

THE DEVELOPMENT OF OBSERVATIONAL INFRASTRUCTURE AT NARIT FOR MULTI-MESSENGER AND TIME-DOMAIN ASTRONOMY

National Astronomical Research Institute of Thailand (Public Organization)

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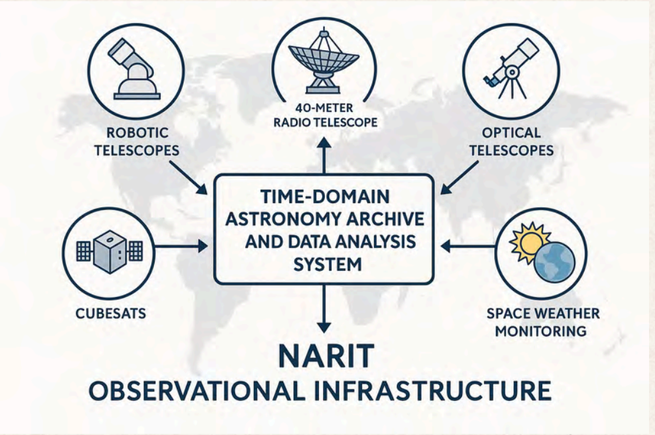
12/9/2025

The 11th East-Asian Meeting on Astronomy
December 8 – 12, 2025
TOKI MESSE, Niigata, Japan

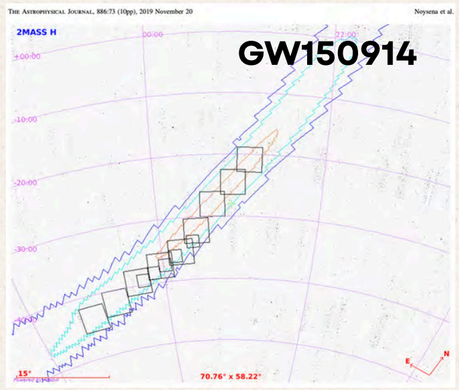


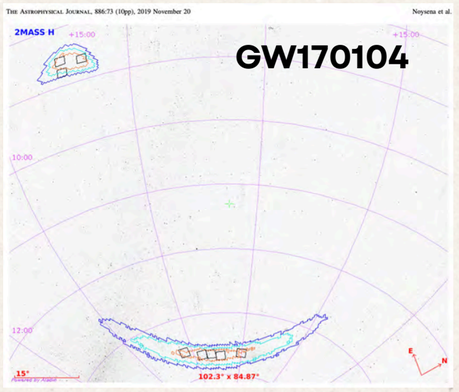
Overview

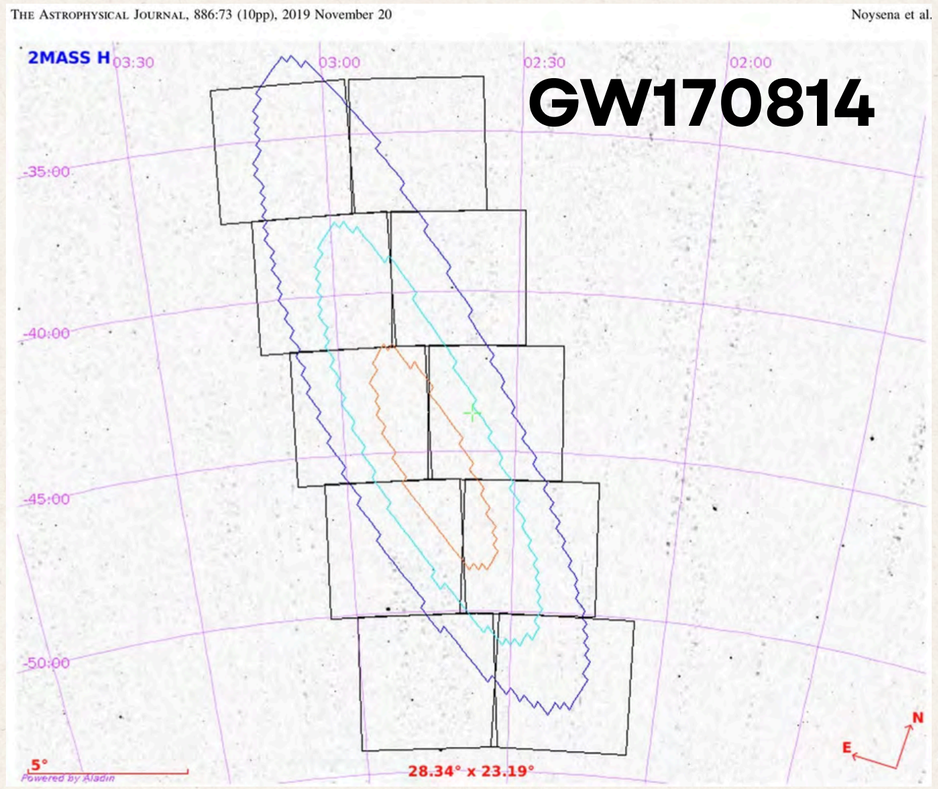
NARIT is building an integrated, multi-wavelength, multi-site system to support global time-domain and multi-messenger astronomy.



