



National Astronomical Research  
Institute of Thailand (Public Organization)  
Ministry of Science and Technology of Thailand ■■■■■

NARIT  
[www.narit.or.th](http://www.narit.or.th)



# Radio Astronomy in Thailand: Present and Future

Phrudth Jaroenjittichai

National Astronomical Research Institute of Thailand (NARIT)

The 1st Asia-Oceania VLBI Meeting  
Tasmania, Australia, 19-20 November 2015

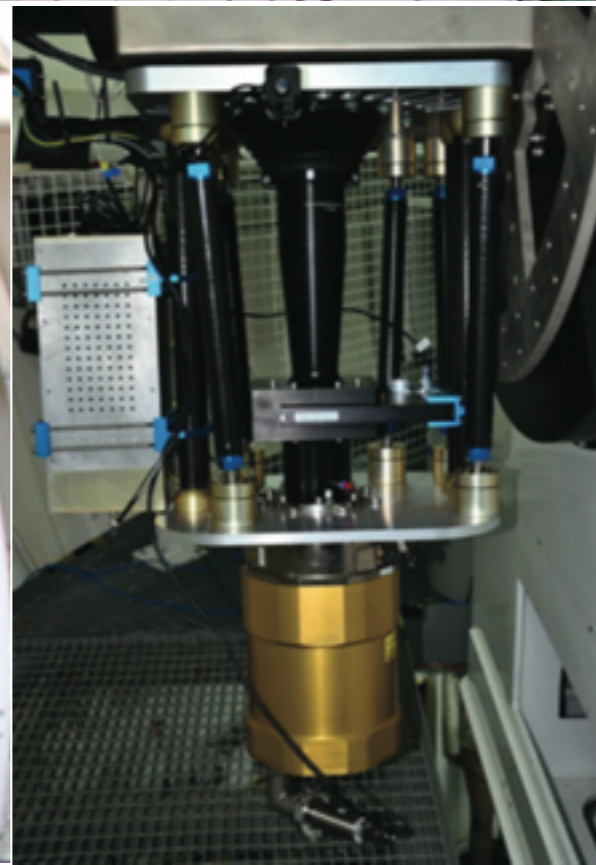
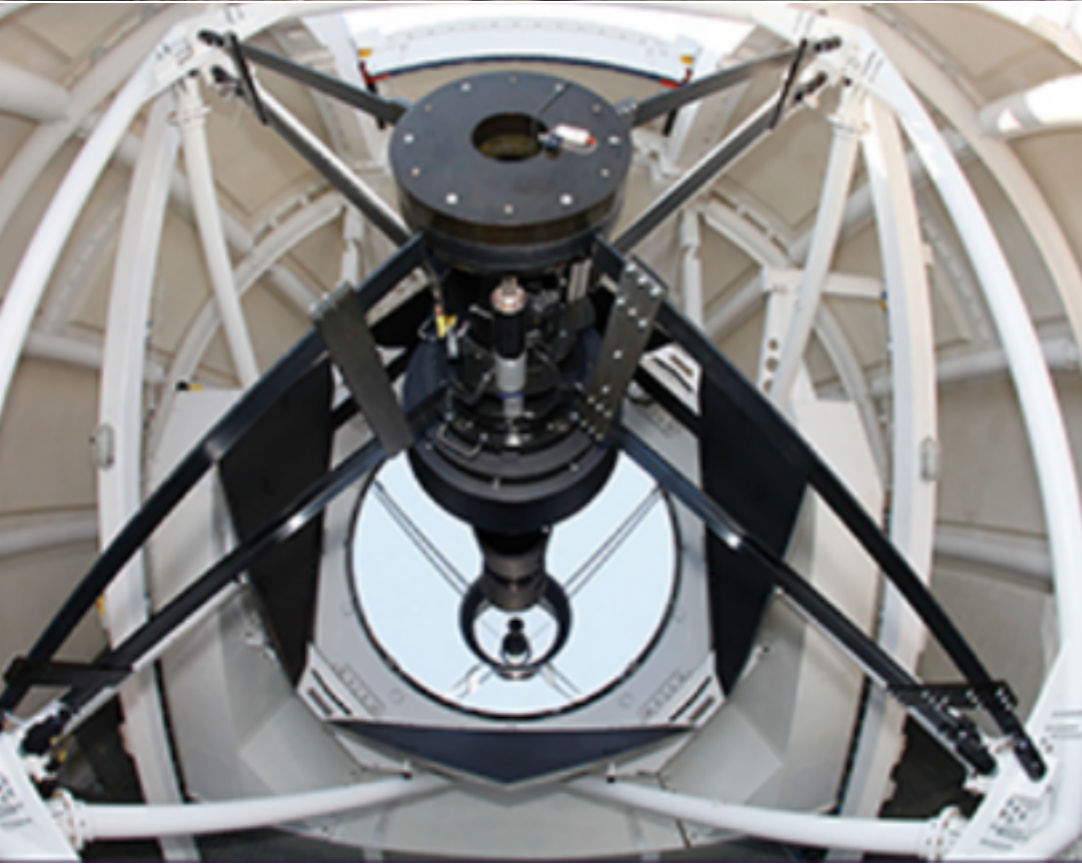
# Outline:

- Introduction to NARIT
- Activities
  - RF surveys
  - Small Radio Telescopes
- Thai Radio Astronomical Observatory
- Timeline

# NARIT: introduction



- NARIT was established in 2008
- Thai National Observatory (TNO) inaugurated in 2013
- 2.4m-diameter reflecting telescope
- Doi Inthanon national park: 2,457 metres altitude (Nov-Apr)
- ULTRASPEC
- Medium-resolution spectrograph:  $R \sim 15,000$
- 4k CCD camera
- TST (PROMPT8) 60cm
- 6 researchers; 4 postdocs



# NARIT: introduction

- Extensive public outreach programs; primary school -> advanced level for high school teachers
- 7 regional observatories, equipped with 50-cm telescope (2 completed, 1 in construction)
- NARIT headquarter: Astroparks



# Thai Radio Astronomer Research Network

*A network of (young) and enthusiastic radio astronomers,  
working towards the Thai national radio observatory.*

## *Active Members*

Dr. Kitiyanee Asanok

Khon Kaen University

Assist. Prof. Nipon Gasiprong

Ubonratchathani University

Dr. Phrudth Jaroenjittichai

NARIT

Dr. Nuanwan Sanguansak

Suranaree University of Technology

Umnart Sathanon

Chulalongkorn University

## *Expert Advisors*

Dr. Busaba Kramer

Max Planck Institute for Radio Astronomy, Germany / NARIT

Dr. Peter Thomasson

Jodrell Bank Observatory, UK / Auckland University of Technology, NZ

Dr. Kaison Aunchaleevarapan

Electrical and electronic product testing center, PTEC

Dr. Komsak Meksamoot

College of Arts, Media and Technology, Chiang Mai

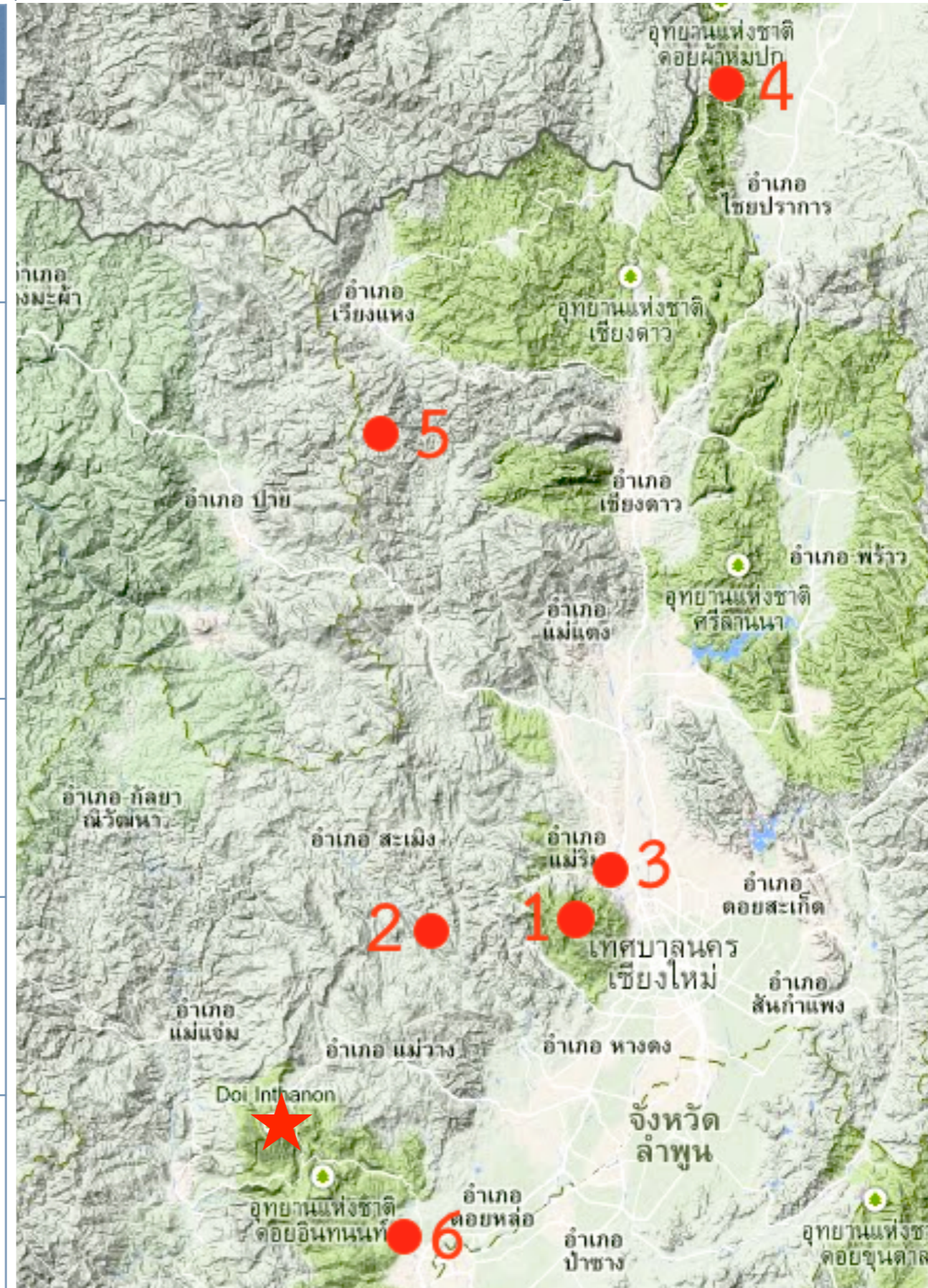


# Activities (2011-2014) : RF survey



# Activities (2011-2014) : RF survey

#	Name	Latitude / Longitude	Date / Time
1	Doi Pui National Park (DPN)	18.8248115 / 98.8916523	5 Aug / 12.30-16.00 (8)
2	Mae Sap Reservoir (MSR)	18.811291 / 98.7264201	6 Aug / 12.12-15.42 (8)
3	Don Kaew District (DKD)	18.8489301 / 98.9542411	7 Aug / 12.30-16.00 (8)
4	Doi Ang Khang Nation Park (DAN)	19.9096558 / 99.0836484	27 Aug / 12.30-16.00 (8)
5	Doi Sam Muen (DSM)	19.4123145 / 98.5905488	28 Aug / 13.30-15.00 (4)
6	Jom Thong District (JTD)	18.4723714 / 98.666391	3 Sep / 12.30-16.00 (8)



# Activities (2011-2014) : RF survey



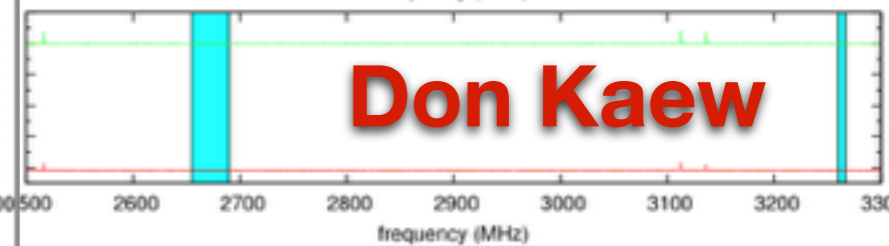
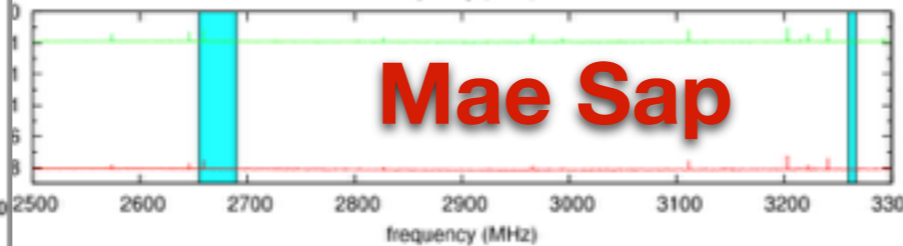
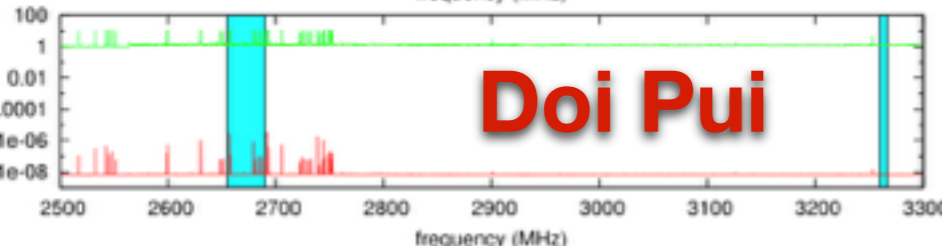
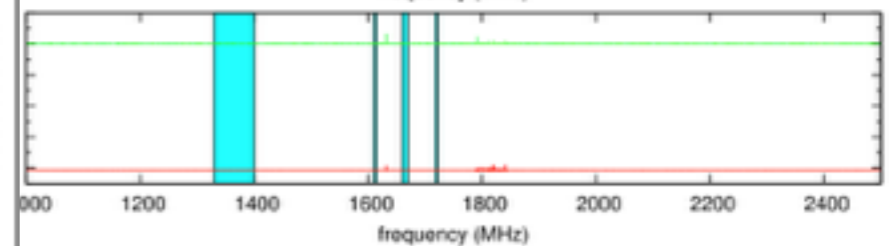
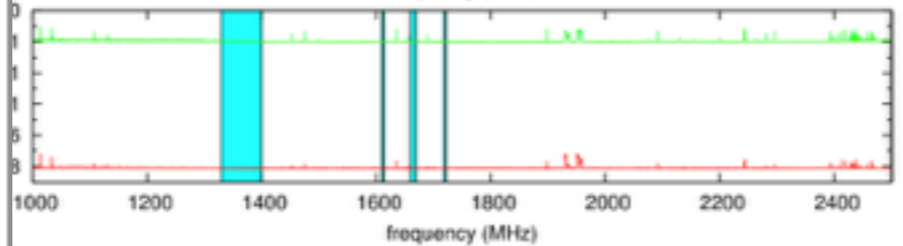
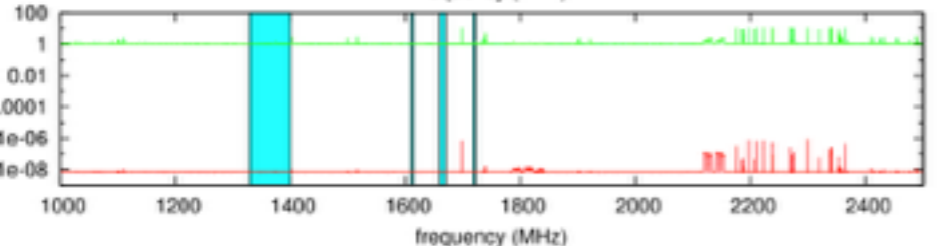
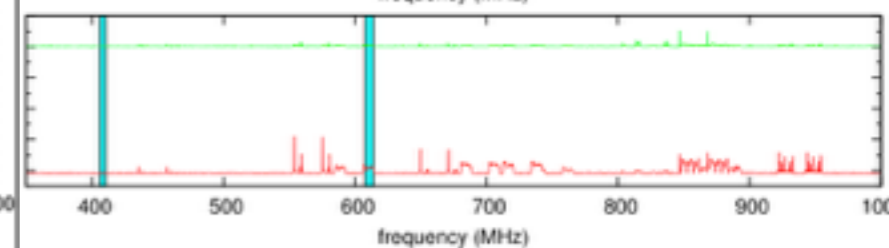
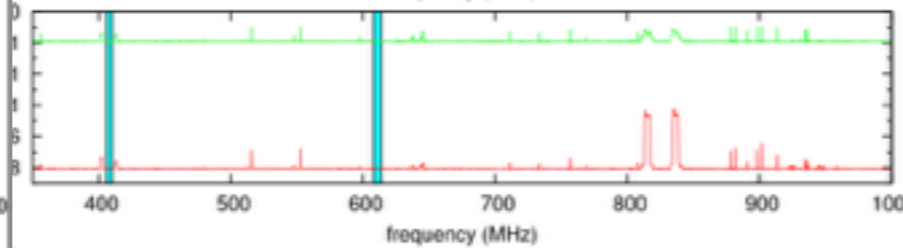
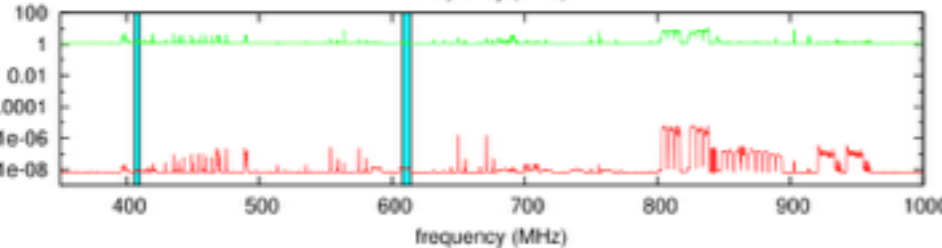
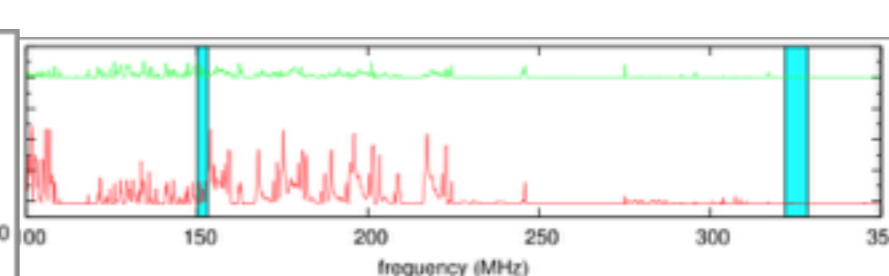
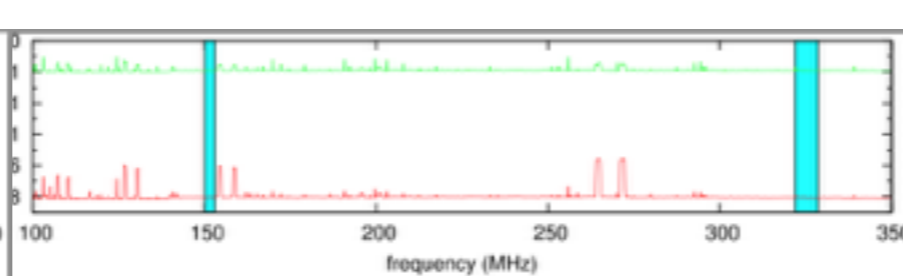
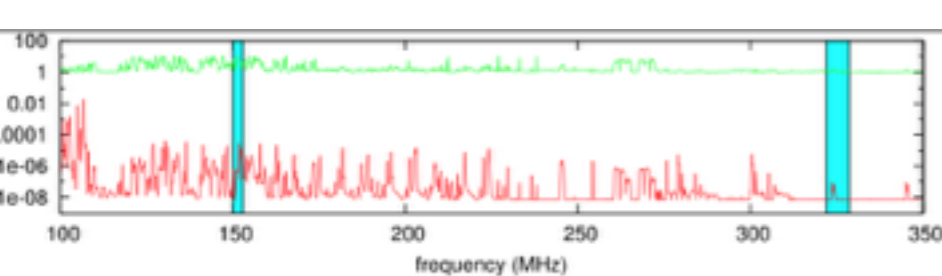
: 100-3300 MHz

