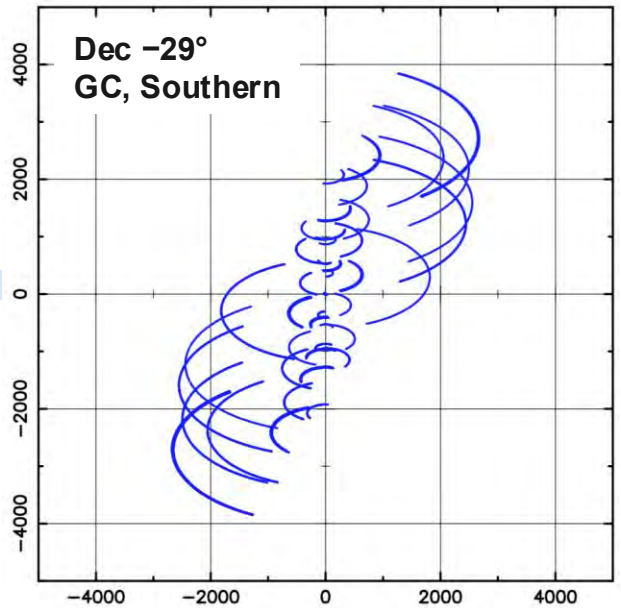
Vision for the Future: South-East Asian VLBI Network

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



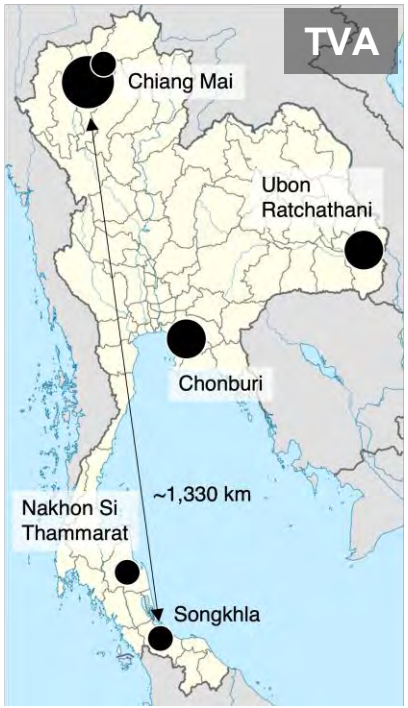
Background © NordNordWest in Wikipedia

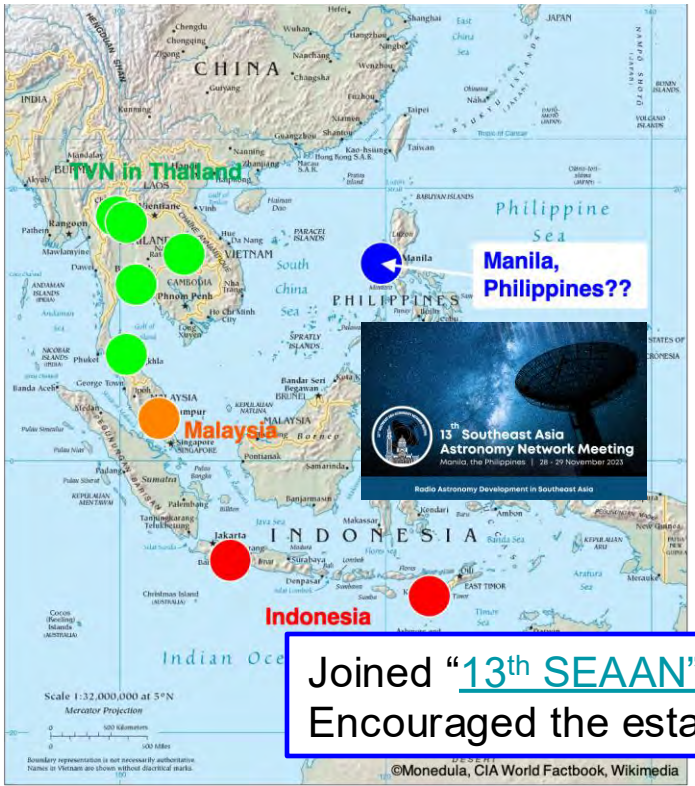


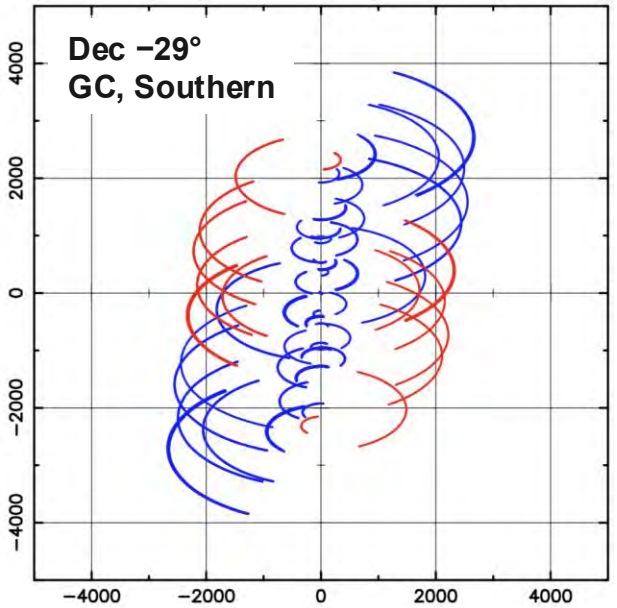


Vision for the Future MORE?: **SEAVN + Philippines?**

in C/X/Ku/K-bands, ???? ~







Joined "13th SEAAN" in Philippines, 28-29 Nov 2023
Encouraged the establishment of SEAVN together!

Vision for CRAE Project in Thailand & Regional VLBIs

【Construction】



- Big Lift
- Assembly System
- AZ/EL Movement

2020 ~ 2021

Big Lift Movie:
https://youtu.be/_wmFGBUDjiw

【Installation】

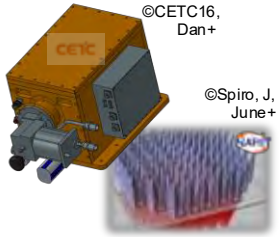


- L/K-band receivers
- Ku Holography
- Call for Proposals

2022 ~ 2023



【Upgrade】



- Upgrade L-band with MPIfR (Gundolf, Christoph, +)
- Develop & Install C/X/Ku-bands receiver
- Prototype L-band PAF
- Initiate designing Q/W-bands receiver

2024 ~ 2026



2025 ~ 2027

【VGOS stations】



- VGOS Building
  - Chiang Mai, Nakorn Si Thammarat, & Songkhla
- Develop Receivers
- Commissioning

2026 ~ 2028

【Establish Regional VLBI Networks】

- Thai National VLBI Array
- South-East Asia VLBI Network

