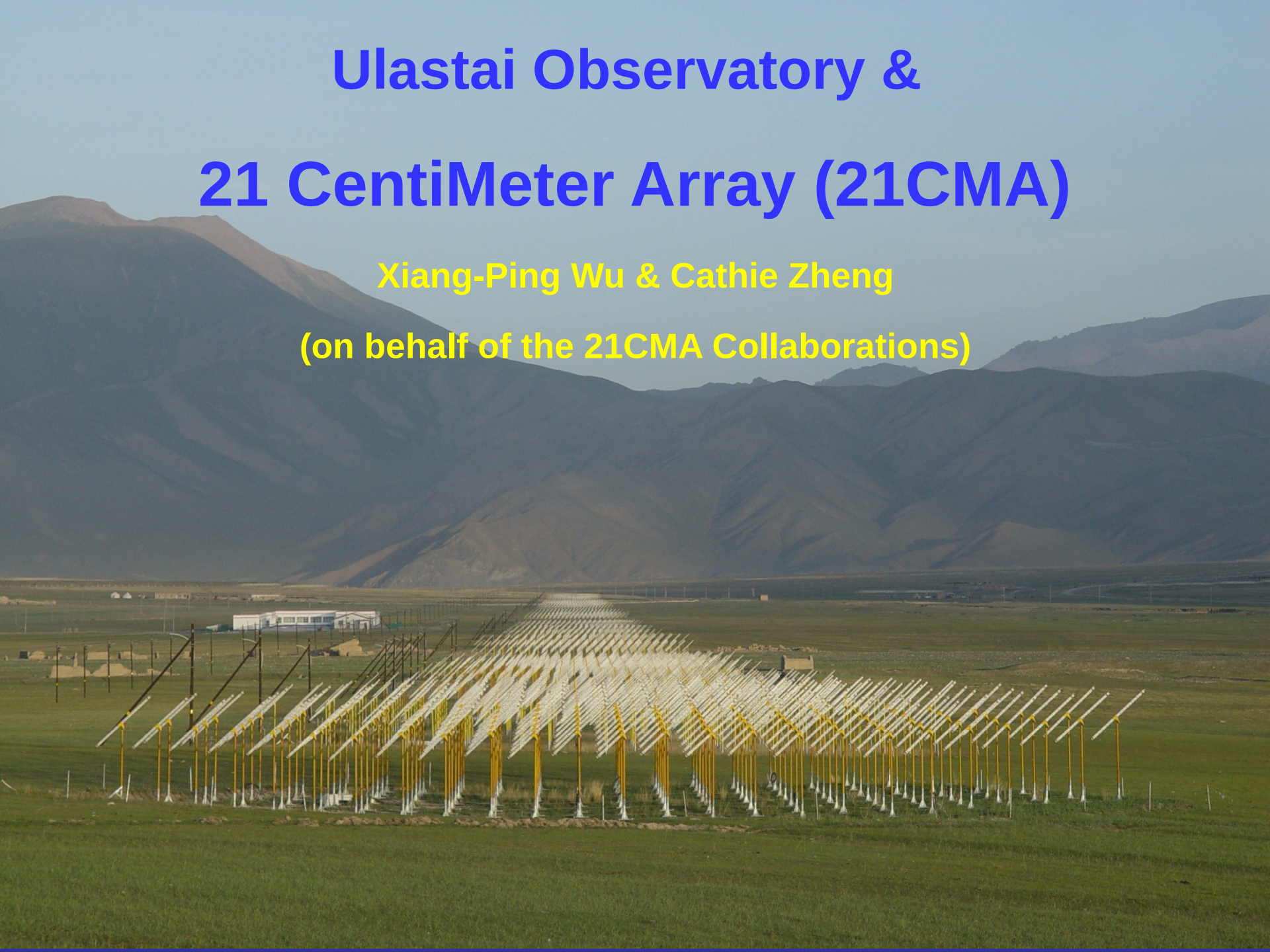


# Ulaistai Observatory & 21 CentiMeter Array (21CMA)

Xiang-Ping Wu & Cathie Zheng  
(on behalf of the 21CMA Collaborations)





A large radio telescope array, likely the Arecibo radio telescope, is shown in silhouette against a dramatic sunset sky. The sky is filled with scattered clouds, and the sun is low on the horizon, creating a warm, golden glow. The telescope's structure consists of numerous long, parallel metal beams extending from a central point towards the horizon, creating a strong sense of perspective. The overall scene is dark, with the primary light source being the setting sun.

**1. A historic review**

**2. Infrastructure**

**3. 21CMA observations**

**4. Future plan**

**5. About the site**



A large array of radio telescope antennas, likely the Arecibo radio telescope, silhouetted against a sunset sky. The antennas are arranged in a grid pattern, and the sky is filled with clouds illuminated by the setting sun.

**1. A historic review**

**2. Infrastructure**

**3. 21CMA observations**

**4. Future plan**

**5. About the site**



# Where is the site ?

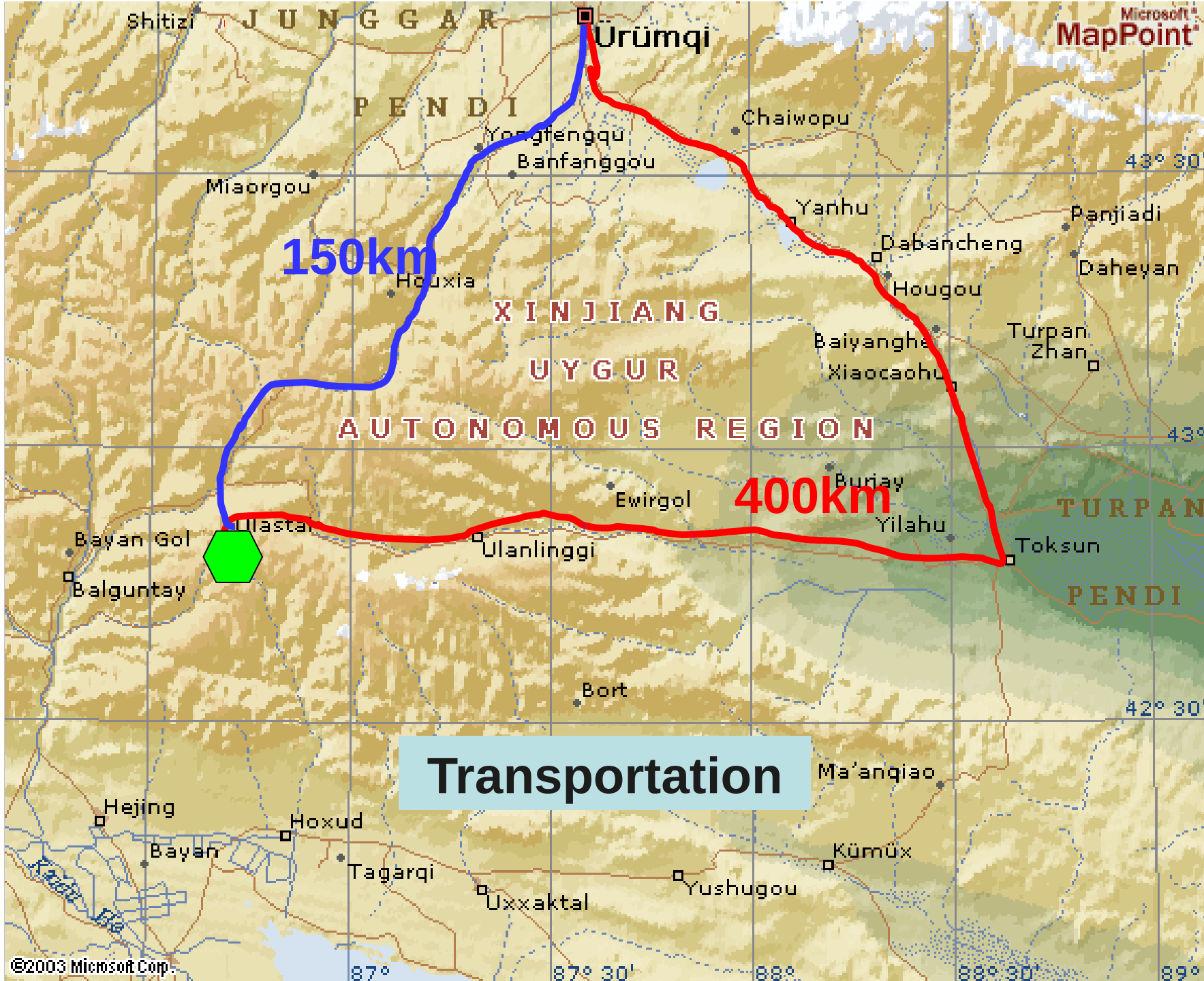




# 21CMA Site







# Transportation



# Tianshan mountains (4280m)



**A shorter way to Ulatai**



# A shorter way to Ulastai



August 13 2007

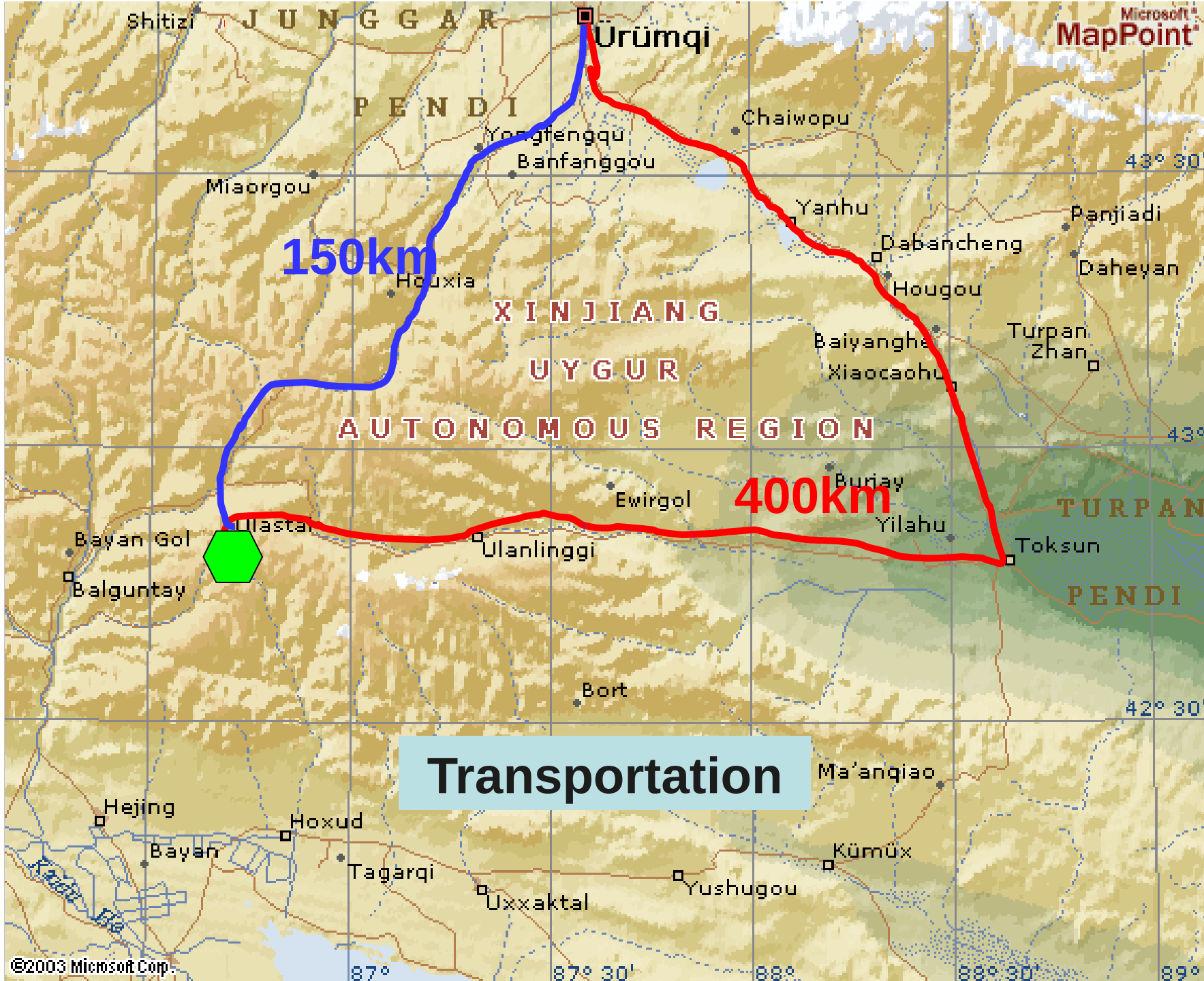


Tiger's mouth

8-12  
-15







150km

400km

Transportation



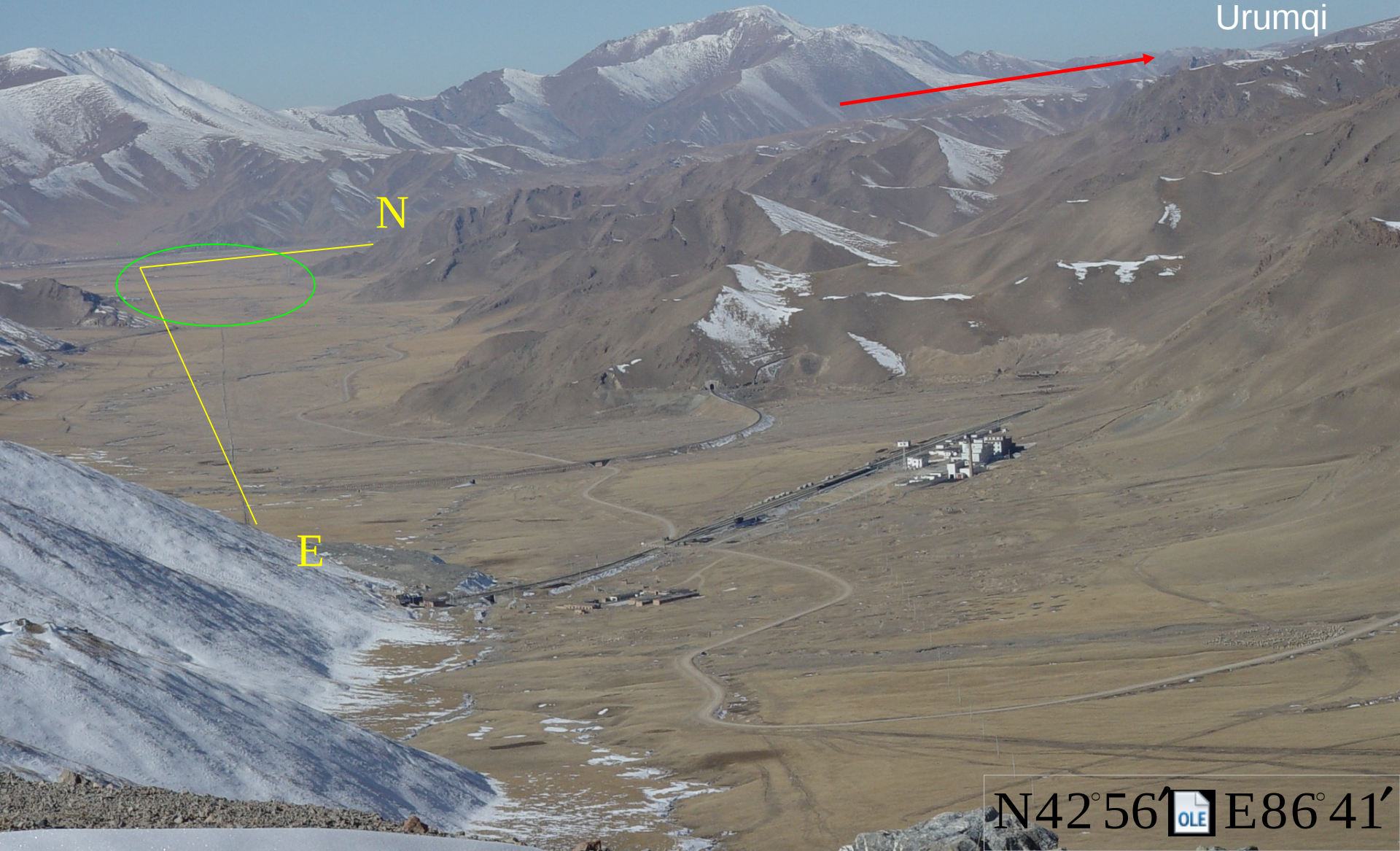


**A longer way to Ulaistai**



# Ulastai Valley : 2700m

Urumqi



N

E

N42°56'  E86°41'