: 24 sec sweep time

: 30 mins x 8 cycles



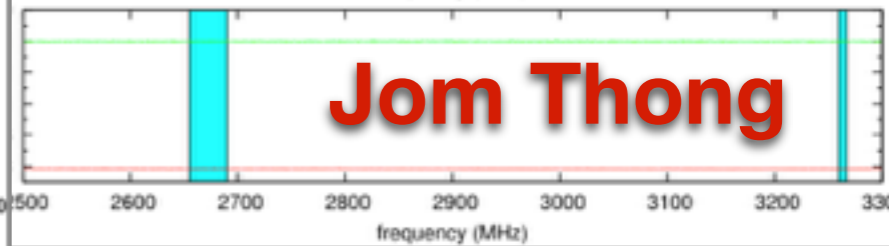
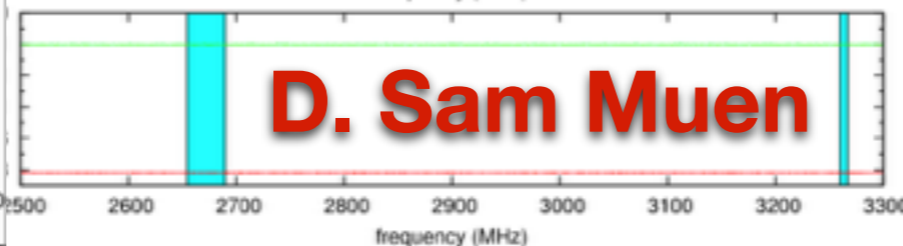
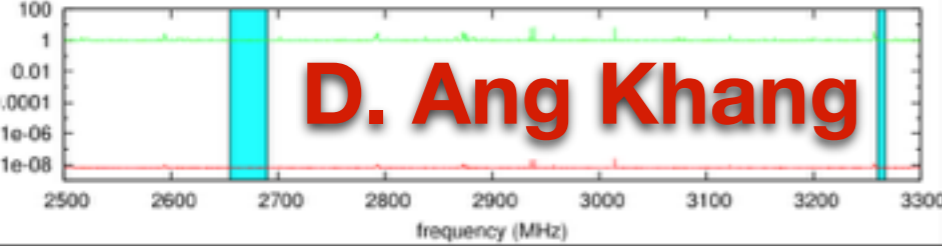
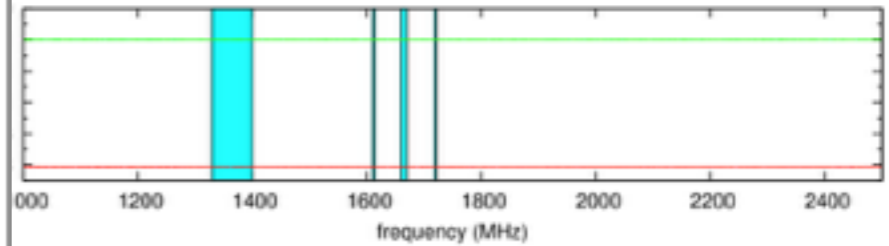
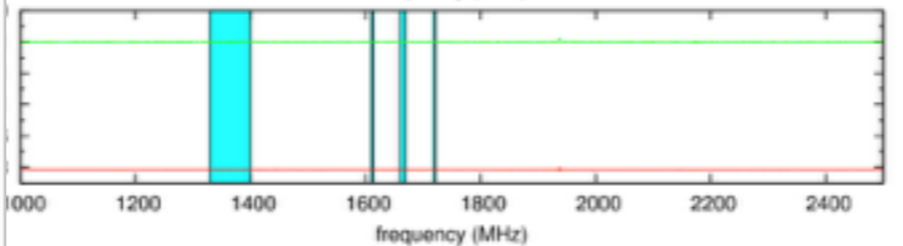
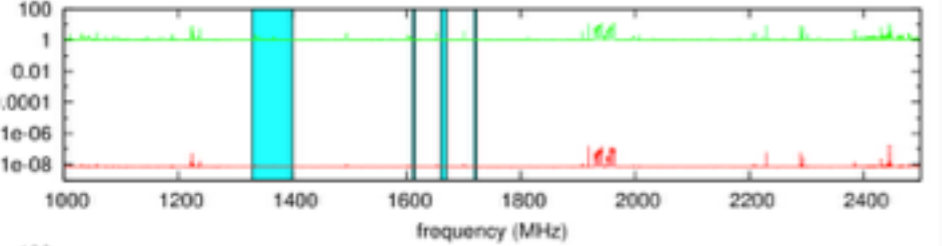
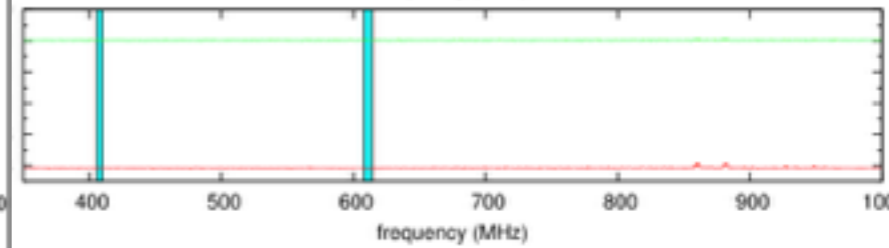
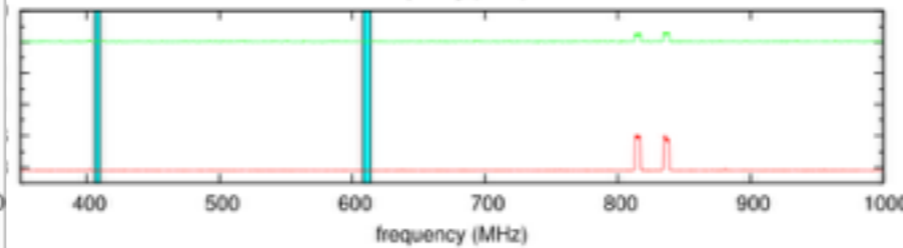
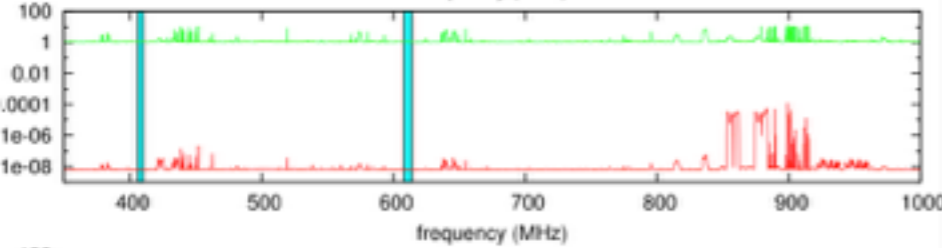
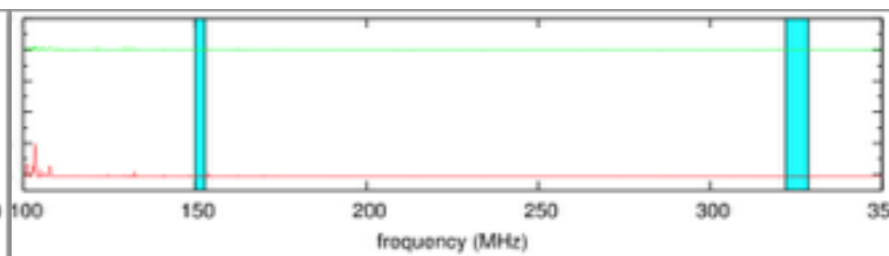
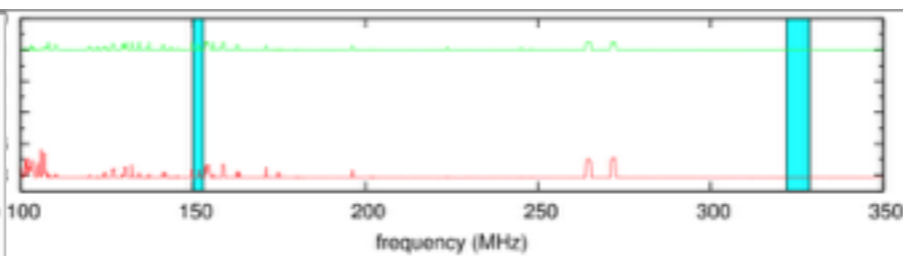
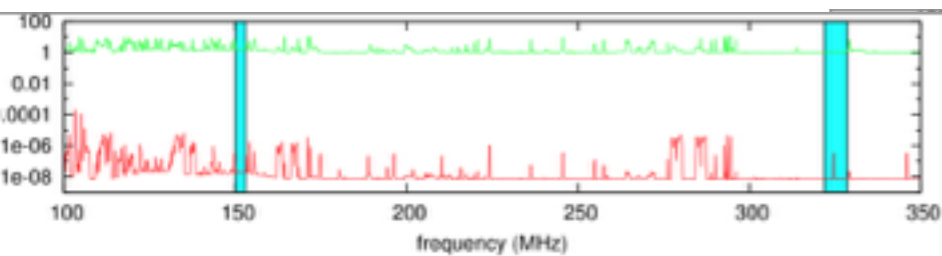




**Doi Pui**

**Mae Sap**

**Don Kaew**

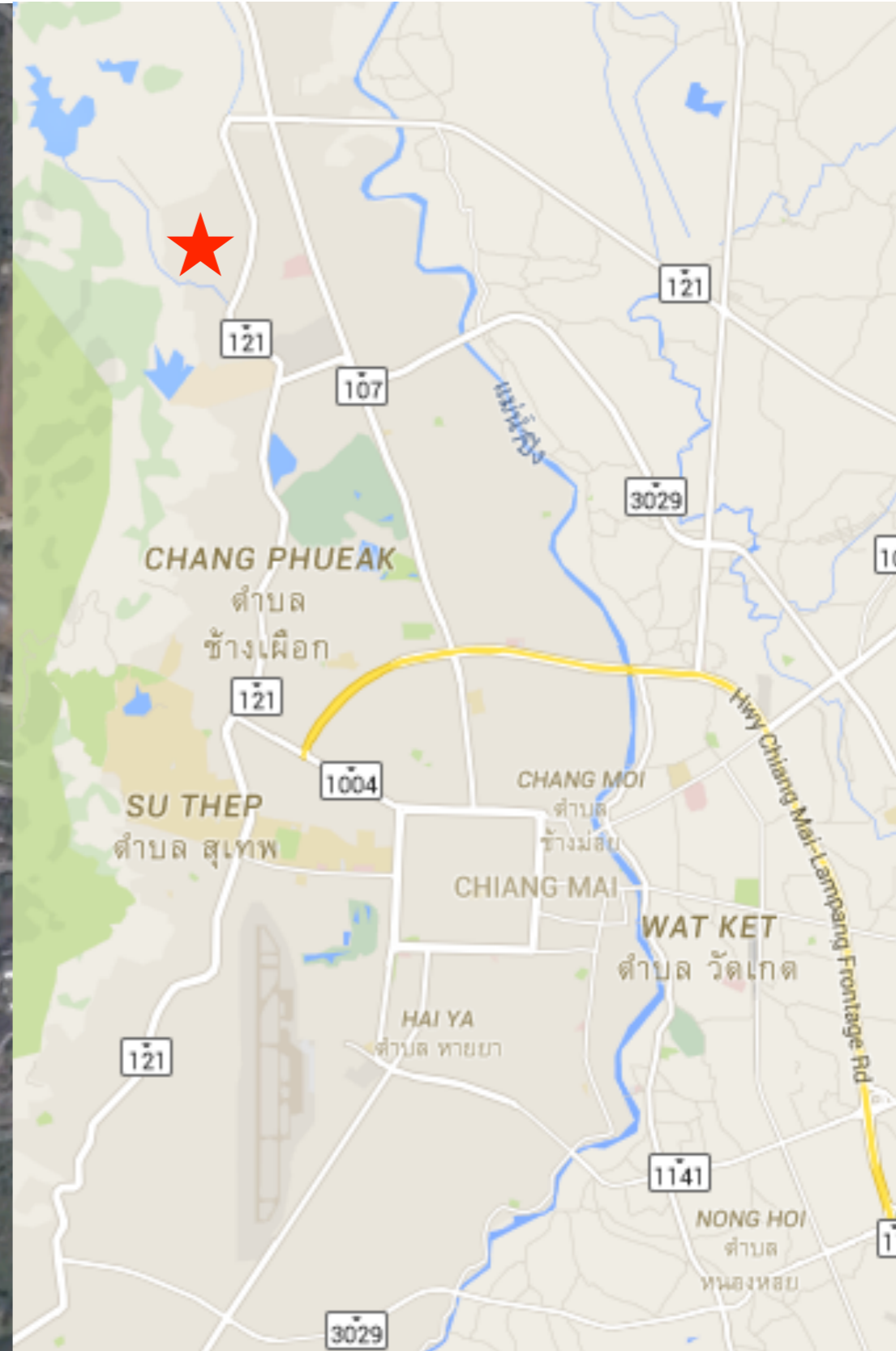
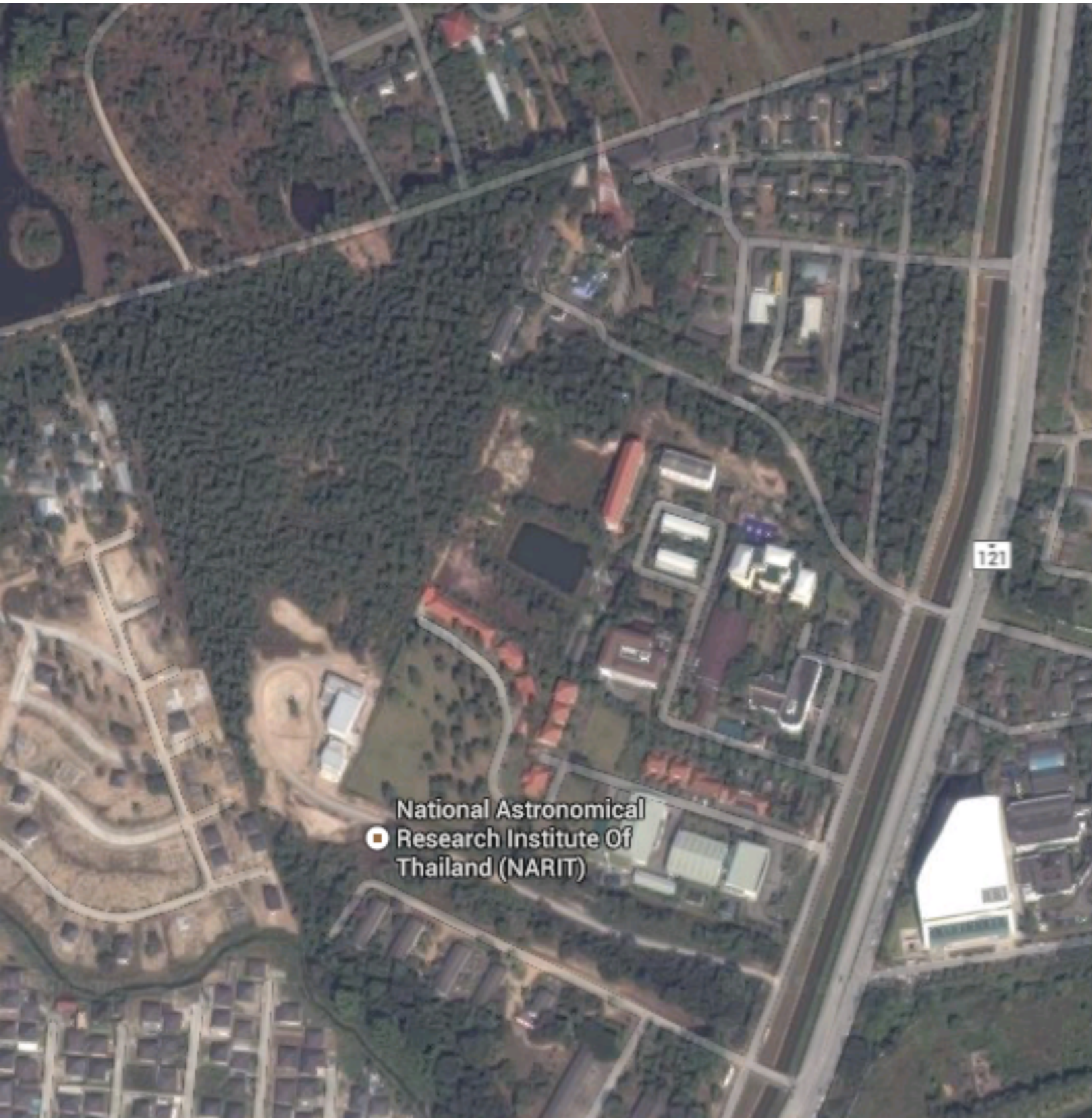


**D. Ang Khang**

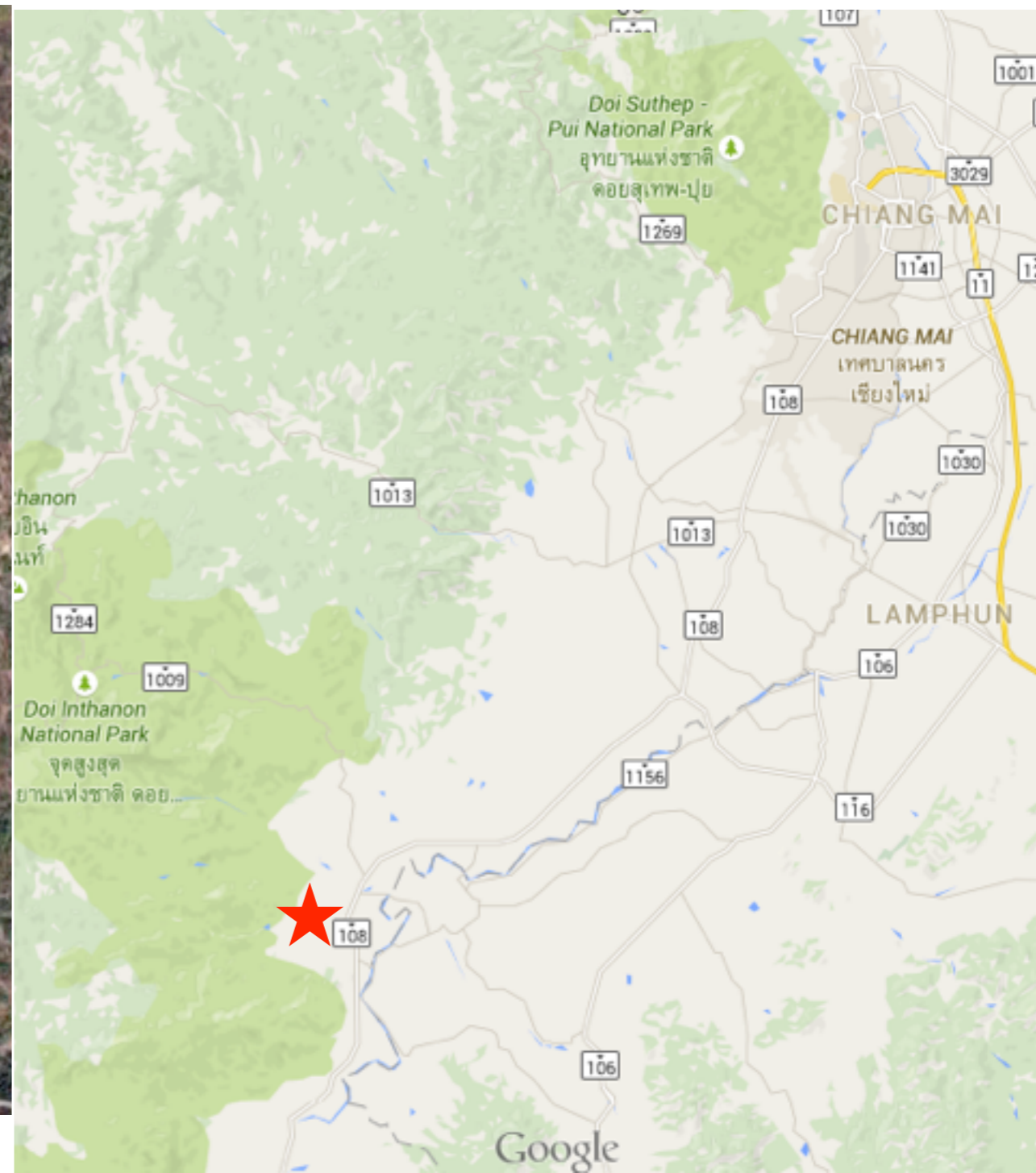
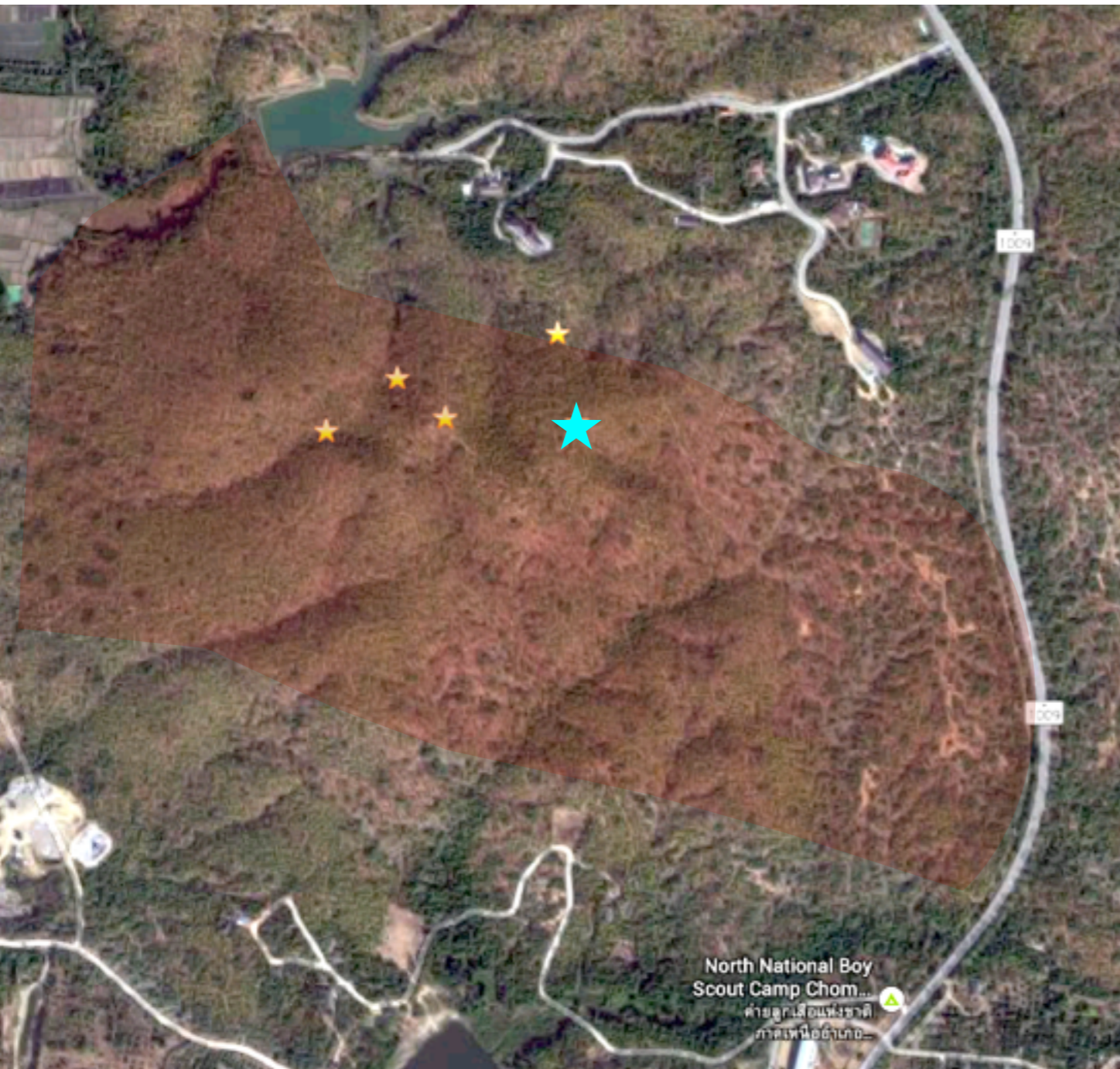
**D. Sam Muen**