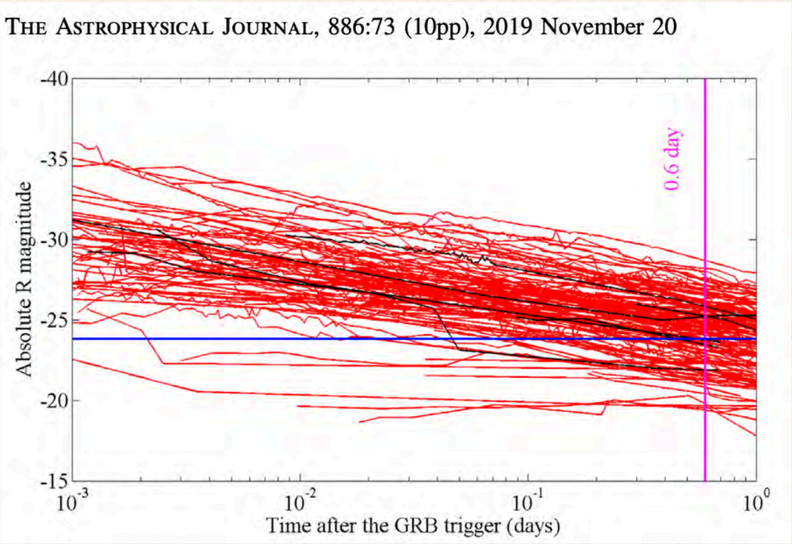
Limits on the Electromagnetic Counterpart of Binary Black Hole Coalescence at Visible Wavelengths







GW Event	Observation Delay After Trigger(day)
GW150914	2.836
LV trigger: G184098	2.857
2015 Sep 14 09:50:45	2.877
$\Delta E = 3.1\ M_\odot$	2.898
Luminosity distance = 430 Mpc	2.989
	2.947
	9.930
GW170104	1.261
LV trigger: G268556	2.253
2017 Jan 4 10:11:59	2.270
$\Delta E = 2.2\ M_\odot$	
Luminosity distance = 960 Mpc	
GW170814	0.522
LV trigger: G297595	0.522
2017 Aug 14 10:30:43	1.402
$\Delta E = 2.7 M_\odot$	
Luminosity distance = 580 Mpc	



Noysena et al. 2019

The primary purpose:

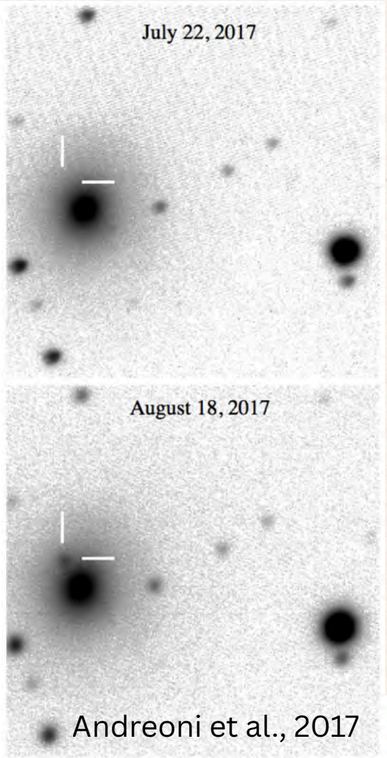
- **To search for and constrain possible electromagnetic (optical) emission associated with binary black hole merger events detected through gravitational waves, using rapid-response telescope networks and automated machine-learning-based source detection techniques.**
- **An excellent example case of how infrastructure + algorithms + global networks work together in TDAMM.**