# Ulastai Valley





Mkr1 113.750 MHz  
-100.7 dBm

Ref -5 dBm

#Atten 5 dB

Peak  
Log  
10  
dB/

Radio Frequency Interference at Ulastai

Marker  
113.750000 MHz  
-100.7 dBm

W1 S2  
S3 FC

50MHz

200MHz

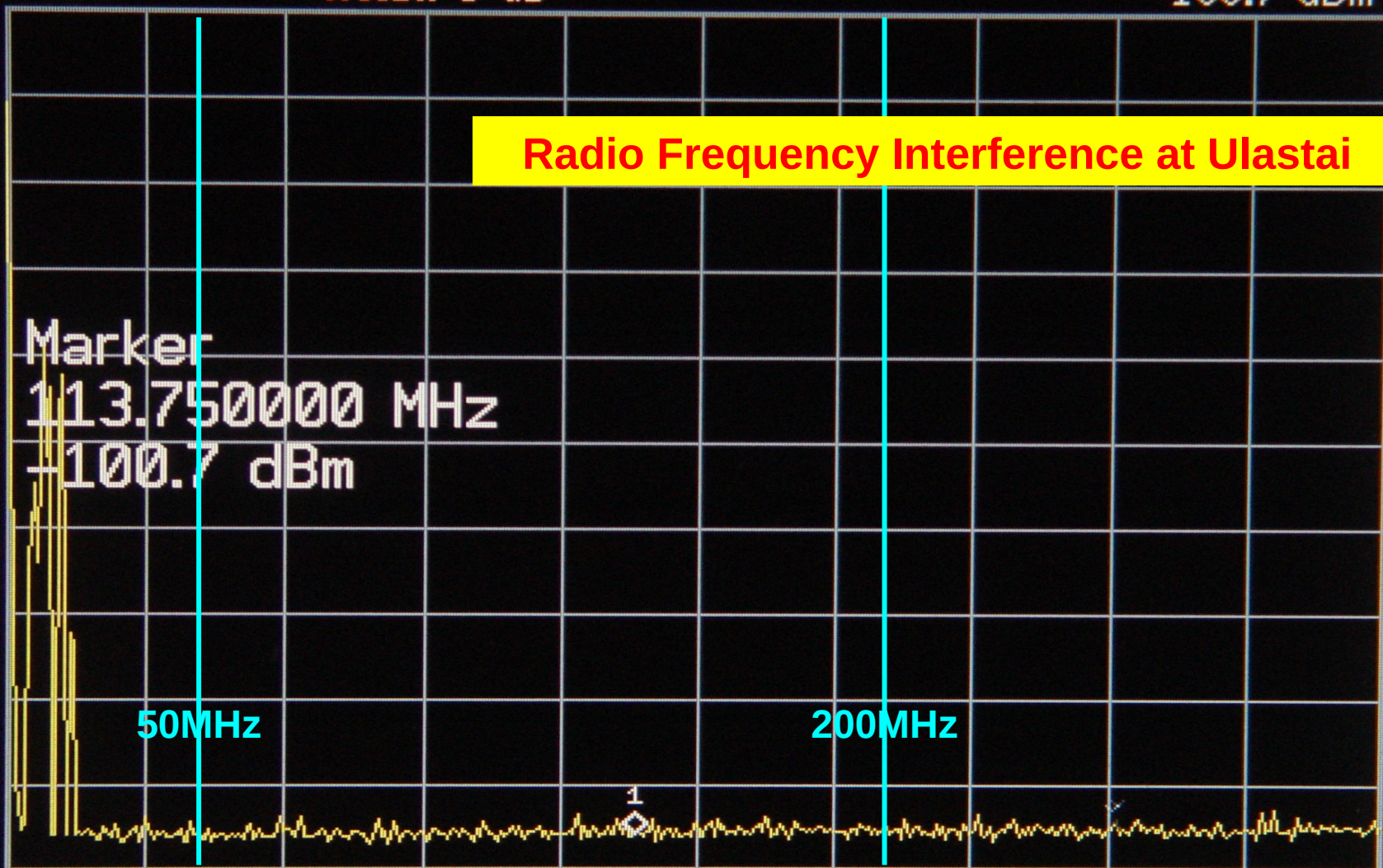
Start 0 Hz

Stop 250 MHz

#Res BW 3 kHz

VBW 3 kHz

Sweep 35.79 s (401 pts)





Mkr1 99.125 MHz  
-38.17 dBm

Ref -41 dBm #Atten 5 dB

Peak  
Log  
5  
dB/

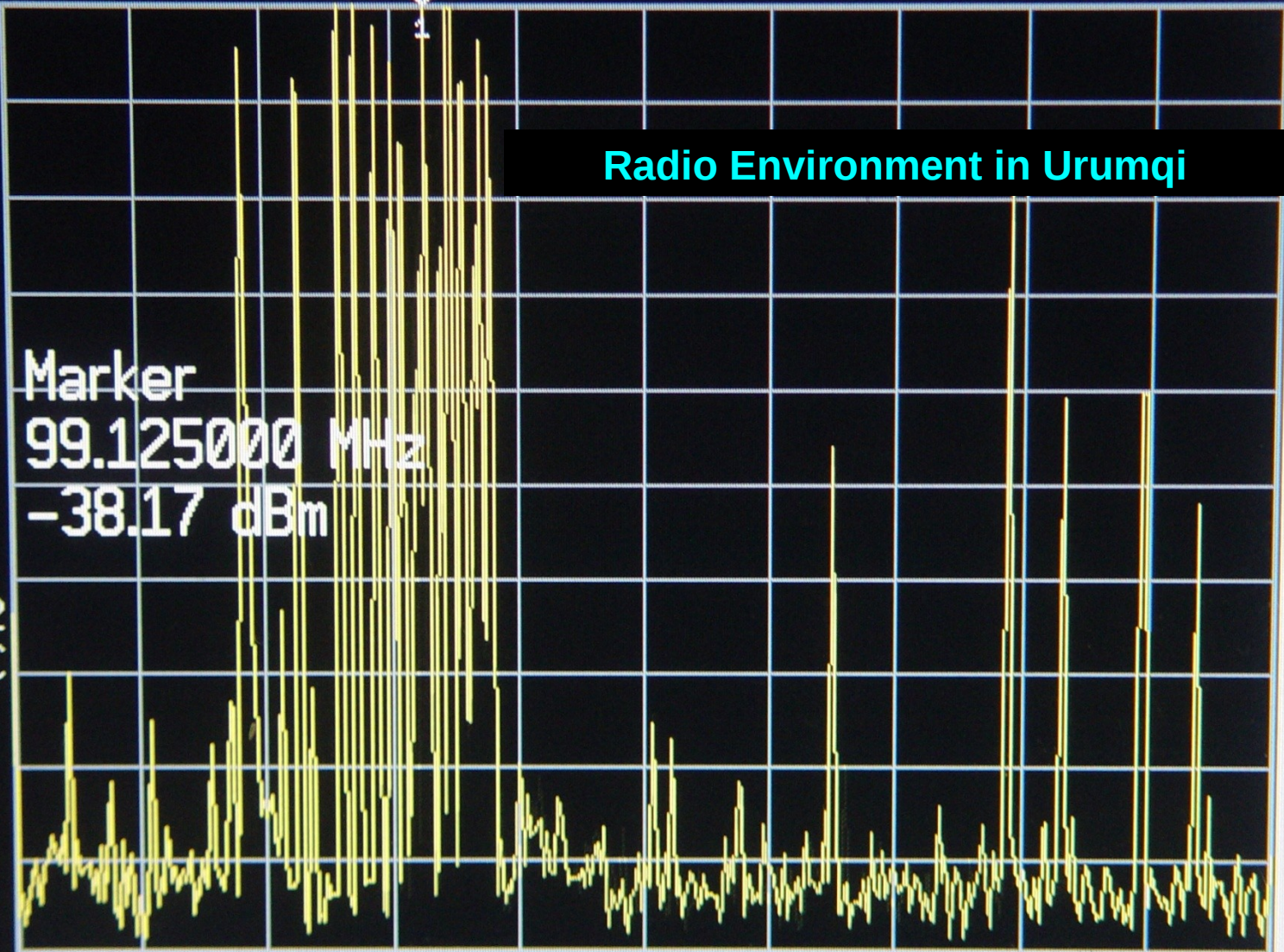
Radio Environment in Urumqi

Marker  
99.125000 MHz  
-38.17 dBm

M1 S2  
S3 FC

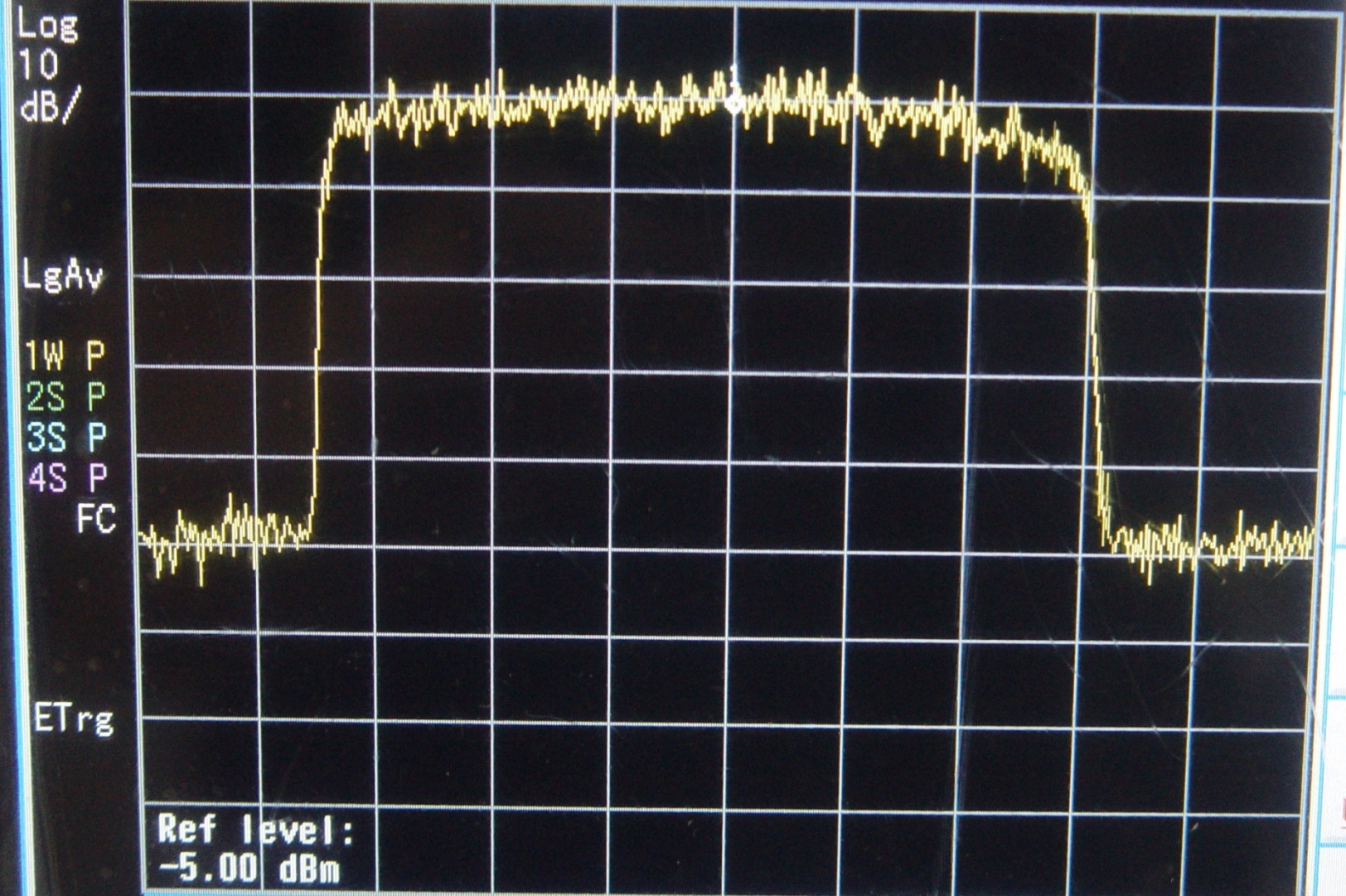
Start 50 MHz Stop 200 MHz  
Res BW 100 kHz VBN 10 kHz Sweep 122.8 ms (401 pts)

- Peak Search
- Measurements
- Next Peak
- Next Peak Right
- Next Peak Left
- Min Search
- Pk-Pk Search





Ref: -5.00 dBm #Att: 15 dB M1: 130.0 MHz -15.97 dBm



Ref L -5.00

Attenua 15

Auto

Pre

Off

Scale/D

Scale ty

Log

HiSensitivity

Off

More

1 of

Start: 10.000000 MHz Stop: 250.000000 MHz

Res BW: 1.000000 MHz VBW: 1.000000 MHz Sweep: 96.78 ms

[F] Mixer Saturate





**Setup of 23pods(2921 antennas), Jan.15, 2005**



**21CMA @ April 2005**





# 21CMA: North-South Baseline Construction (July 2005)





**Construction in progress, January 2006**





**June 2006: construction completed**

**81 pods of 127 each -> 10287**

**Physical area : 50544m<sup>2</sup>**

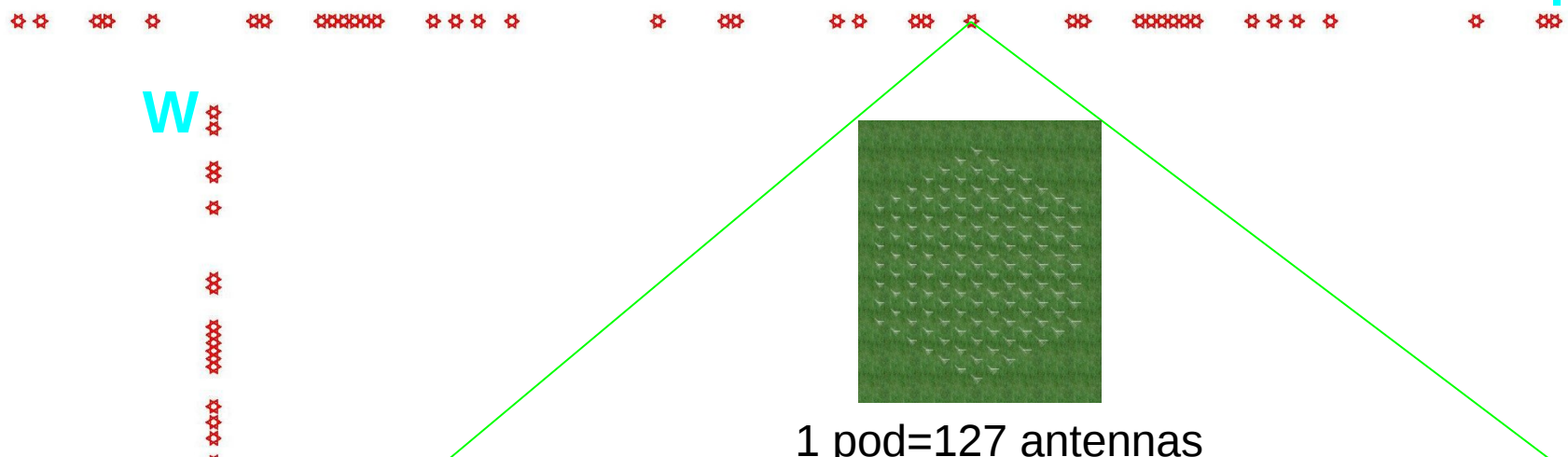




S

N

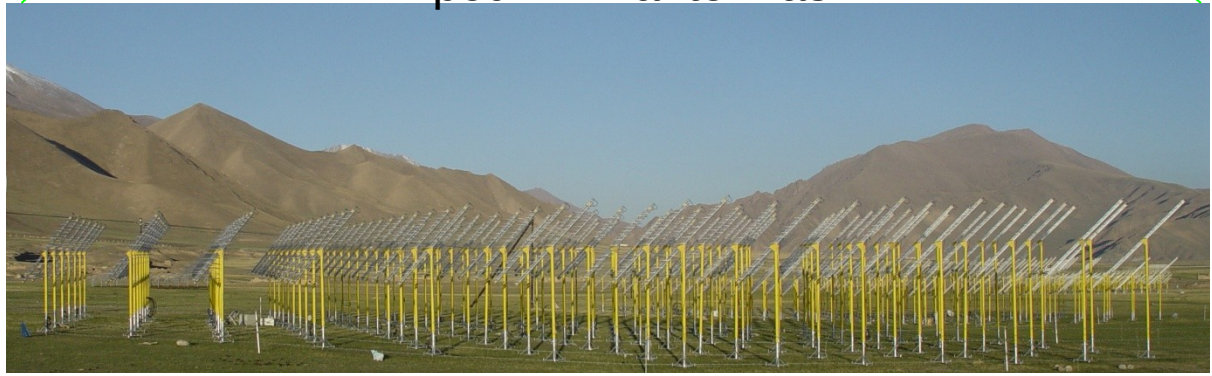
W



1 pod=127 antennas



control room



21CMA Layout

81 pods along two perpendicular arms (6km+4km)

E

Baselines: 3240

Channels: 8192

Correlations: 26,542,080



# Log Periodic Antenna (16 pairs of wire)



**Frequencies: 50 — 200 MHz**



Ref -15 dBm

#Atten 0 dB

Mkr1 164.4 MHz  
-26.15 dBm

Peak  
Log  
5  
dB/

Meas To

System, Alignments, Align Now, All required

Next P

Marker  
164.400000 MHz  
-26.15 dBm

Next Pk Ri

Next Pk L

M1 S2  
S3 FC

Min Search

Pk-Pk Search

75

200

Start 50 MHz

Stop 300 MHz

#Res BW 100 kHz

VBW 100 kHz

Sweep 32.21 ms (401 pts)