**Jom Thong**

# RFI survey: Don Kaew (Astropark)



# RFI survey: Jomthong





# RFI survey: PTEC

Electrical and Electronic Products Testing Center  
Ministry of Science and Technology



- 3 antennas
- 72 hours monitoring (not simultaneous)
- 360 Azimuthal degree

GHz	antenna beam size	# pointing (H, V)	pointing time	Total
0.03 - 1	40	18	4.23 mins	330 mins
1 - 18	30	24		
18 - 26.5	20	36		

# RFI survey: PTEC

Electrical and Electronic Products Testing Center  
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# RFI survey: PTEC

Electrical and Electronic Products Testing Center  
Ministry of Science and Technology



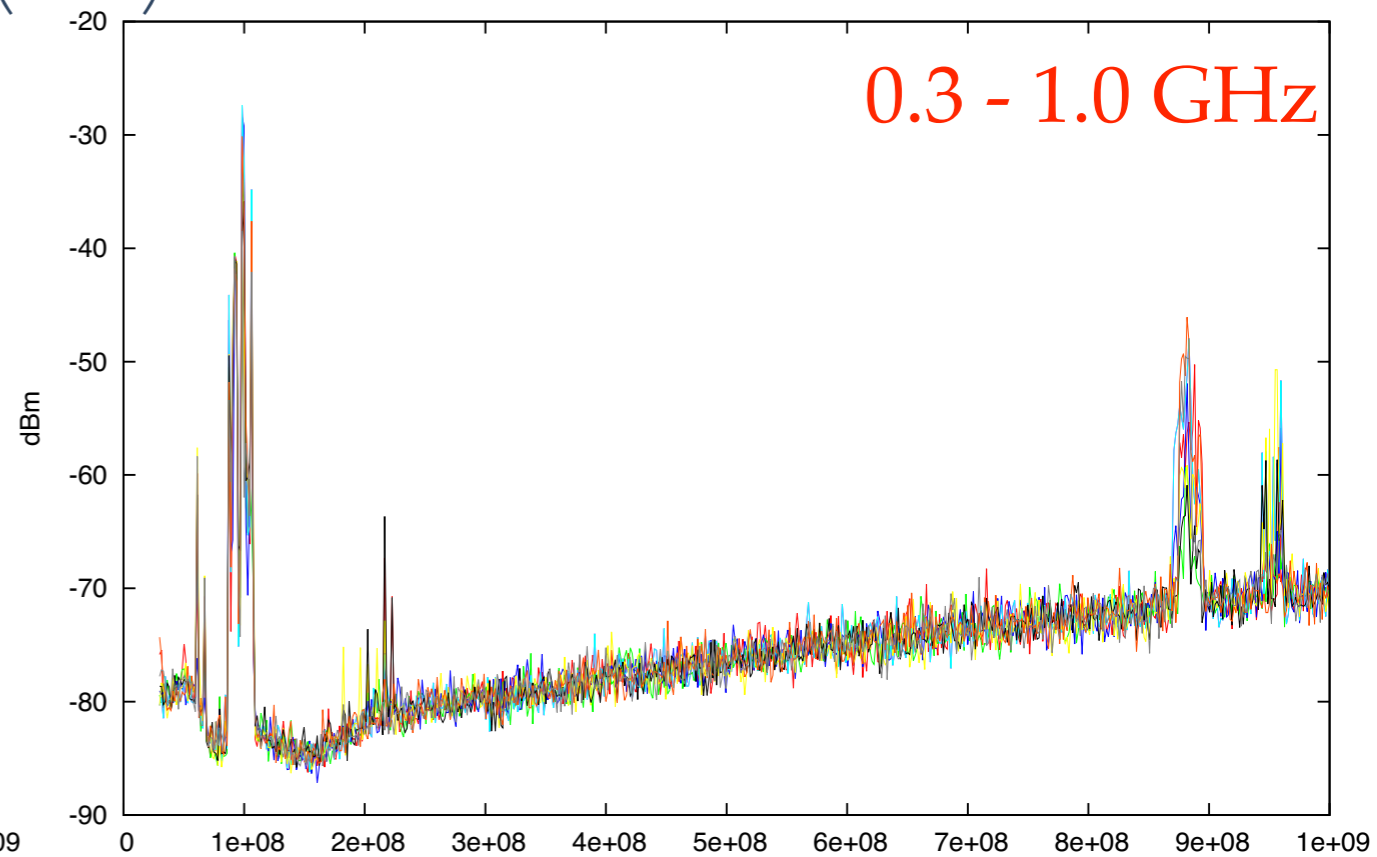
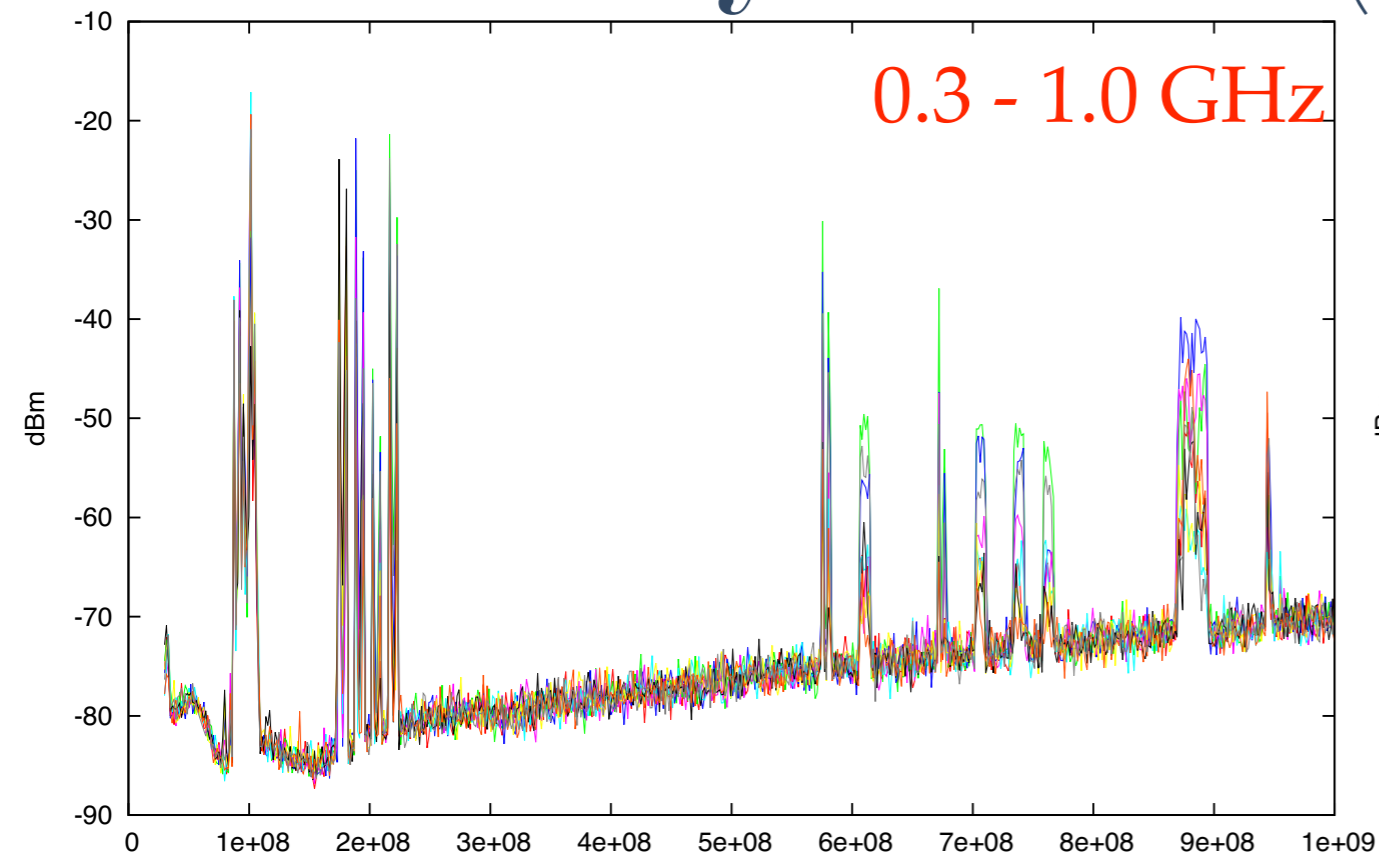
# RFI survey: PTEC (H)

Bi-log Horizon

Bi-log Horizon

0.3 - 1.0 GHz

0.3 - 1.0 GHz

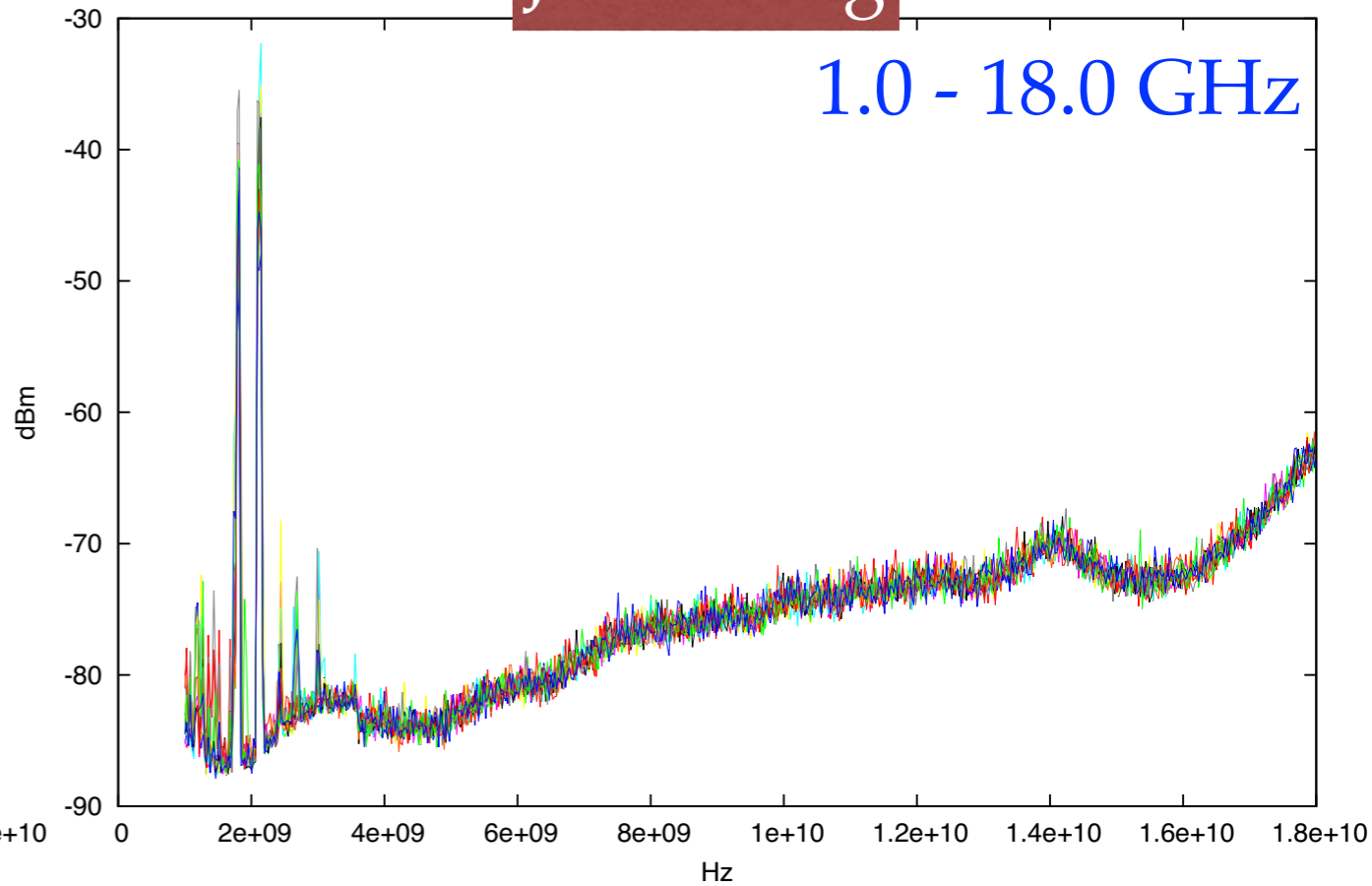
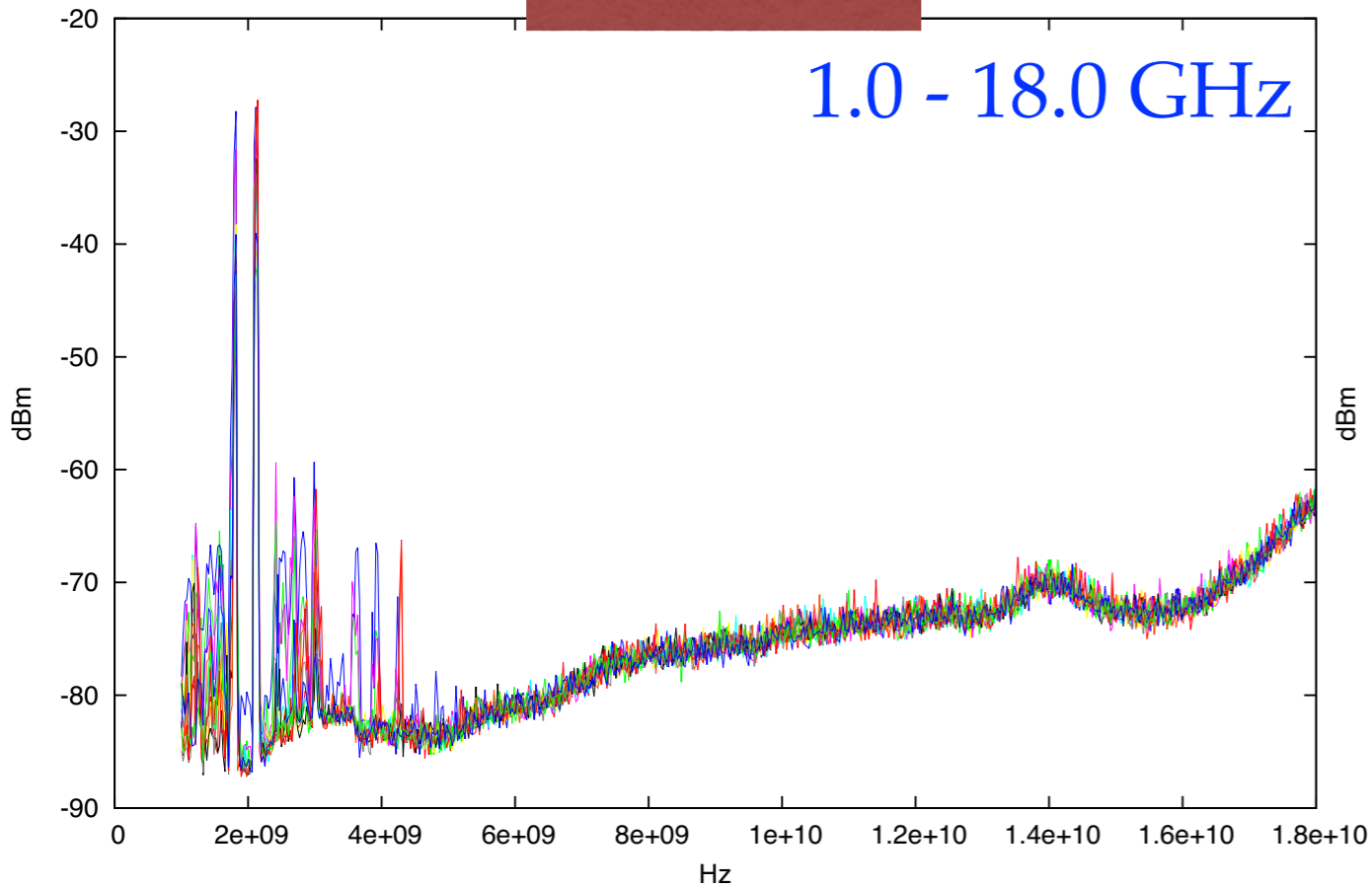