Research Result:

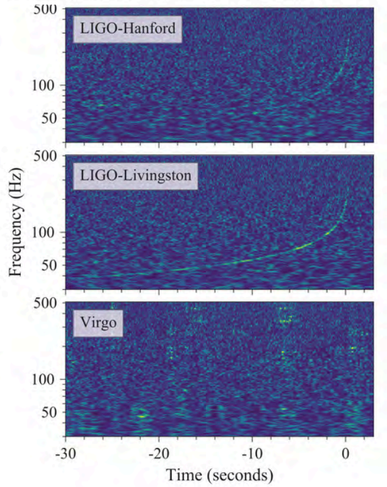
- **No confirmed optical counterpart from BBH mergers.**

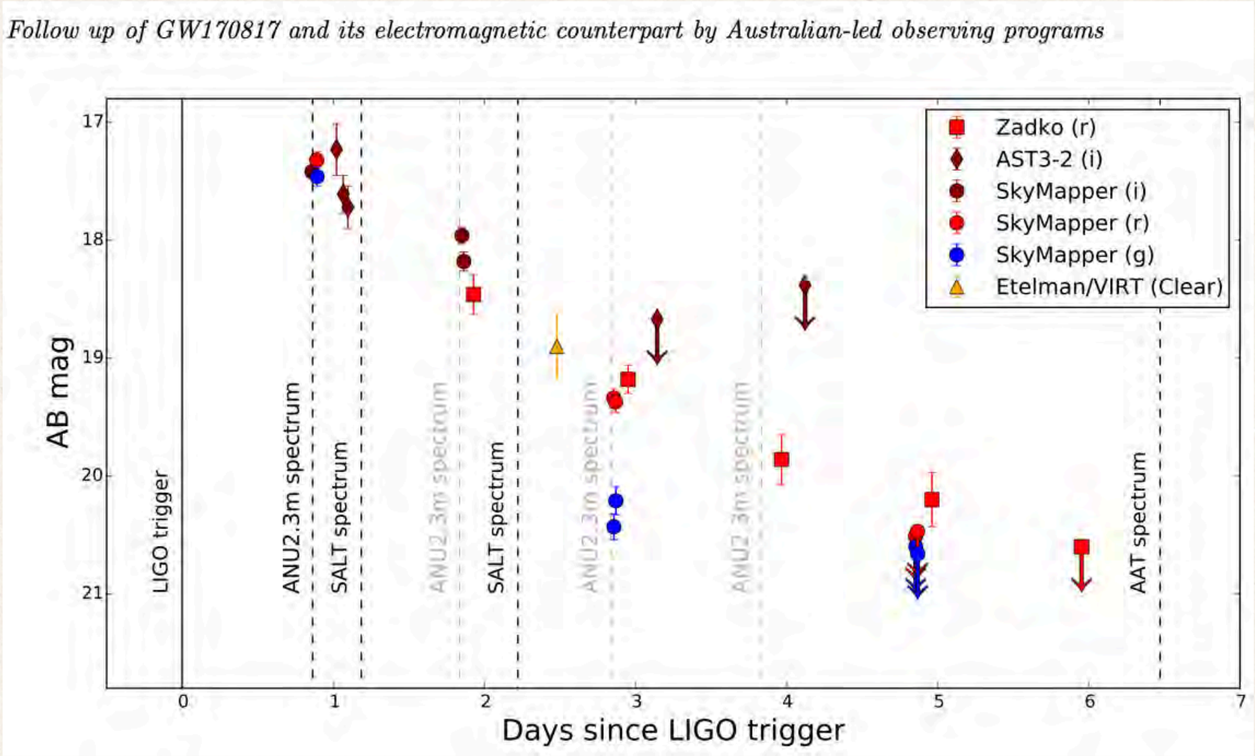
Why Time-Domain & Multi-Messenger Astronomy?

