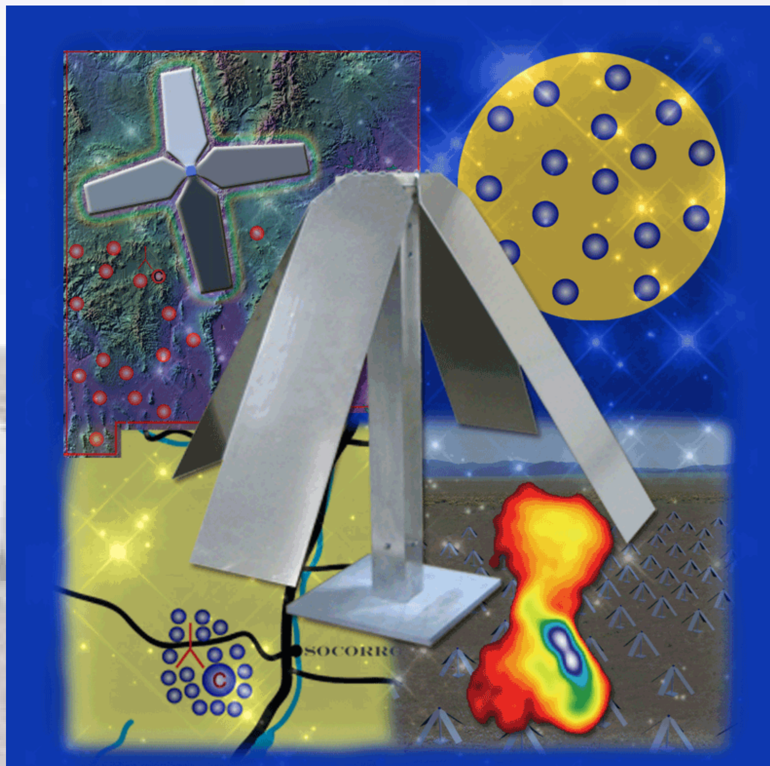
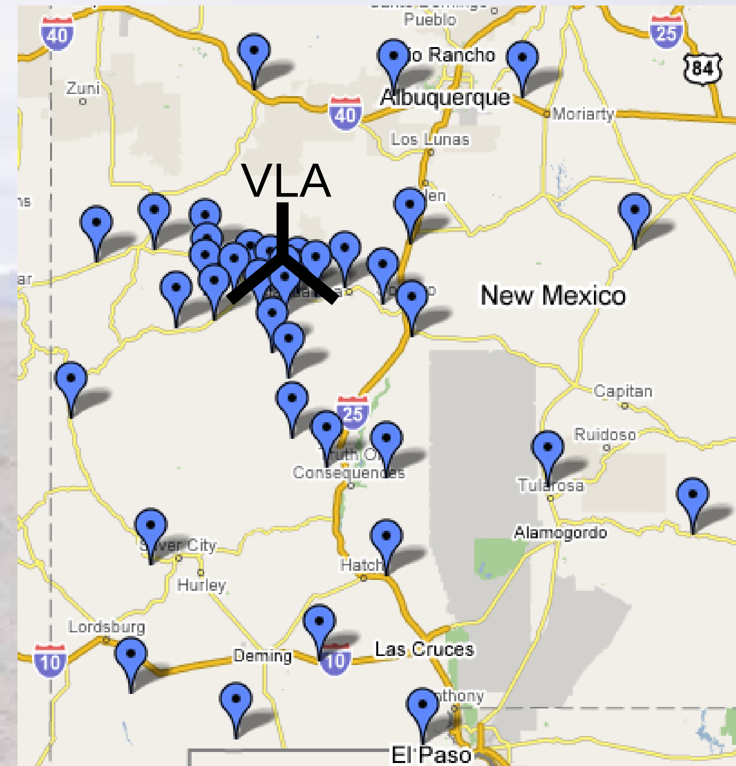
1.Simulations and Analysis for the Long Wavelength Array

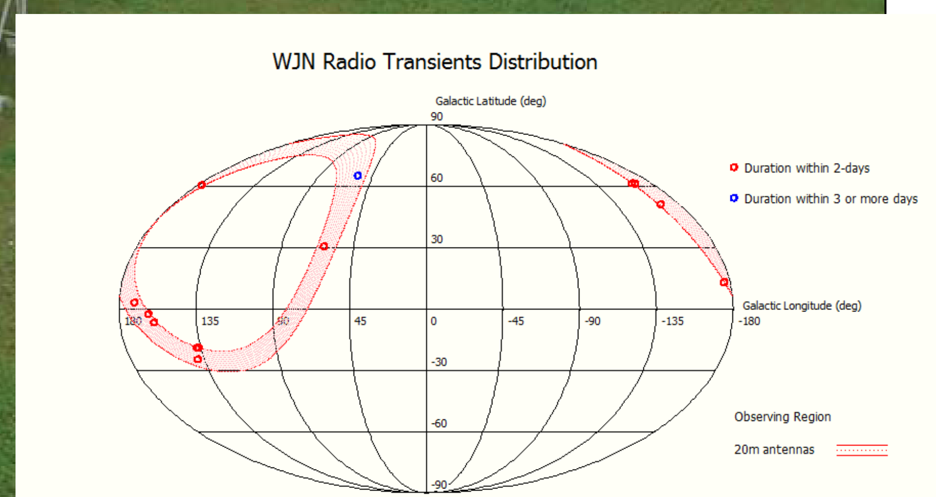
Masaya kuniyoshi (UNM), Sanjay Bhatnagar (NRAO), Greg Taylor (UNM)

(The LWA Project collaboration)



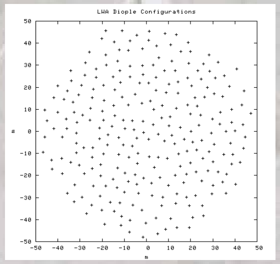


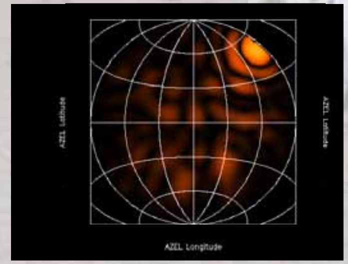
2.Waseda Nasu Observatory

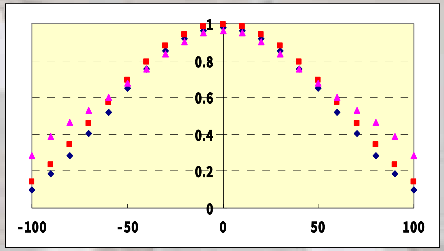


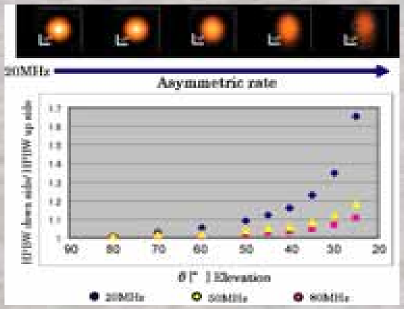
Outline

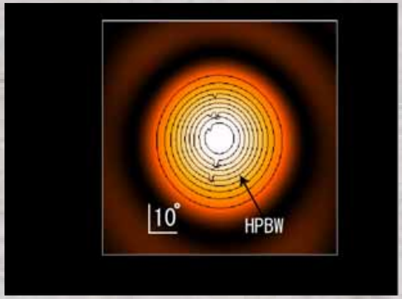
1. Long Wavelength Array
2. LWA station beam
   - Elliptical beam
   - Asymmetric beam
   - Pointing error
3. LWA imaging simulation
4. Tapers on the station
5. Summary

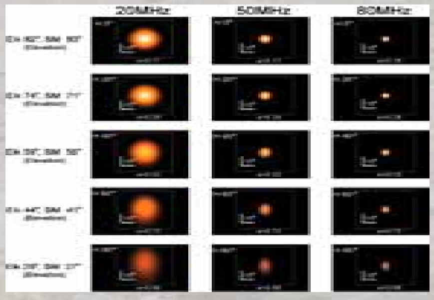


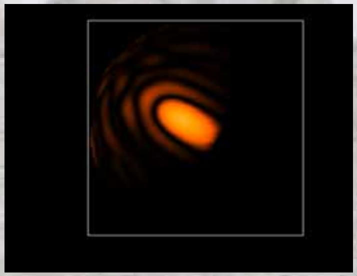






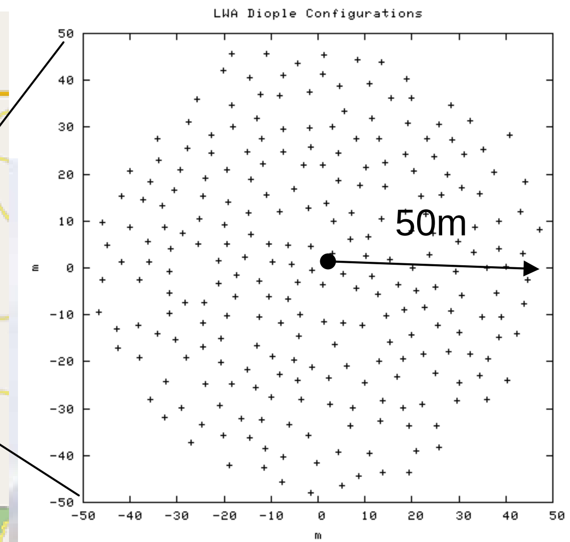






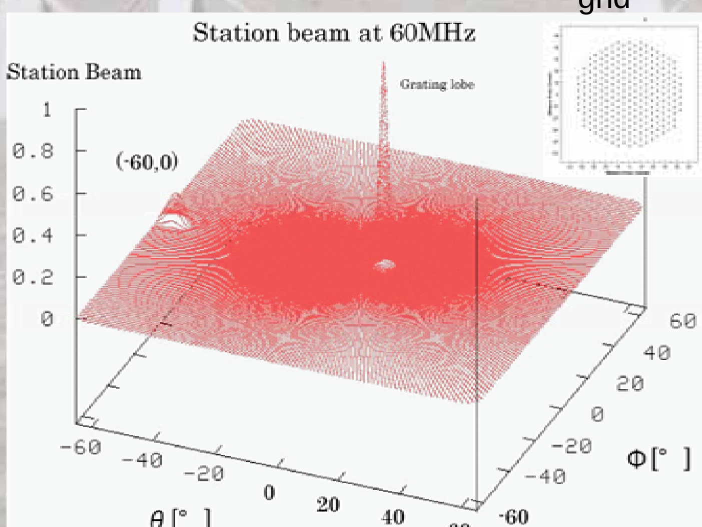
Long Wavelength Array (LWA)

Distribution of 53 LWA stations

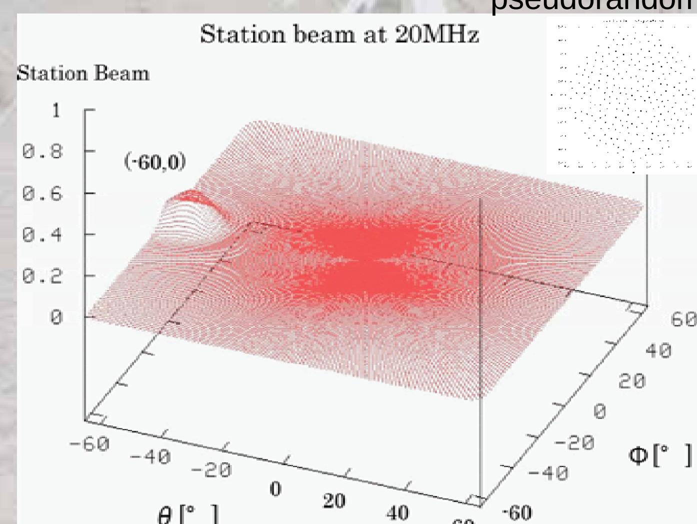


Dipole configuration in one station (L.Kogan)