Don Kaew

Jom thong

1.0 - 18.0 GHz

1.0 - 18.0 GHz

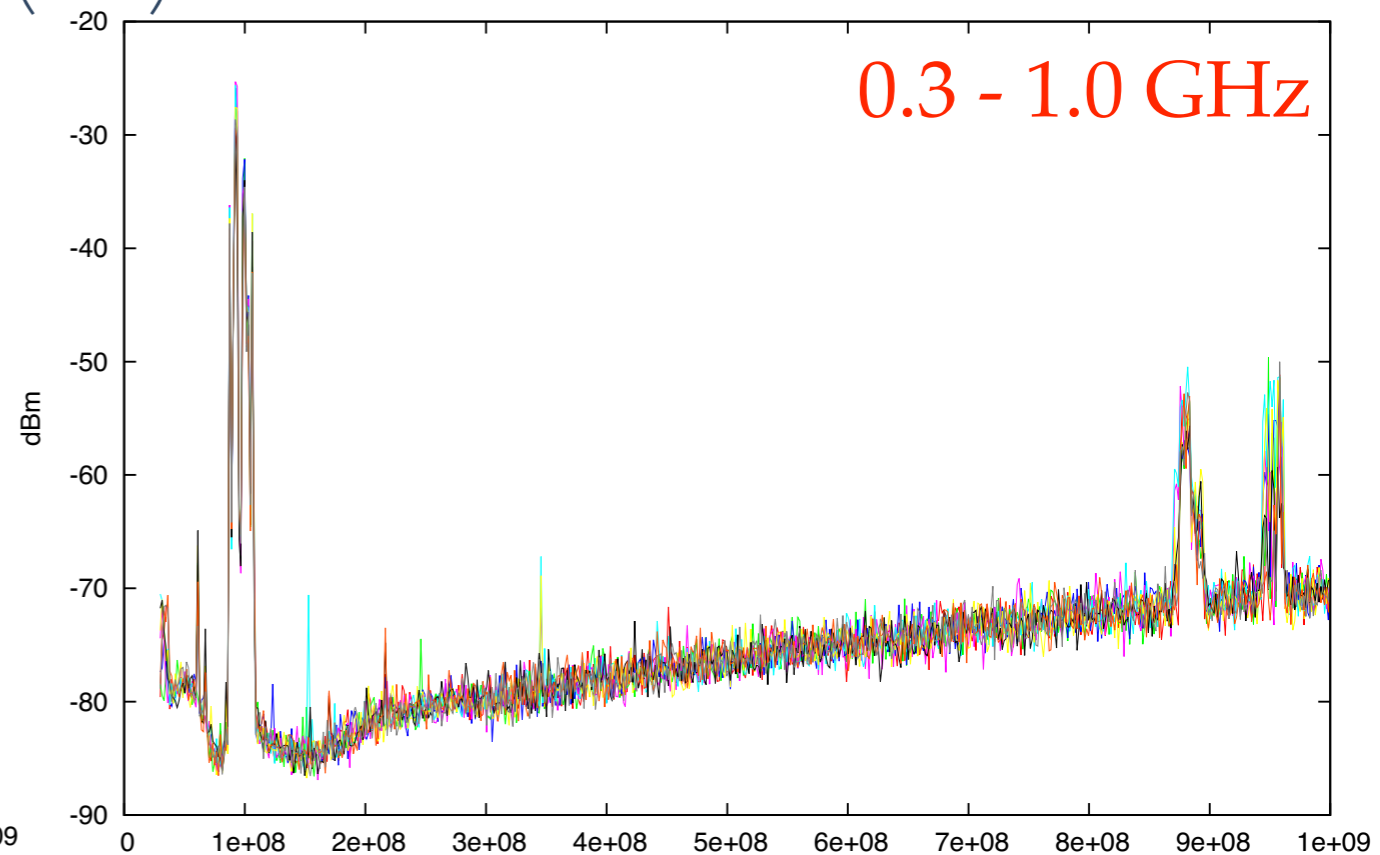
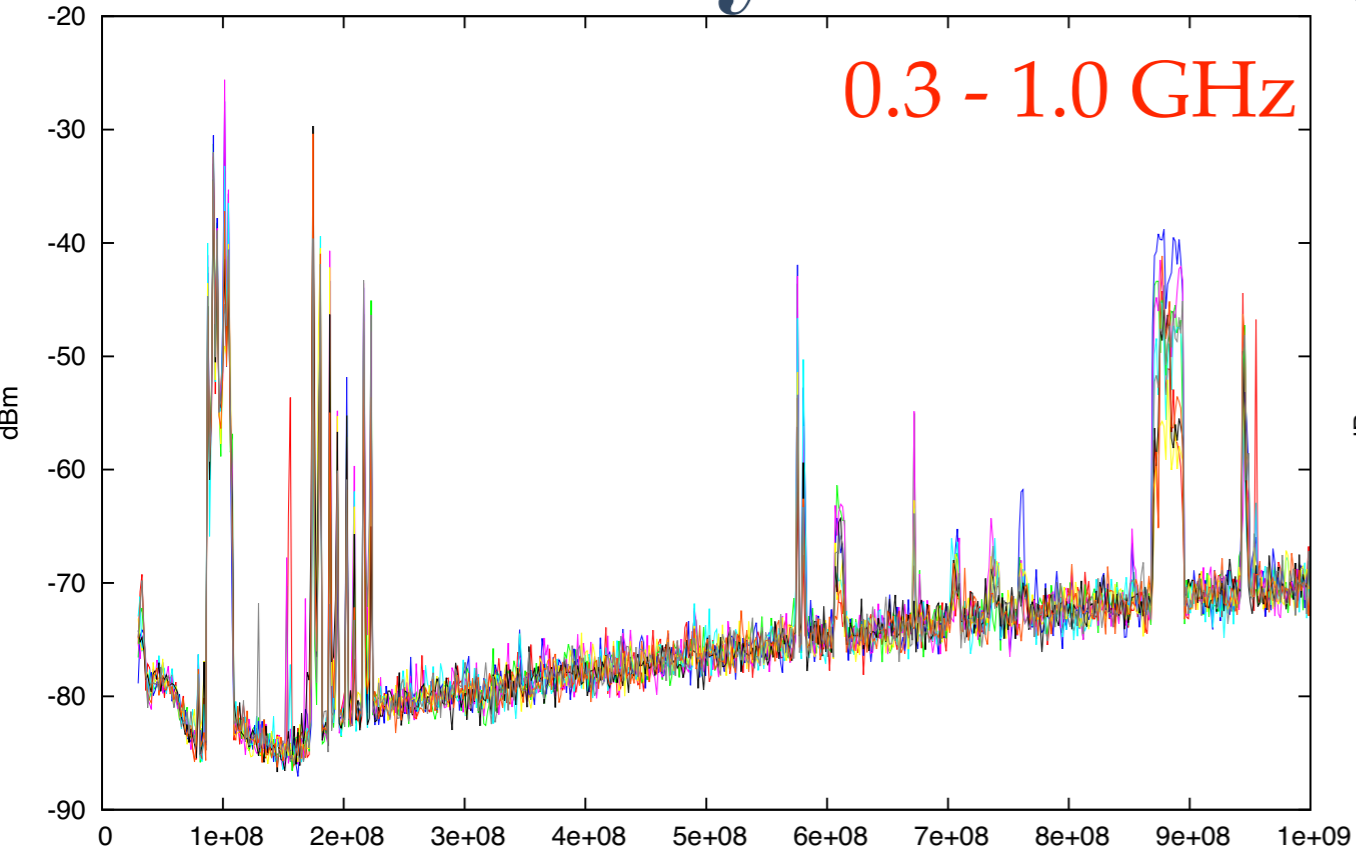




# RFI survey: PTEC (V)

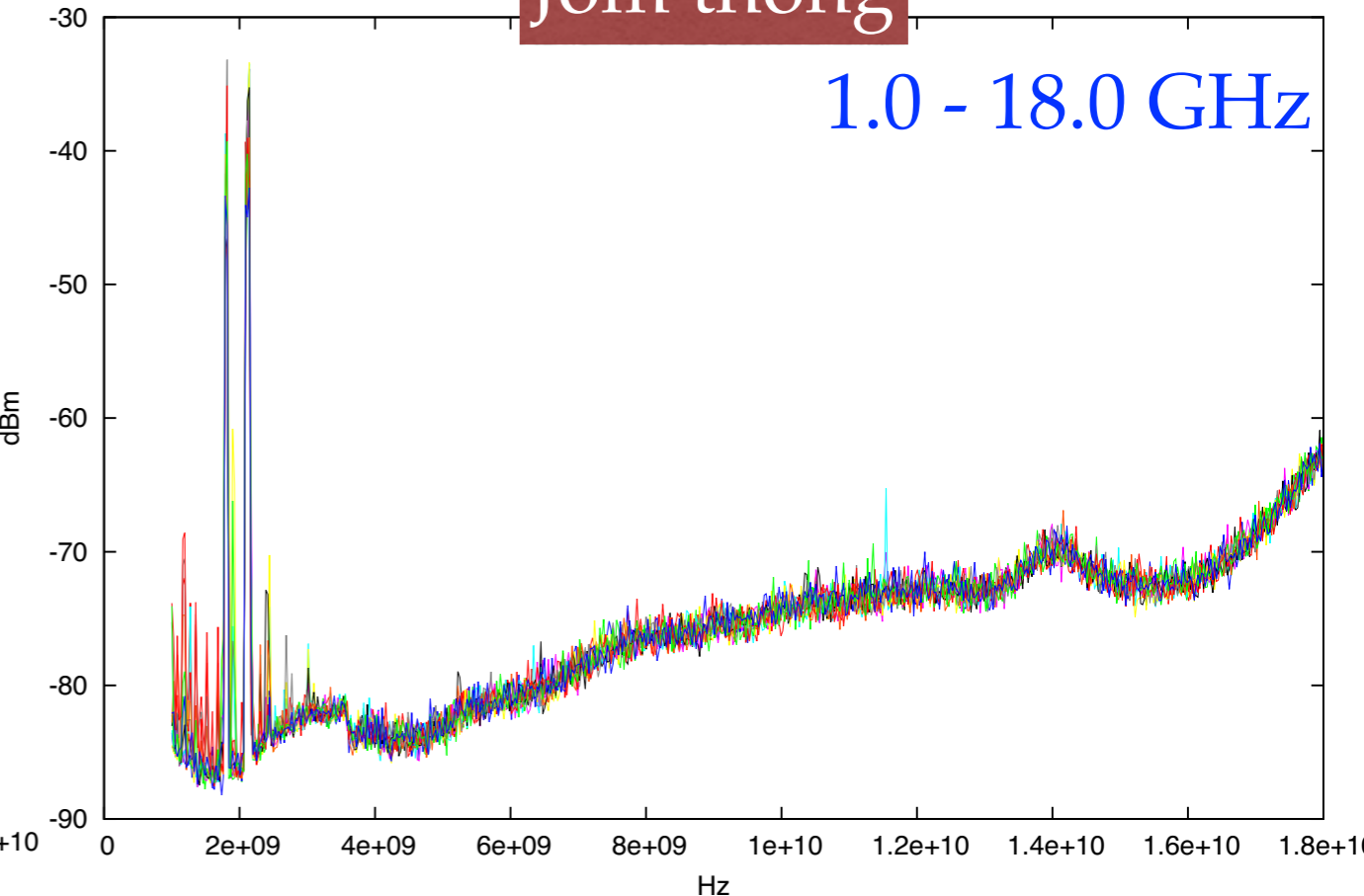
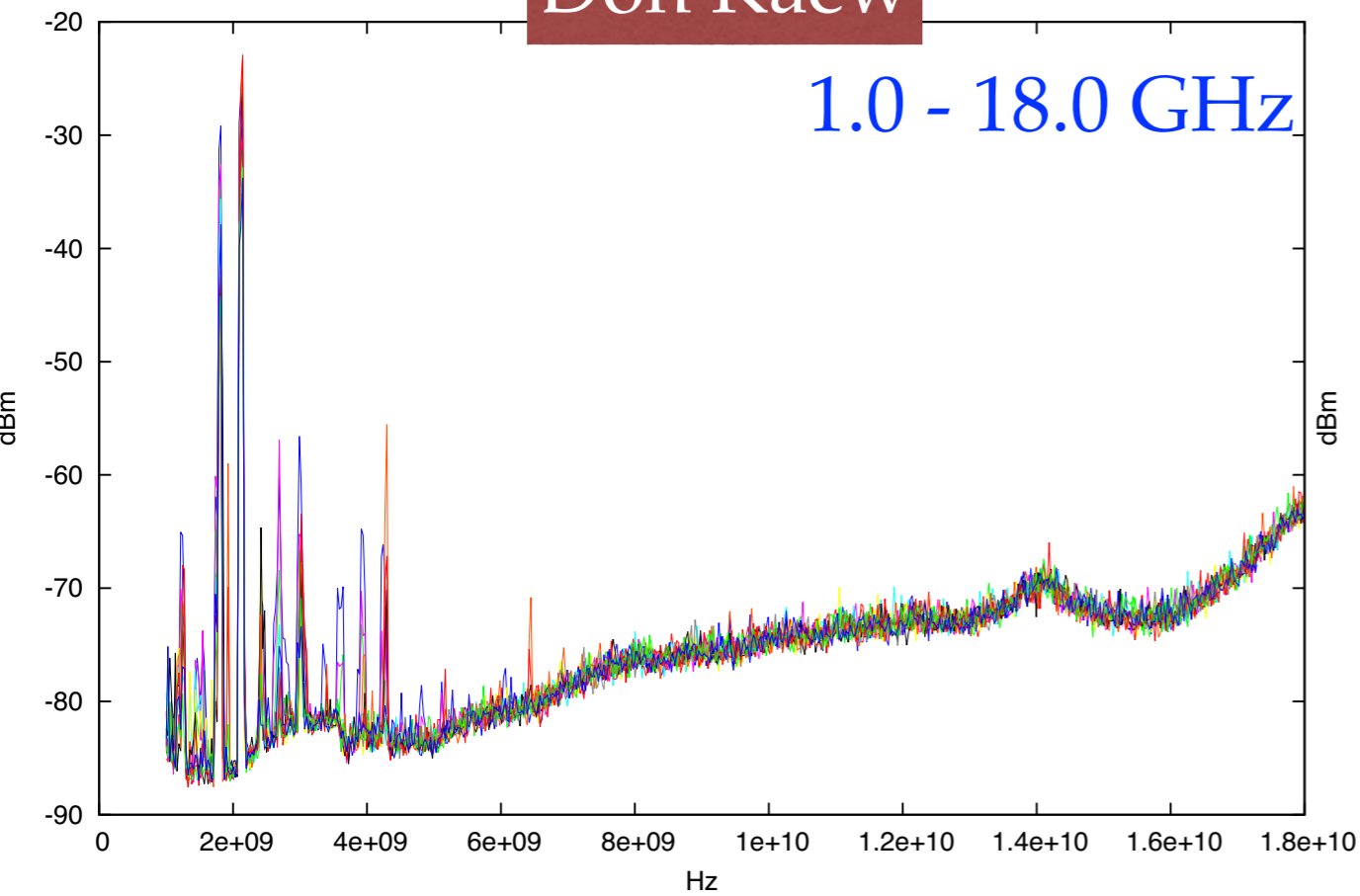
Bi-log Vertical