M  
1



# 21CMA consists of 81 stations or pods



Log-Periodic  
Antenna

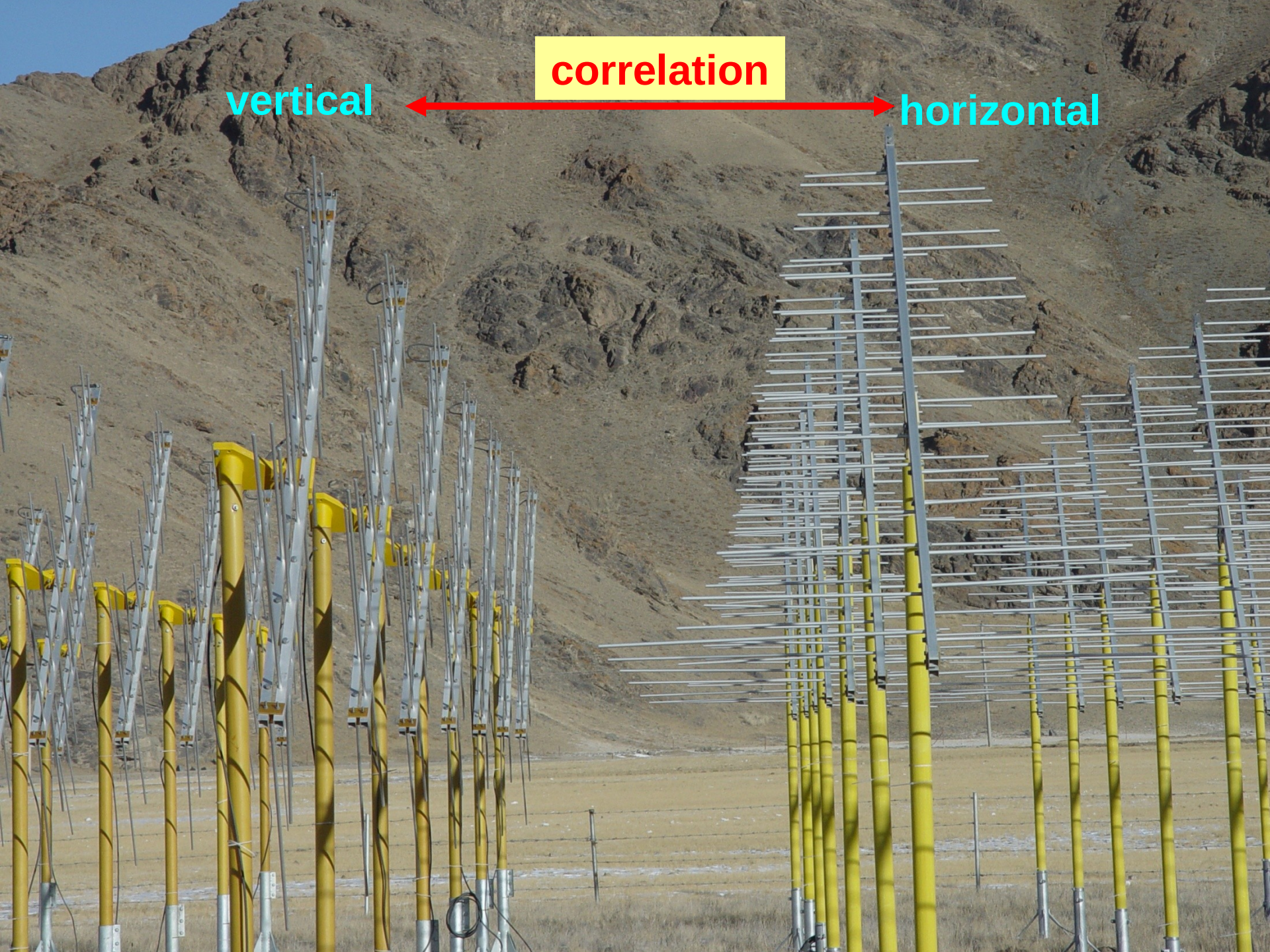




vertical

correlation

horizontal





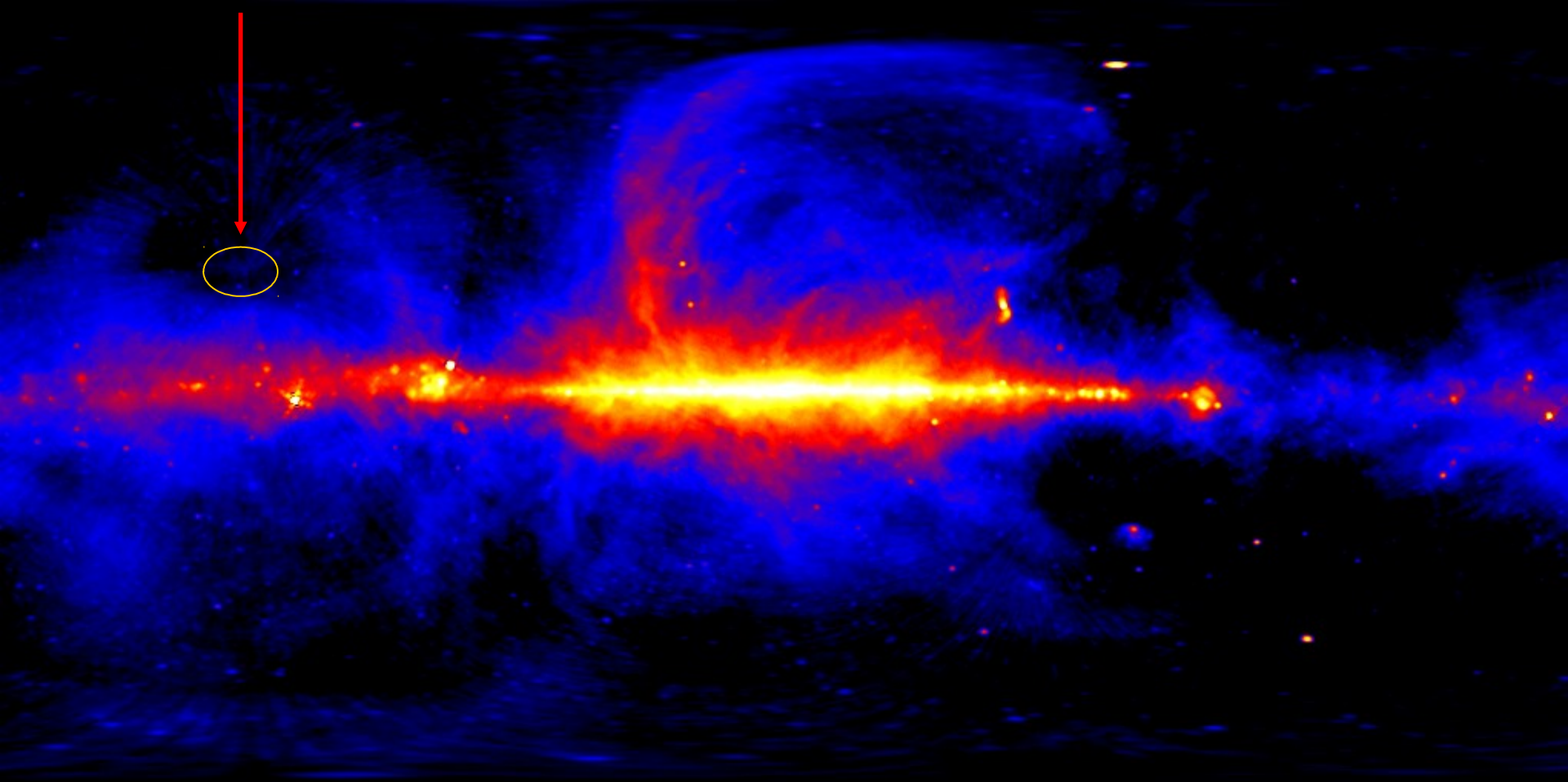
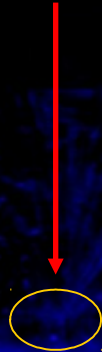
# Dual Polarization Antennas