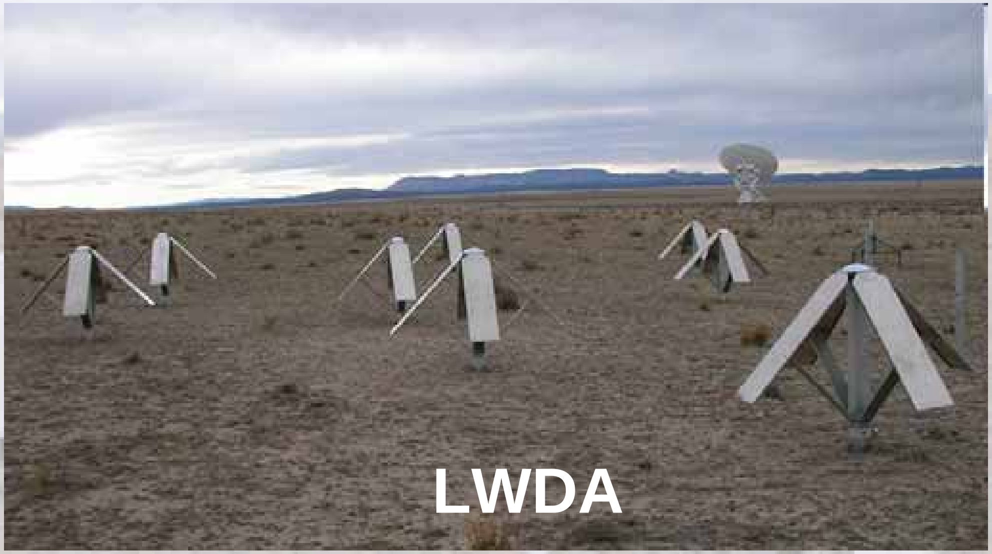
grid



pseudorandom



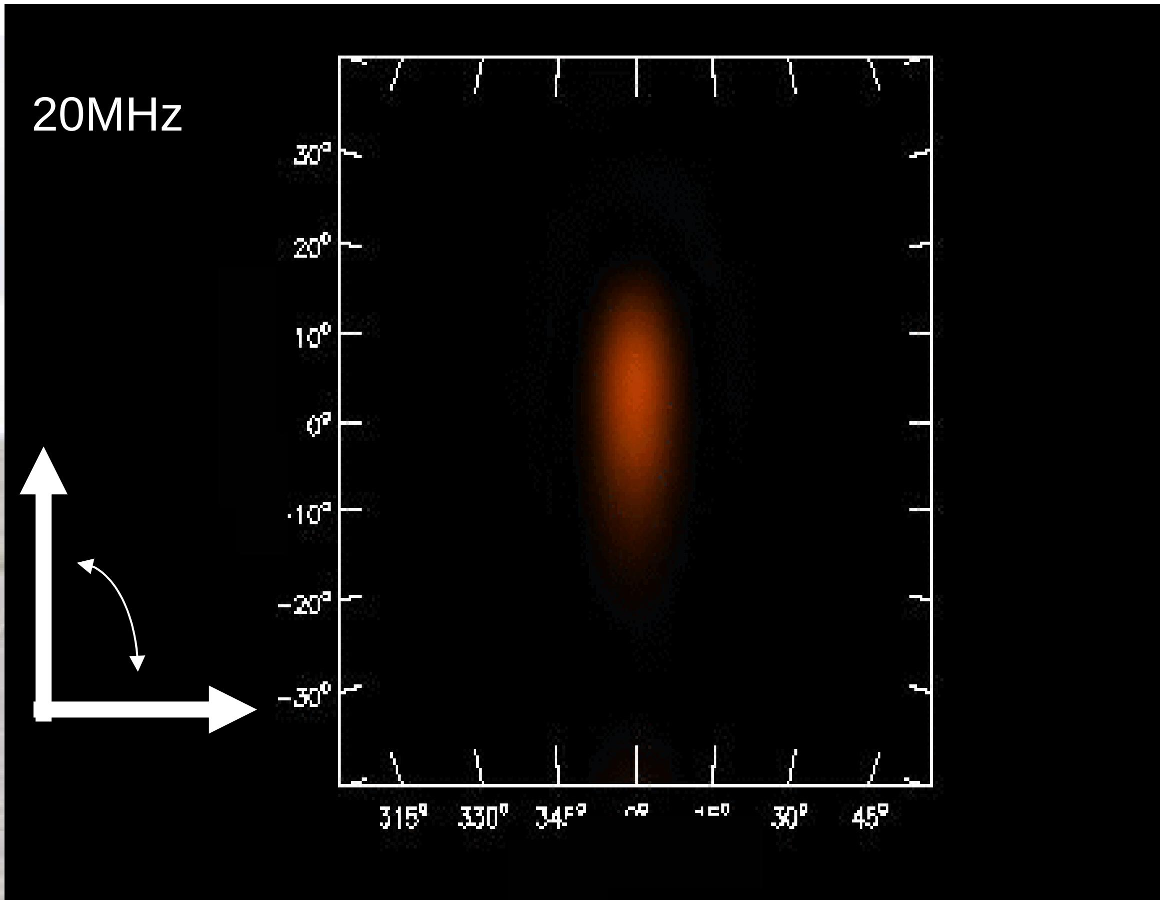
VLA Tour on May 1st

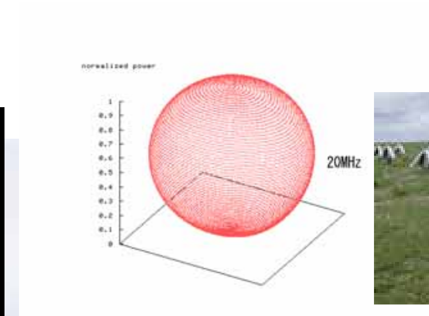


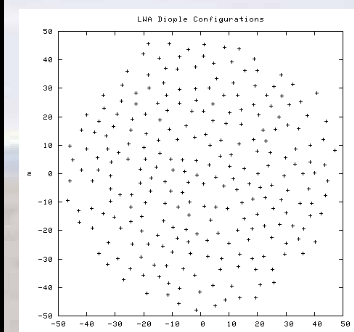

ONLY
ONLY

The End

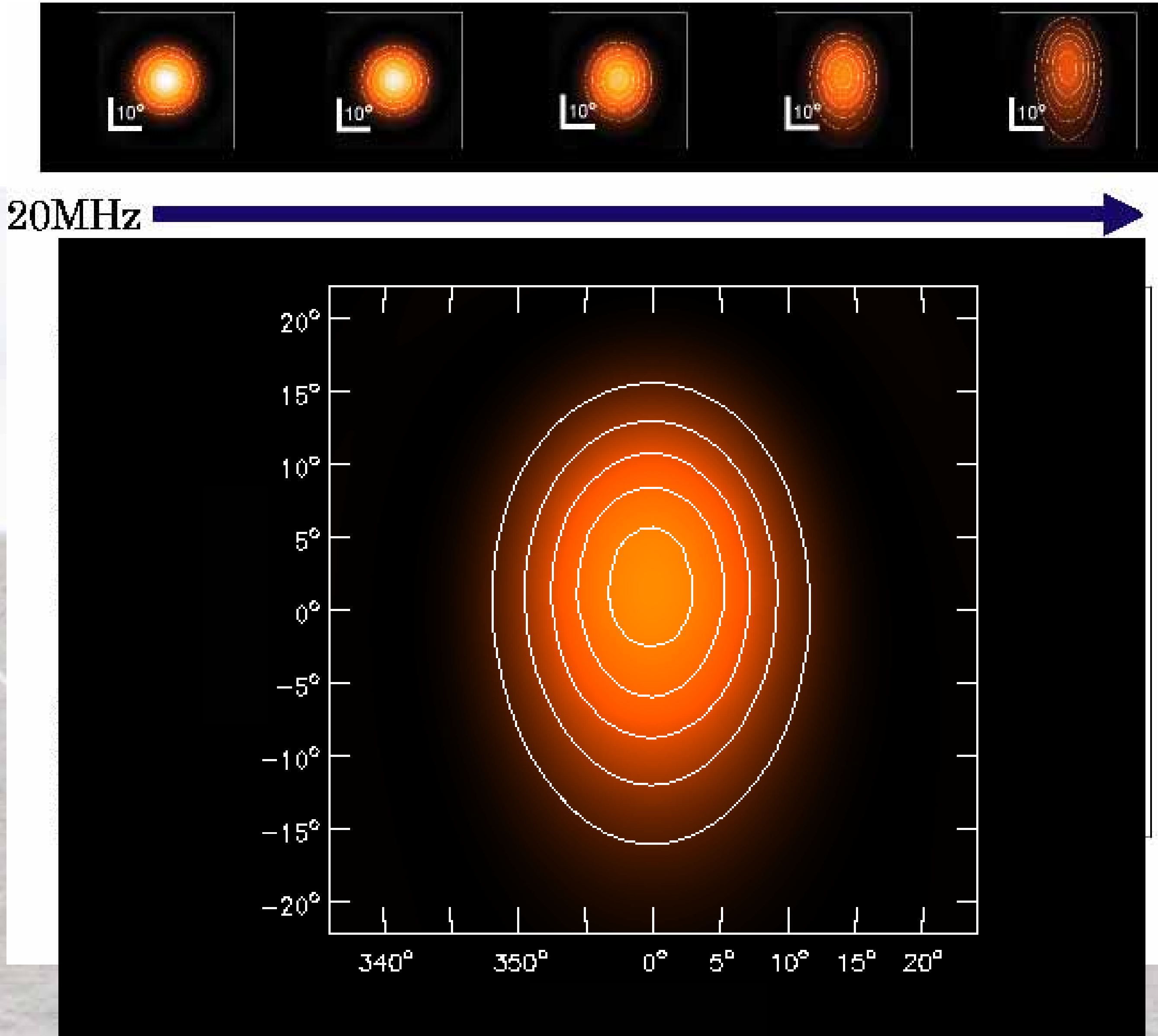
Station Primary Beam



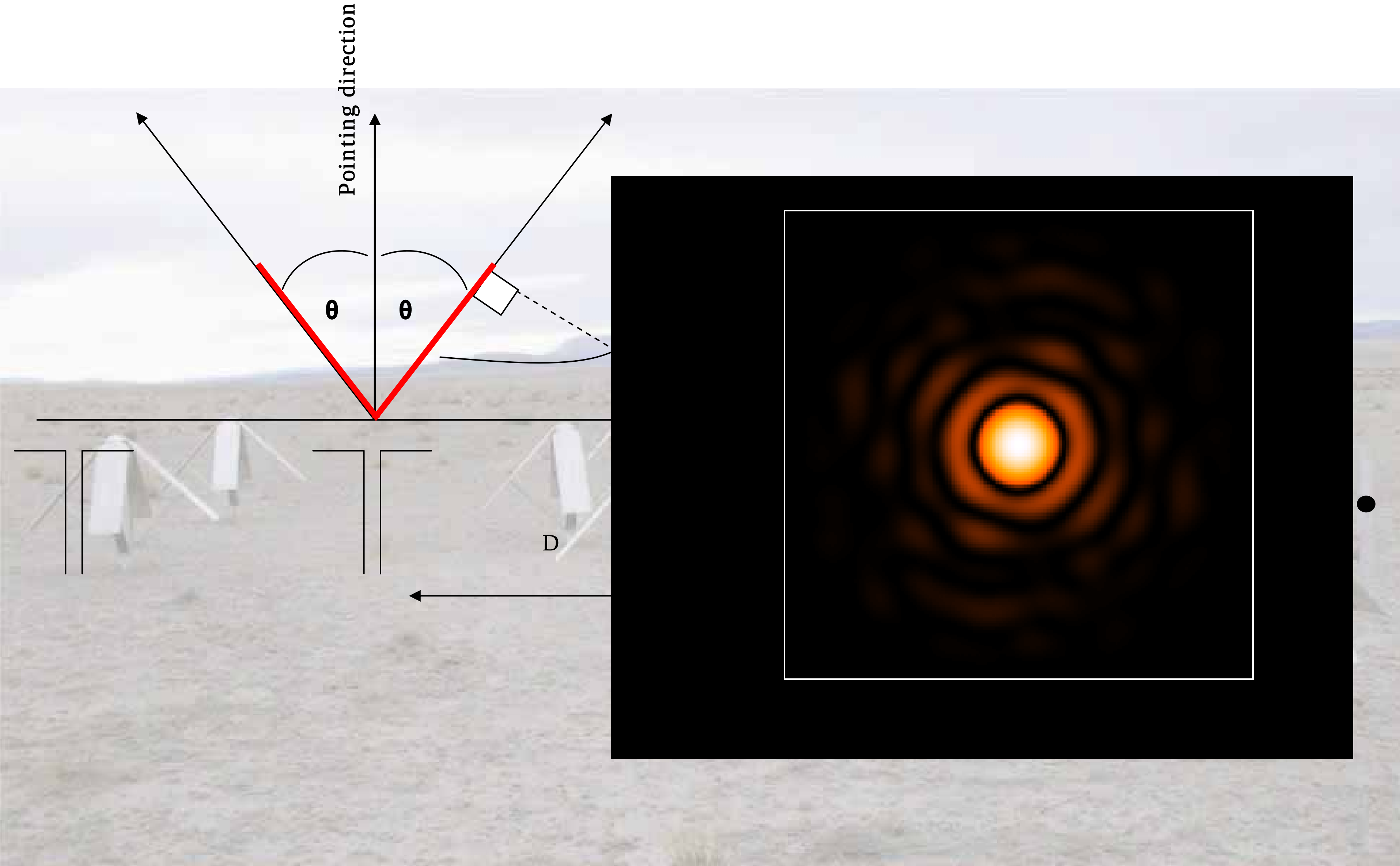




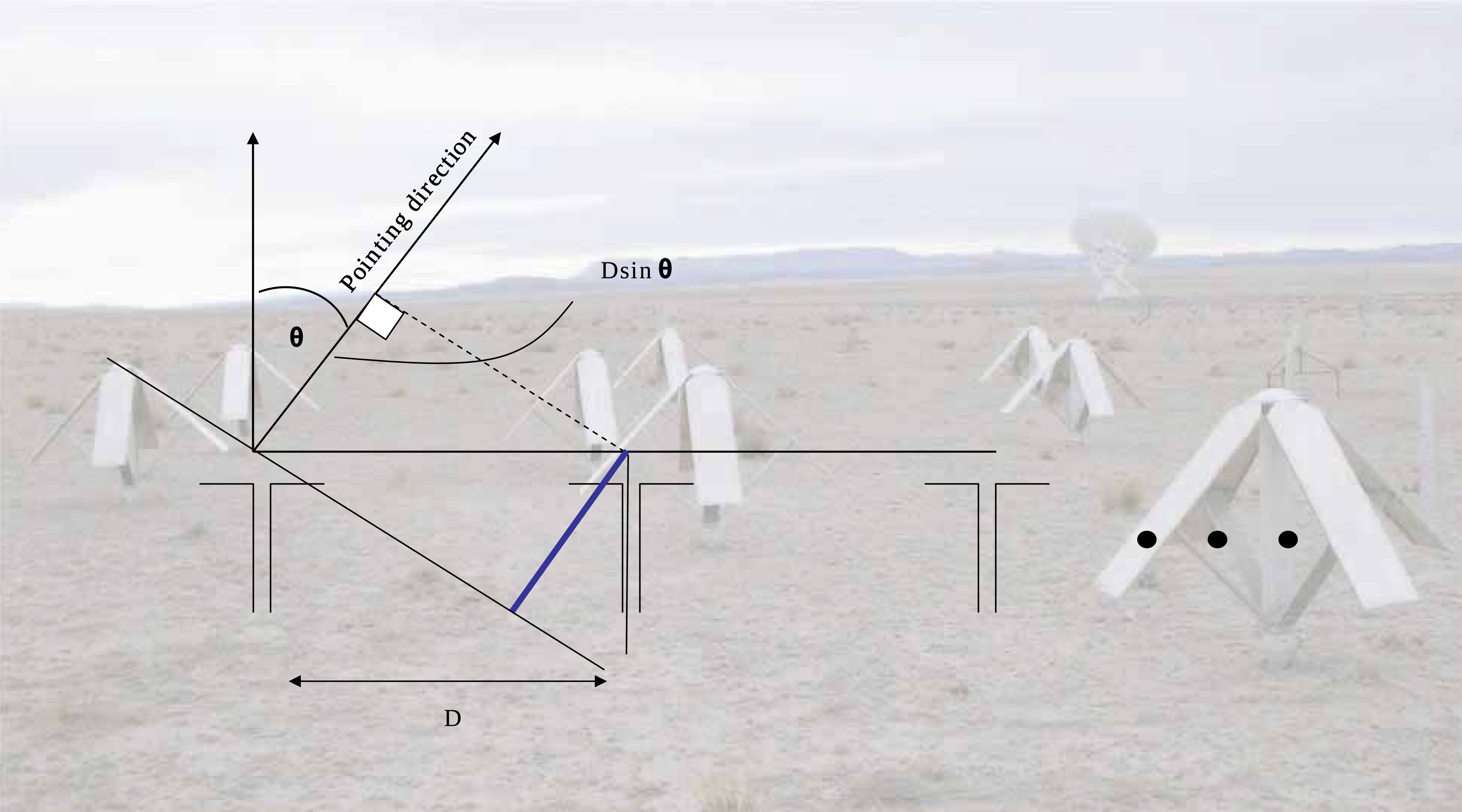
Asymmetric Station Beam



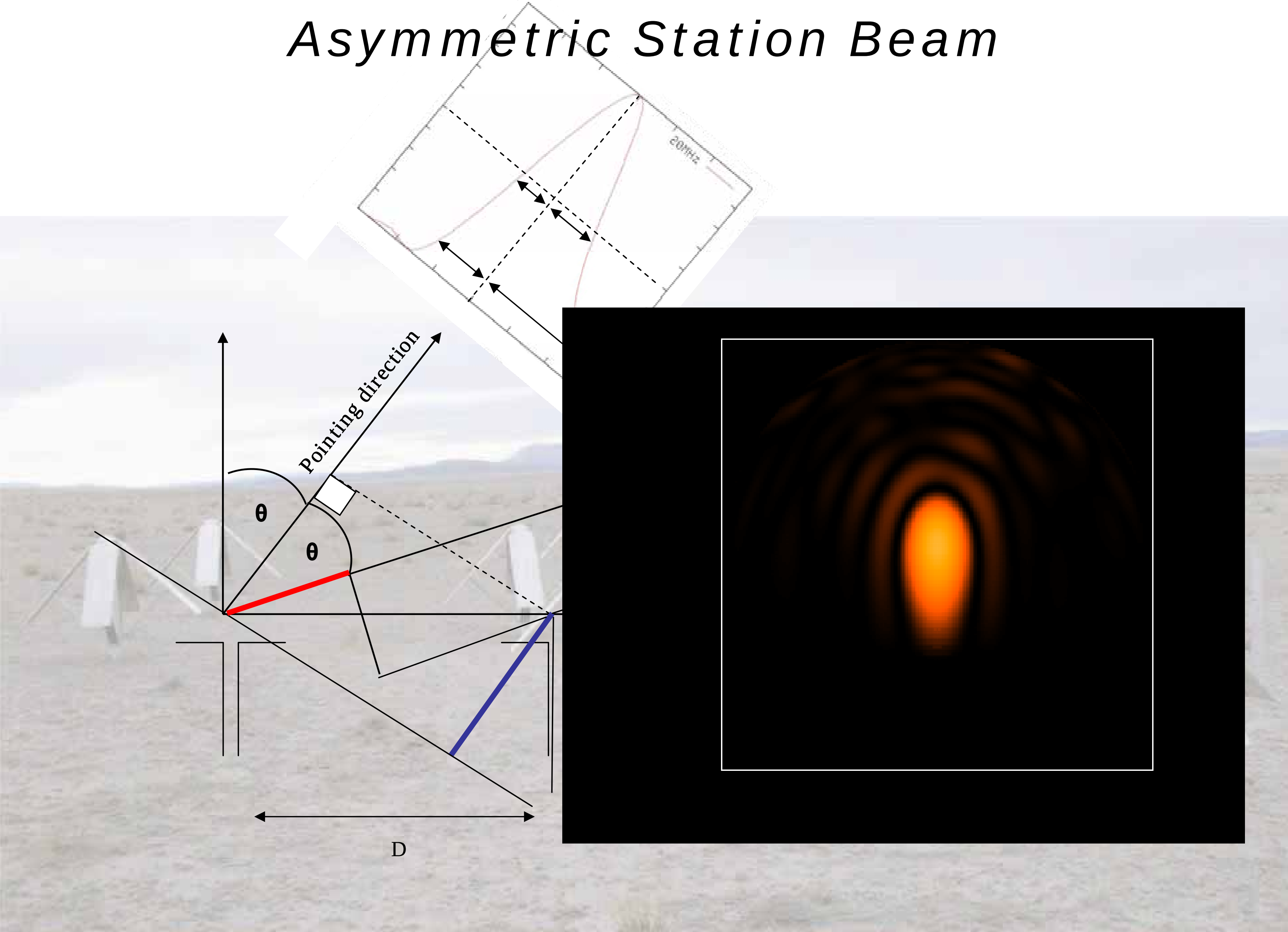
Symmetric Station Beam



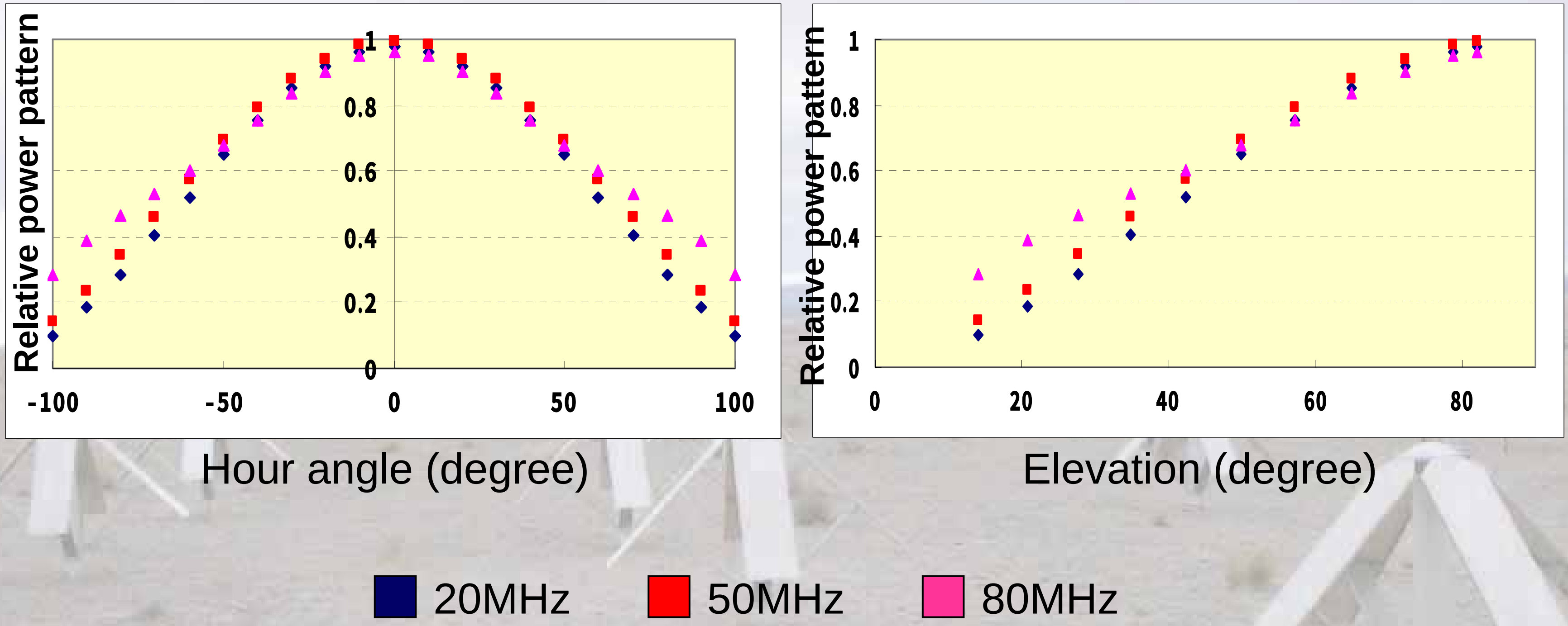
Asymmetric Station Beam



Asymmetric Station Beam

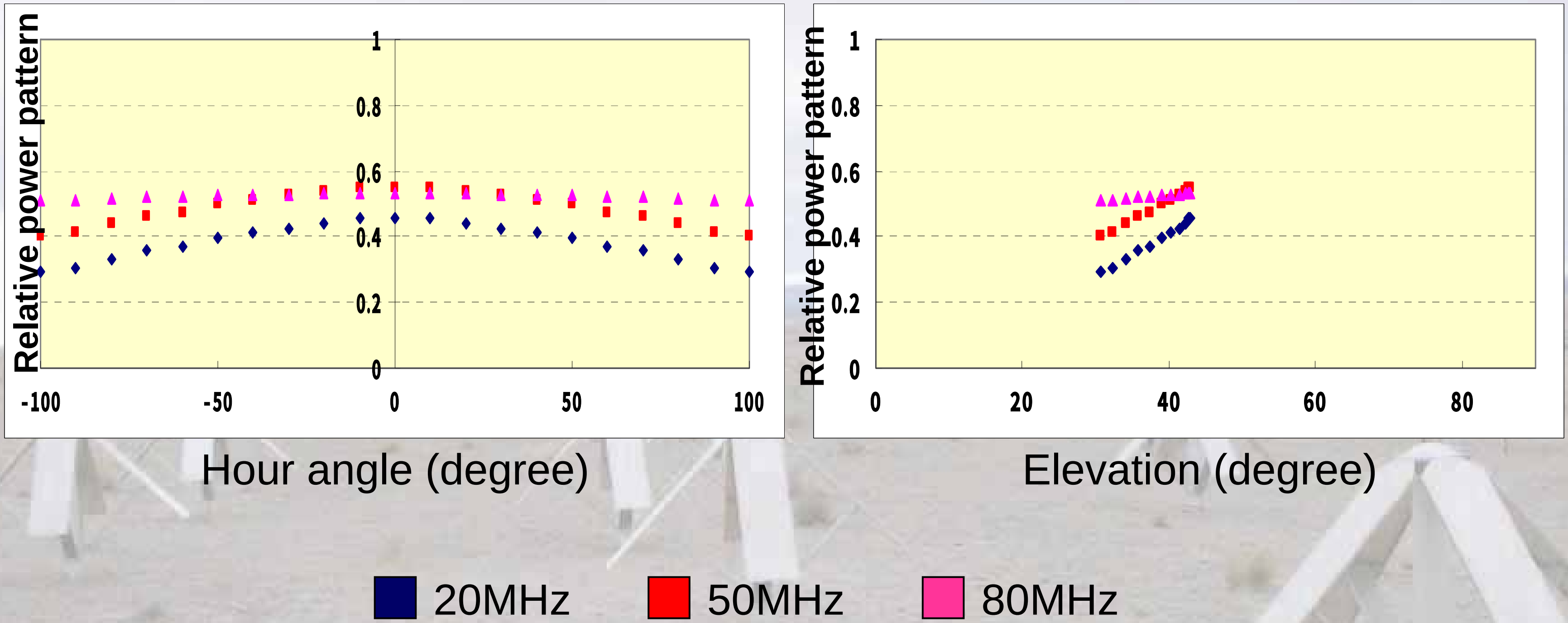


Relative Power Pattern (example1)



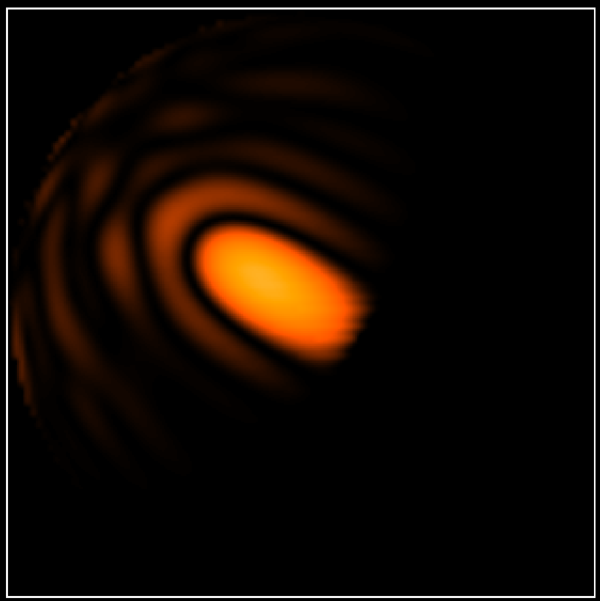