Bi-log vertical



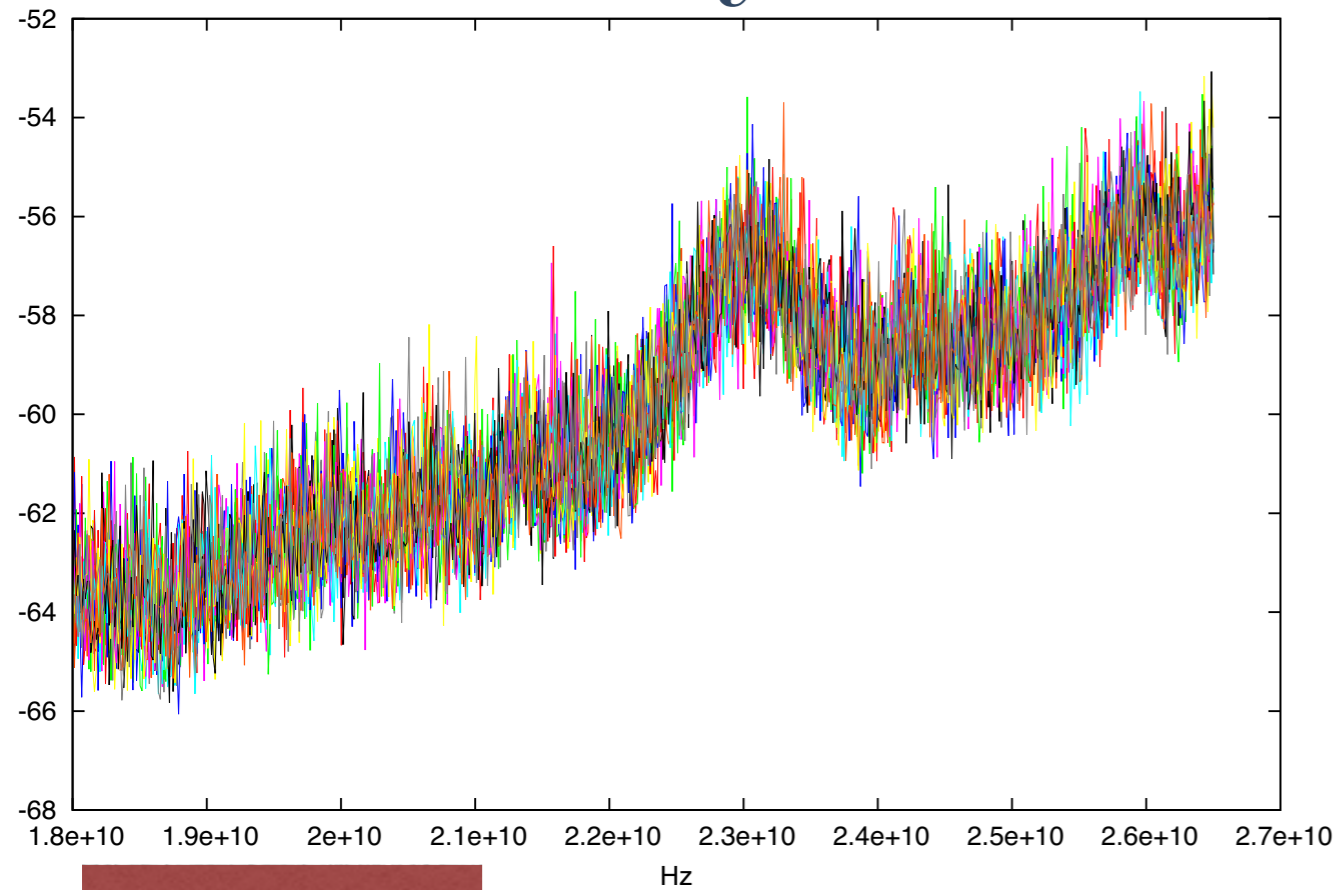
Don Kaew

Jom thong



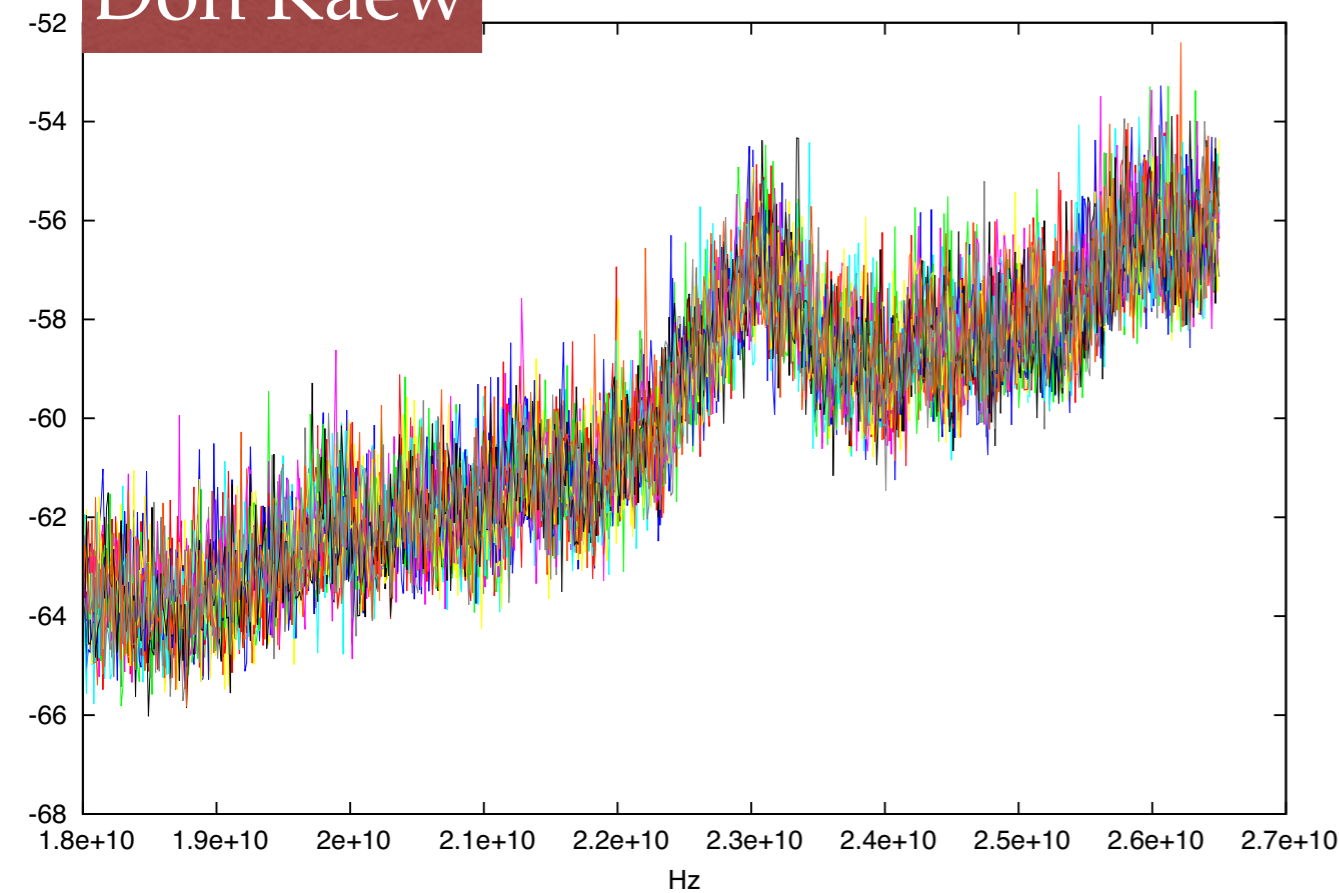
# RFI survey: PTEC

Horn-high vertical



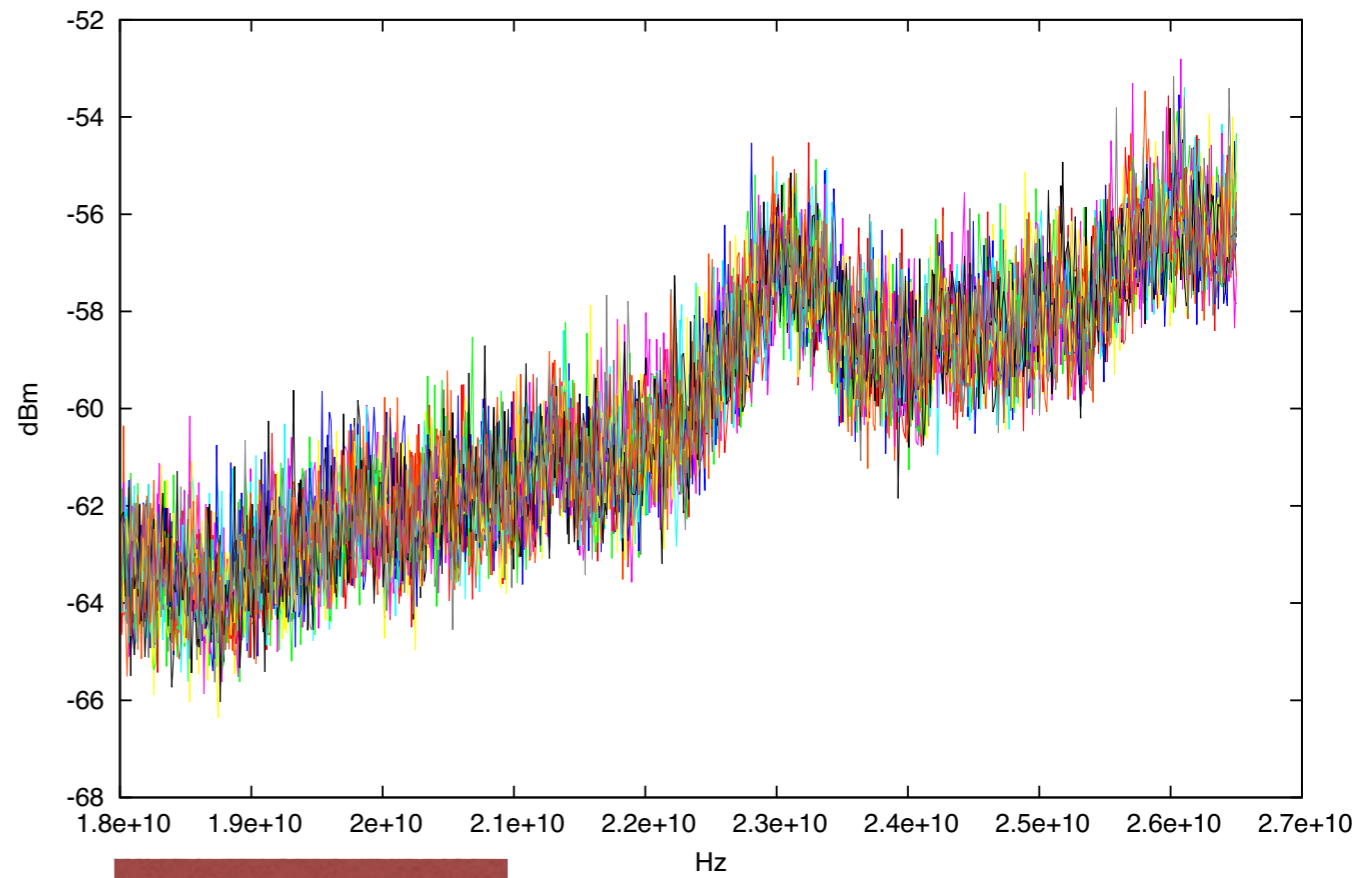
Don Kaew

Horn-high Horizontal



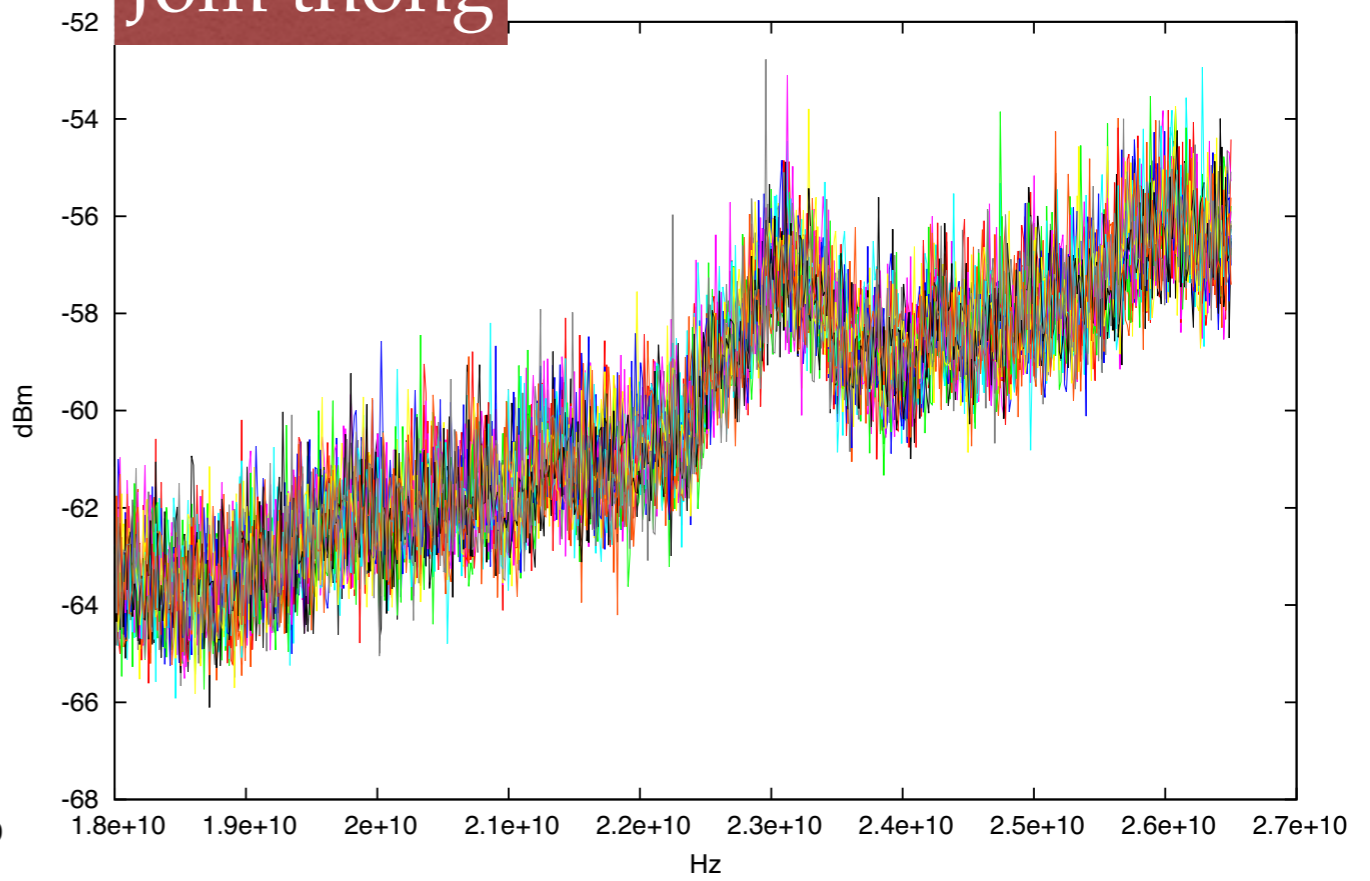
# 18 - 26.5 GHz

Horn-high vertical



Jom thong

Horn-high Horizontal

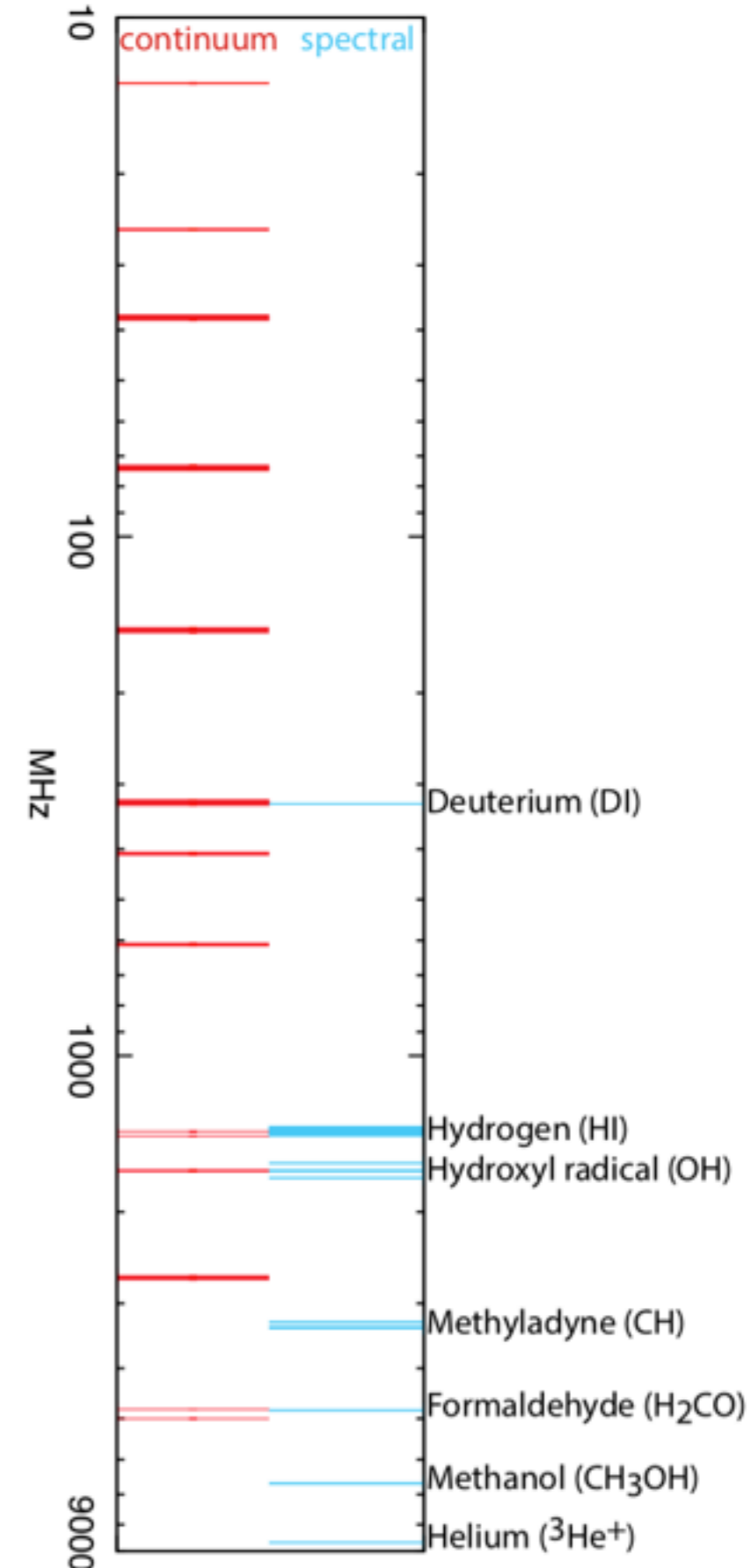


# Activities (2011-2014) : Spectrum Management

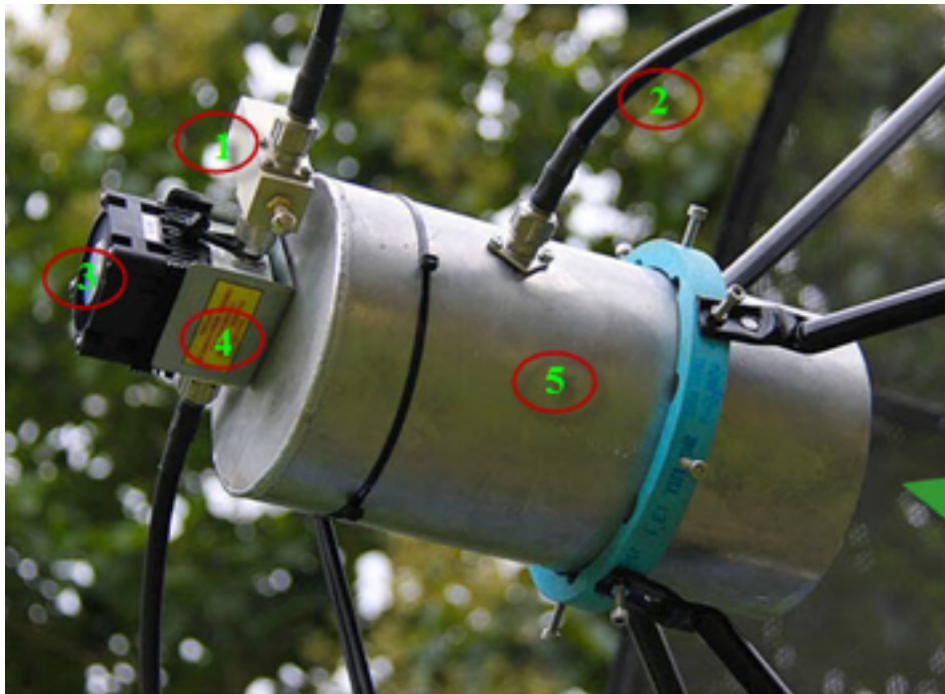
- Preferred frequency bands for radio astronomical measurements, Recommendation ITU-R RA.314-10. (ITU 2003)
- Thai National Broadcasting and Telecommunication Committee (Thai NBTC)
- Compiled with ITU, **but only continuum bands**
- Radio quiet zone around the observatory

kHz	
13.36	13.41
25.55	25.67
37.5	38.25
MHz	
322	328.6
406.1	410
1400	1427
1610.6	1613.8
1660	1670
2655	2700
4800	5000

GHz	
10.6	10.7
14.47	14.5
15.35	15.4
22.21	22.5
23.6	24
31.3	31.8
42.5	43.5
76	116
123	158.5
164	167
182	185
200	231.5
241	275



# Activities (2011-2014) : 3m SRT



: 3-metre dish  
: 1420 MHz (21 cm)



A screenshot of the software control interface. The interface includes a status section, control buttons, and a data table.

Status : Stop	Time : 11:09:49 UT
Az : 00.0000	Date : 3 / 4 / 2014
Alt : 91.3156	
AZ : Moving	
Alt : Moving	
<input checked="" type="checkbox"/> Forward Unit	

Control:

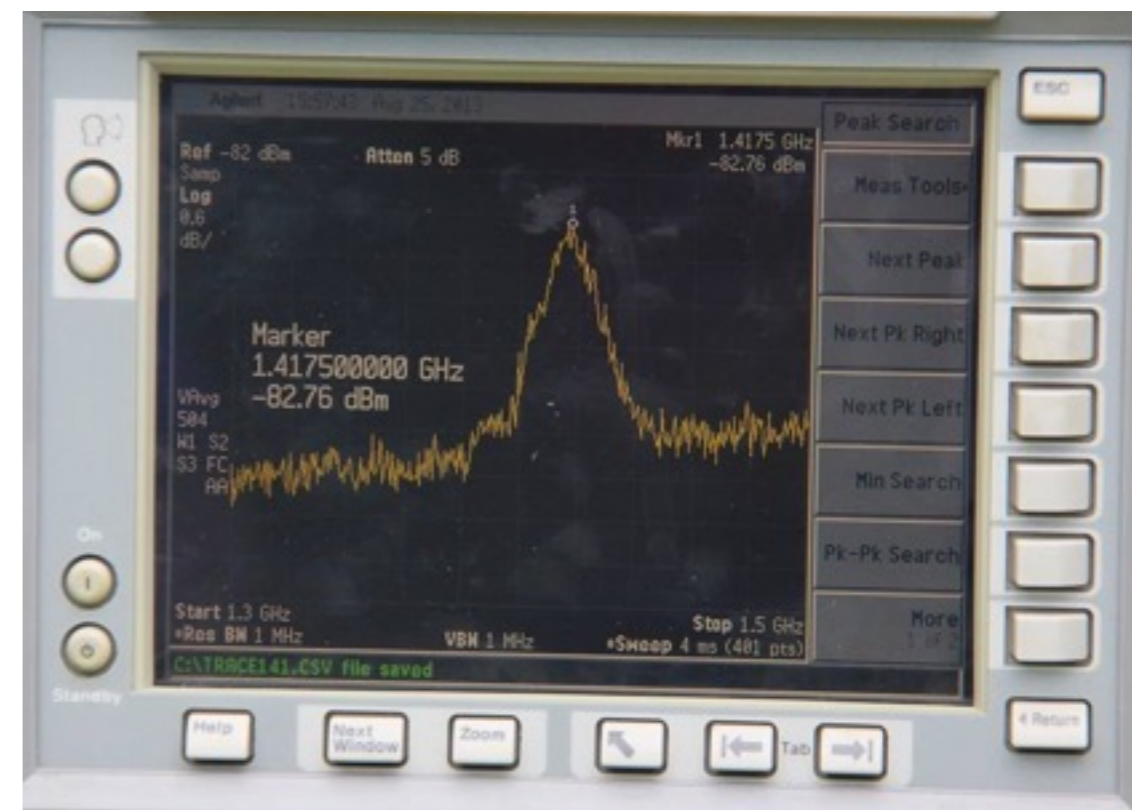
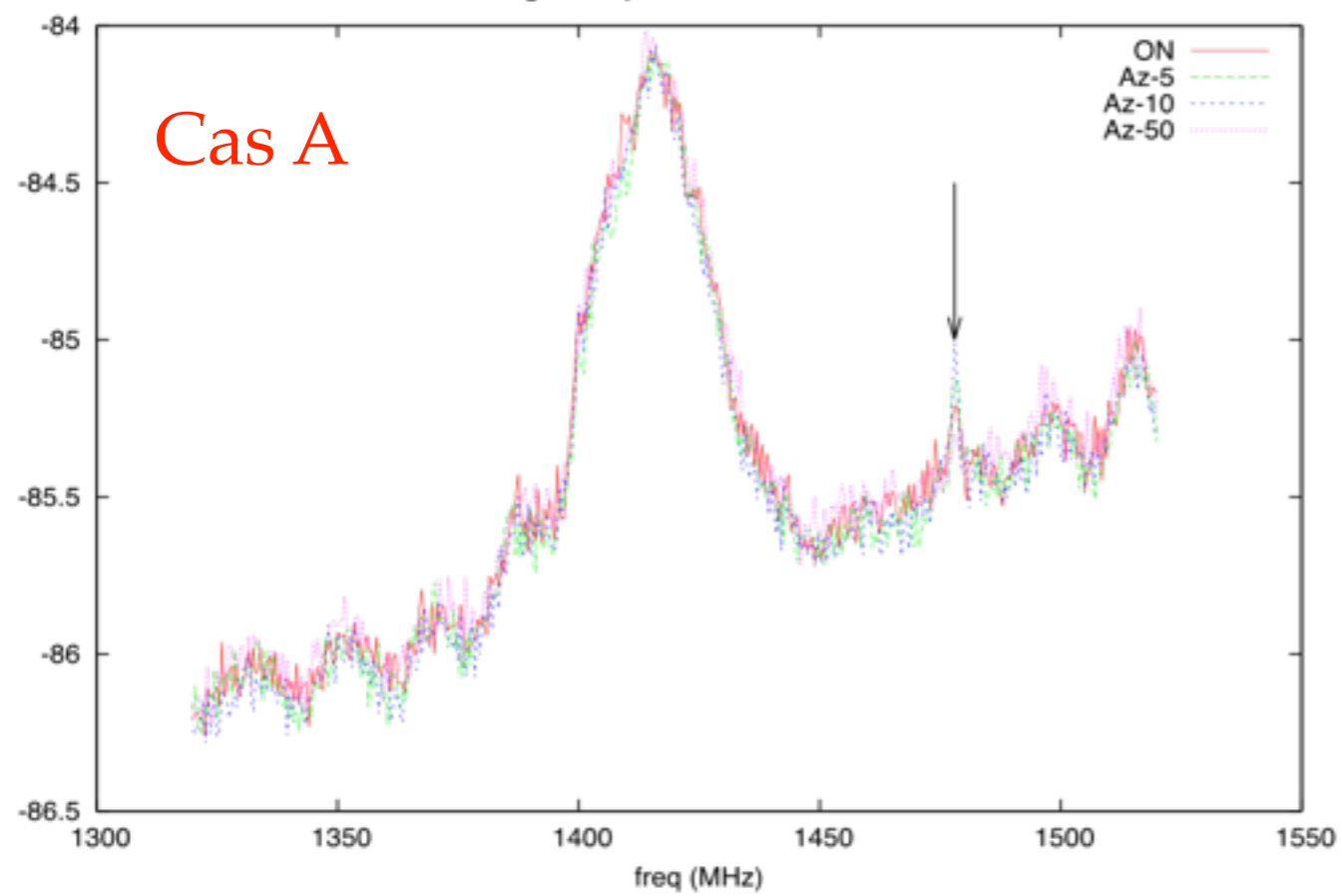
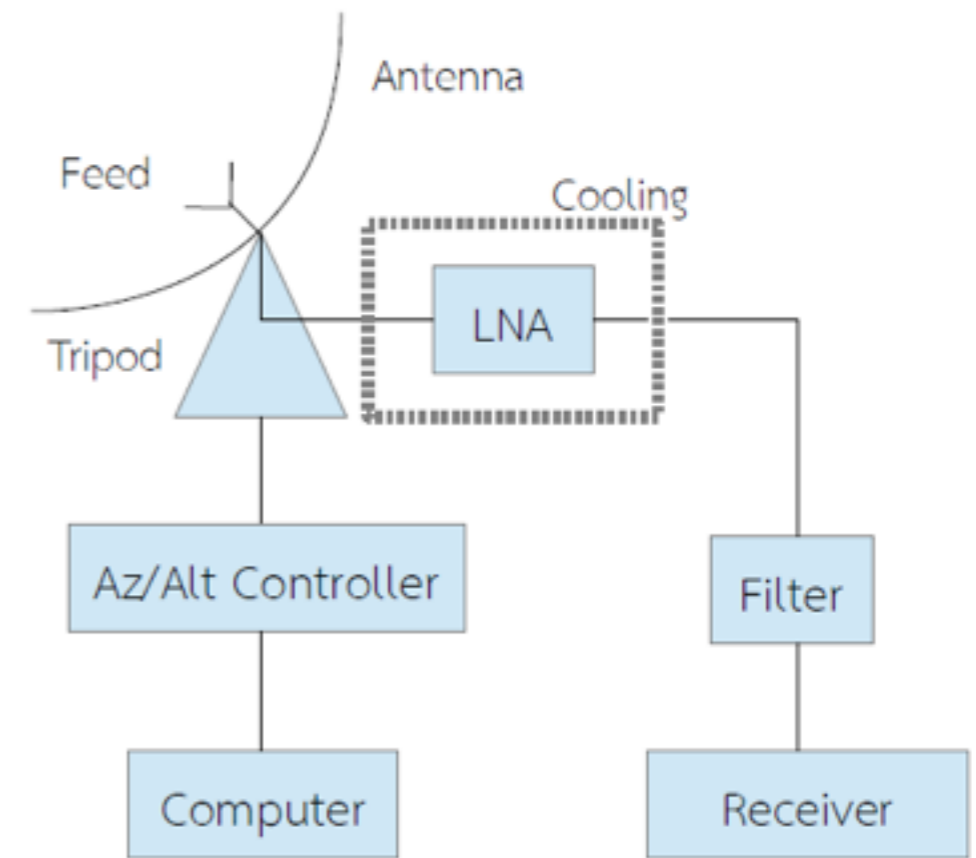
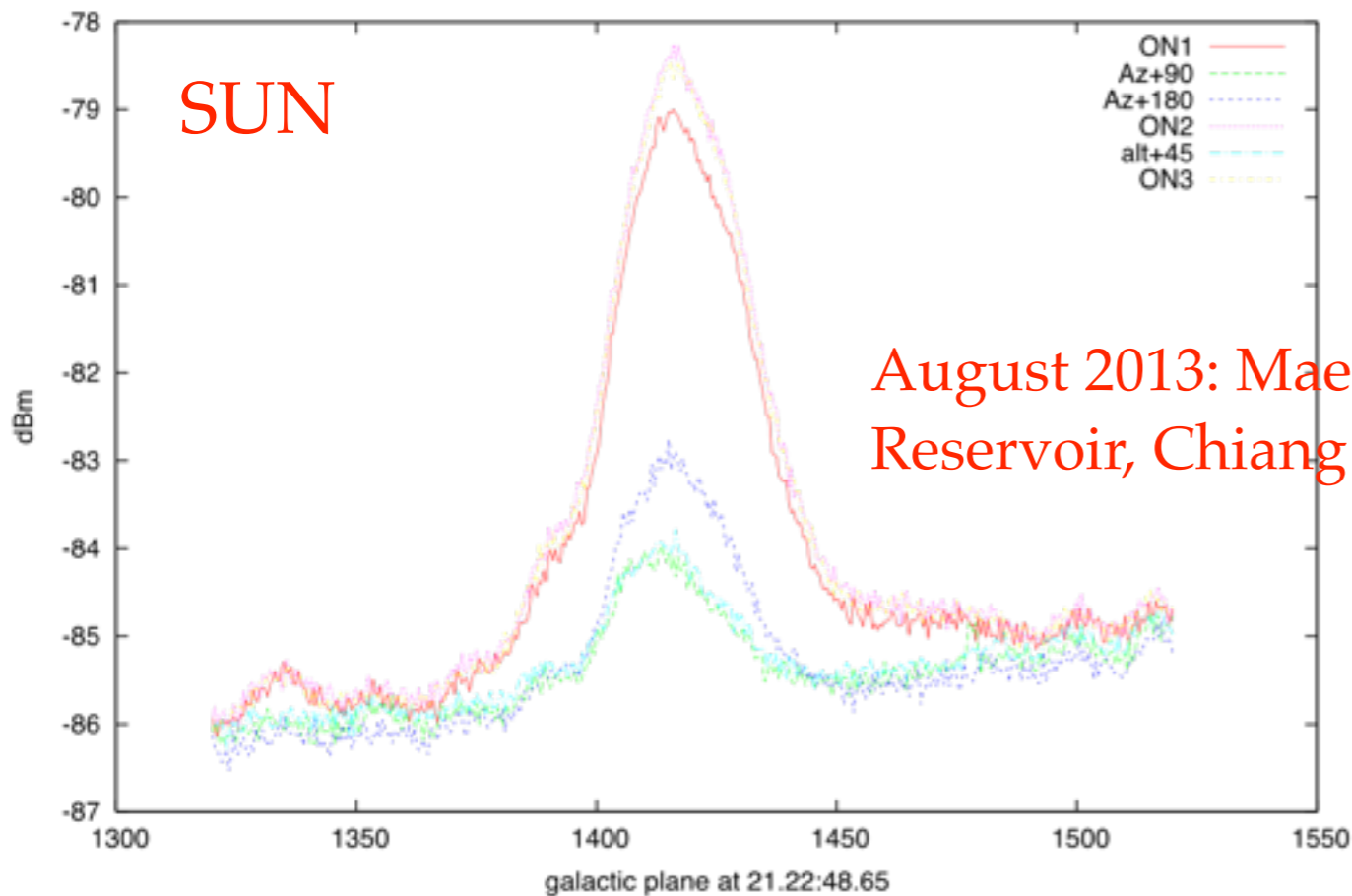
Speed:  x1  x5  x10  x20

Latitude : 18.80754722	RA :	Az : 50.0000 + 00.00
Longitude : 96.72724722	DEC :	Alt : 90.0000 + 00.00
Time : 11.158167	JD : 5205.964924	HA : -97.8035
	LST : -97.803496	LST : 06 : 31

RA/Dec:

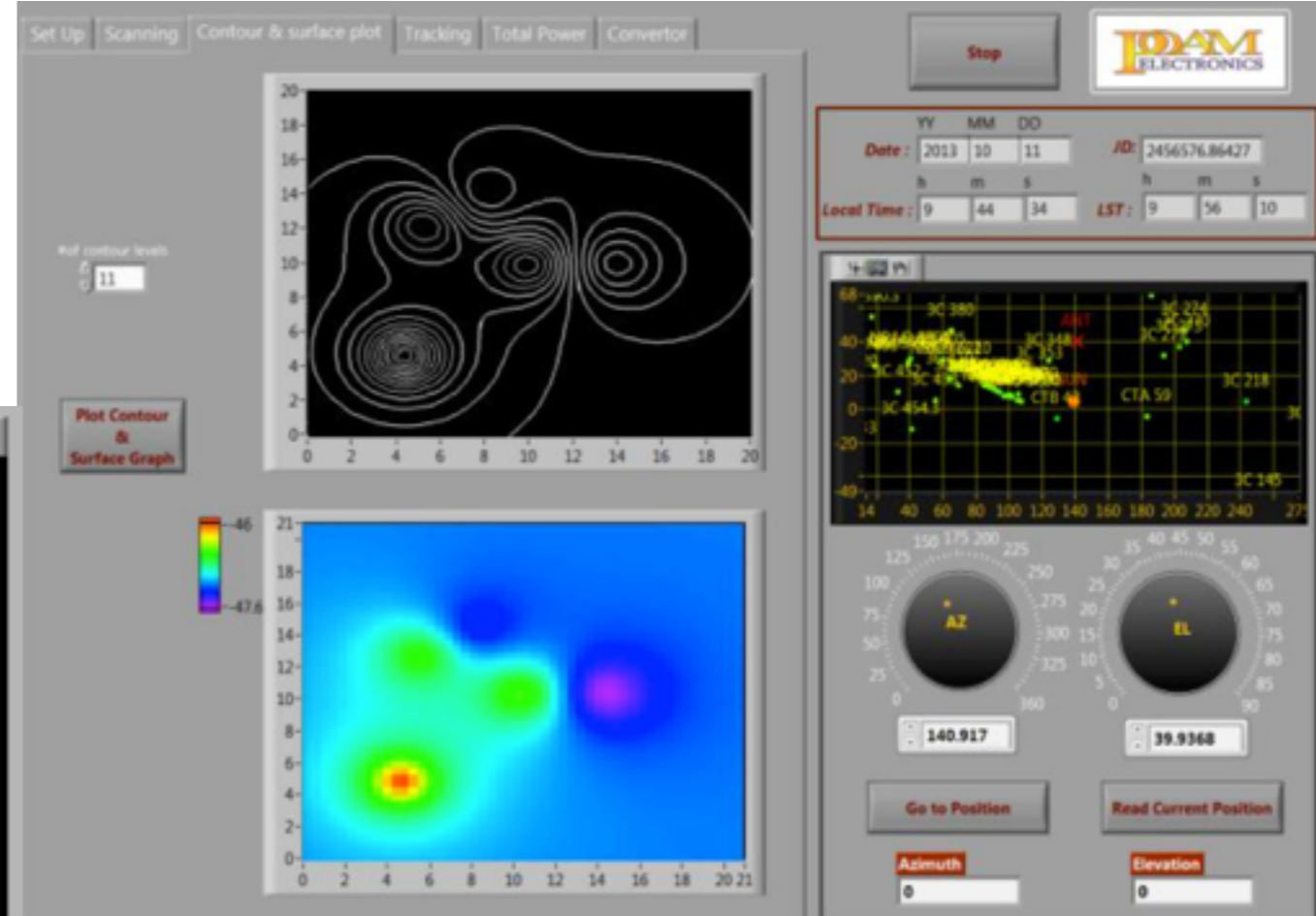
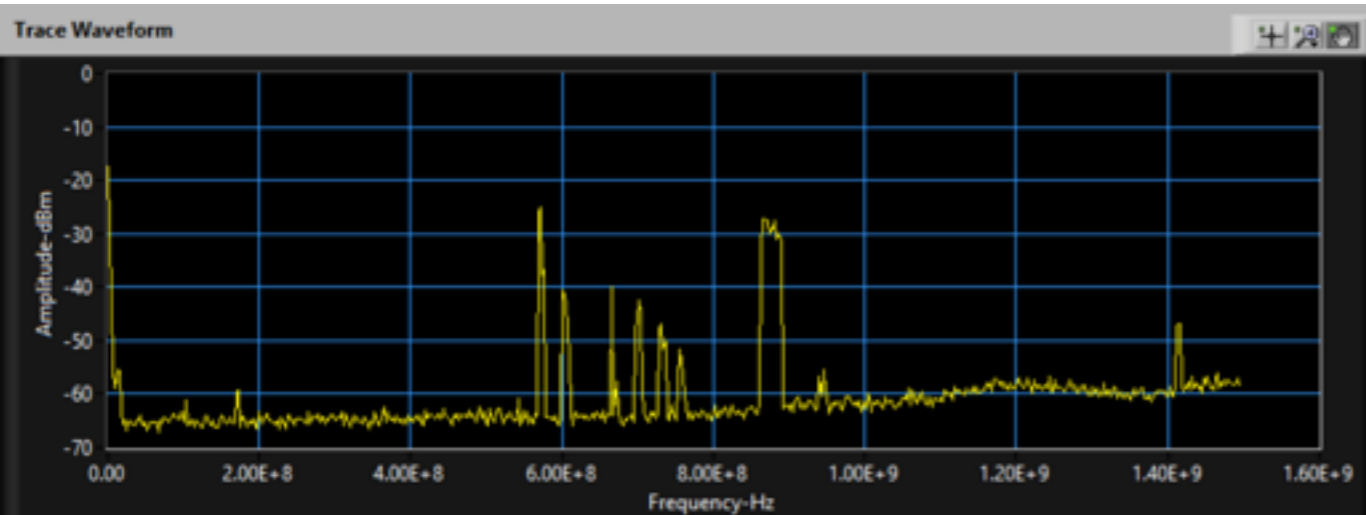
CallQueue.dll 05:00  
Call1.dll 1.4.4  
5001 OPEN ERROR: OFFLINE specified to Call Queue

# Activities (2011-2014) : 3m SRT



# Activities (2015) :

- POAM radio telescope system
  - 4.5 diameter, up to 18 GHz
  - 1420 MHz, 500 MHz BW
  - ACU, receiver, software
- Radio lab. demonstrations
  - HI galaxy rotation



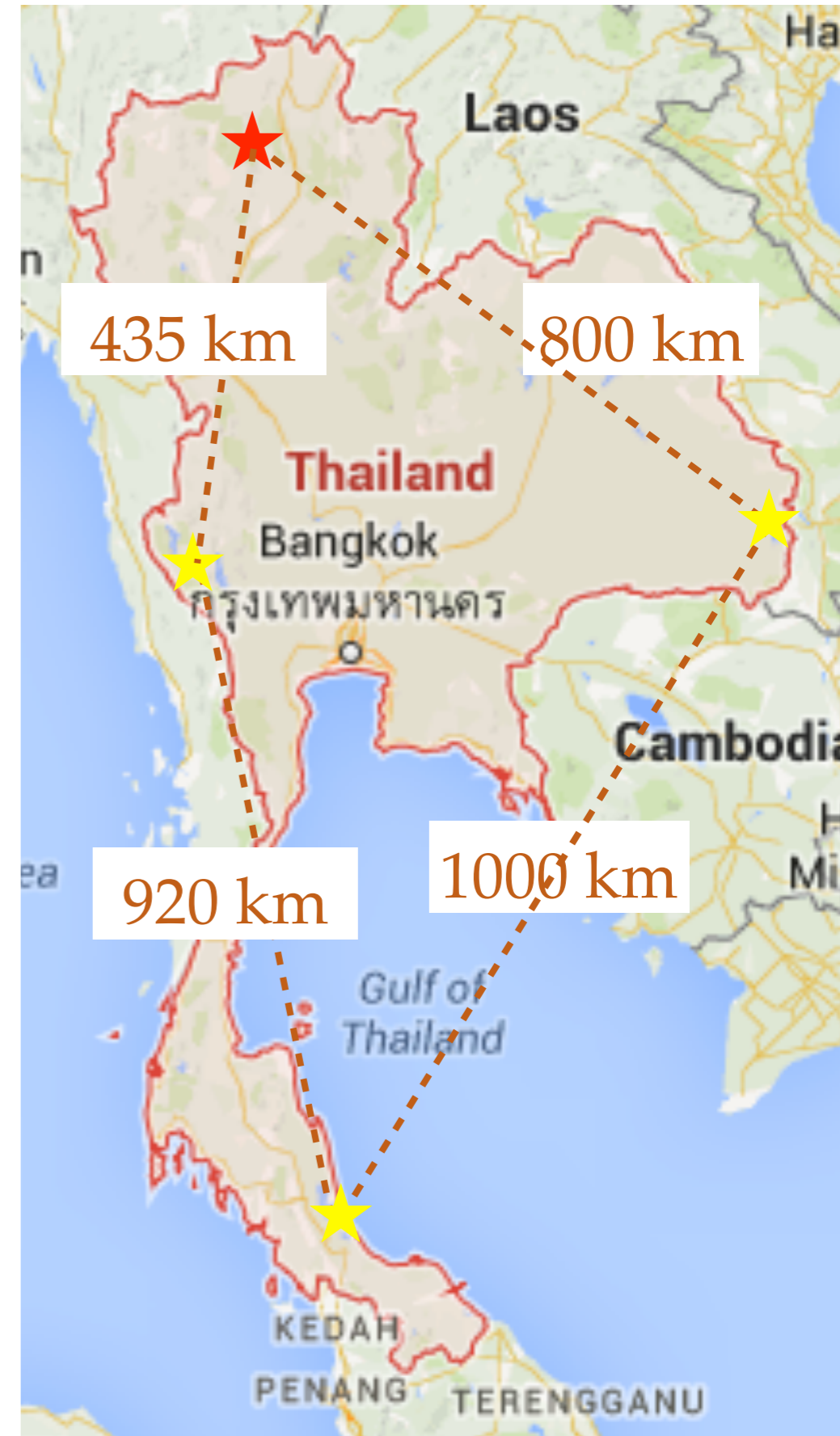
# Thai National Radio Observatory (TNRO)

- 2nd national astronomical facility
- Strategic importance in the SEA region
- (Phase I) ~25m dish
- Operating frequency (<43 GHz?)
- Science: Star-forming regions, AGN, (pulsars)
- Geodetic VLBI: tectonic motion, atmospheric monitoring
- Contribution to EAVN, LBA
- Cabinet Proposal: early 2016



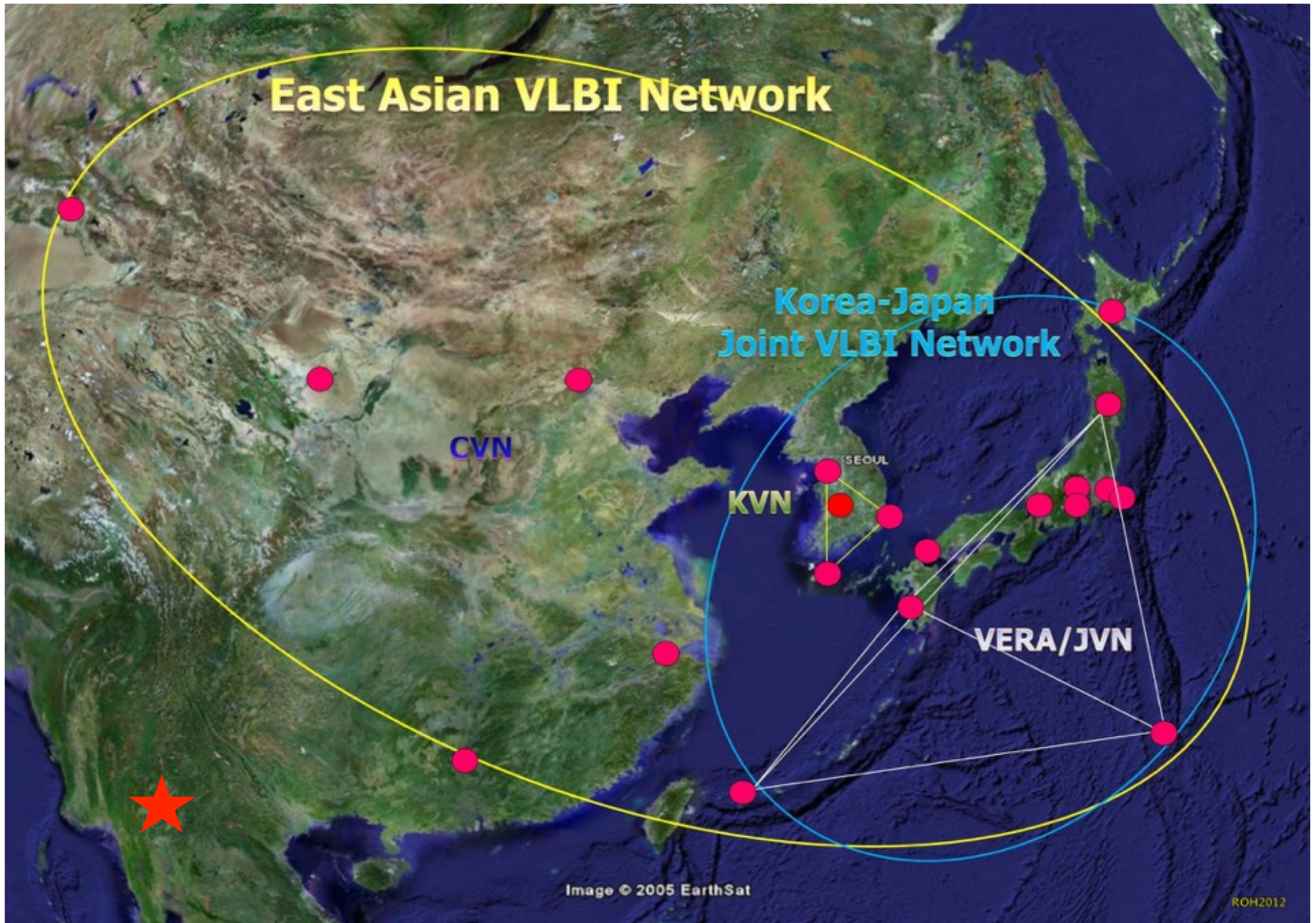
# Thai National Radio Observatory (TNRO)