# VHF Sky (408 MHz)

21CMA



Points at NCP only – economical reason and simplicity



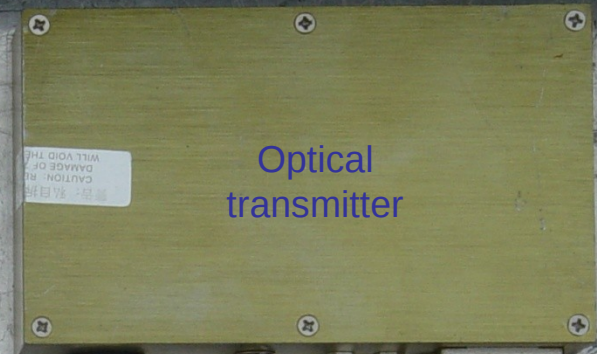


**(pre) LNA  
(20dB, 50K)**

**power** →



# 21CMA RECEIVER BOARD



filter  
50 —  
200

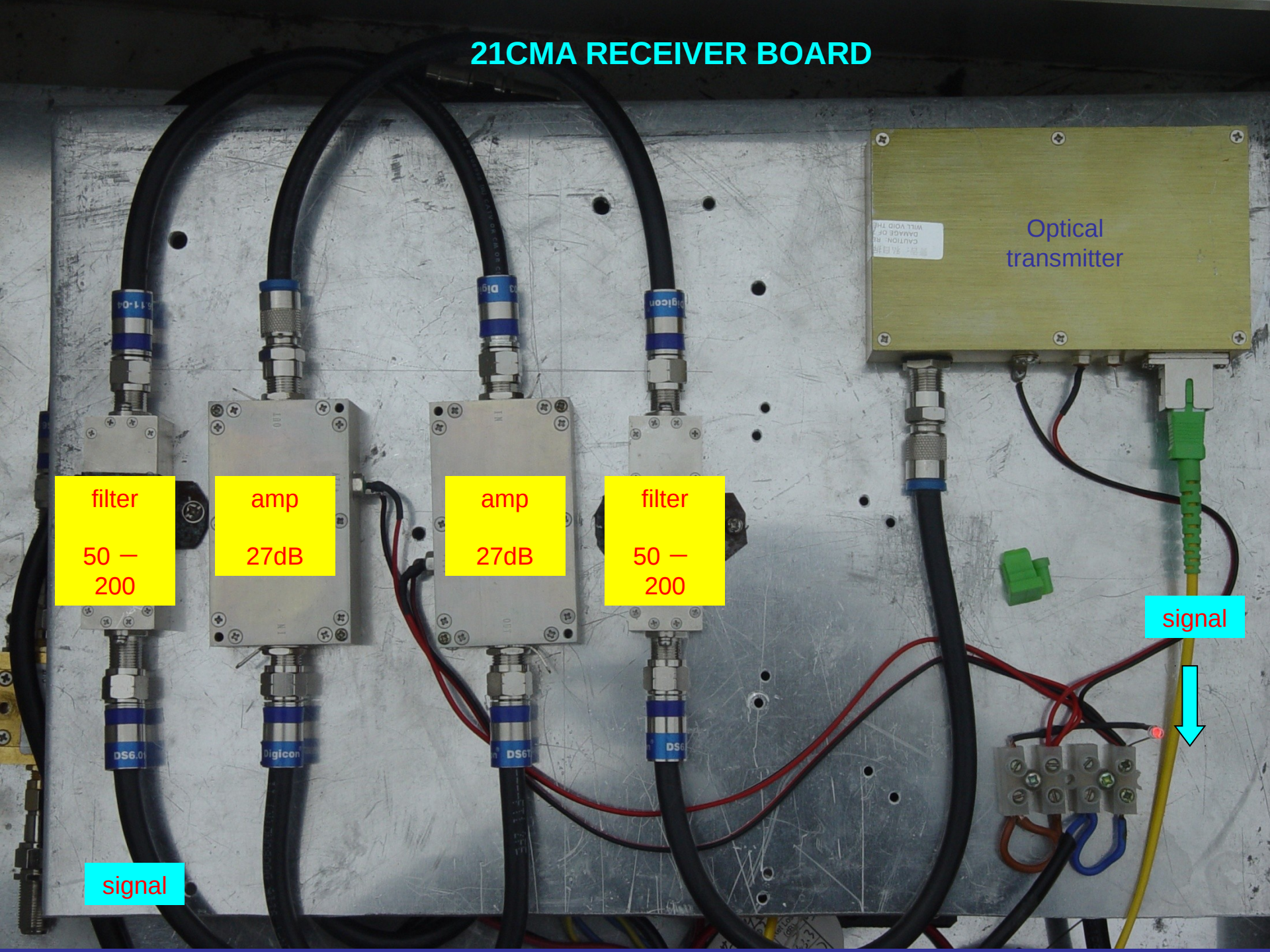
amp  
27dB

amp  
27dB

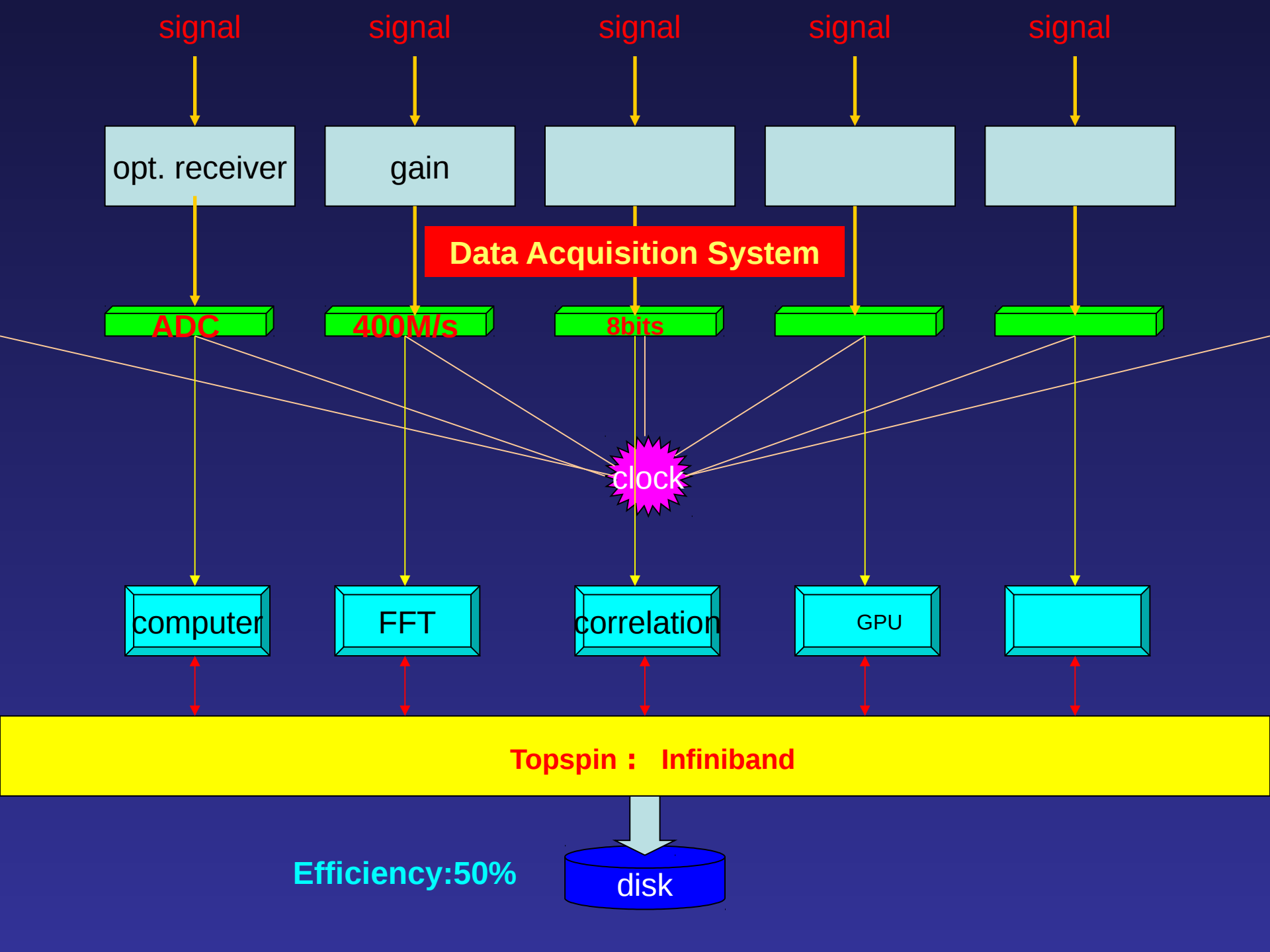
filter  
50 —  
200

signal

signal

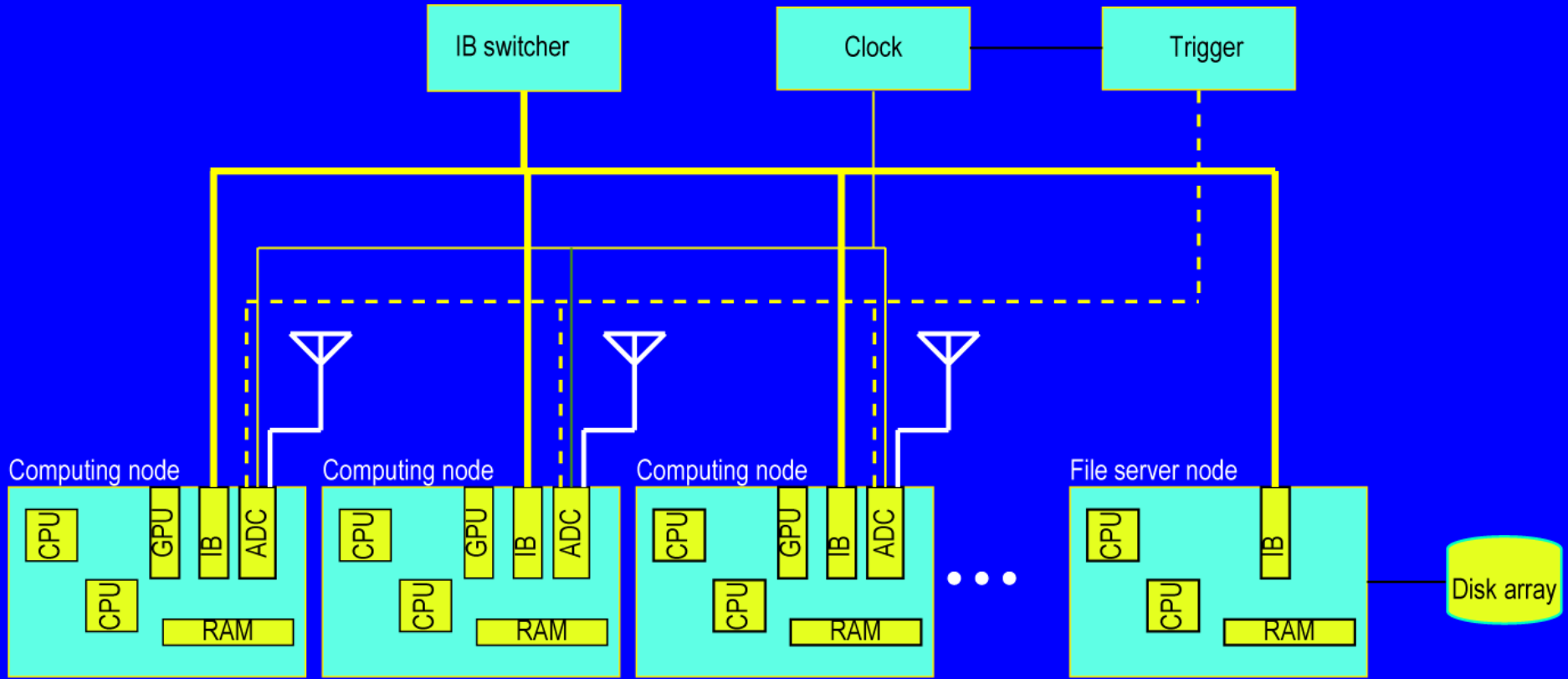








# Data Communication



Efficiency:50%

32G/s



# Optical Receivers







# 21CAM Data Acquisition System

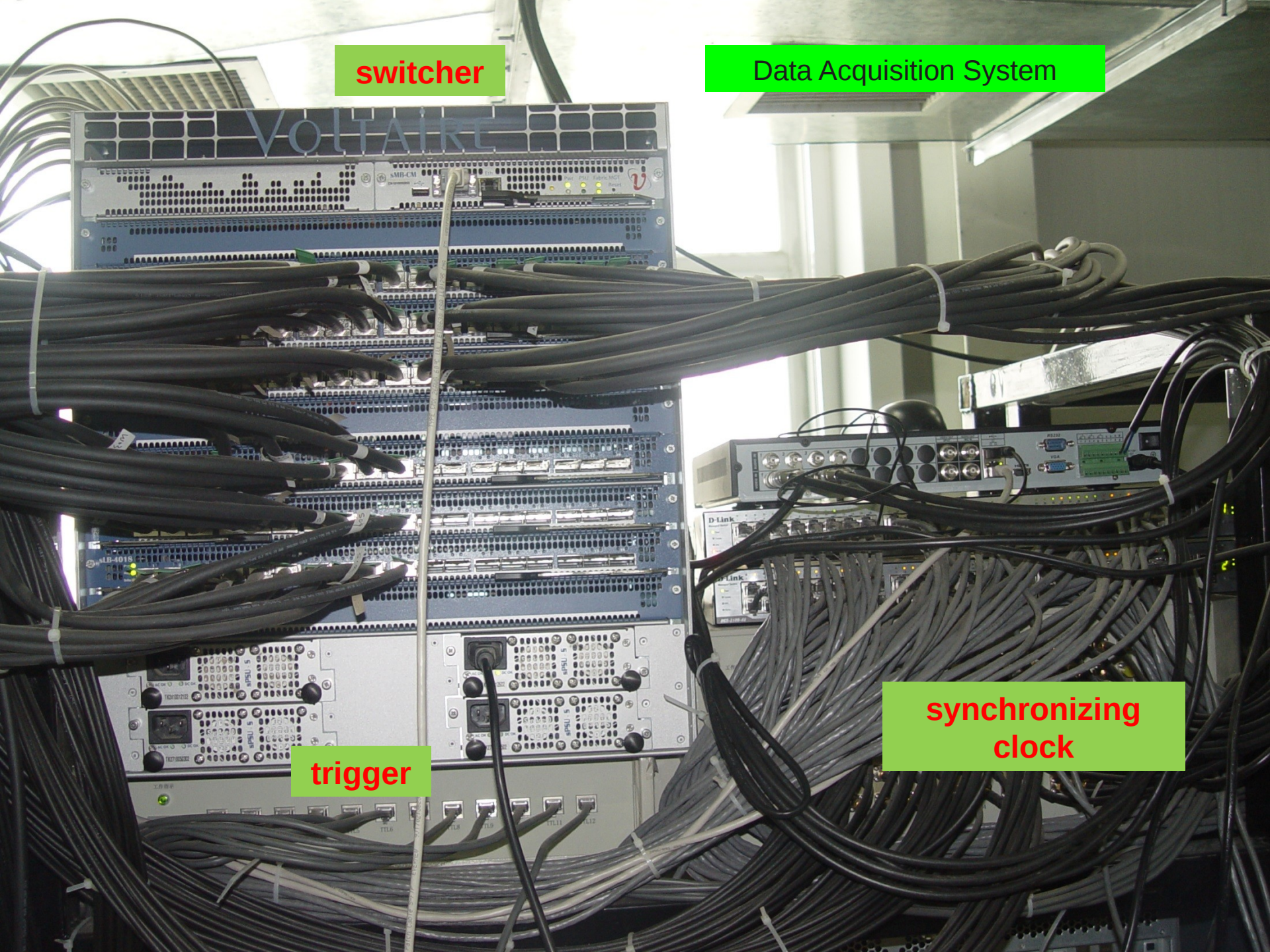


switcher

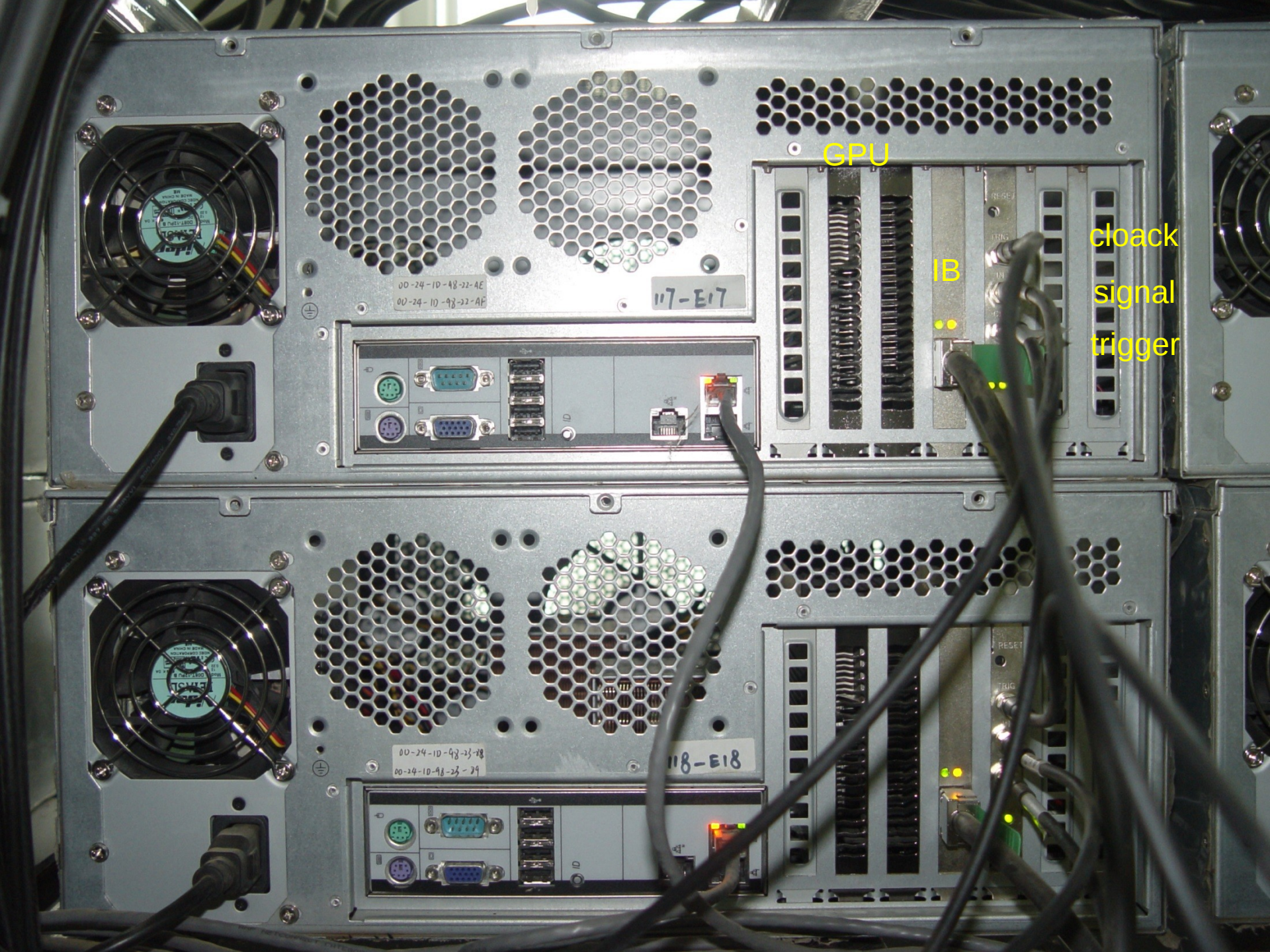
Data Acquisition System

trigger

synchronizing  
clock







GPU

IB

clock  
signal  
trigger

00-24-10-48-22-AE  
00-24-10-92-22-AF

117-E17

00-24-10-93-23-28  
00-24-10-98-23-29

118-E18







# Remote Control System

## 宇宙第一缕曙光探测

- [Cluster Status](#)
- [Antenna Signal](#)
- [MPI Bandwidth](#)
- [CPU Temperature](#)
- [Cpu Load](#)
- [Mem Usage](#)
- [Disk Usage](#)
- [Network Control](#)
- [System Log](#)

### Antenna\_report

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[hour](#) [day](#) [week](#) [month](#) [year](#)



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[hour](#) [day](#) [week](#) [month](#) [year](#)



A large radio telescope array, likely the Murchison Widefield Array (MWA), is shown in silhouette against a dramatic sunset sky. The sky is filled with scattered clouds, and the sun is low on the horizon, creating a warm, golden glow. The telescope structures are complex, with many long, thin arms extending upwards and outwards, each equipped with various antennas and sensors. The overall scene conveys a sense of advanced scientific infrastructure in a natural setting.

**1. A historic review**

**2. Infrastructure**

**3. 21CMA observations**

**4. Future plan**

**5. About the site**



# Infrastructure Construction



August 2004



# Infrastructure Construction



December 25 2004





**March 13 2005**



# Infrastructure Construction

Aug. 14, 2005





# Infrastructure Construction

Oct. 1, 2005





garage

living area

control room

Ulastai Observatory

Altitude: 2650m



# Ulastai Observatory





# Ulastai Observatory





# People @ Ulastai





# TREND Pioneers @ Ulastai





# TREND Pioneers @ Ulaistai





# TREND Pioneer @ Ulaistai







1. A historic review

2. Infrastructure

3. 21CMA observations

4. Future plan

5. About the site



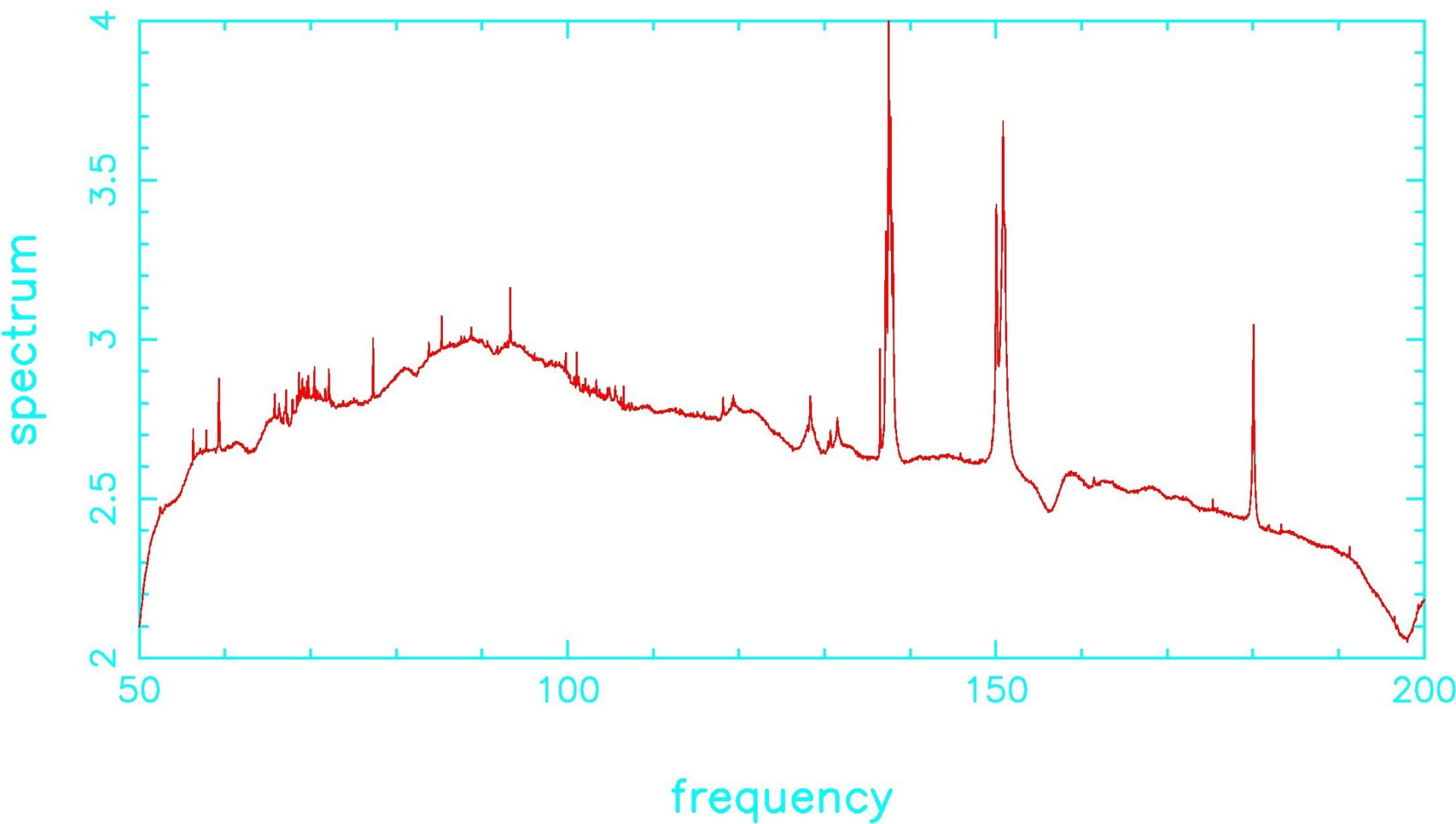
# 21CMA Observation Log

Year/ month	1	2	3	4	5	6	7	8	9	10	11	12	total
2009	15	6	11	10	8	0	0	0	5	11	10	13	89
2010	31	6	11	7	19	2	5	25	25	15	11	9	166
2011	19	3	28	30	31	26	26	25	27	25	15	0	255
2012	31	25	27	24	16	29	1	1	28	27	7	26	242
2013	20	0	26	26	31	26	20	29	8	16	15	27	244
2014	12	0	27	30	27	26							122
total	128	40	130	127	132	109	52	80	93	94	58	75	1118