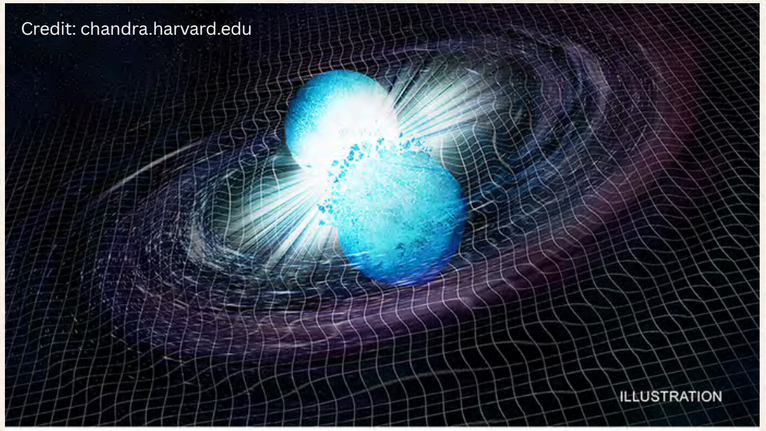
GW170817



Andreoni et al., 2017











Credit: https://chandra.harvard.edu/photo/2018/gw170817/

Key points:

- **Astrophysical events evolve rapidly → require fast observation**
- **Multiple messengers (EM, GW, neutrinos, cosmic rays) provide complementary physics**
- **GW170817 as the landmark example**

Purpose:

- **why TDAMM matters and why infrastructure is essential!**



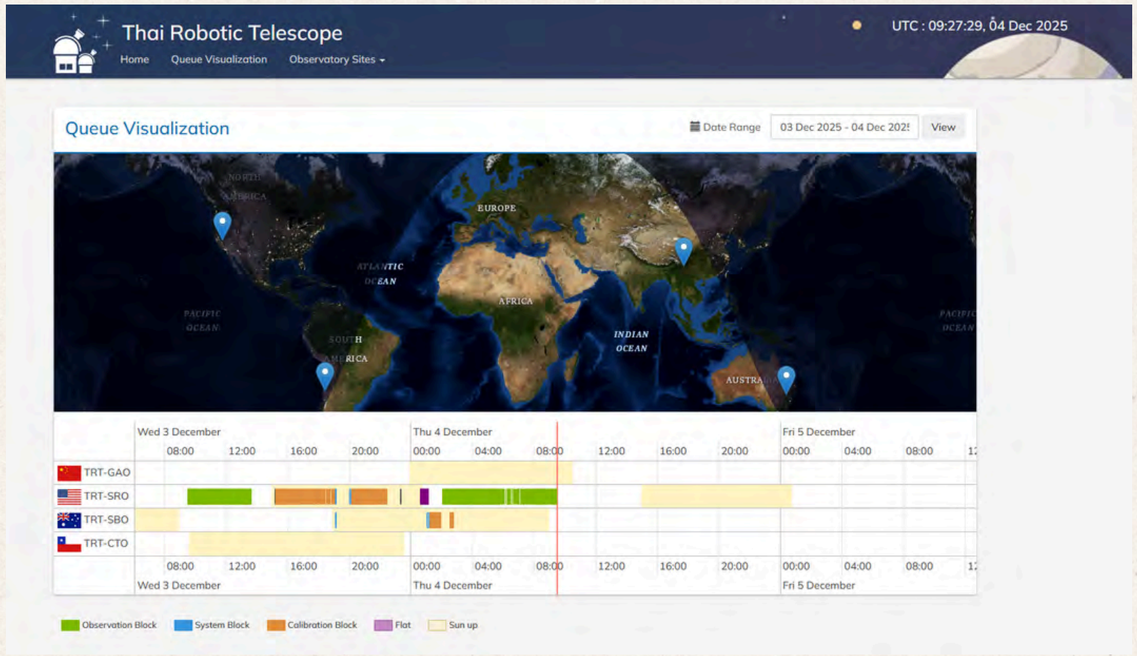


⌀ 2.4 meters ⌀ 1 meters ⌀ 0.7 meterst ⌀ 0.4 meters ⌀ 40 meters ⌀ 13 meters









Key points:

- **Telescopes in multiple longitudes (e.g., Thailand, USA, Chile, China)**
- **Automated scheduling, fast-response follow-up**
- **Capabilities: photometry, astrometry, rapid transient imaging**