Above shows the simulation results when the LWA Elk station beam (latitude32.9°) tracks the CygA position (Dec 40.7°).

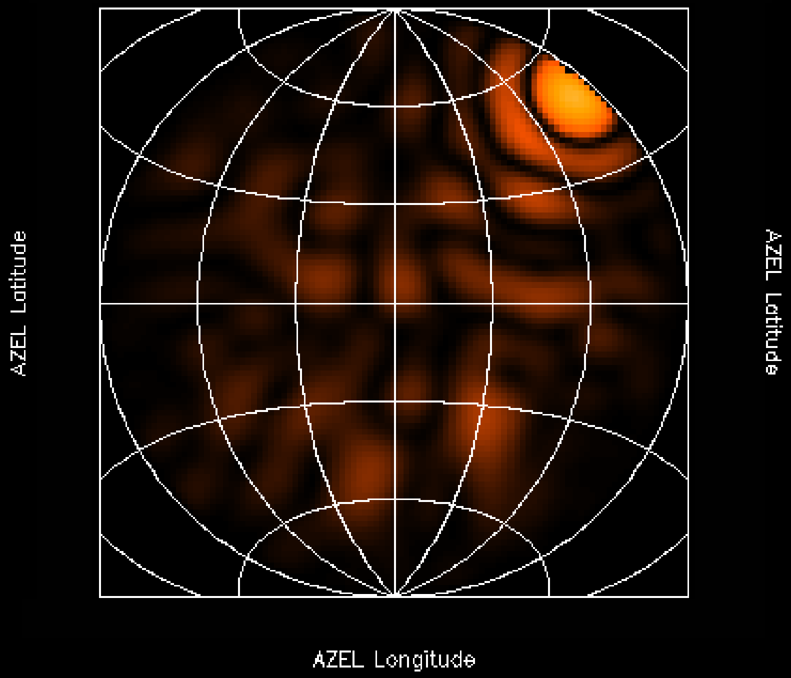
Relative Power Pattern (example2)



Above shows the simulation results when the LWA Elk station beam (latitude32.9°) tracks Dec 80° position.

Elk station beam at 20 MHz





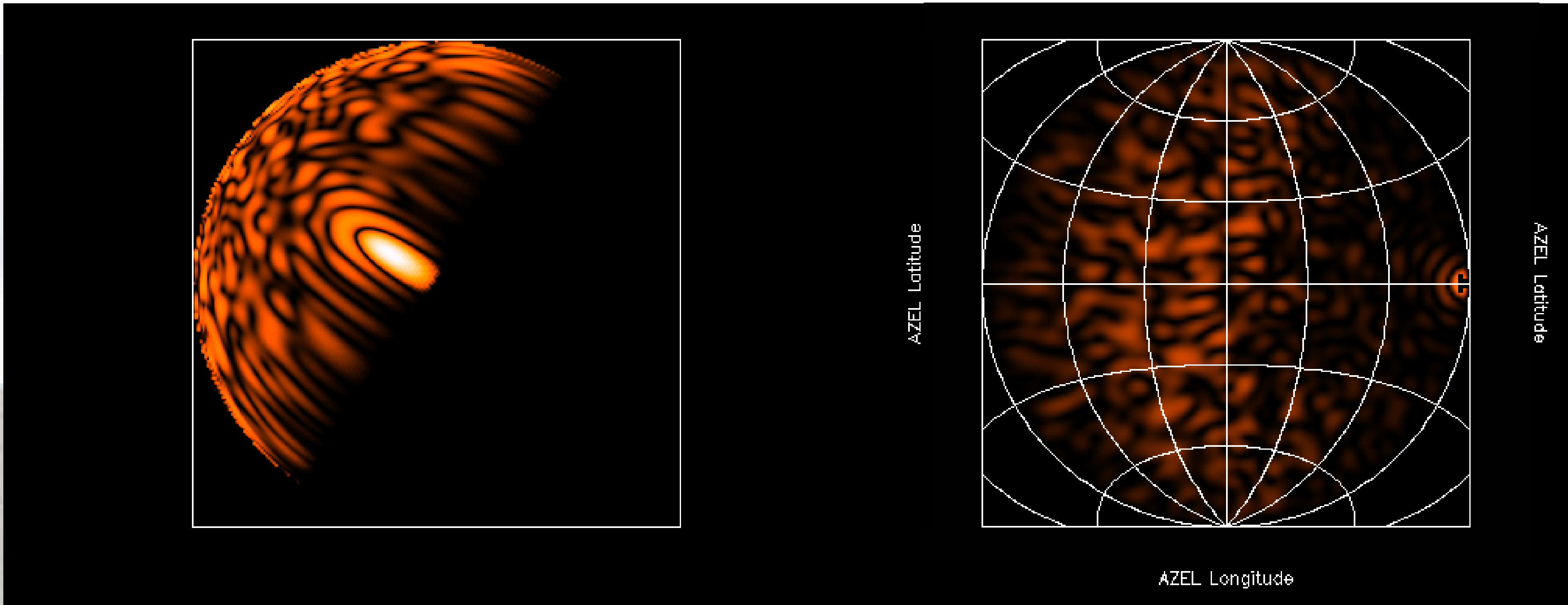
l m coordinate

Ground coordinate

(-6.7h ~ +6.7h)

Above shows the simulation results when the LWA Elk station beam (latitude32.9°) tracks the CygA position (Dec 40.7°).

Elk station beam at 50 MHz



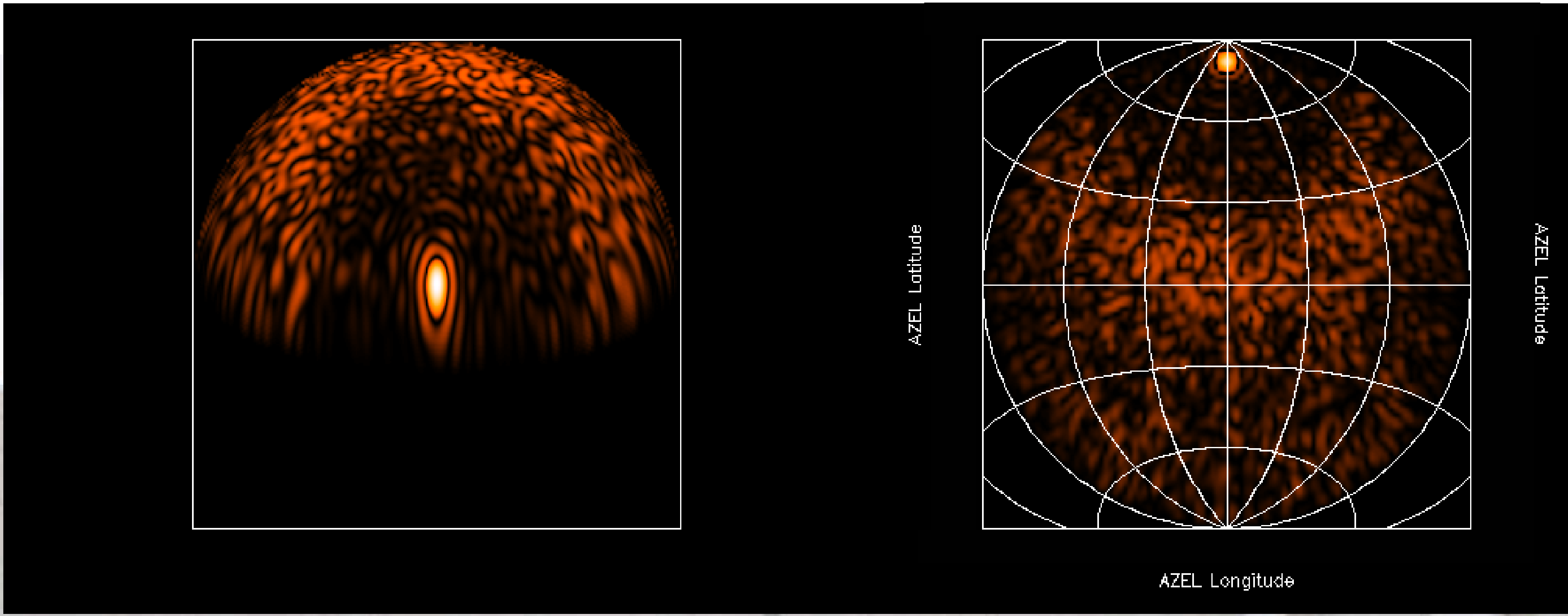
l m coordinate

Ground coordinate

(-6h ~ +6h)

Above shows the simulation results when the LWA Elk station beam (latitude32.9°) tracks Dec 0° position.