**Observing Efficiency = 56%**



# The Milky Way Dominated Spectrum

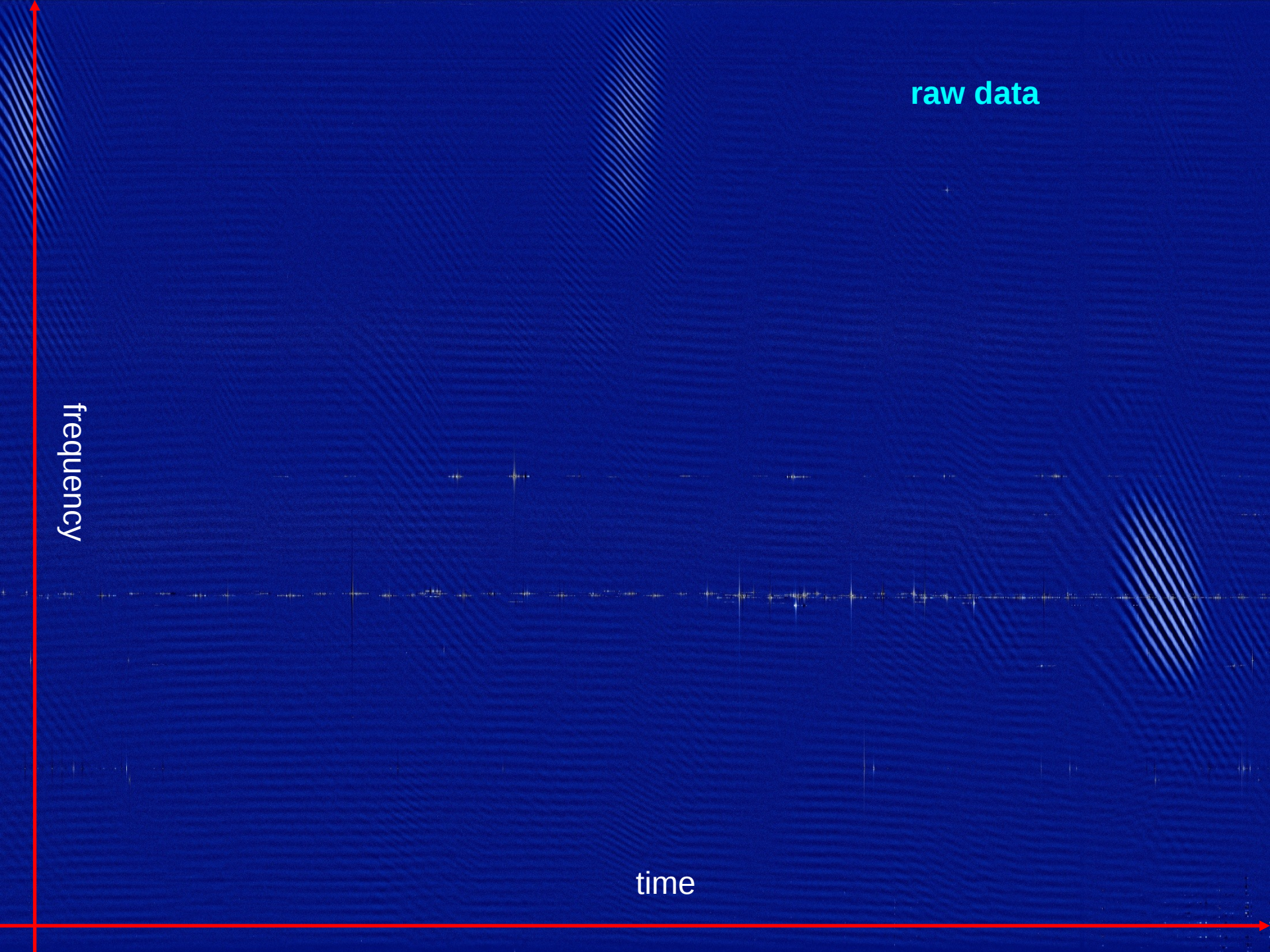




raw data

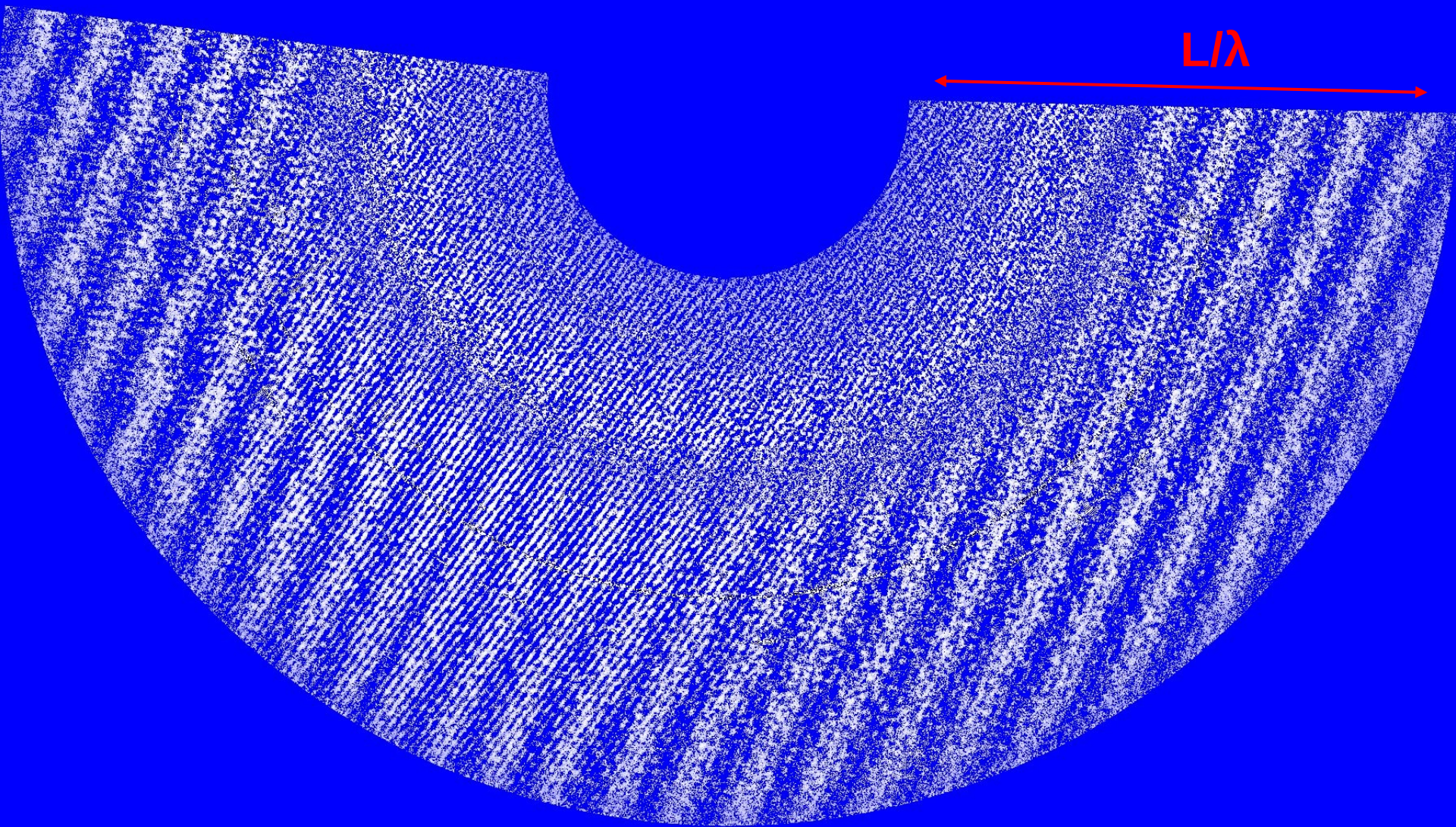
frequency

time



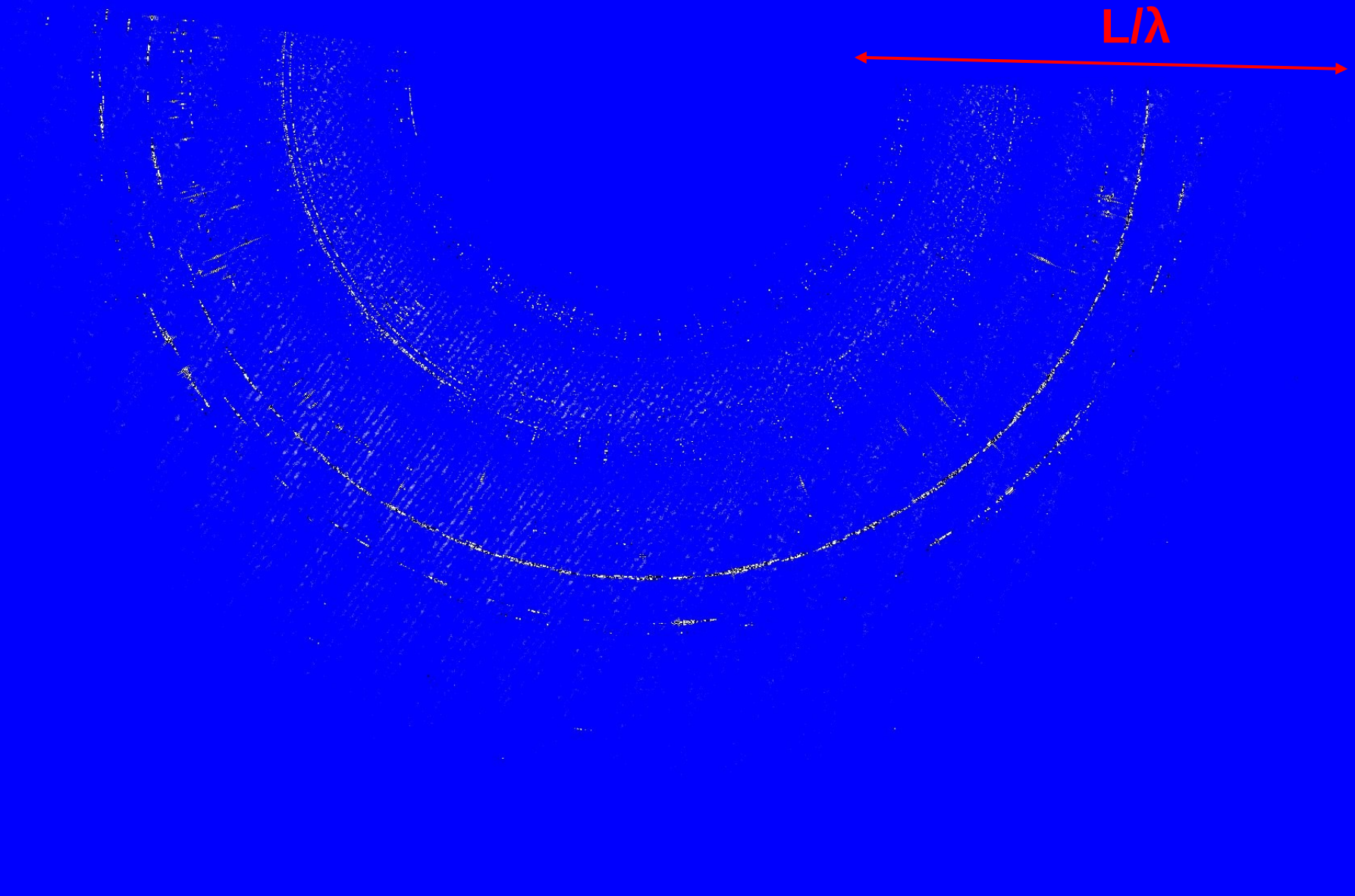


# UV Map

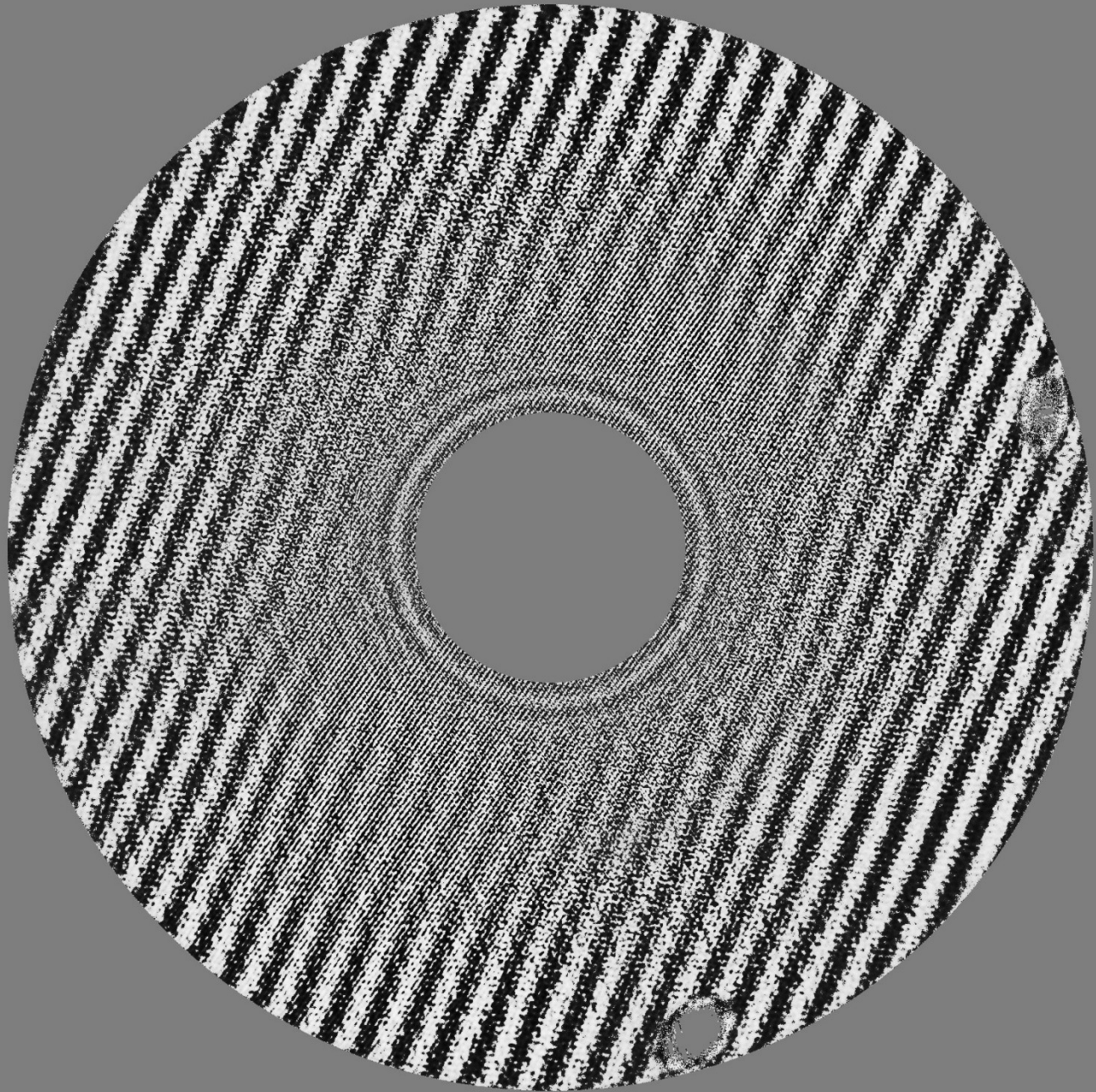




# UV Map







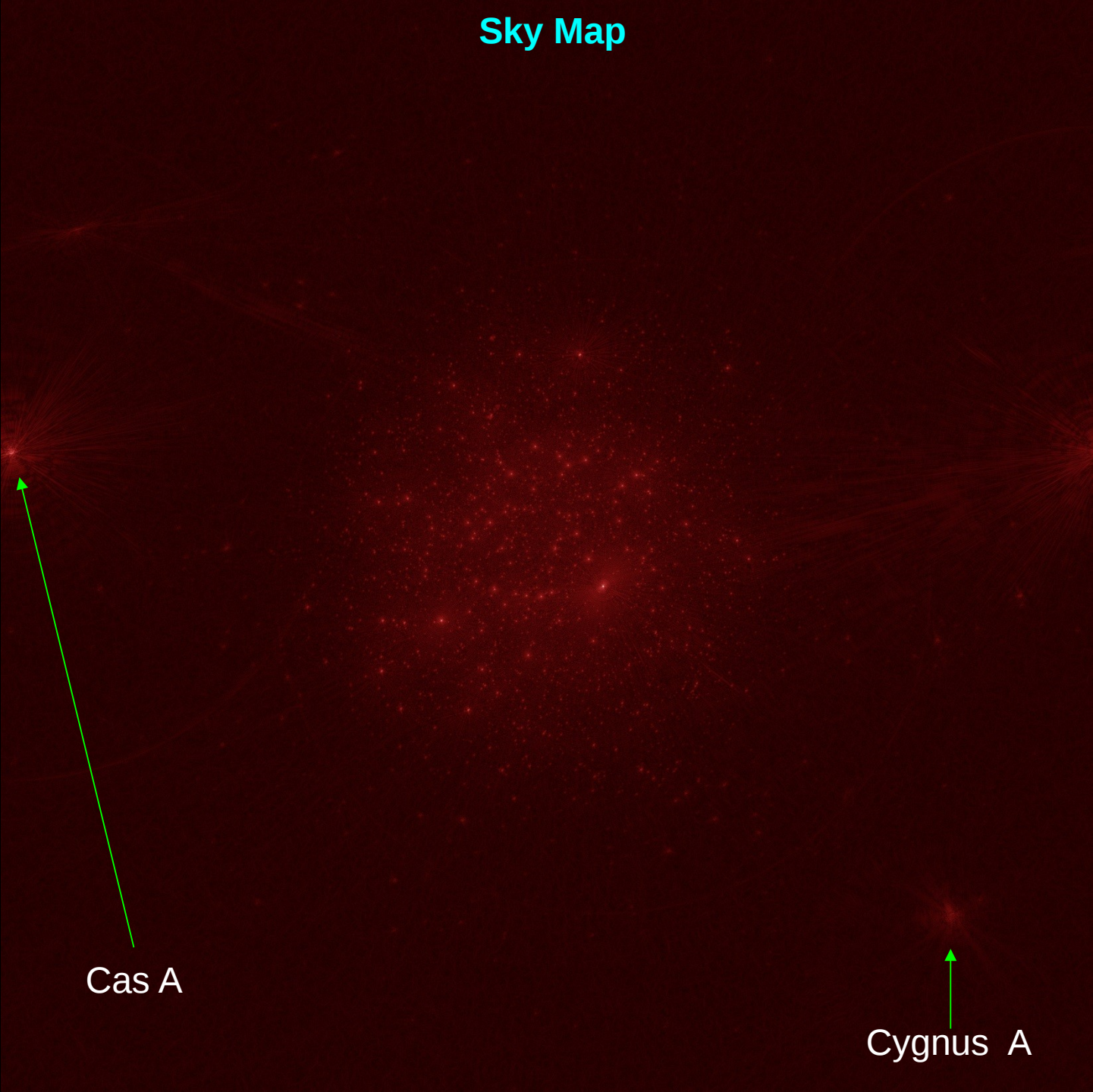


# Sky Map

57 deg

Cas A

Cygnus A







20o

20o

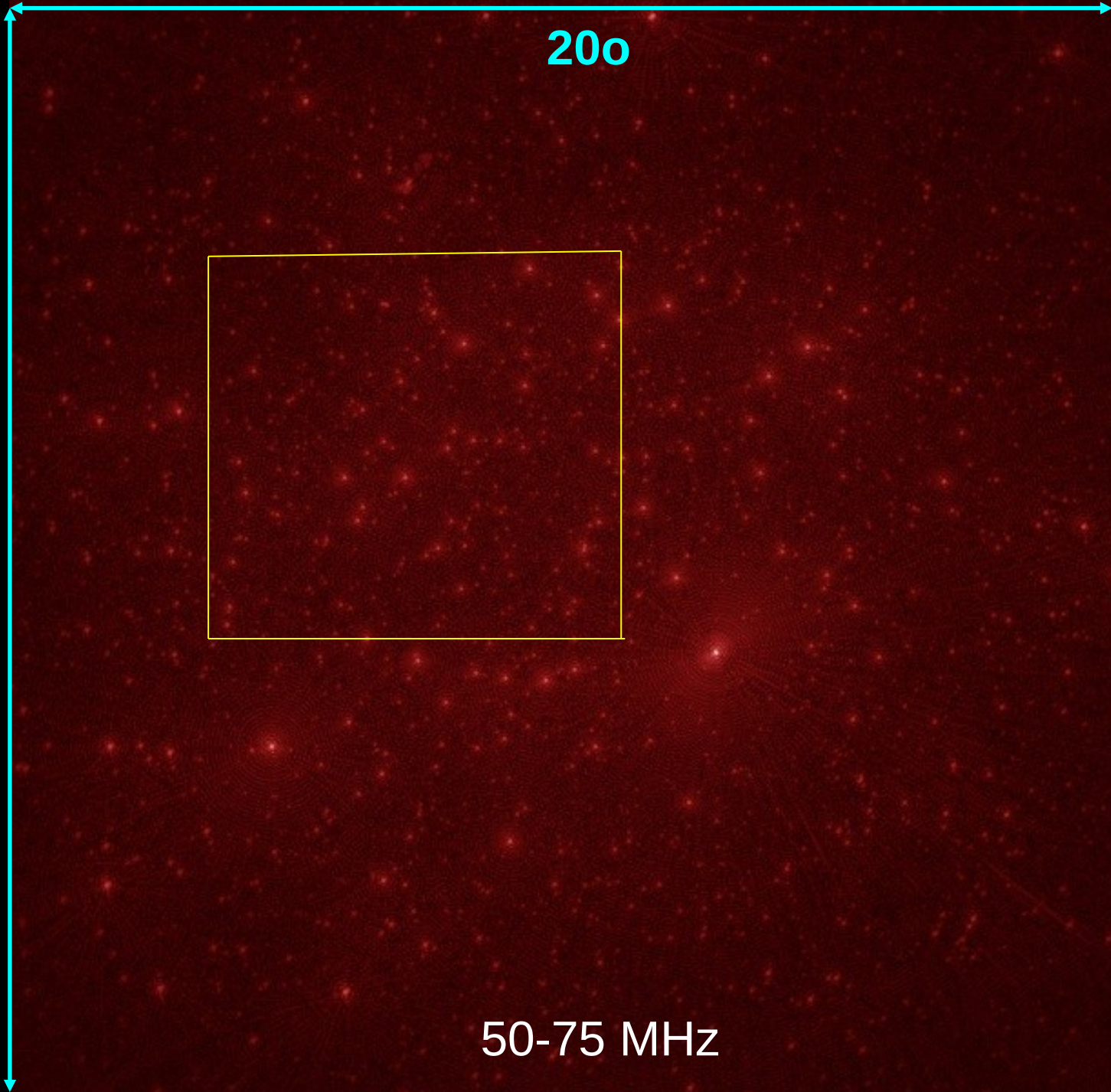
50-75 MHz



20o

20o

50-75 MHz

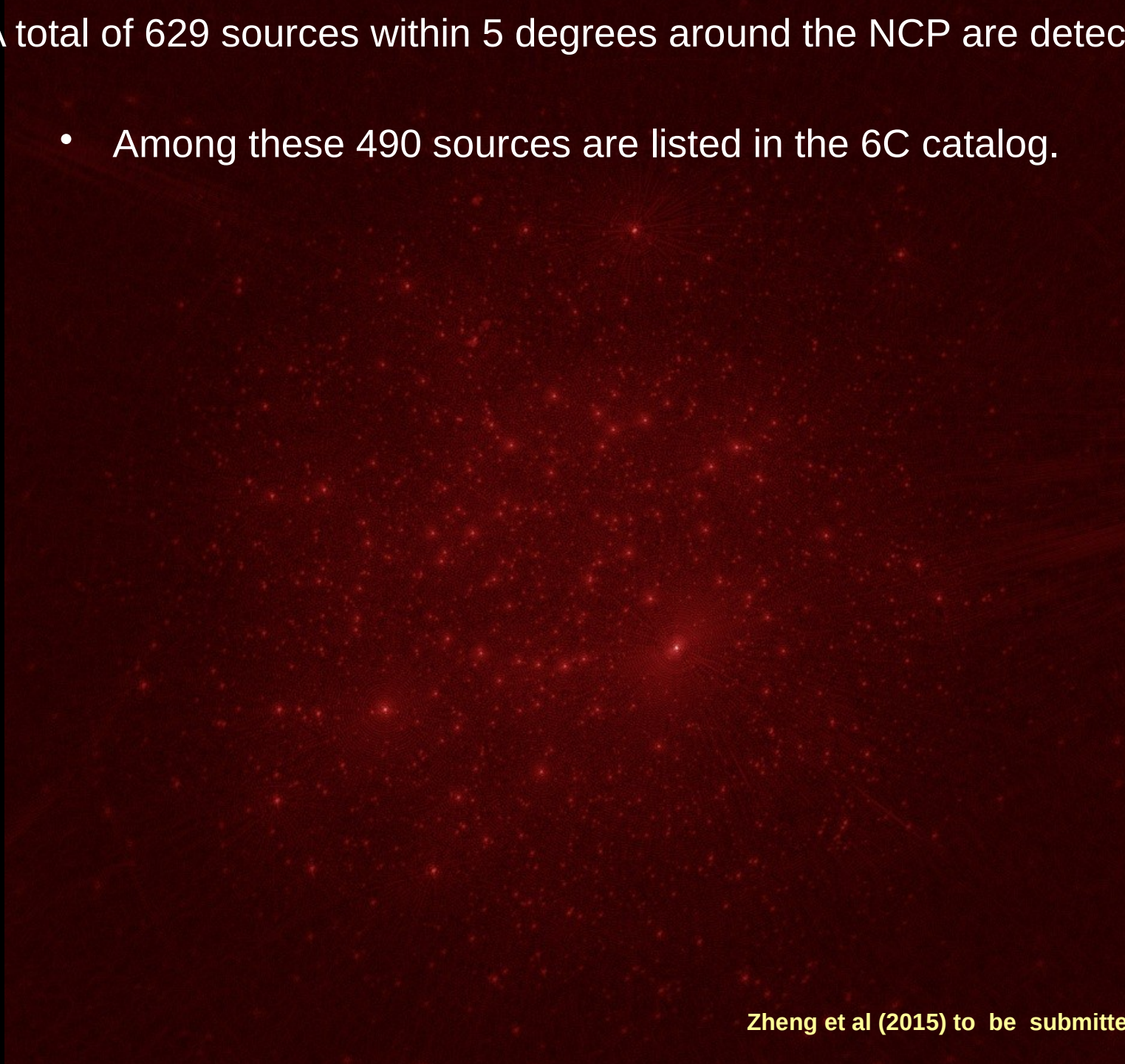








- A total of 629 sources within 5 degrees around the NCP are detected.
  - Among these 490 sources are listed in the 6C catalog.





A large radio telescope array, likely the Murchison Widefield Array (MWA), is shown in silhouette against a dramatic sunset sky. The sky is filled with scattered clouds, and the sun is low on the horizon, creating a bright glow. The telescope structures are