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- Contribution to EAVN, LBA
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- (Phase II) -> TVN





# Thai National Radio Observatory (TNRO)



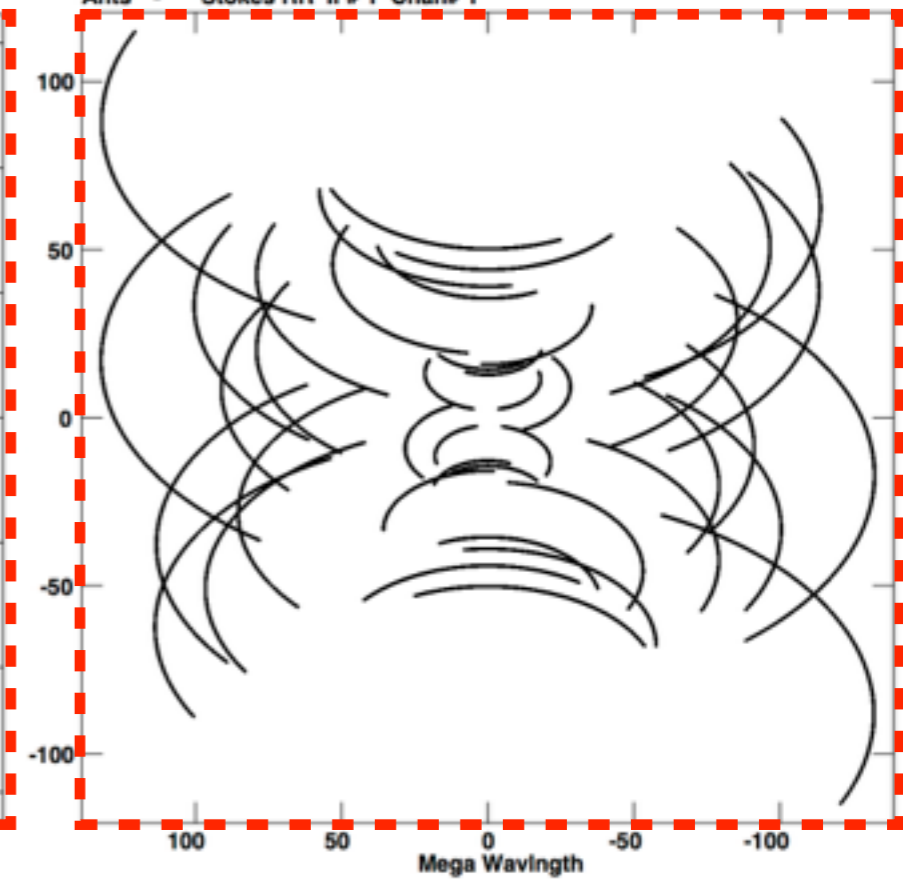
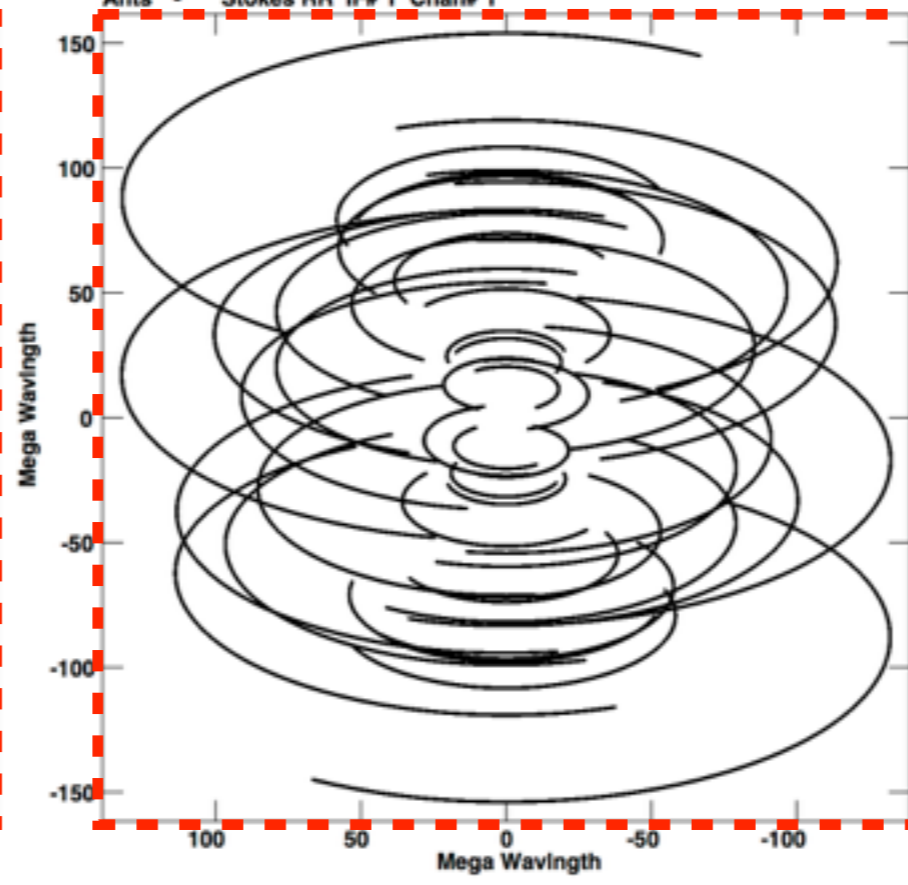
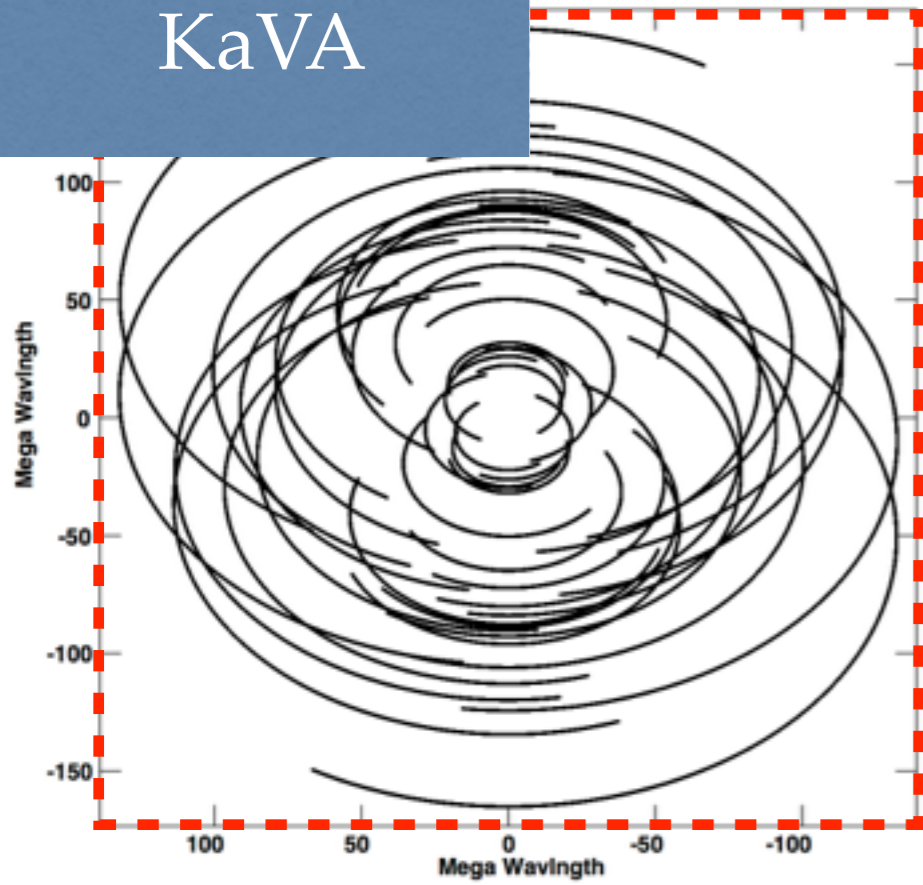
KaVA

19:05:26

e:

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V vs U for KAVA-K+30.UVCON.1 Source:  
Ants \*-\* Stokes RR IF# 1 Chan# 1

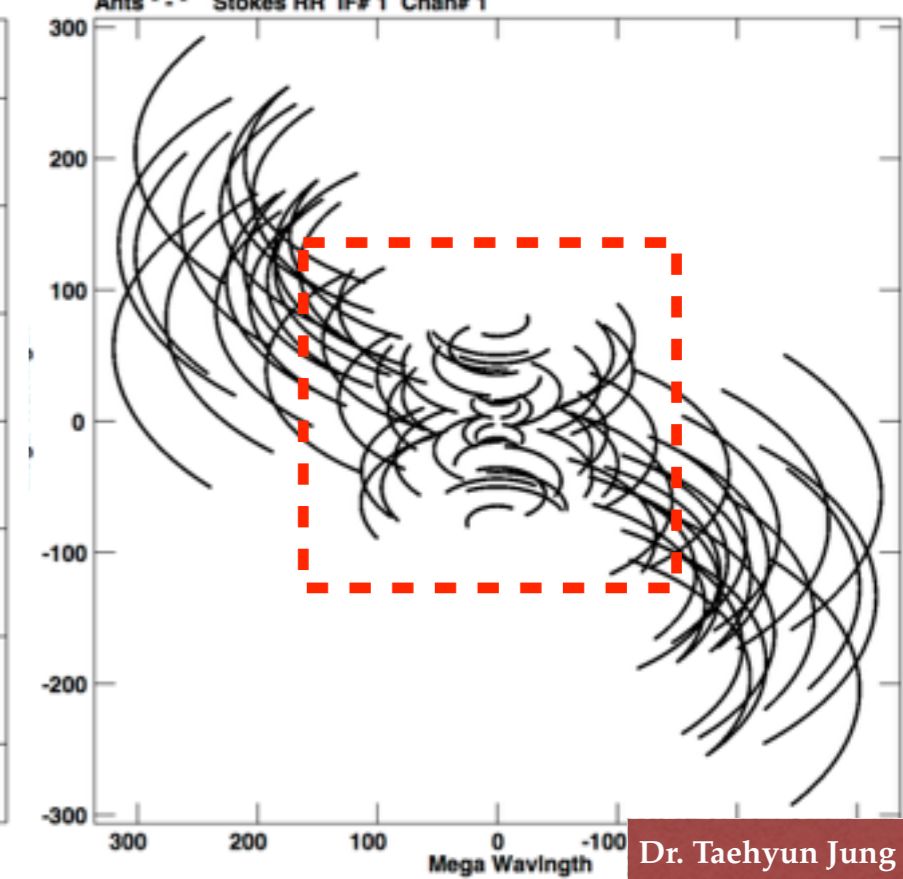
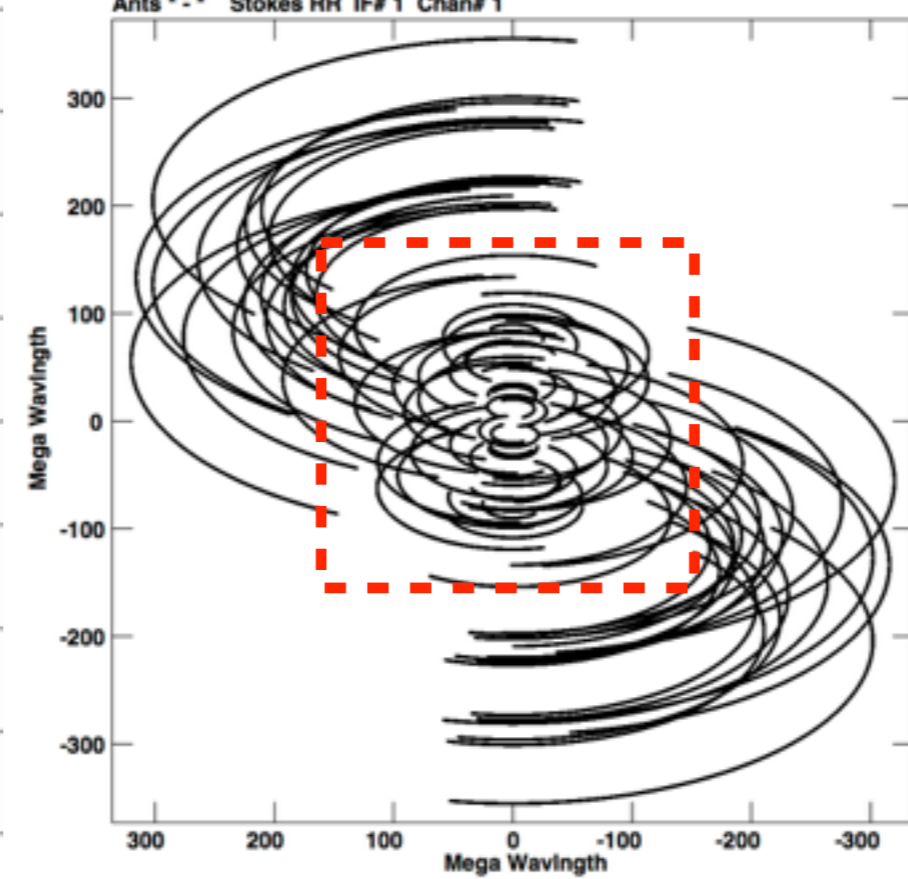
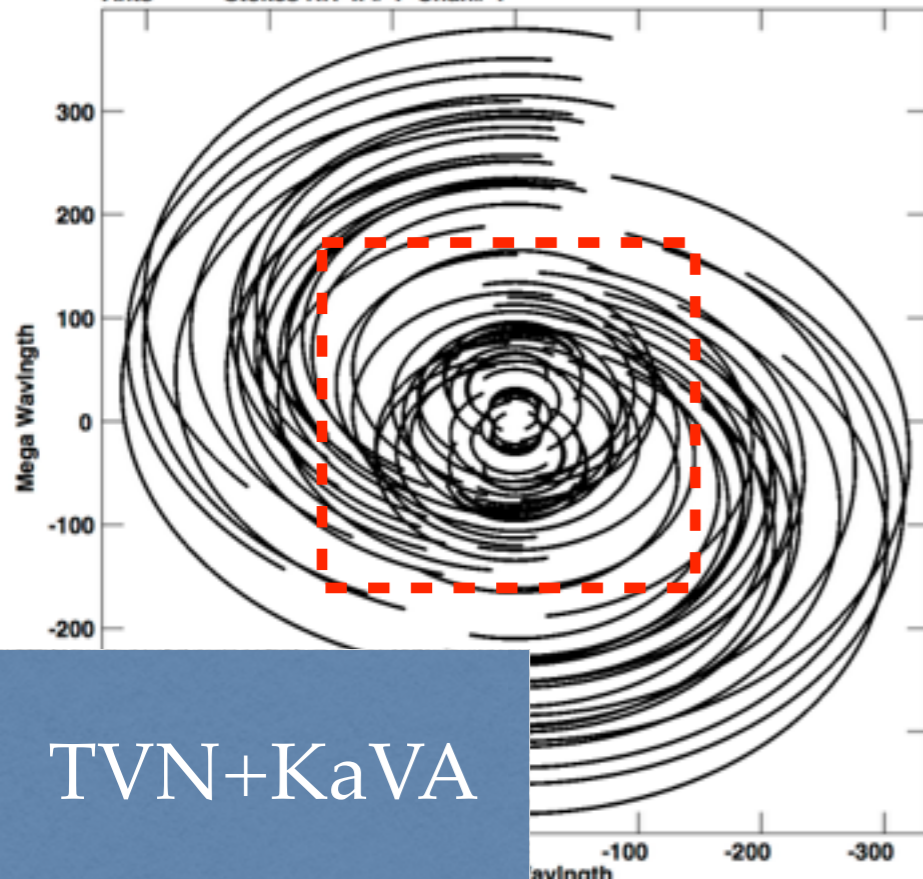
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V vs U for KAVA-K-30.UVCON.1 Source:  
Ants \*-\* Stokes RR IF# 1 Chan# 1



Plot file version 1 created 26-JAN-2015 19:05:35  
V vs U for TKJ-K+60.UVCON.1 Source:  
Ants \*-\* Stokes RR IF# 1 Chan# 1

Plot file version 1 created 26-JAN-2015 19:05:32  
V vs U for TKJ-K+30.UVCON.1 Source:  
Ants \*-\* Stokes RR IF# 1 Chan# 1

Plot file version 1 created 26-JAN-2015 19:05:28  
V vs U for TKJ-K-30.UVCON.1 Source:  
Ants \*-\* Stokes RR IF# 1 Chan# 1



TVN+KaVA

SOUTHEAST ASIA



Australian Long Baseline Array (LBA)