Elk station beam at 80 MHz



l m coordinate

Ground coordinate

(-12h ~ +12h)

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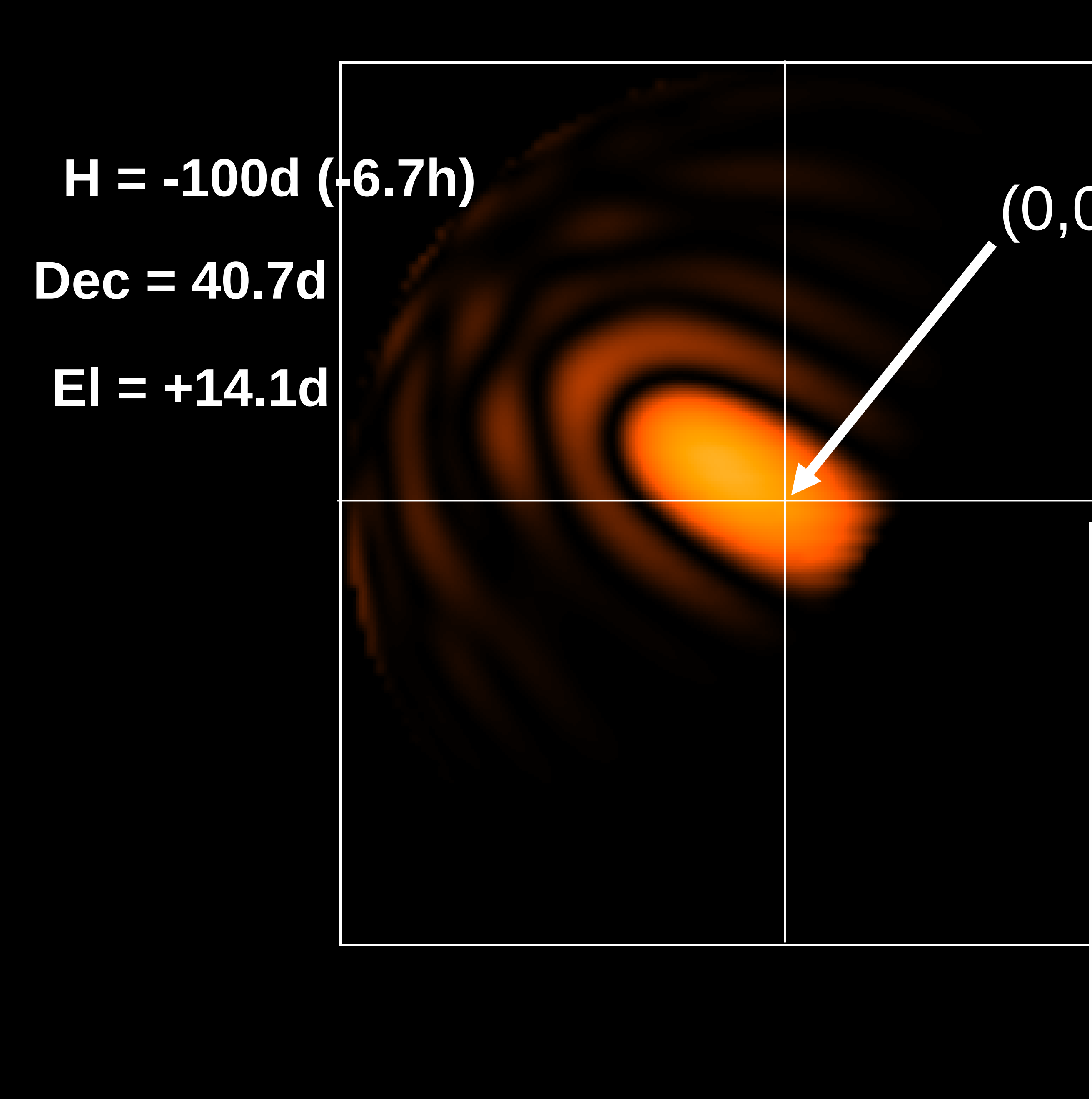
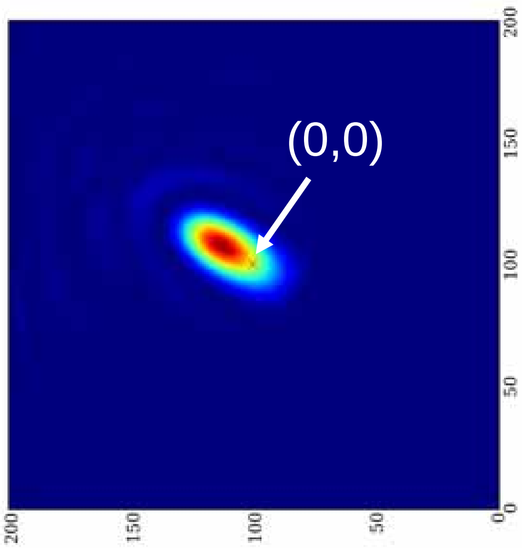
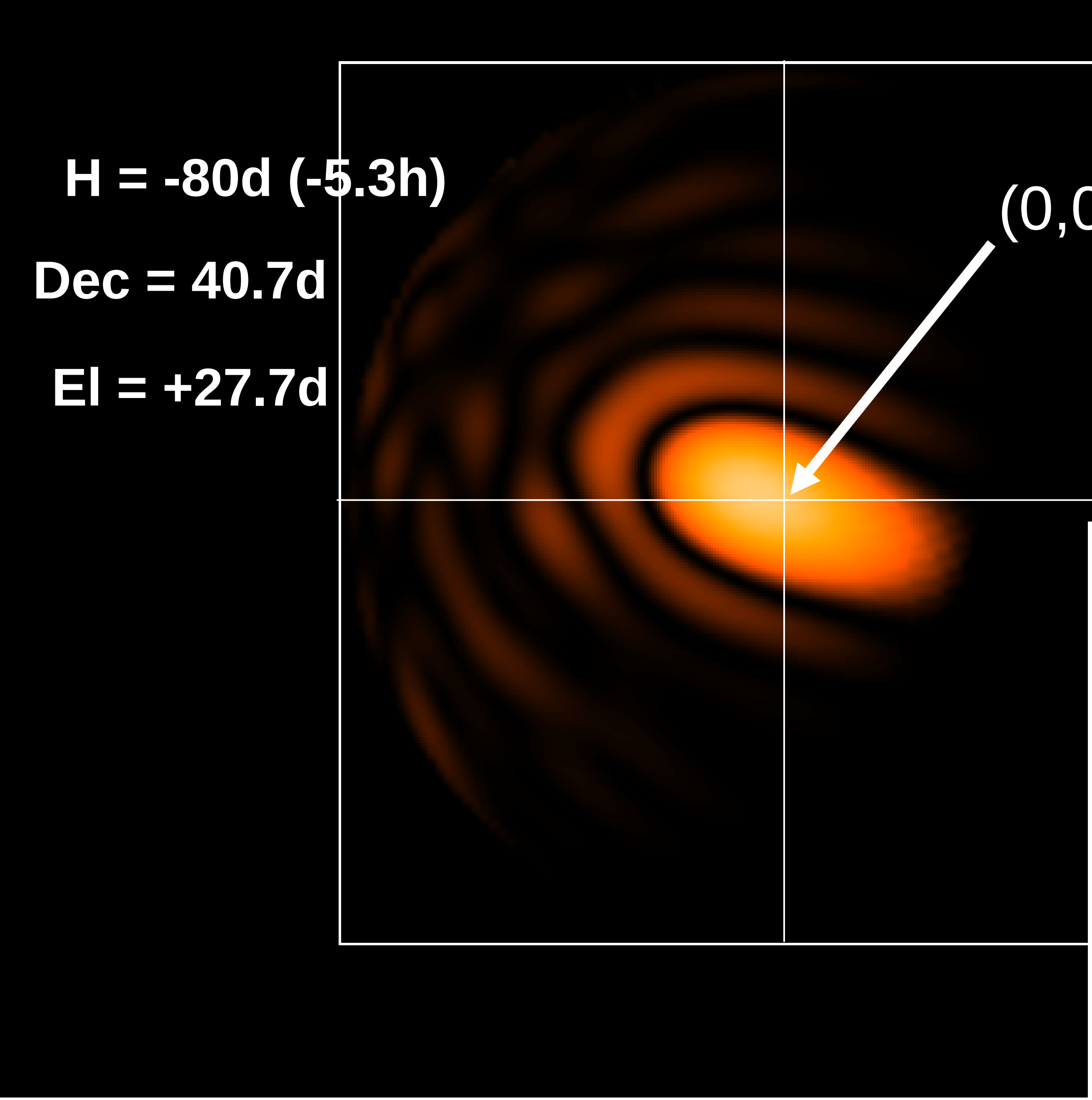
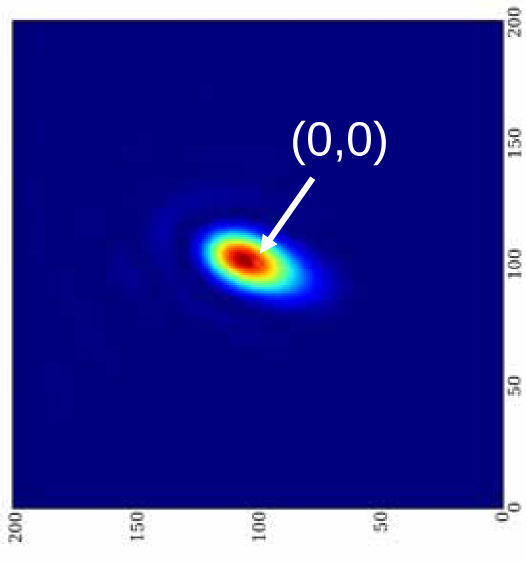