complex, with many long, thin arms extending upwards and outwards, each equipped with numerous small antennas. The overall scene is dark, with the primary light source being the setting sun.

1. A historic review

2. Infrastructure

3. 21CMA observations

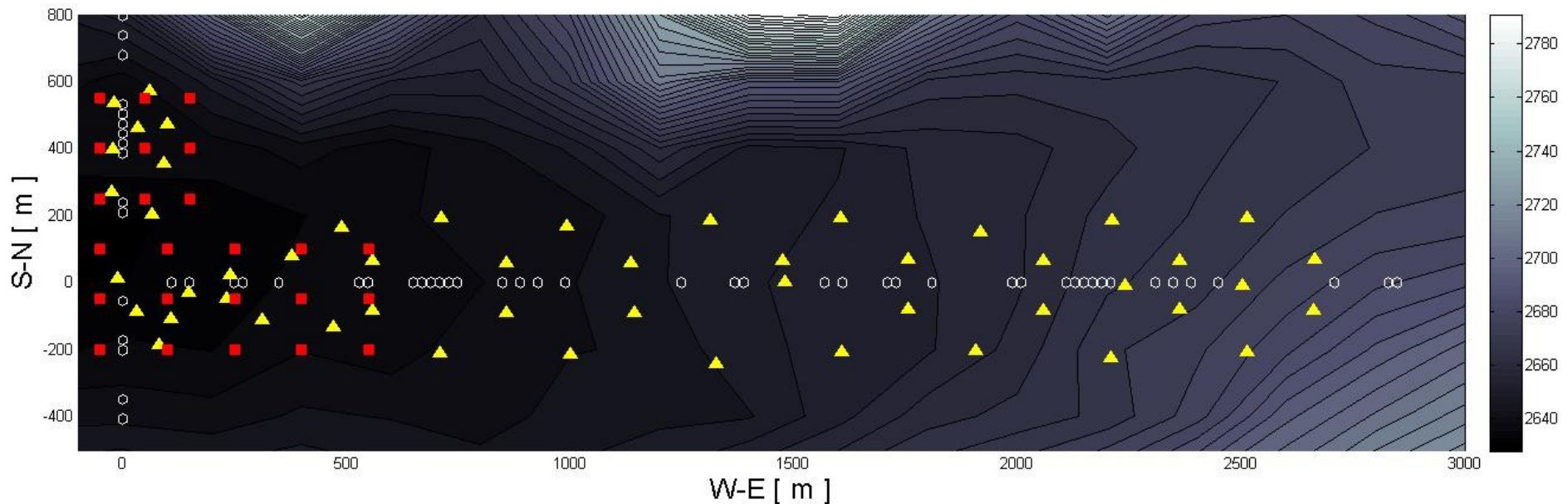
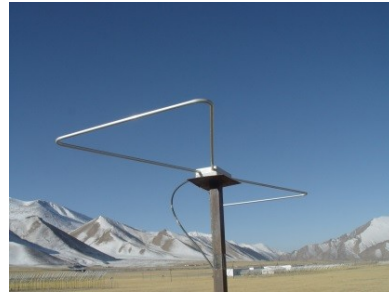
4. Future plan

5. About the site



# Current TREND

## 50 Butterfly Antennas at Site







3 Scintillators ( Feb 2010 )



# TREND DAQ System





# Fund Situations for TREND

7M RMB over past 6 years

1. 'First Light' project (21CMA) :	3M
2. Foreign Experts (Olivier) @ CAS : 0.5M x 2yr	1M
3. Foreign Young Scientist @CAS :	0.165M
4. NSFC :	0.1M
5. NSFC (IHEP+NAOC) :	1M
6. NAOC :	1.9M

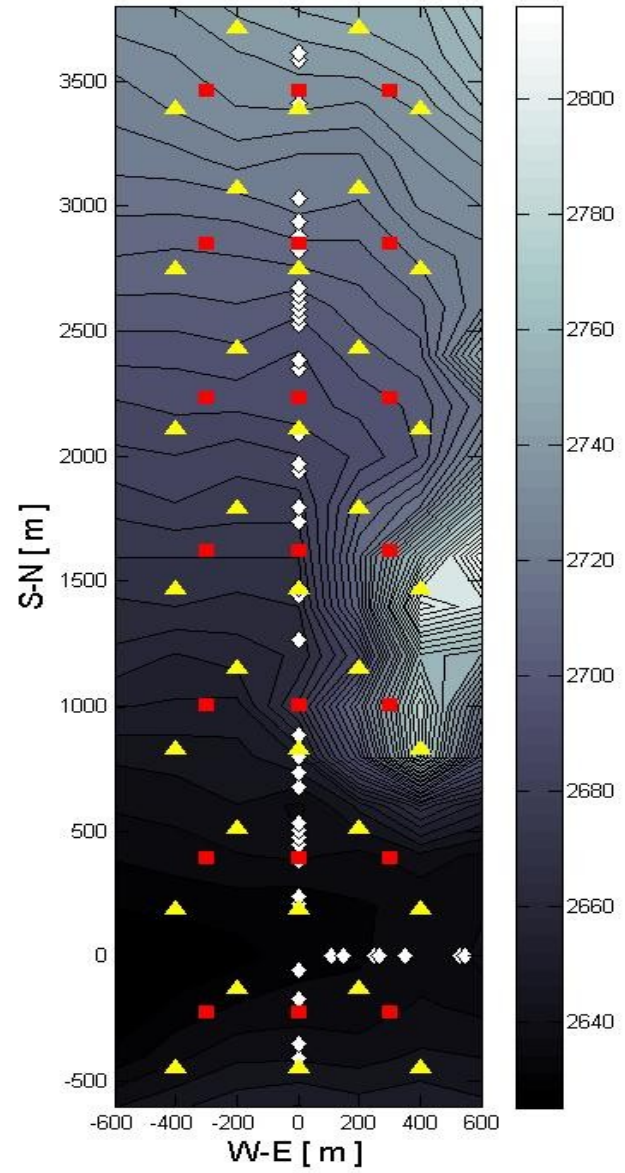
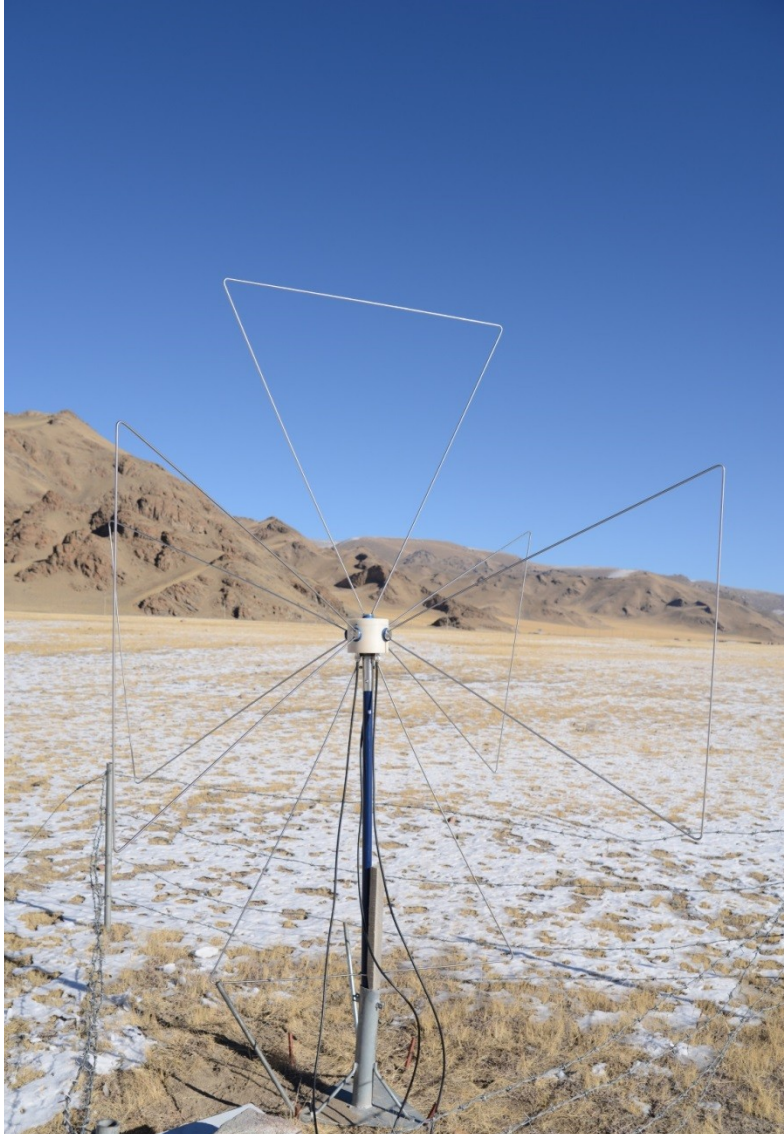
# Fund Situations for 21CMA

5M Euros over past 10 years



# In Progress



( NSFC 1M + NAOC1.9M )