Example applications: GRBs, SNe, FRBs (optical), near-Earth objects

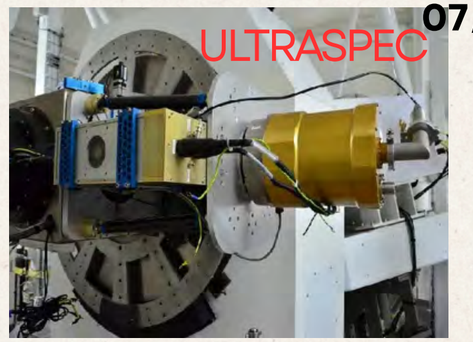
Purpose:

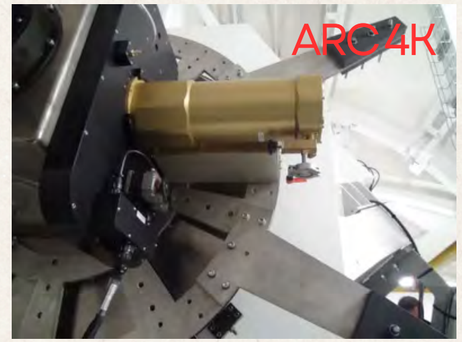
- **NARIT's strongest operational asset for TDA**

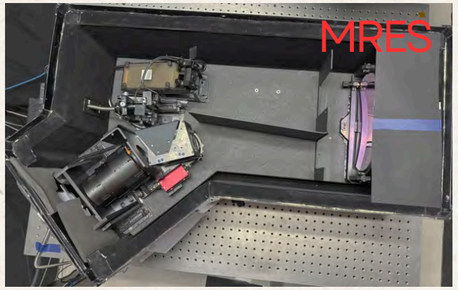
Thai National Observatory, Optical Telescope: 2.4 and 1.0 m.

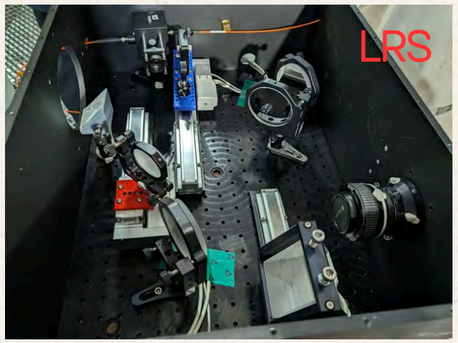












Key points:

- 2.4m Thai National Telescope + other large-aperture facilities
- Equipped with spectrographs & imagers

Role:

- Spectroscopic classification
- Host-galaxy studies
- Late-time monitoring

Purpose:

- NARIT's contribution to deeper, high-quality follow-up.

Call for Proposals

The 40 m Thai National Radio Telescope (TNRT)

Big Lift in Feb 2020
Installed receivers in 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

Slide credit:
K. Sugiyama

© D. Singwong

Sciences with the TNRT

See K. Sugiyama's talk
(Tue 9th Dec 15:25, PR-4C)

Key sciences

e.g. Pulsars & FRBs

Molecular and maser line surveys / monitoring programs

-- Star-forming regions, evolved stars, extragalactic sources

AGN jets

Astrometric and (future) geodetic VLBI

White paper:

Cycle 1: completed in Aug 2025

Webpage:

11 accepted proposals, 1000 hrs

1.0 – 1.8 GHz, full band in L-band

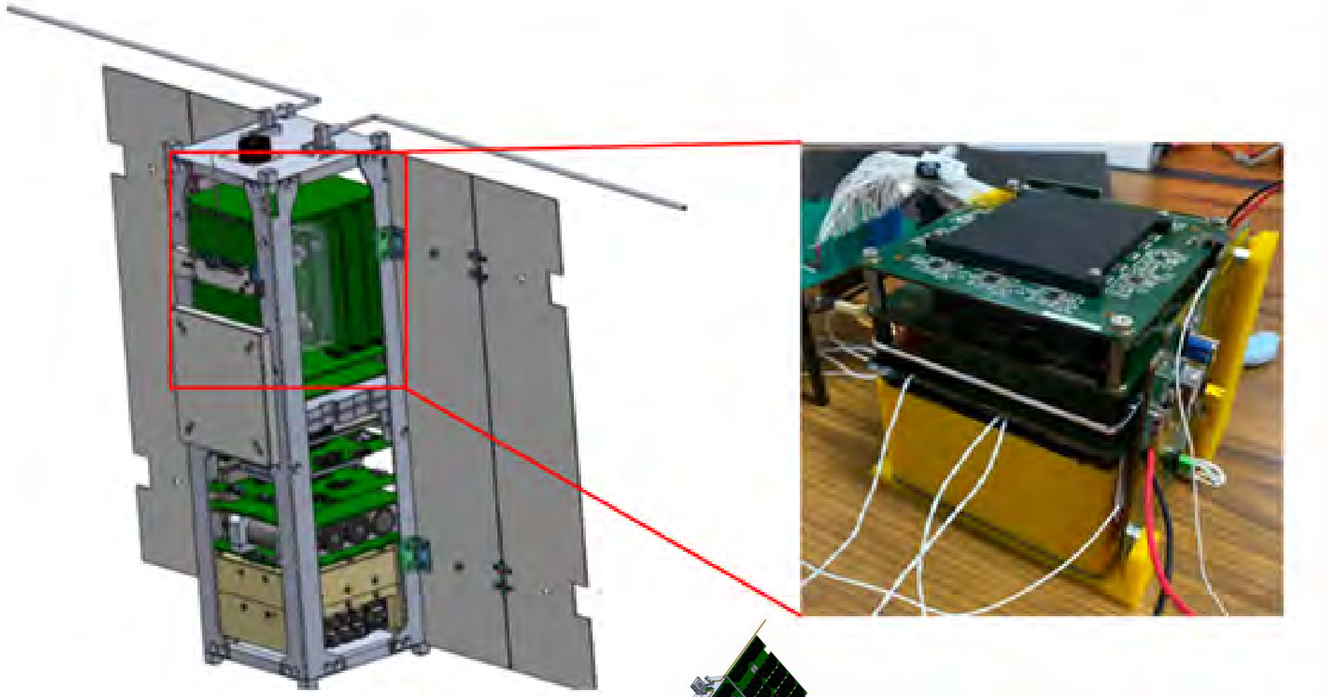
Polarizations : **V & H** (* NO “full-Stokes polarimetry” mode yet)

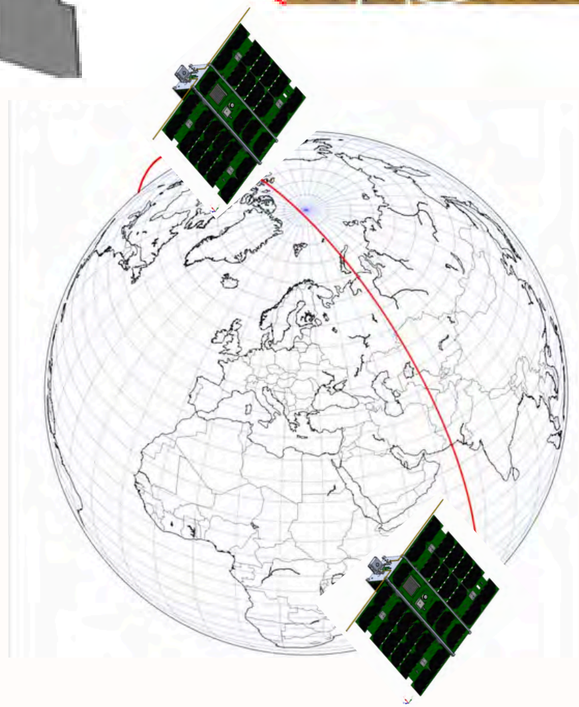
Observation modes: OH maser lines, Continuum, **+ 21-cm HI line** emissions

Stay tuned for the next cycle!

Adapted from
K. Sugiyama's slides







Key points:

- NARIT's CubeSats for:
  - Space weather monitoring
  - Upper-atmospheric parameters

Complementary geospace data relevant to TDAMM

- Long-term vision: small-satellite contribution to alerts + atmospheric characterization

Purpose:

- Innovation and expansion into space-based capabilities.







Key points:

- **Working with international observatories and networks**
- **Rapid-response campaigns with partners**
- **Importance of geographic location for global coverage**
- **Vision: integrate fully into the global MMA ecosystem (GW follow-up, GRB alerts)**

Purpose:

- **NARIT is not isolated – it's part of a global response framework.**

Summary

NARIT enhances Thailand's capacity in Time-Domain and Multi-Messenger Astronomy by expanding its observational infrastructure, allowing for rapid discovery and follow-up of dynamic astrophysical events across various wavelengths.

Thank You