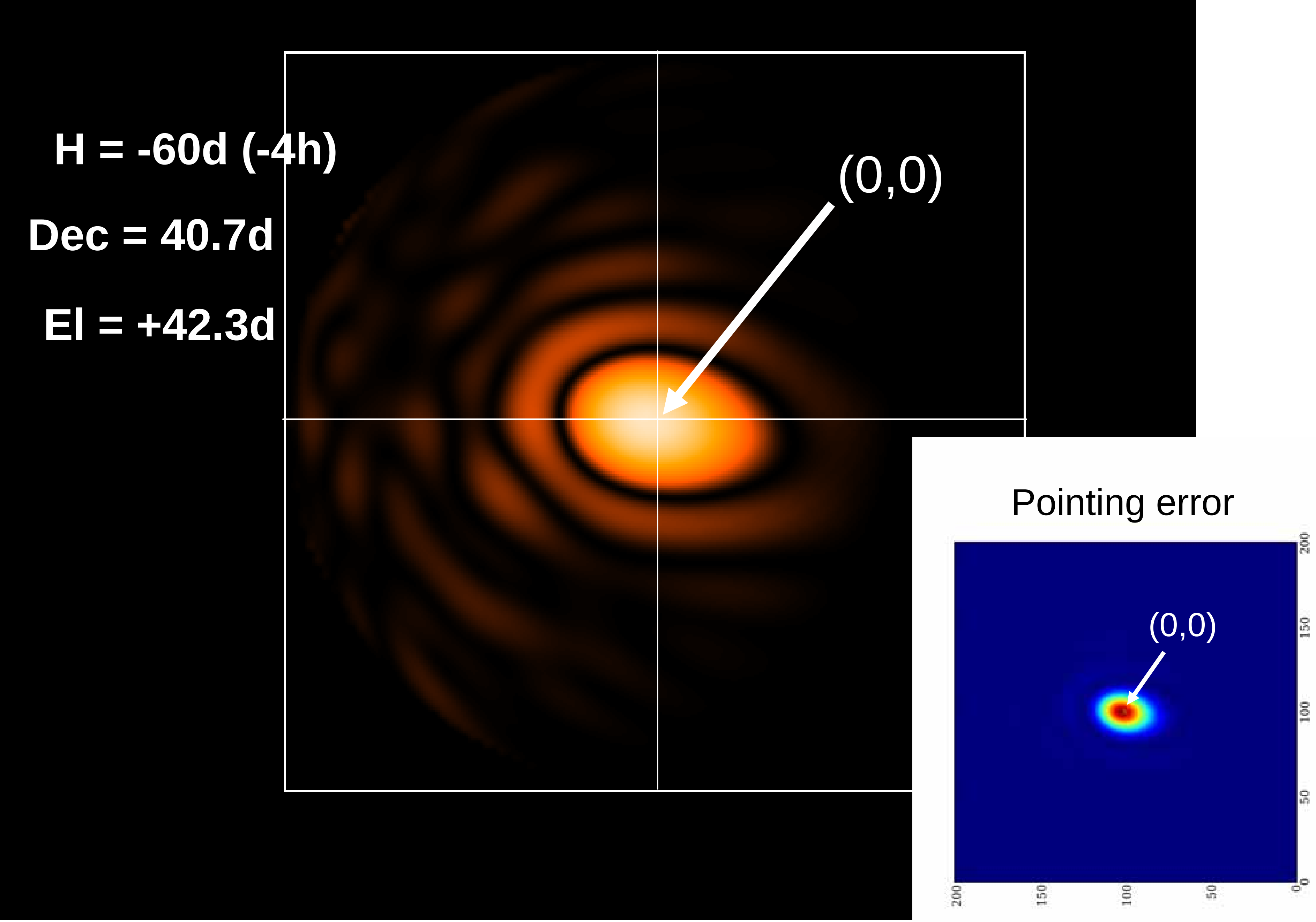
Pointing error

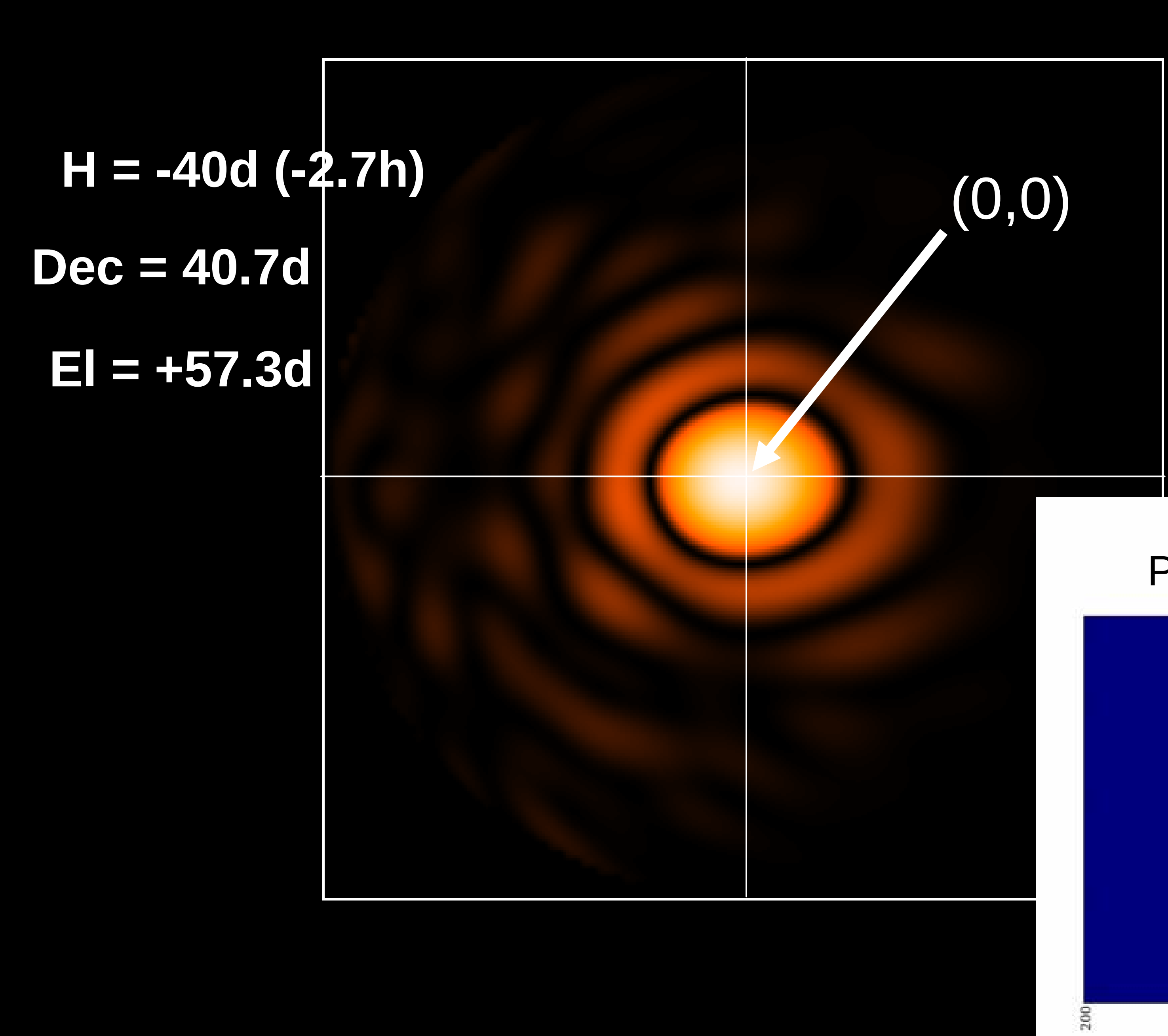




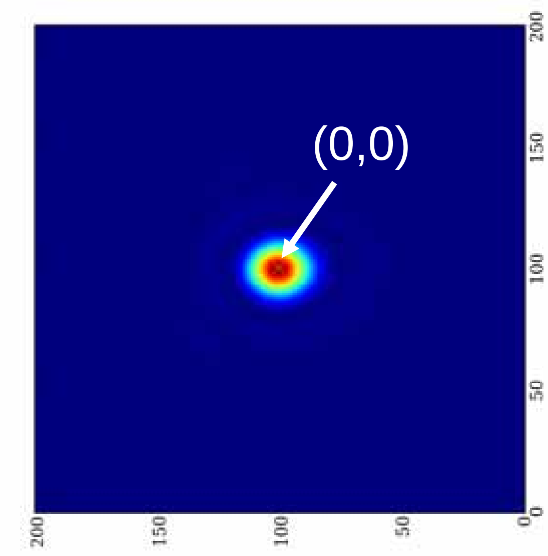
Pointing error

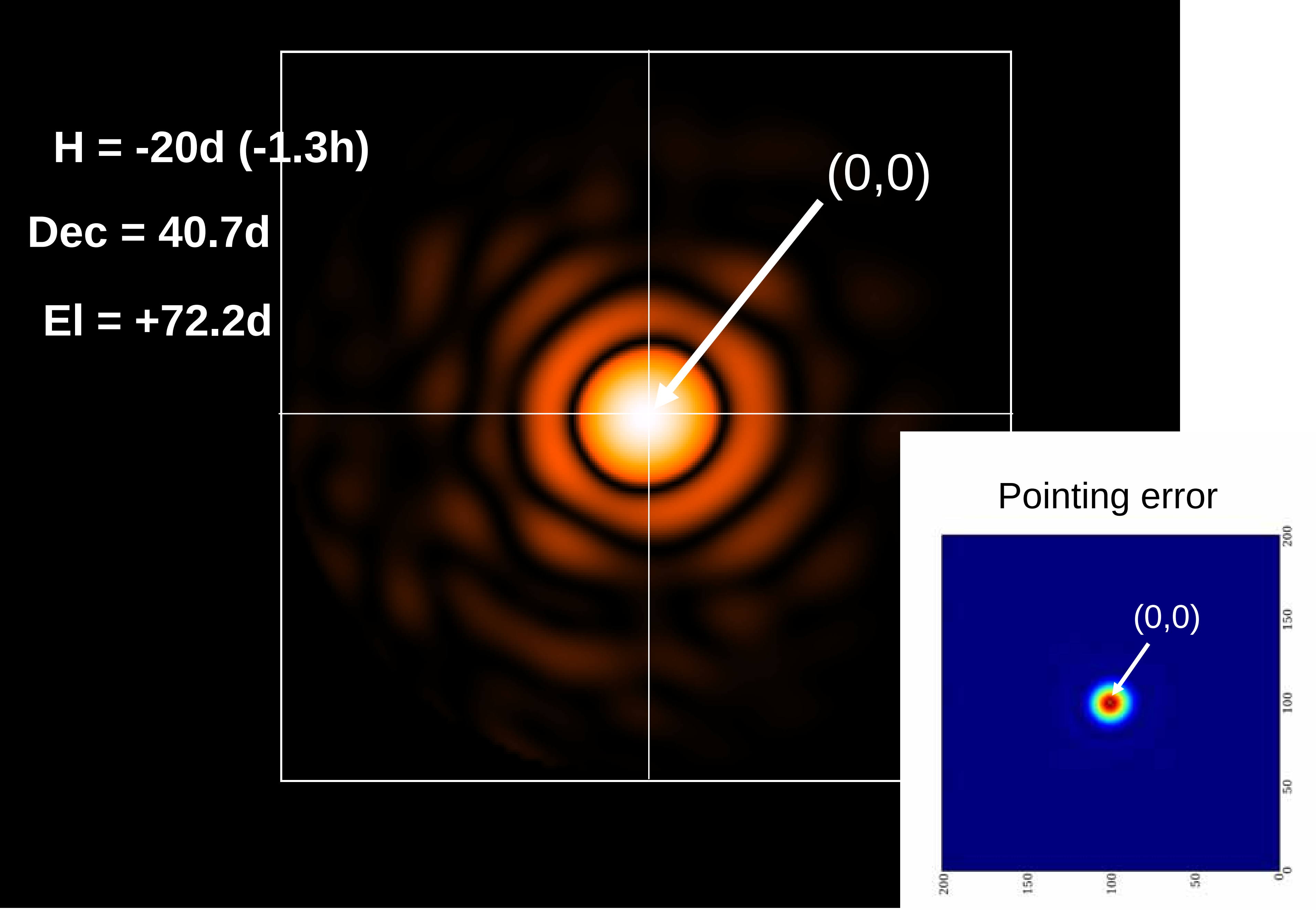


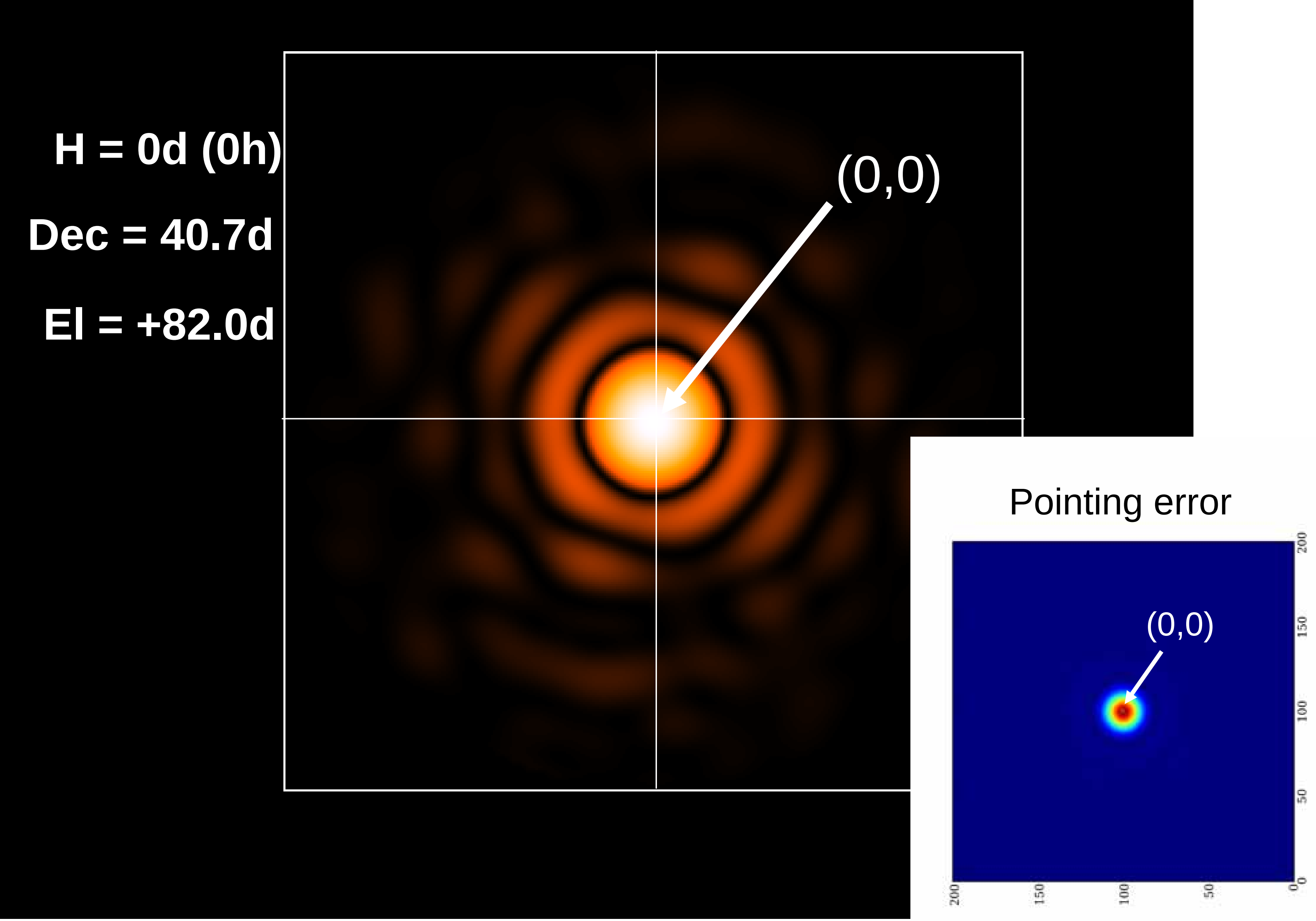

H = -60d (-4h)
Dec = 40.7d
El = +42.3d
(0,0)
Pointing error
(0,0)