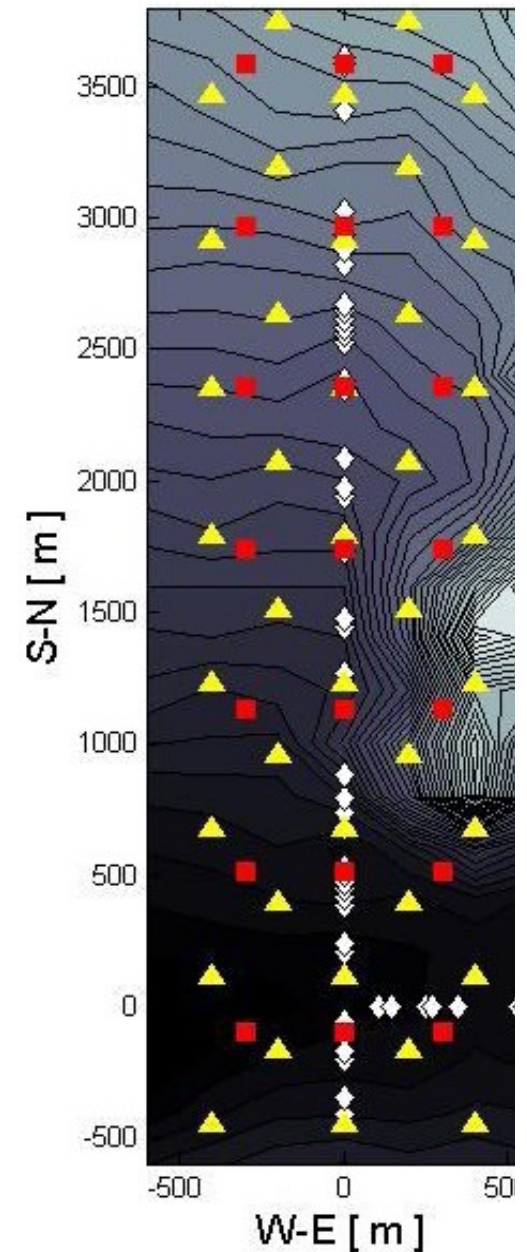




# Phase III: Work in progress

( NSFC 1M + NAOC1.9M )

- 35 antennas() + 21 scintillators ()

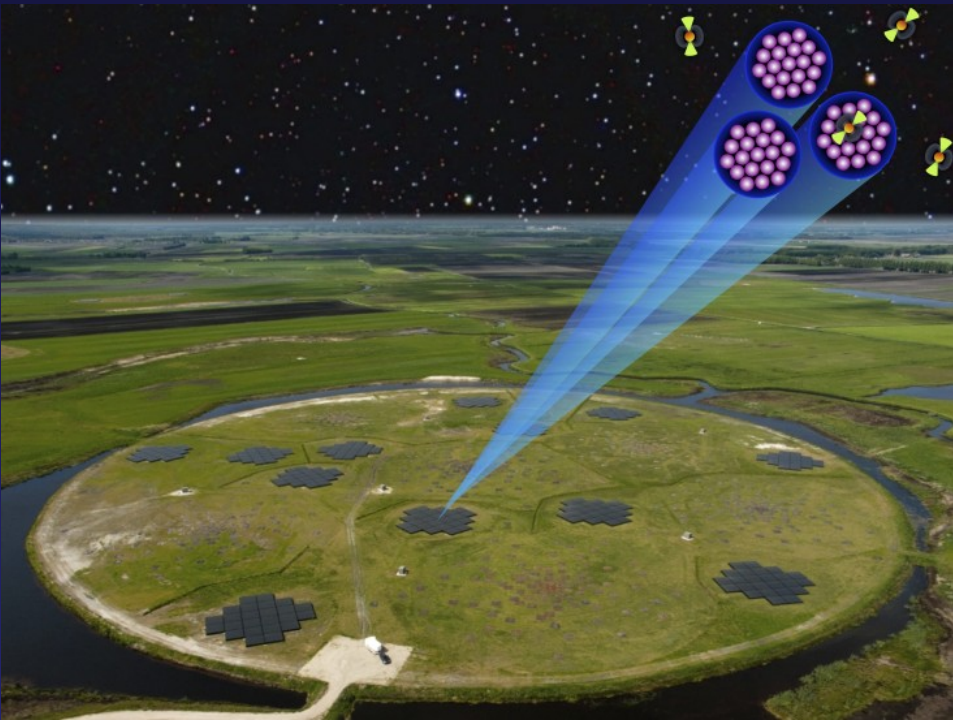




# Fund Situations for Future Upgrade: 21CMA and GRAND Prototype

- |  |          |
|--|----------|
| 1. Maintenance & Operation (Ulastai) : | 2M/yr    |
| 2. China SKA pathfinder (NAOC)         | 4M       |
| 3. China SKA pathfinder (MOST)         | 100M (?) |