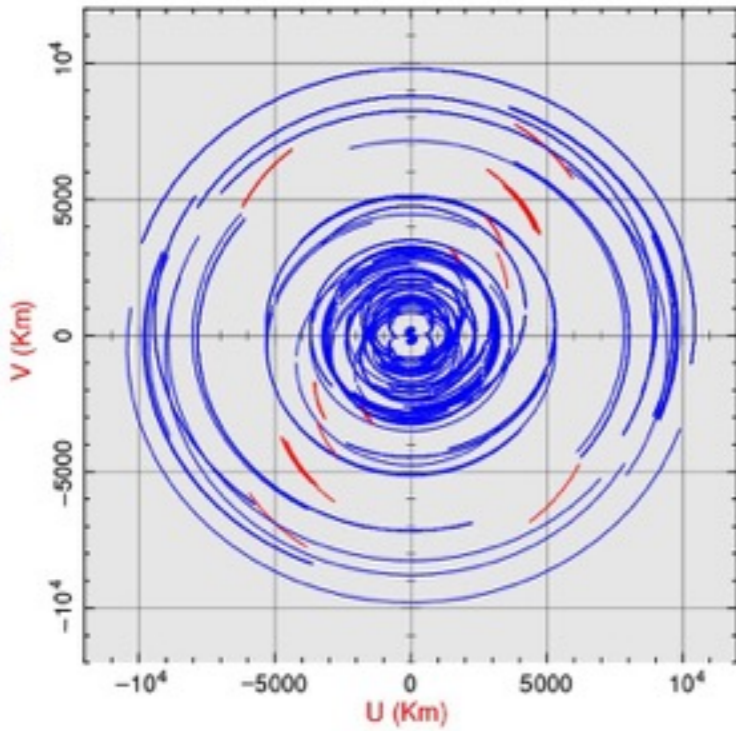


# Thai National Radio Observatory (TNRO)

TVN+LBA

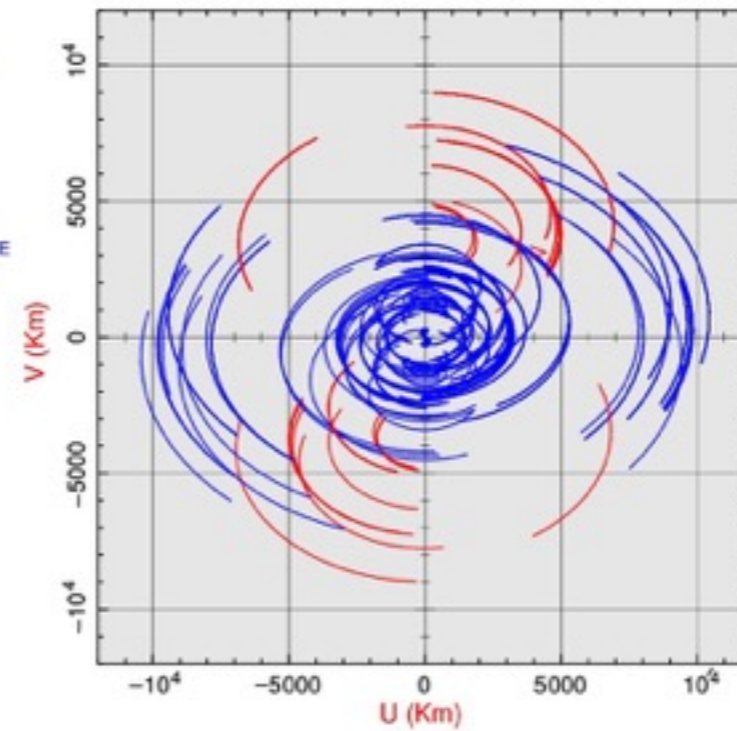
UV Coverage for 1934-638

WARK 12M  
ATCA  
PARKES  
HOBART  
CEDUNA  
MOPRA  
ASKAP  
HART  
THAI  
YARRAGADEE  
KATHERINE  
1934-638



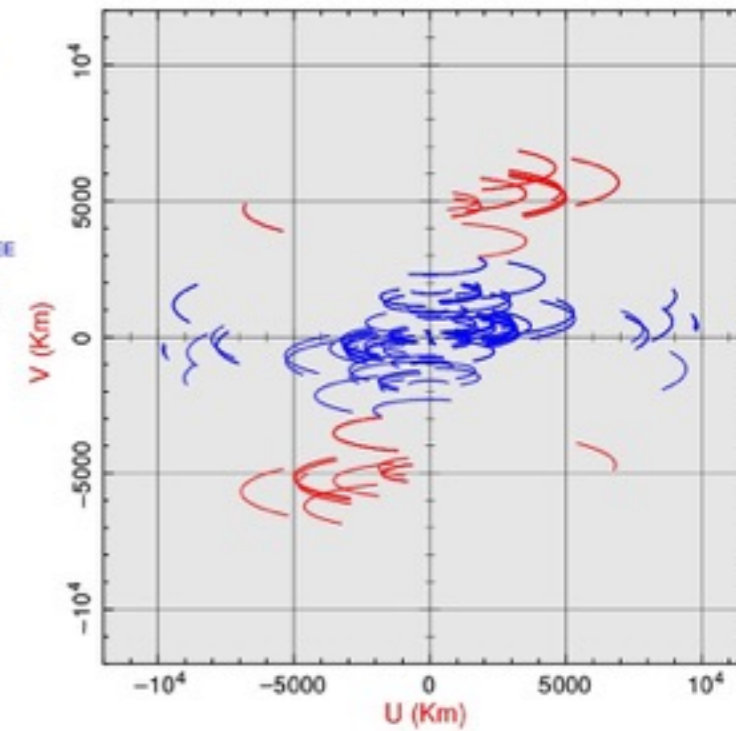
UV Coverage for 0537-441

WARK 12M  
ATCA  
PARKES  
HOBART  
CEDUNA  
MOPRA  
ASKAP  
HART  
THAI  
YARRAGADEE  
KATHERINE  
0537-441



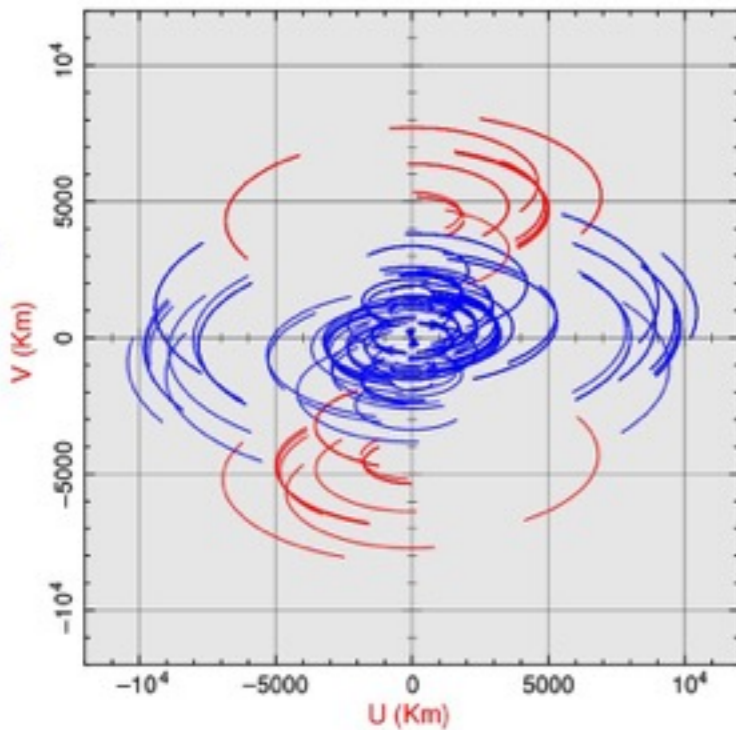
UV Coverage for 0007+106

WARK 12M  
ATCA  
PARKES  
HOBART  
CEDUNA  
MOPRA  
ASKAP  
HART  
THAI  
YARRAGADEE  
KATHERINE  
0007+106



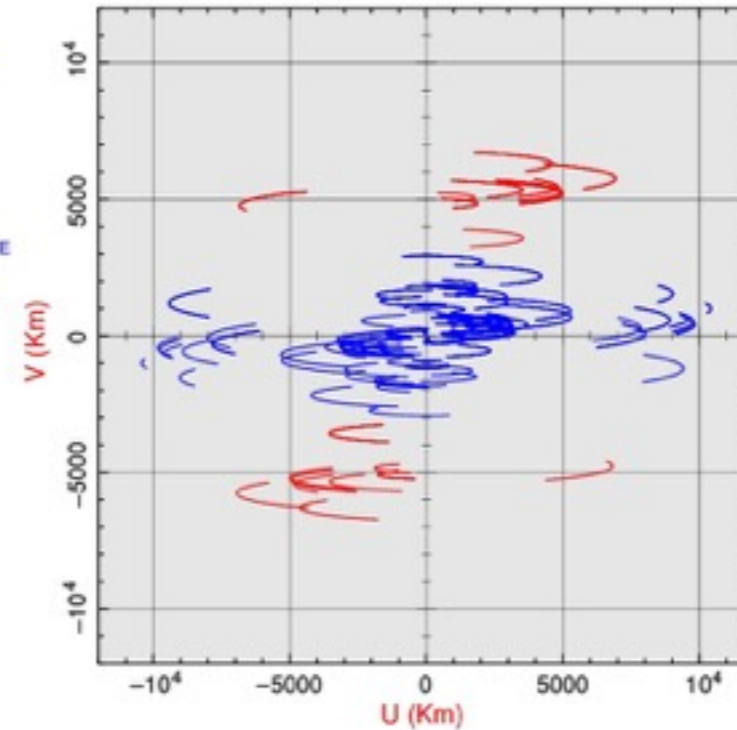
UV Coverage for 0008-264

WARK 12M  
ATCA  
PARKES  
HOBART  
CEDUNA  
MOPRA  
ASKAP  
HART  
THAI  
YARRAGADEE  
KATHERINE  
0008-264



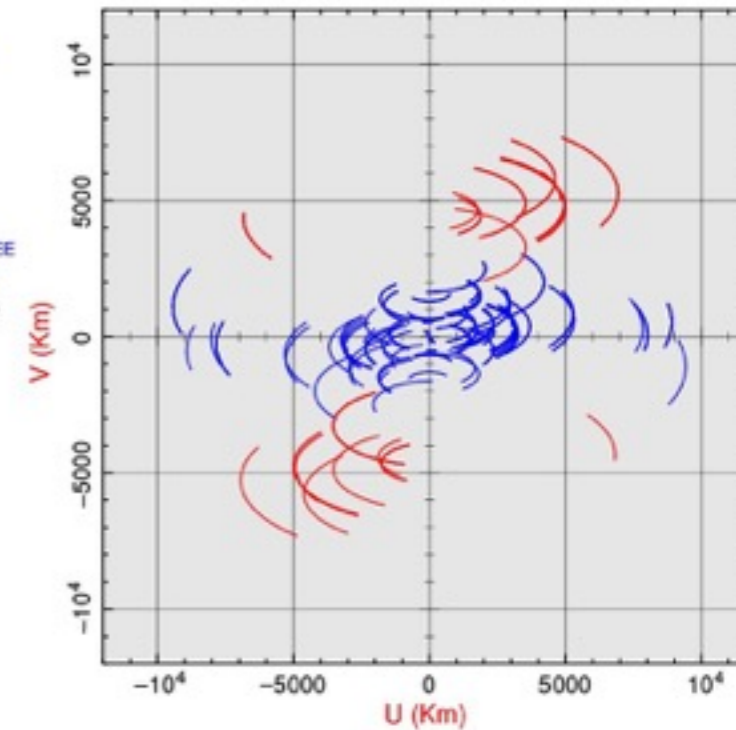
UV Coverage for 0539-057

WARK 12M  
ATCA  
PARKES  
HOBART  
CEDUNA  
MOPRA  
ASKAP  
HART  
THAI  
YARRAGADEE  
KATHERINE  
0539-057



UV Coverage for 0004+240

WARK 12M  
ATCA  
PARKES  
HOBART  
CEDUNA  
MOPRA  
ASKAP  
HART  
THAI  
YARRAGADEE  
KATHERINE  
0004+240



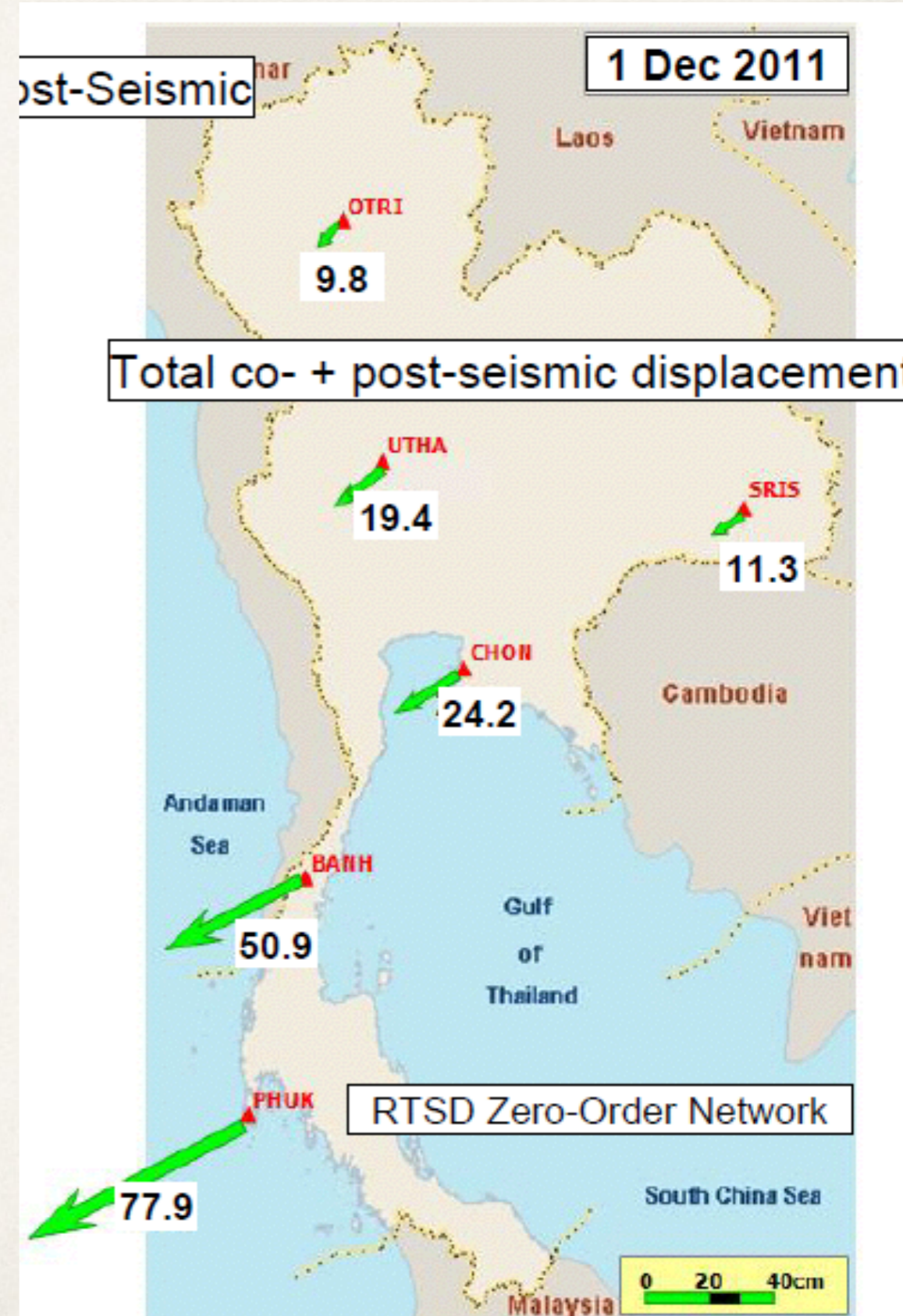
# Thai National Radio Observatory (TNRO)

- NARIT workshop on Geodesy and Radio Astronomy, August 2015
  - Royal Thai Survey Department
    - National Geodetic Network
    - Crustal movement, land subsidies
  - GEO2TECDI (GNSS, InSAR, SALT)
  - National Institute of Metrology of Thailand



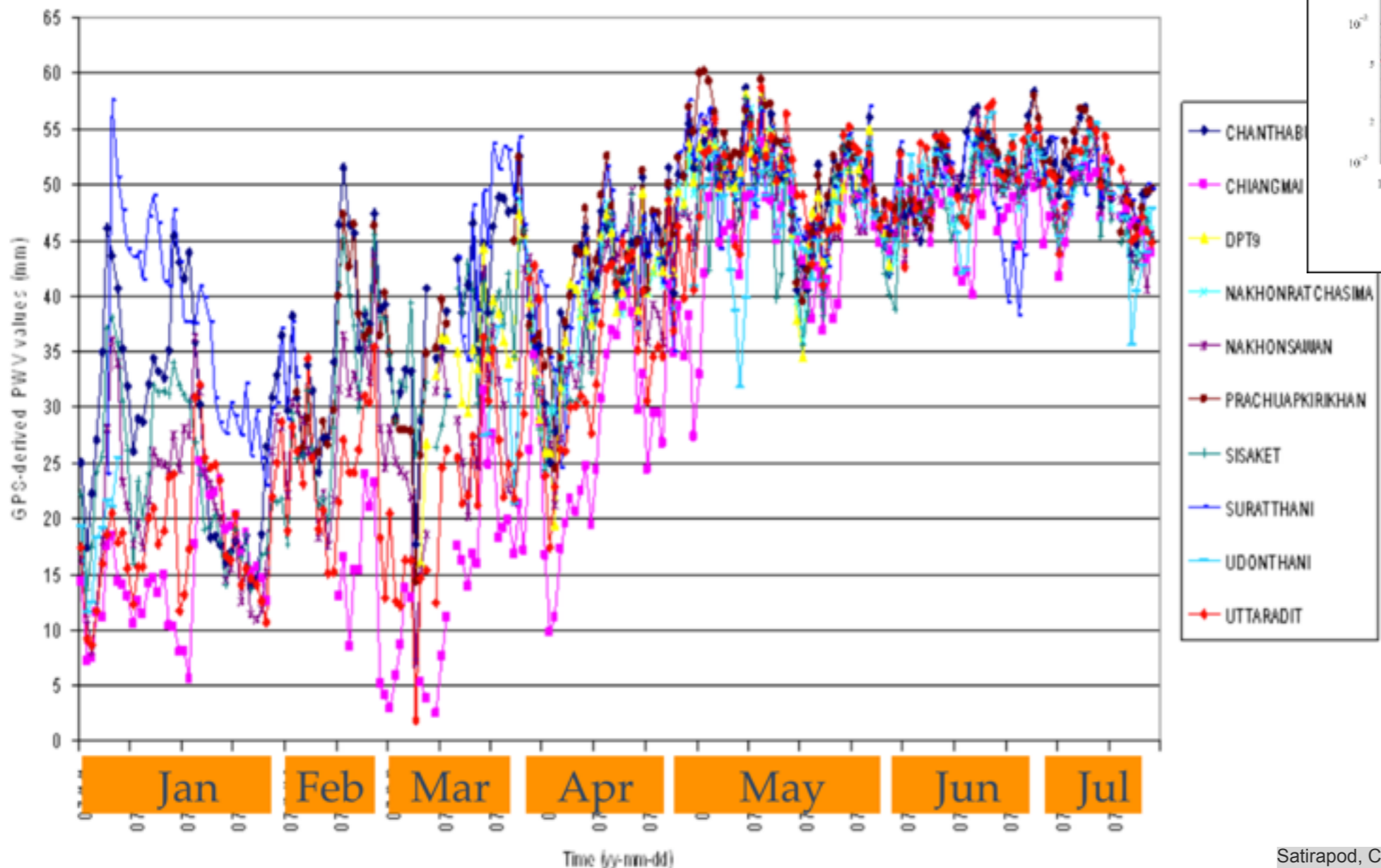
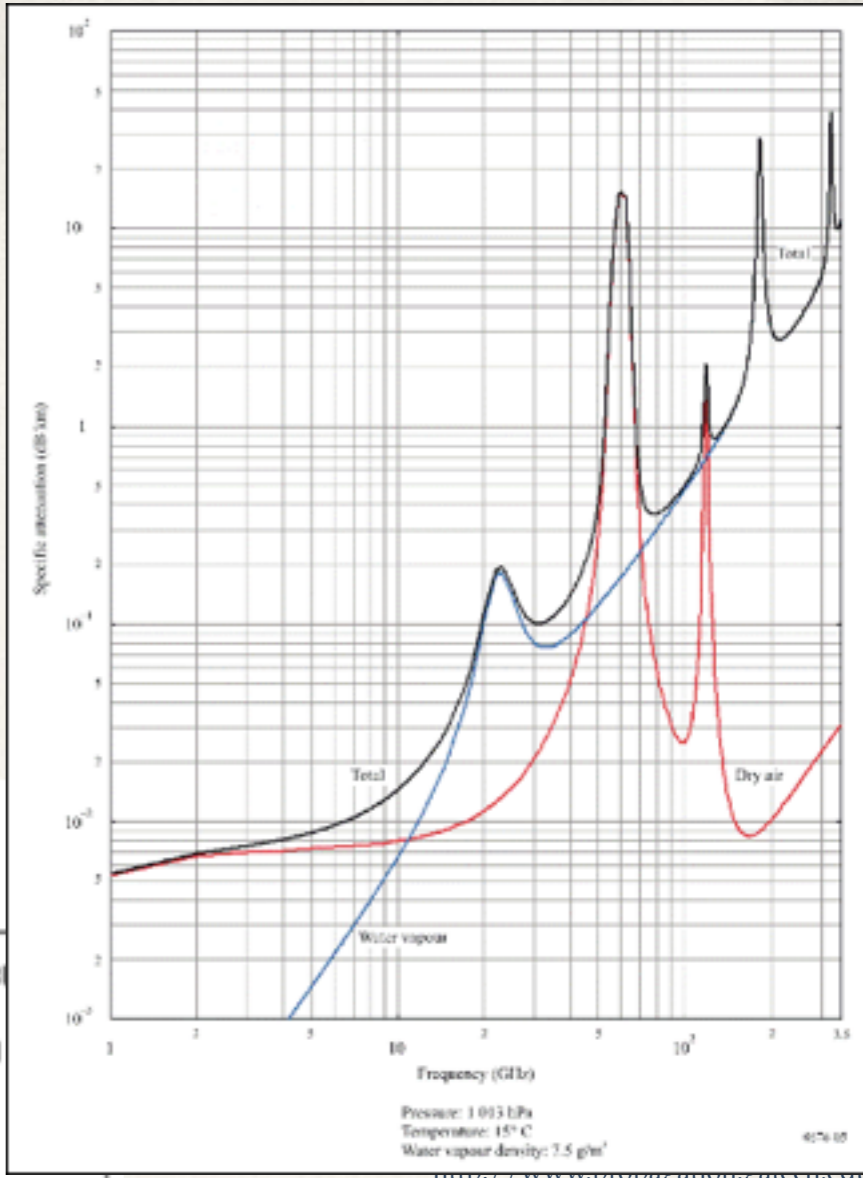
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# Precipitable Water Vapour:

- H<sub>2</sub>O molecular rotational band at 22 GHz
- GPS (Microwave Radiometer, Radiosondes...)
  - Zenith Time Delay due to Refraction & Scattering
- Department of Royal Rainmaking and Agricultural Aviation



# Timeline:

<b>SRTs</b>	<ul style="list-style-type: none"><li>• Pulsar observation</li><li>• Tied-array with 2 SRTs</li></ul>	2016 2016
<b>RF survey</b>	<ul style="list-style-type: none"><li>• Permanent RF monitoring station 24/7</li><li>• Microwave radiometer</li></ul>	early 2016 mid 2016
<b>Thai National Radio Observatory</b>	<ul style="list-style-type: none"><li>• Telescope specifications / Site decision</li><li>• Cabinet proposal</li><li>• Contract signing</li><li>• Construction</li><li>• Operational</li></ul>	2015 early 2016 2017 2018-2020 2021



Thank you