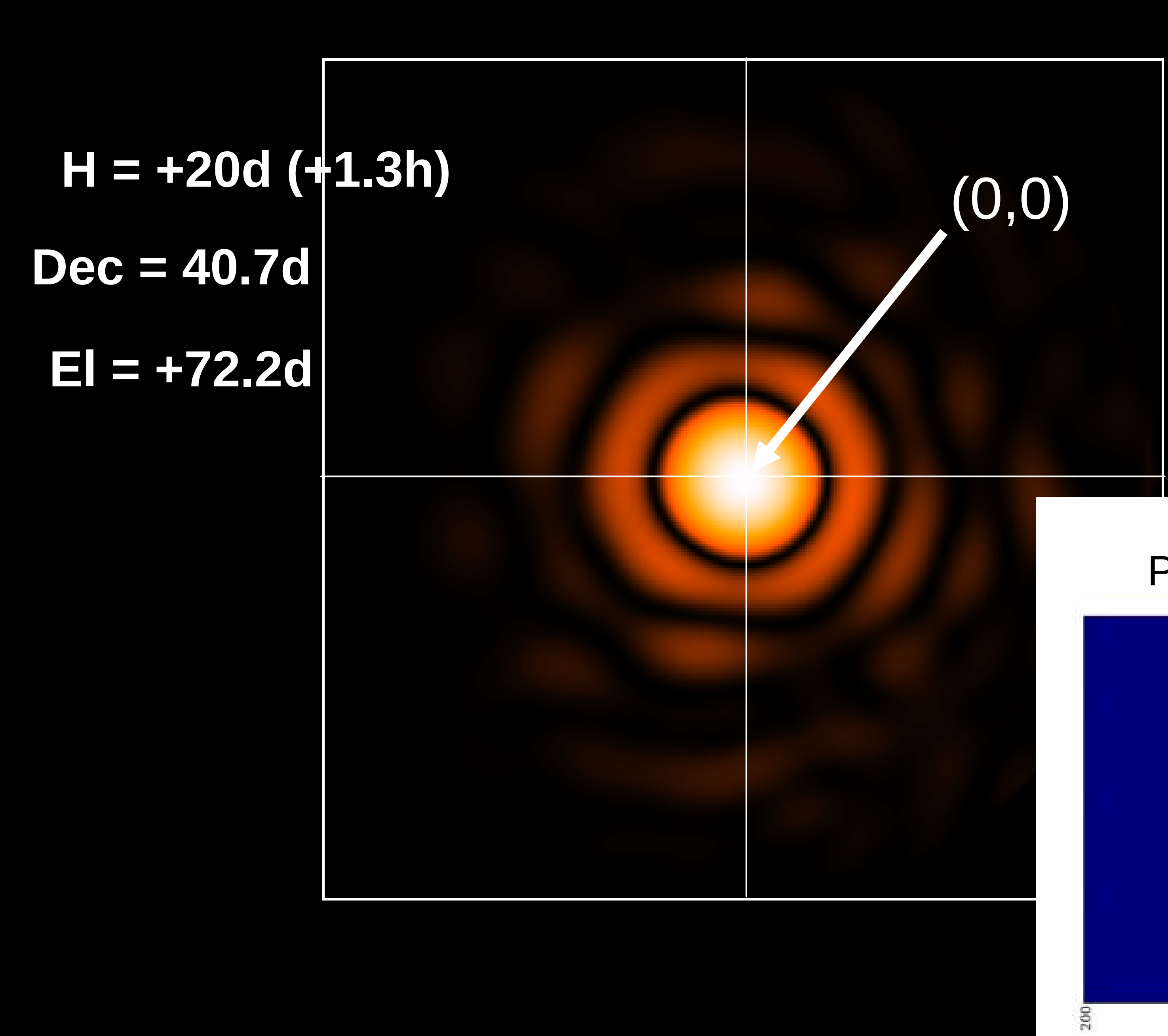


Pointing error

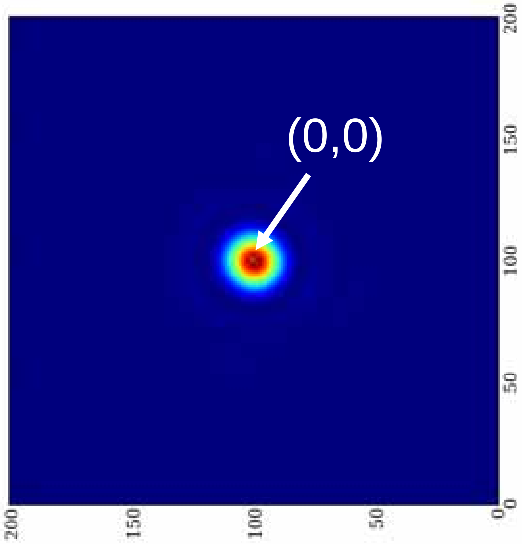


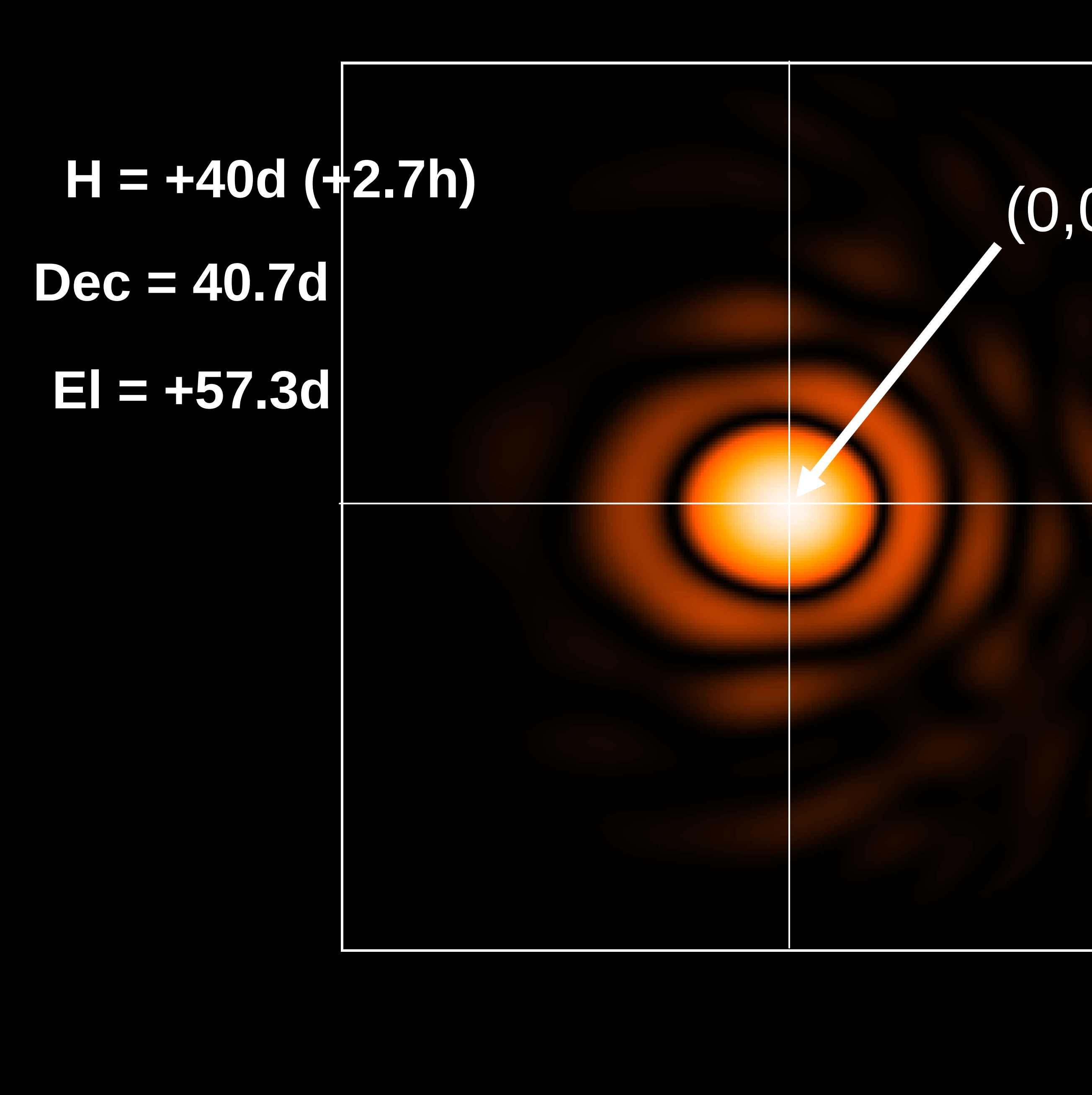
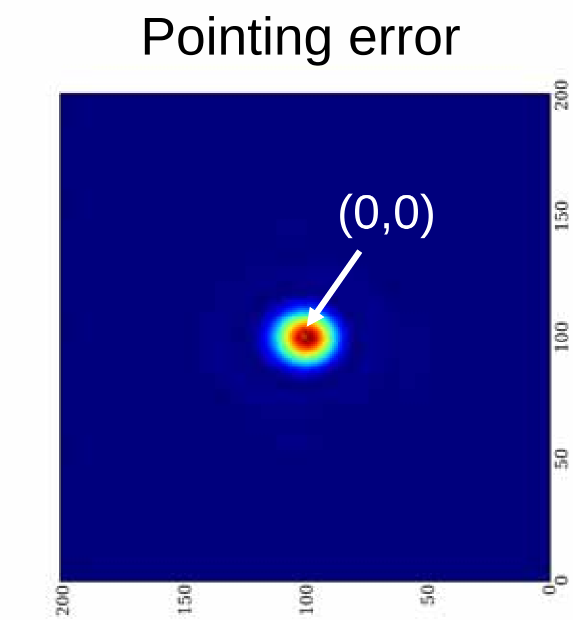

H = -20d (-1.3h)
Dec = 40.7d
El = +72.2d
(0,0)
Pointing error
(0,0)
200
150
100
50
0
200
150
100
50
0

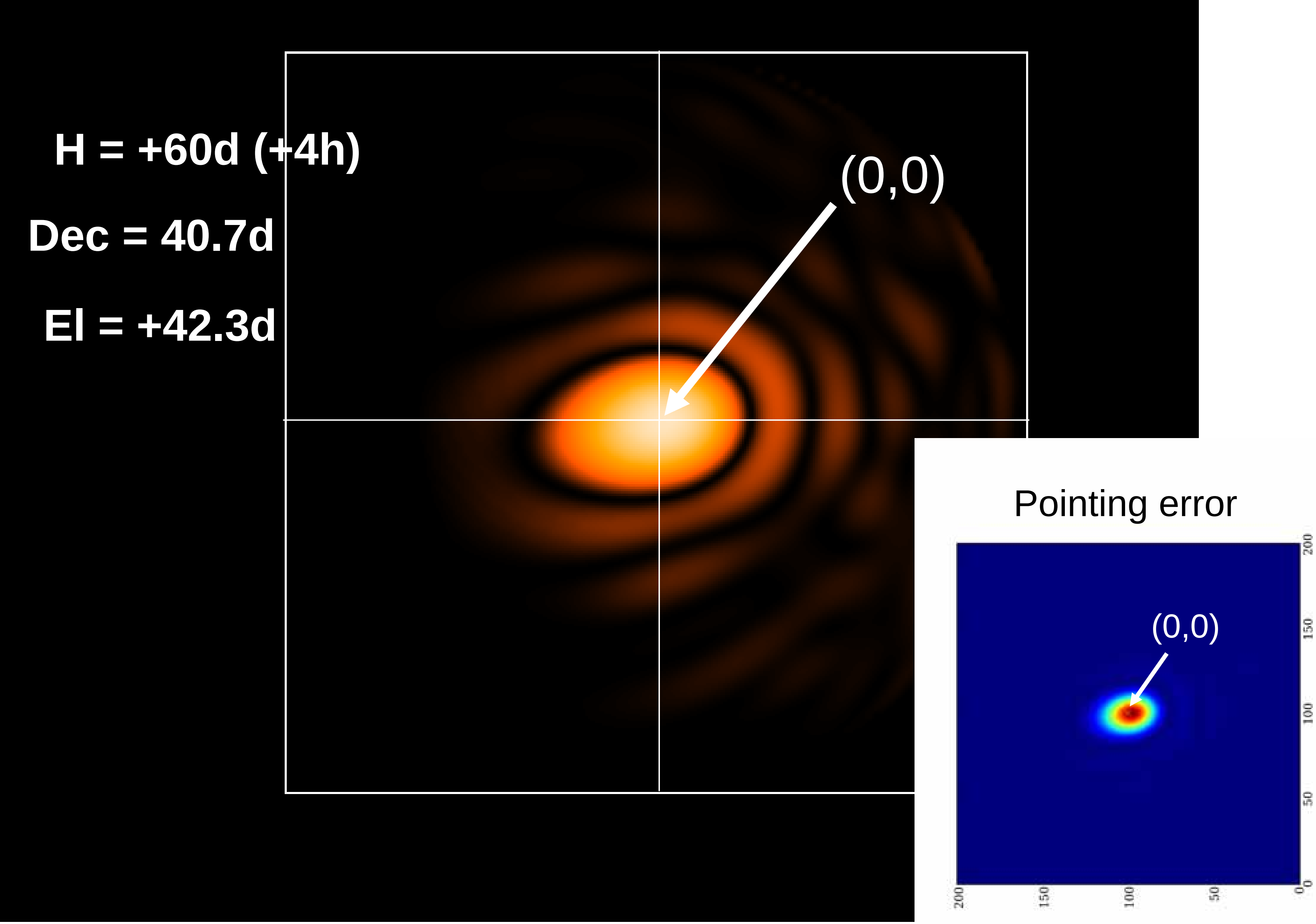

H = 0d (0h)
Dec = 40.7d
El = +82.0d
(0,0)
Pointing error
(0,0)
200
150
100
50
0
200
150
100
50
0

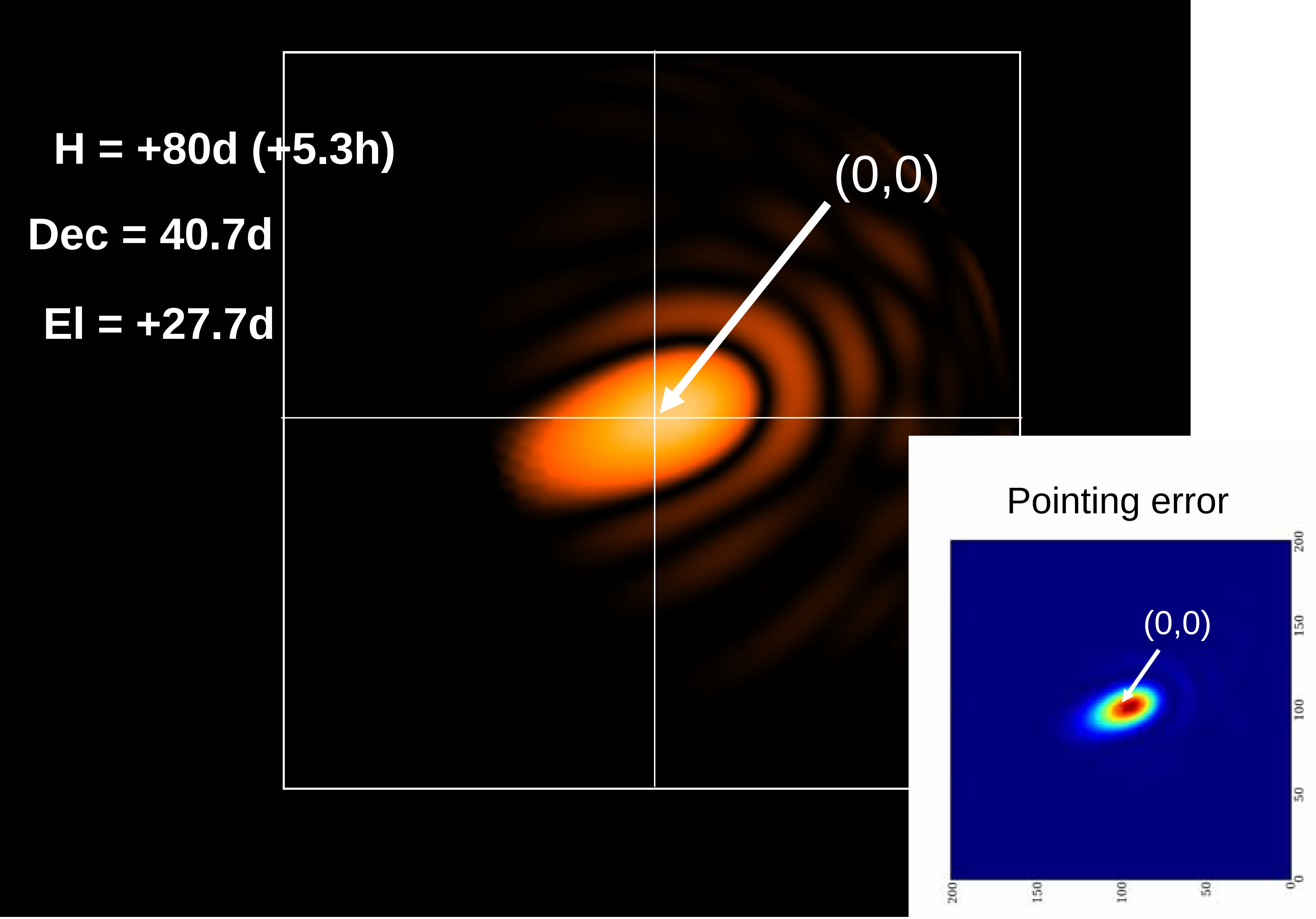


Pointing error




H = +40d (+2.7h)
Dec = 40.7d
El = +57.3d
(0,0)

Pointing error
(0,0)
200
150
100
50
0

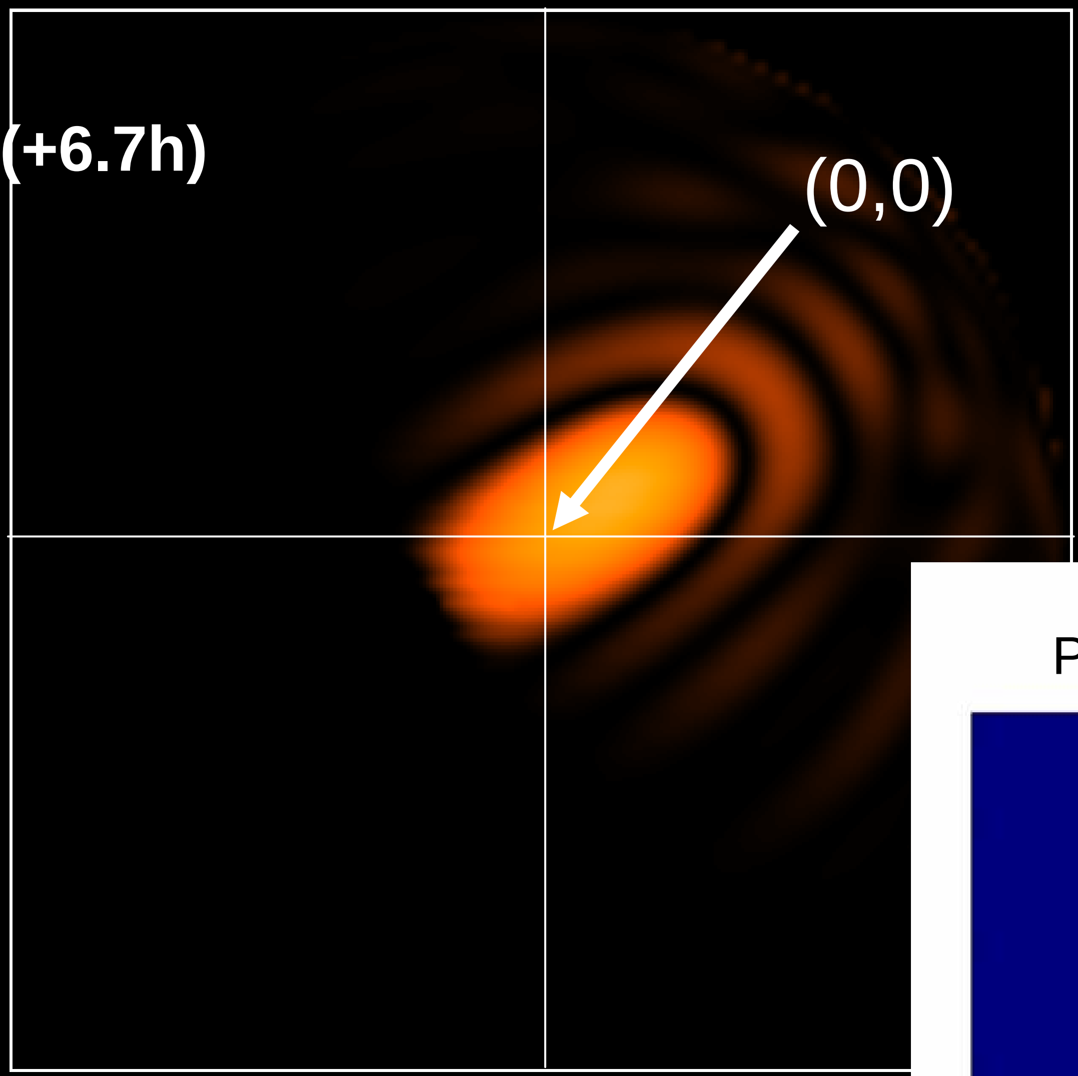

H = +60d (+4h)
Dec = 40.7d
El = +42.3d
(0,0)
Pointing error
(0,0)
200
150
100
50
0