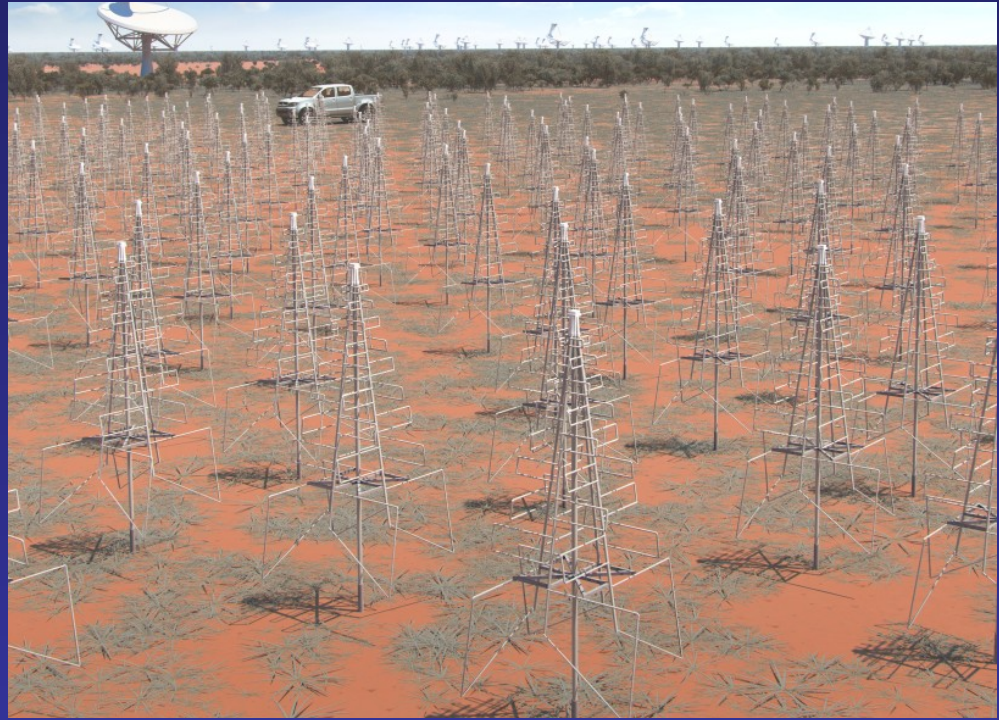




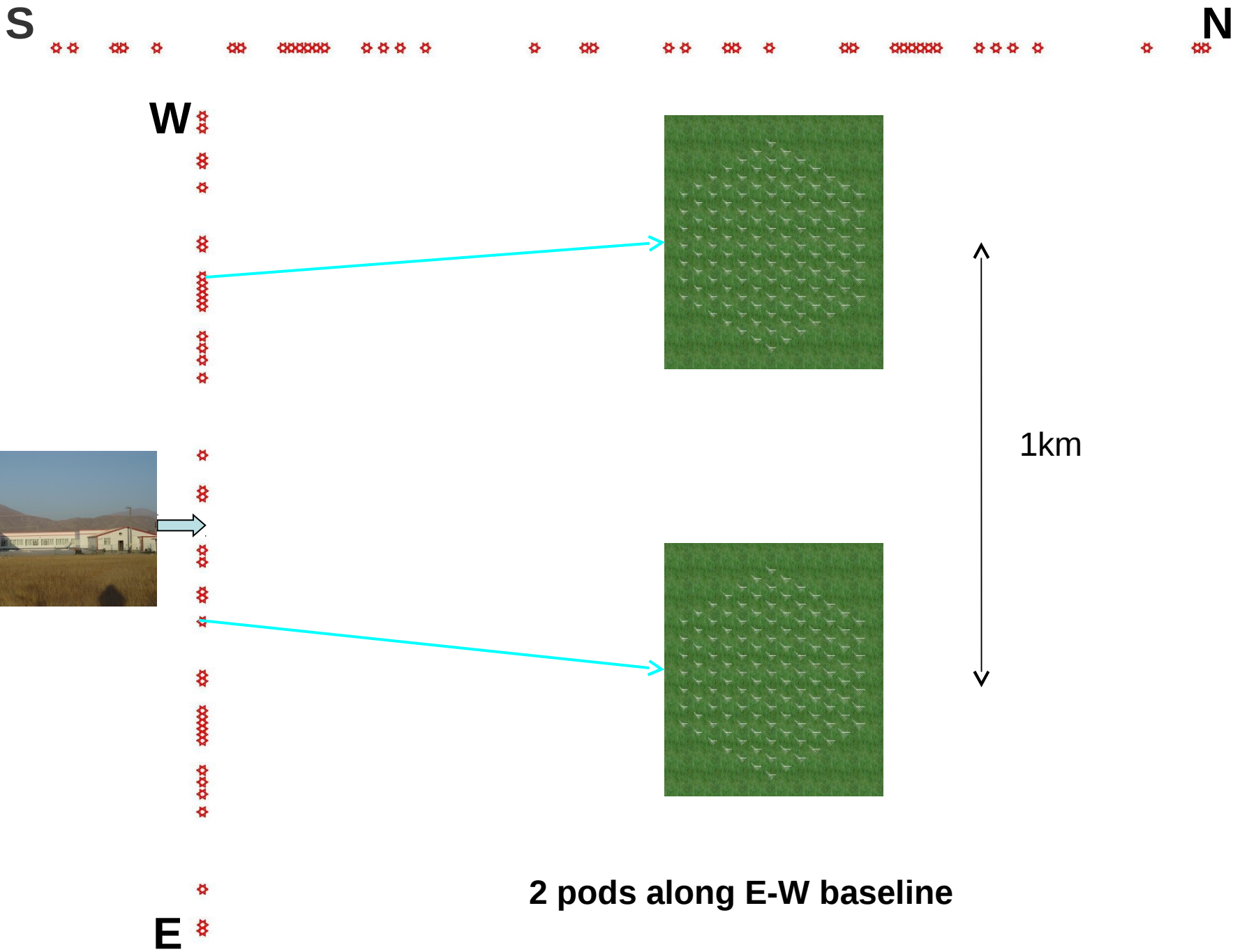
**LOFAR**

# Multi Beam (China SKA Pathfinder: 21CMA)

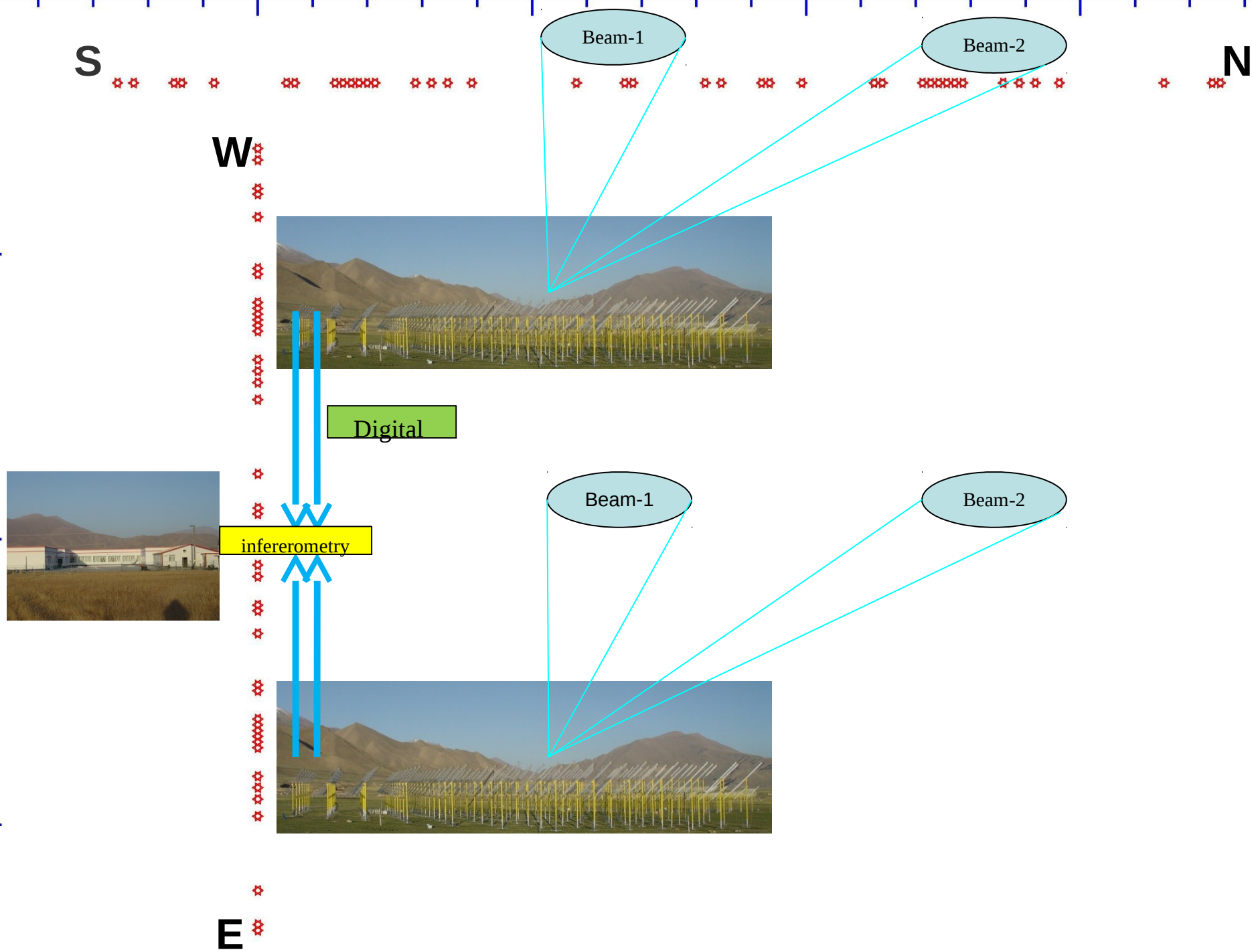
**SKA-LOW**







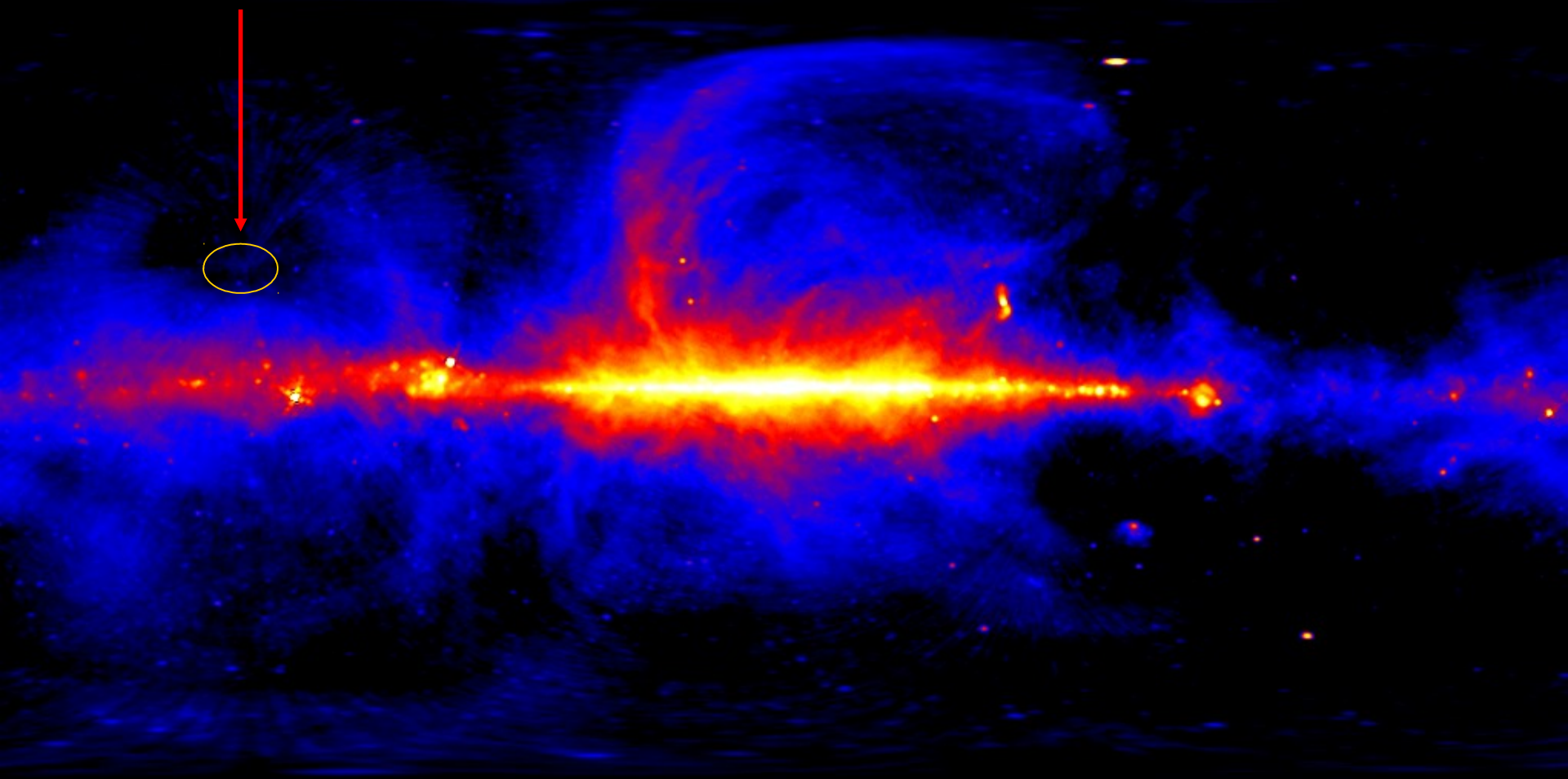






# VHF Sky (408 MHz)

21CMA

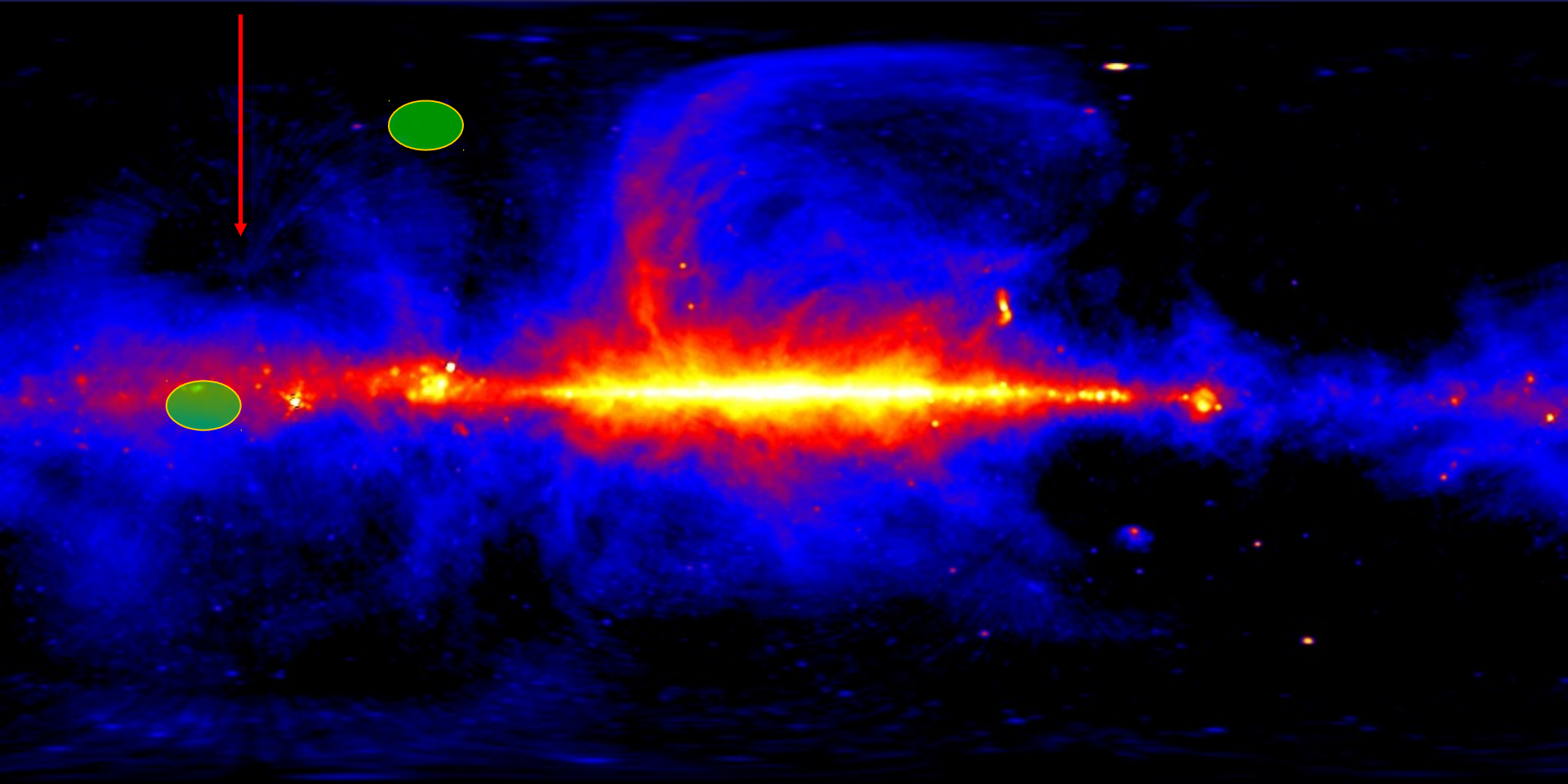


Points at NCP only



# VHF Sky (408 MHz)

NCP

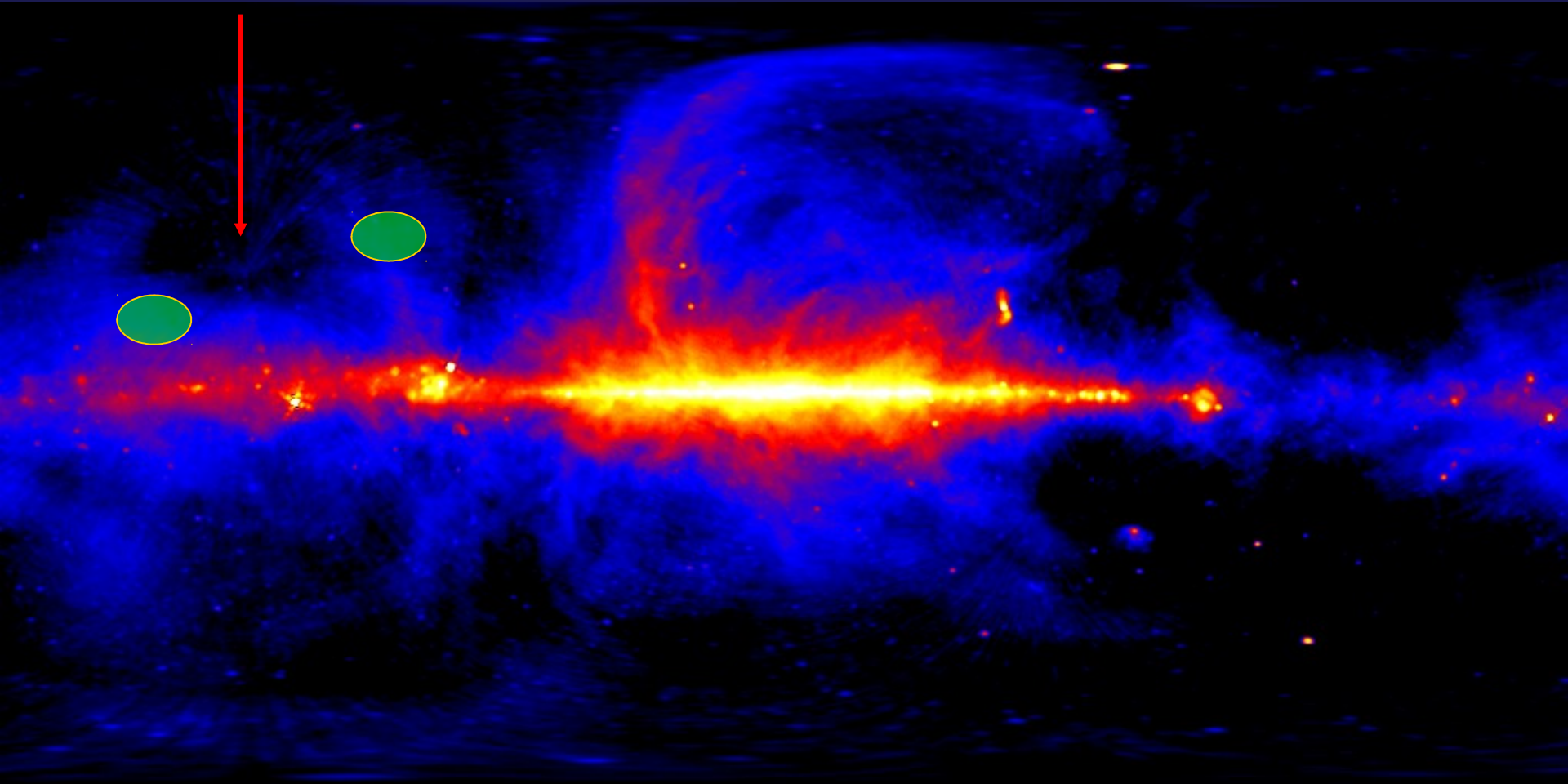


Two Beam Pointing



# VHF Sky (408 MHz)

NCP

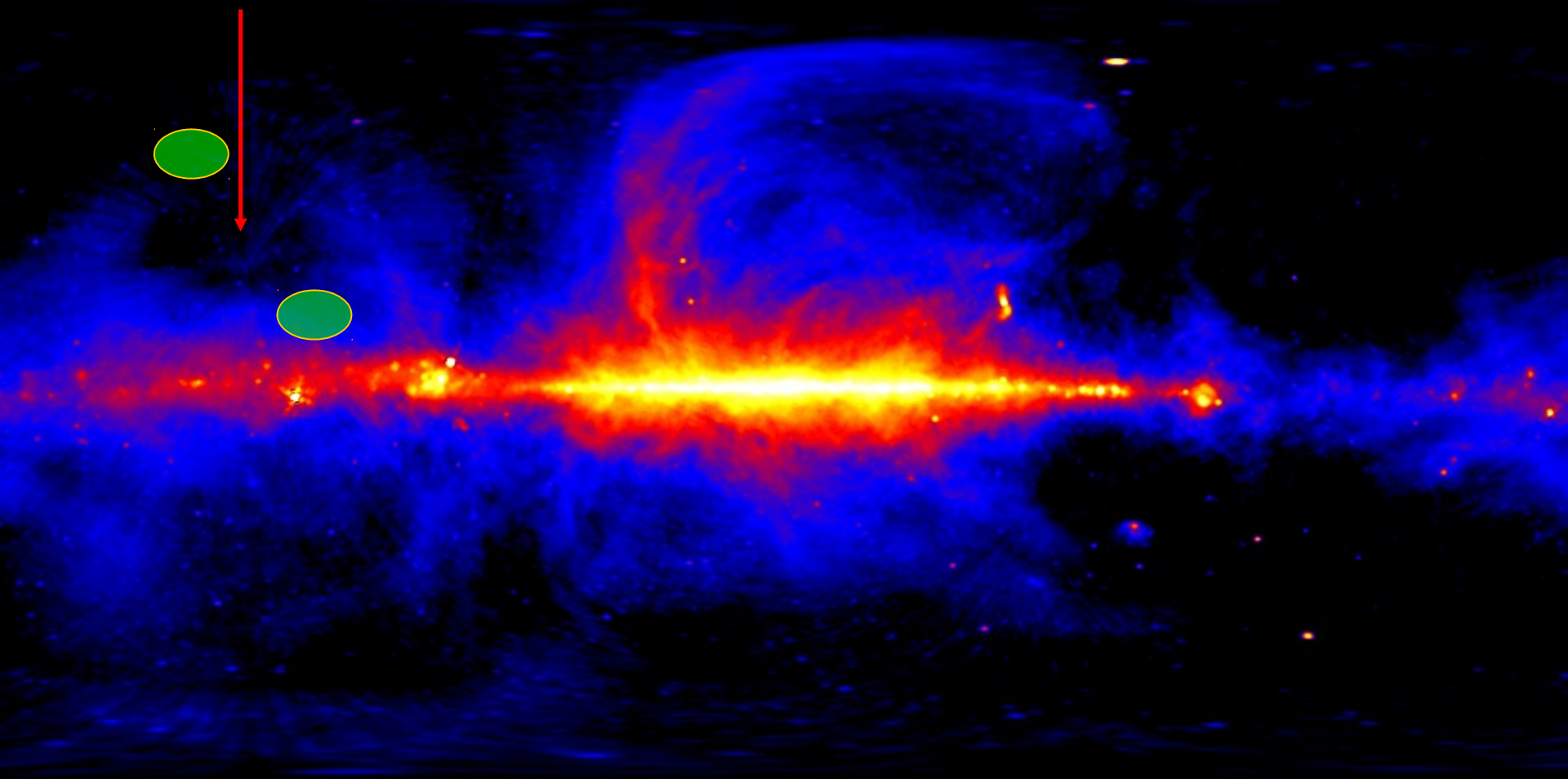


Two Beam Pointing



# VHF Sky (408 MHz)

NCP



Two Beam Pointing



# Design Parameters

---

Baseline	1km
Antenna Units	127
Number of Stations	2
Frequency Range	50-200MHz
Instantaneous Bandwidth	150MHz
Digital Beams	2
ADC precision	12bits
Sampling (beams)	200MHz
Frequency Resolution	24kHz
System Temperature	<50K
Polarization	linear
Synchronizing clock	400MHz



A large radio telescope array, likely the Arecibo Observatory, is shown in silhouette against a dramatic sunset sky. The sky is filled with scattered clouds, and the sun is low on the horizon, creating a warm, golden glow. The telescope's structure, including its long boom and various antennas, is clearly visible in the foreground and middle ground.

**1. A historic review**

**2. Infrastructure**

**3. 21CMA observations**

**4. Future plan**

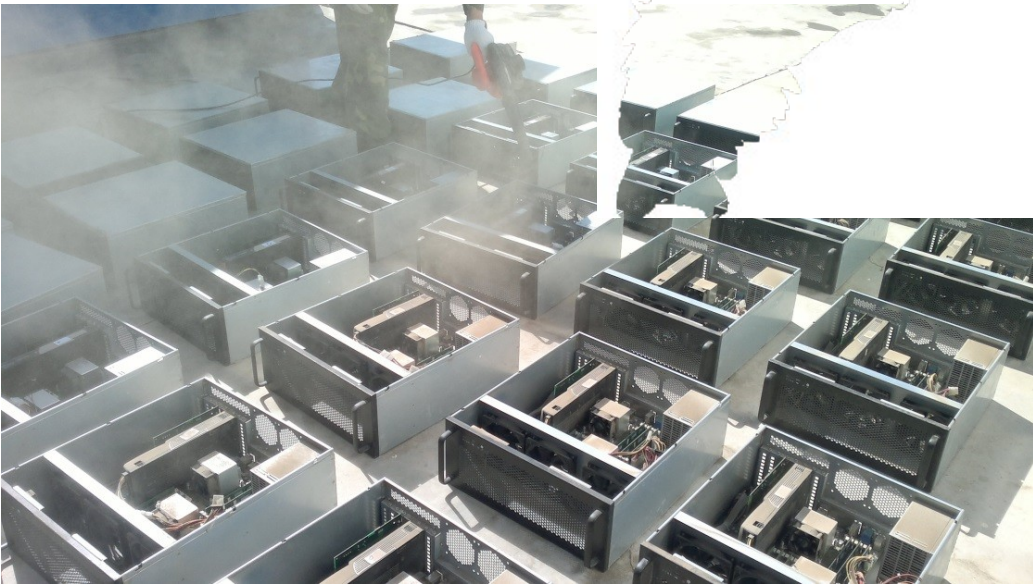
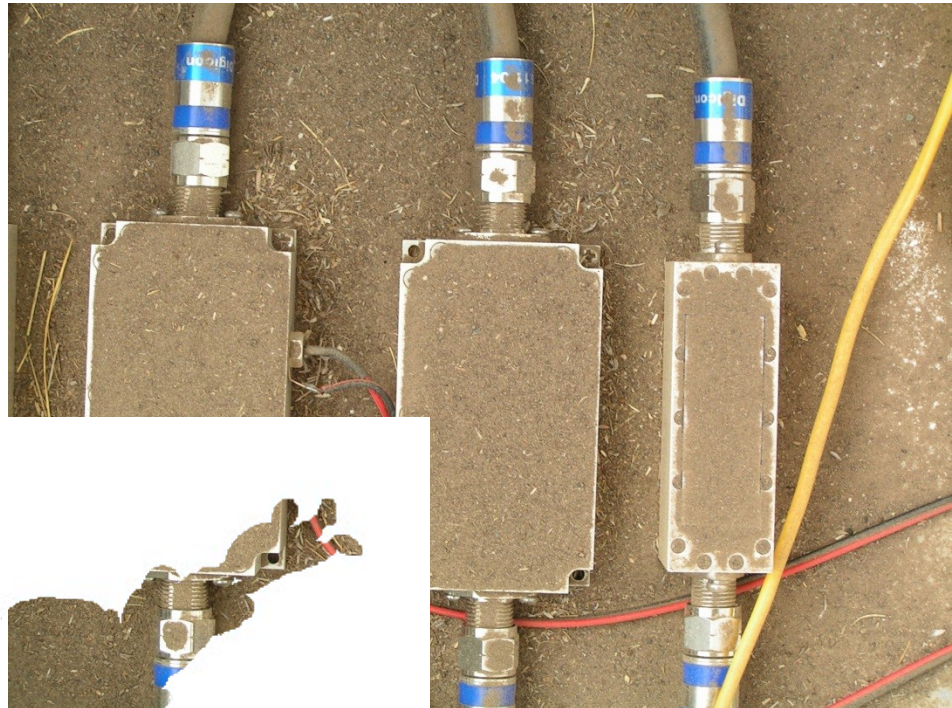
**5. About the site**



Ulastai Night  
(photo by Junhua Gu)











**Unexpected events**



**-49C**

(2005)

**-30C**





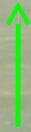
# A cool summer



2008.08.18



animals at site











prairie dog





cattle





dogs & donkeys









yak



# Trouble Makers







Mongolian Gutturusa





vulture





**A Crazy Guy**



# Welcome to Ulastai