H = +80d (+5.3h)
Dec = 40.7d
El = +27.7d
(0,0)
Pointing error
(0,0)
200
150
100
50
0
200
150
100
50
0

H = +100d (+6.7h)

Dec = 40.7d

El = +14.1d



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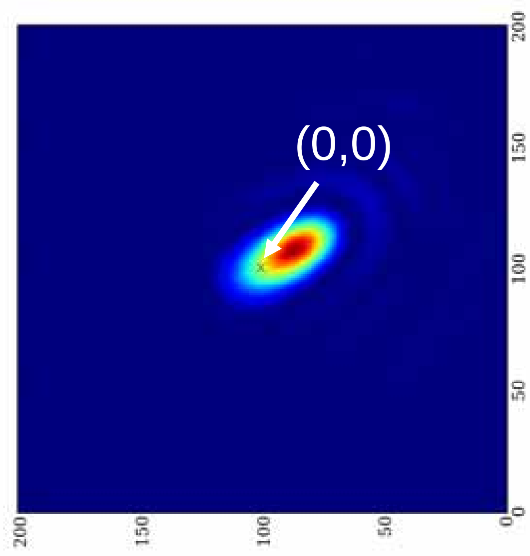

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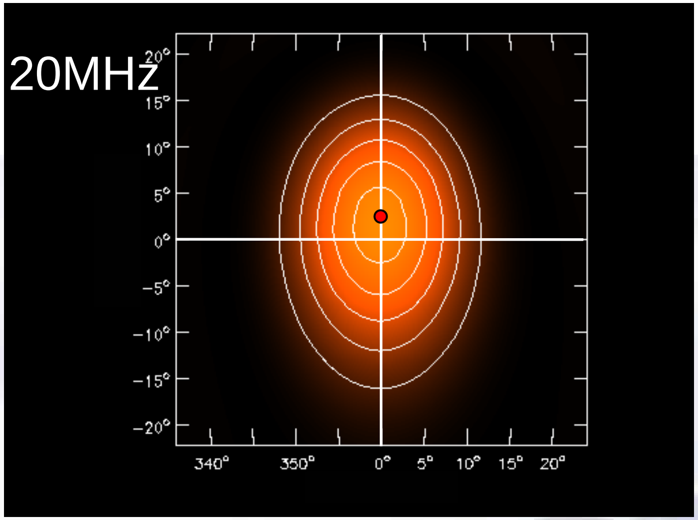
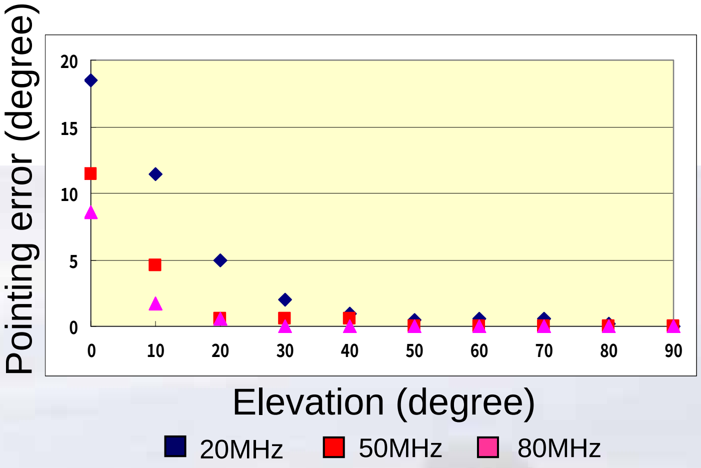
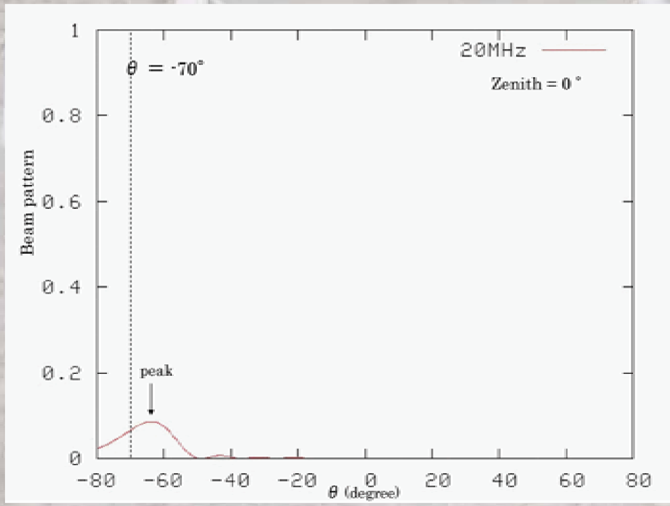
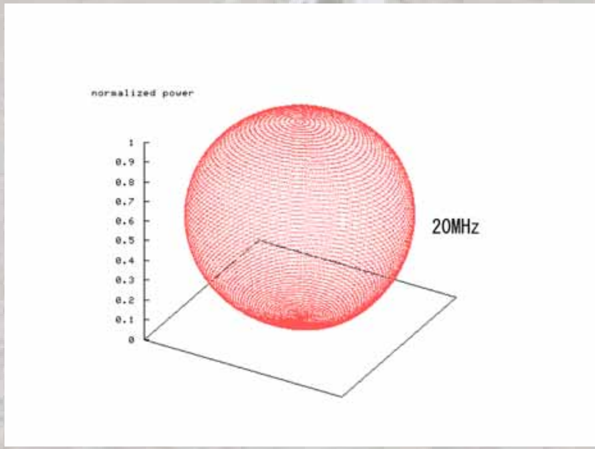




Pointing error as a function of elevation angle (degree).

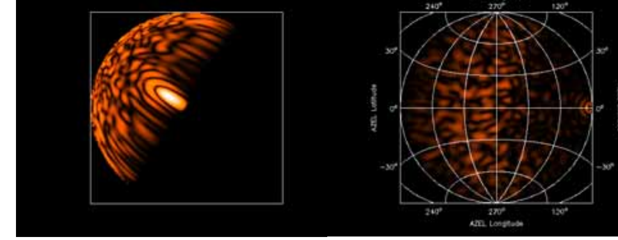


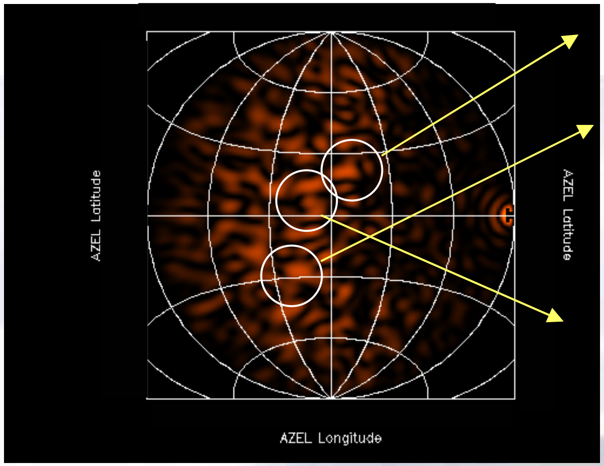
Pointing error



antenna reception patterns

Side lobe at 50MHz



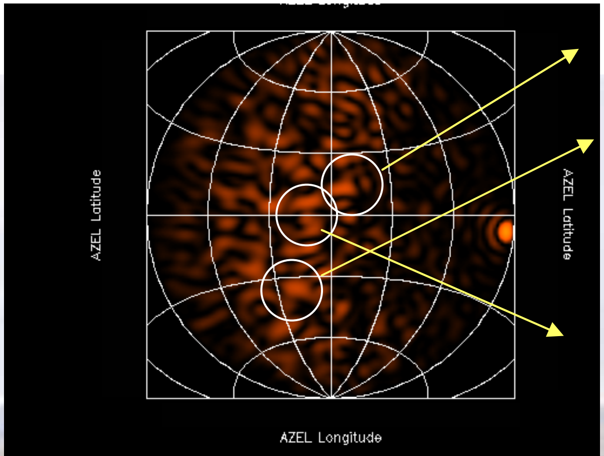


-5.8dB

-6.4dB

-6.3dB

(1) El 32.3°

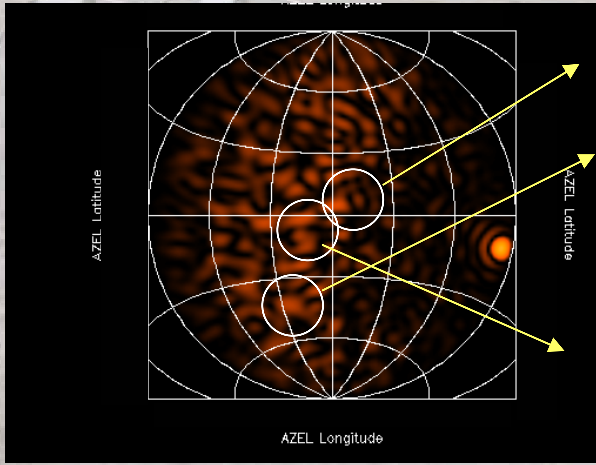


-7.5dB

-8.2dB

-6.4dB

(2) El 34.0°

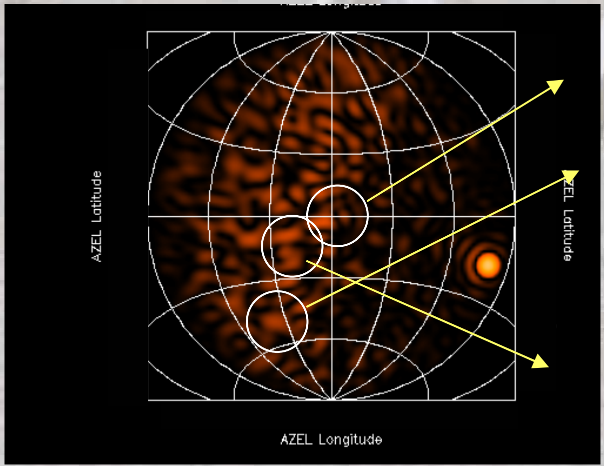


-10.3dB

-10.8dB

-11.9dB

(3) El 35.8°



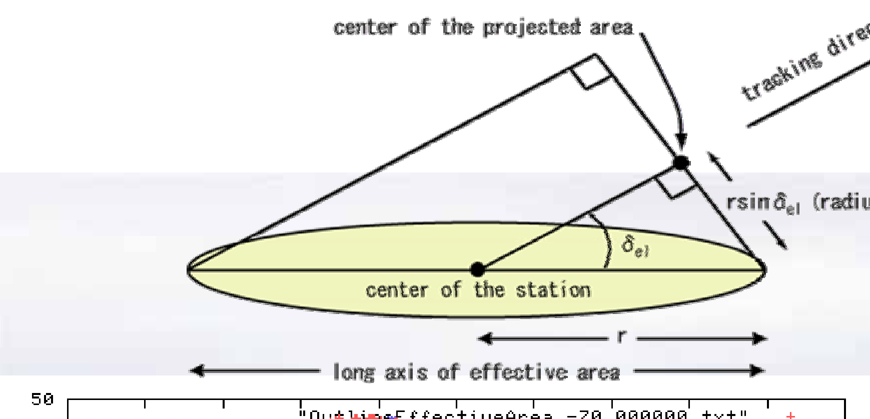
-12.9dB

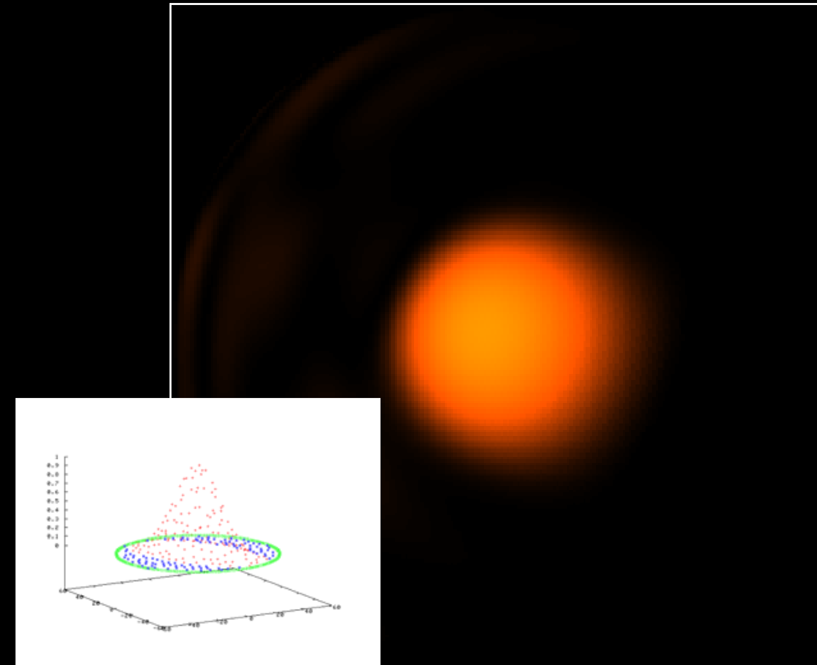
-13.6dB

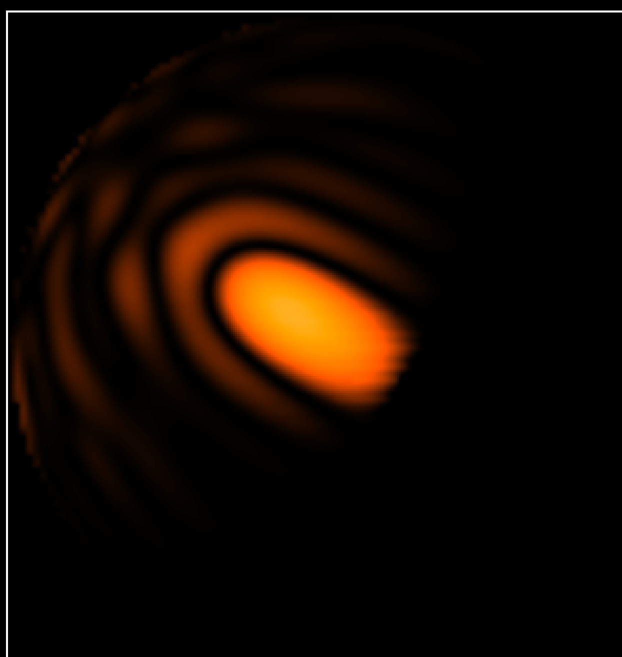
-14.9dB

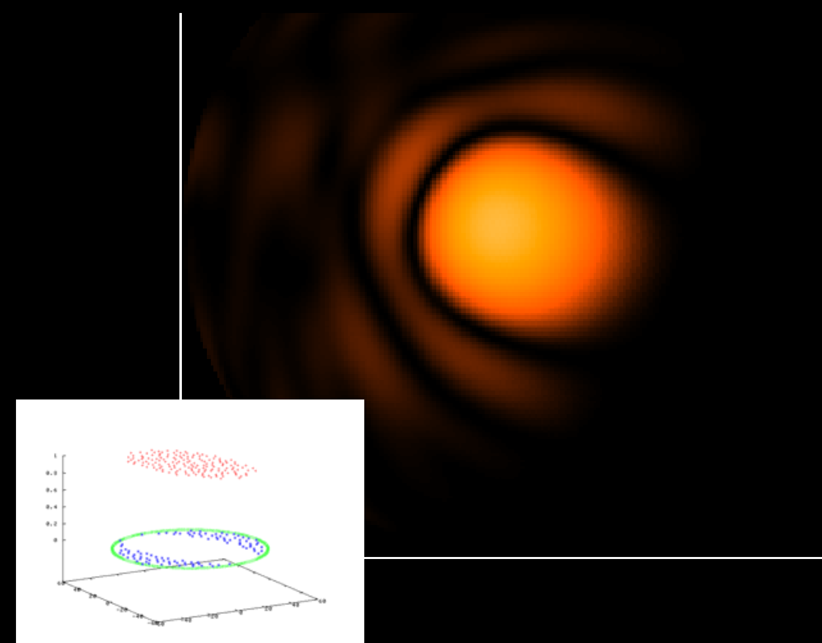
(4) El 37.4°

Circular Beam ... the effective



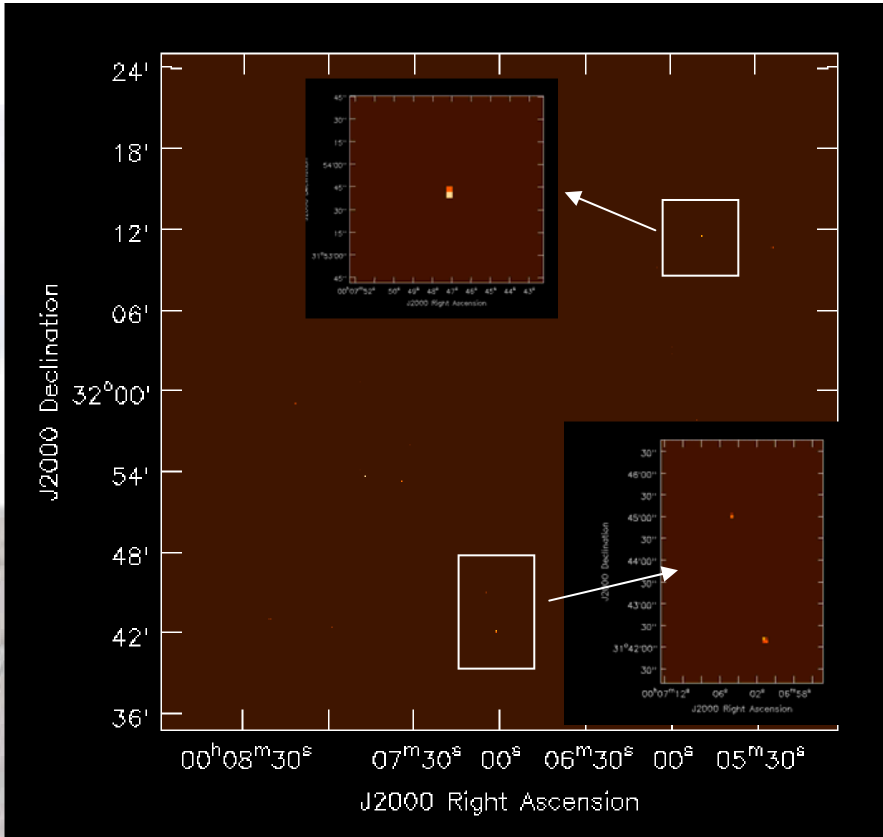




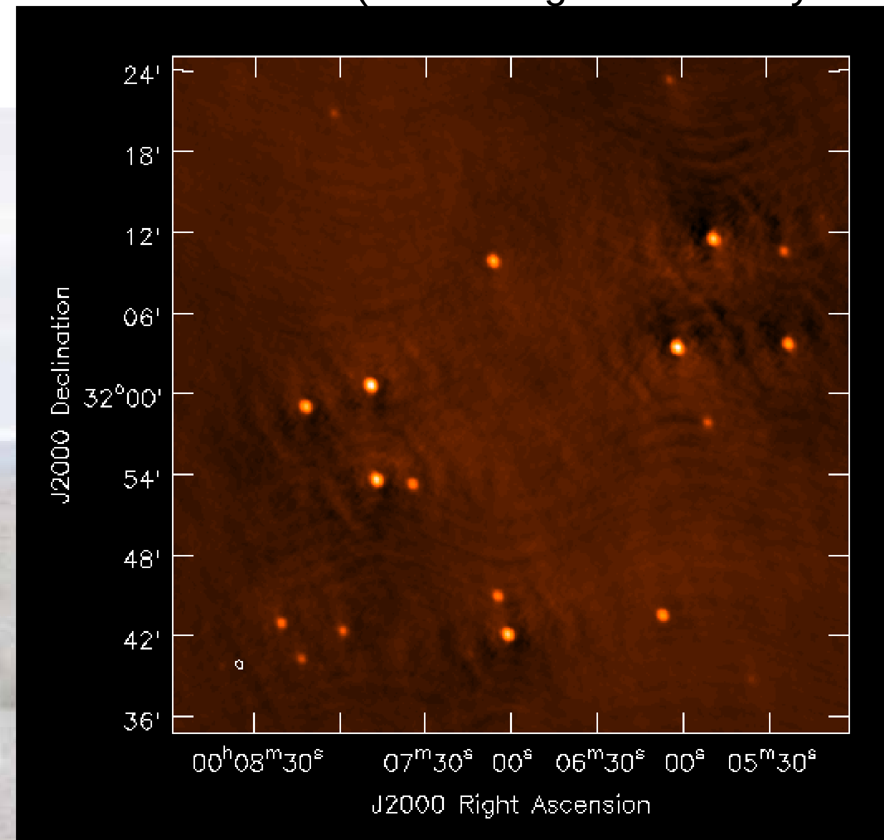


LWA image at 20MHz

(S.Bhatnagar & M.Kuniyoshi)



Simulation model



LWA image at 20MHz

(Jy/pixel)

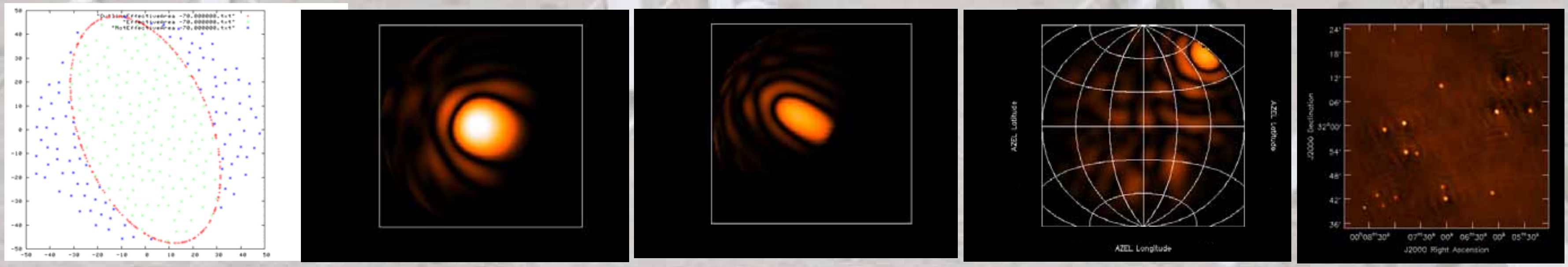
Std Dev	**RMS**	**Mean**
5.974e-05	5.974e-05	3.694e-07
Median	**Min**	**Max**
0.00	7.868e-05	0.01981

(Jy/beam)

Std Dev	**RMS**	**Mean**
0.0005373	0.0005528	0.0001299
Median	**Min**	**Max**
0.0001221	-0.0007181	0.02770

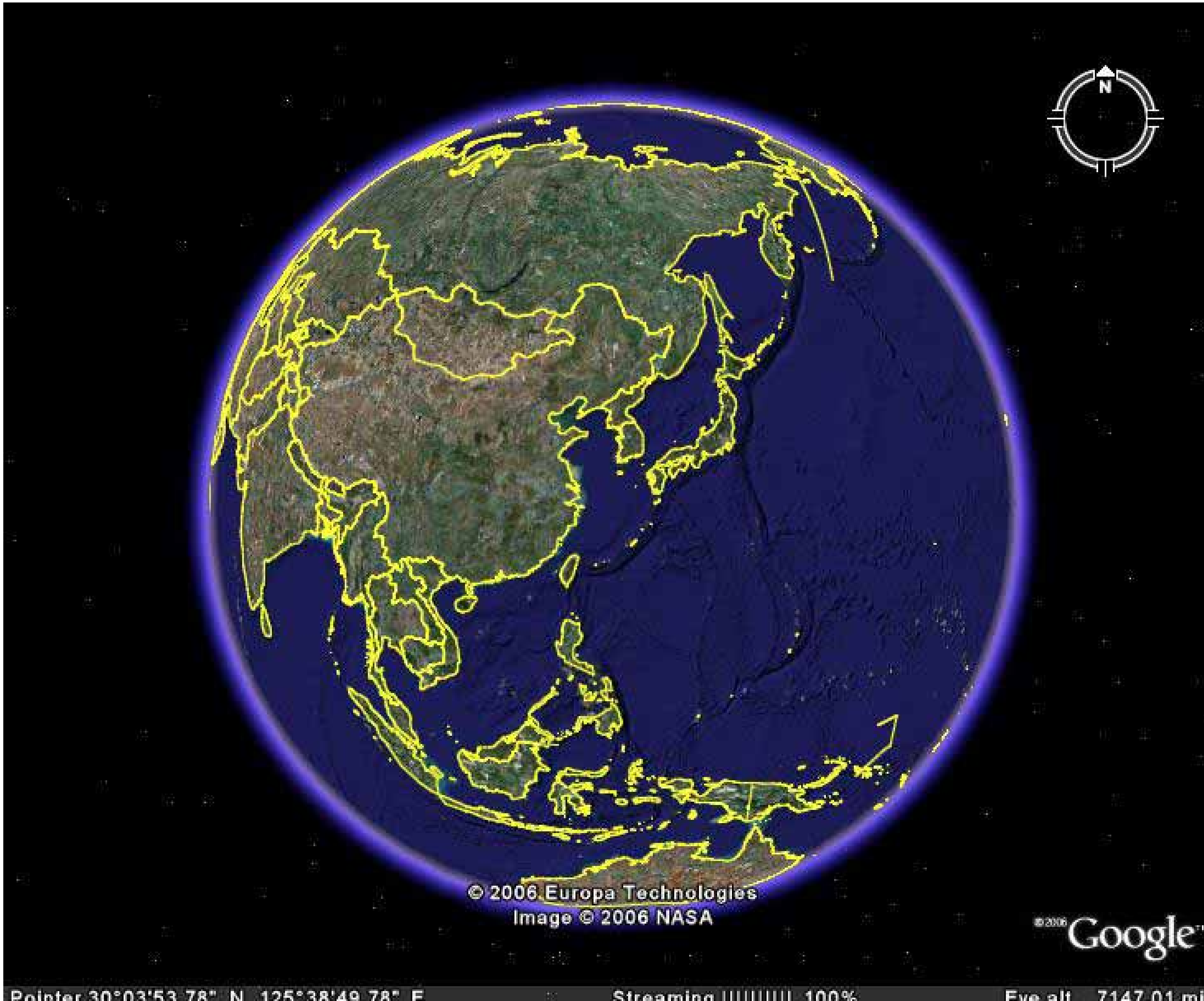
Summary and Future work

- Pointing error depends on the observing frequency and elevation.
- Sensitivity changes with observing elevation due to the primary beam of the dipole in the station.
- Phased station beams are not constant during tracking a target area.
- Asymmetric beams
- Taper scheme makes the sensitivity decrease, but make the beam constant.



Future Work

Simulations with a 110m x 100m station (possible LWA station size) using a taper scheme.


N
© 2006 Europa Technologies
Image © 2006 NASA
©2006 Google
Pointer 30°03'53.78" N 125°38'49.78" E
Streaming |||||||||| 100%
Eye alt 7147.01 mi


© 2006 Europa Technologies
Image © 2006 NASA
Image © 2006 TerraMetrics
©2006 Google
Pointer 34°15'03.38" N 134°15'06.61" E
Streaming |||||||||| 100%
Eye alt 3451.47 mi


Harbin
Shenyang
Beijing
Dalian
North Korea
Pyongyang
Incheon
Seoul
Daegu
(Pusan)
Busan
Japan
Tokyo
Nagoya
Osaka
Nanjing
Shanghai
Taipei
Taiwan
Pointer 27°51'15.60" N 134°13'02.65" E
Streaming |||||||||| 100%
Eye alt 1686.46 mi

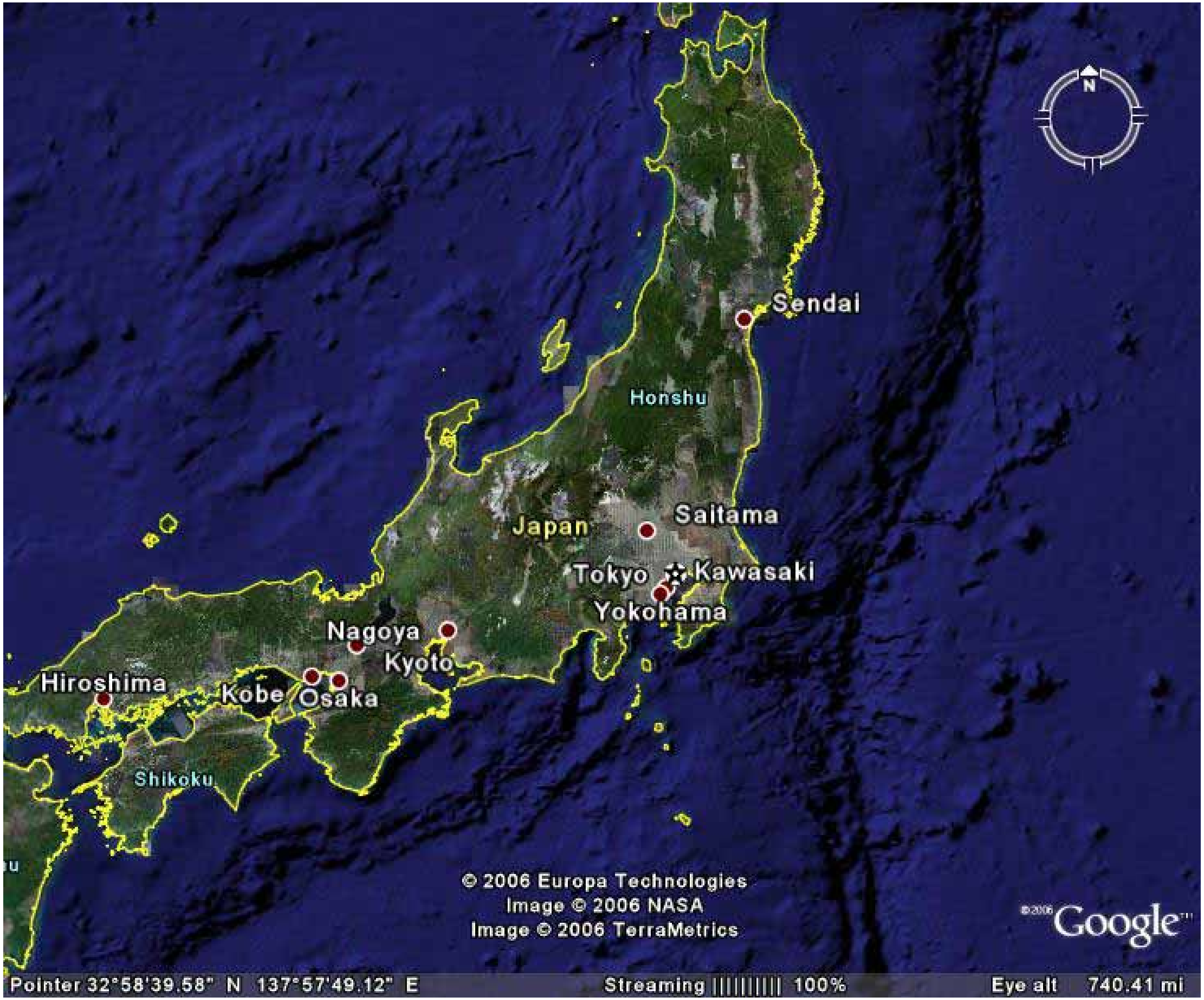

Sendai
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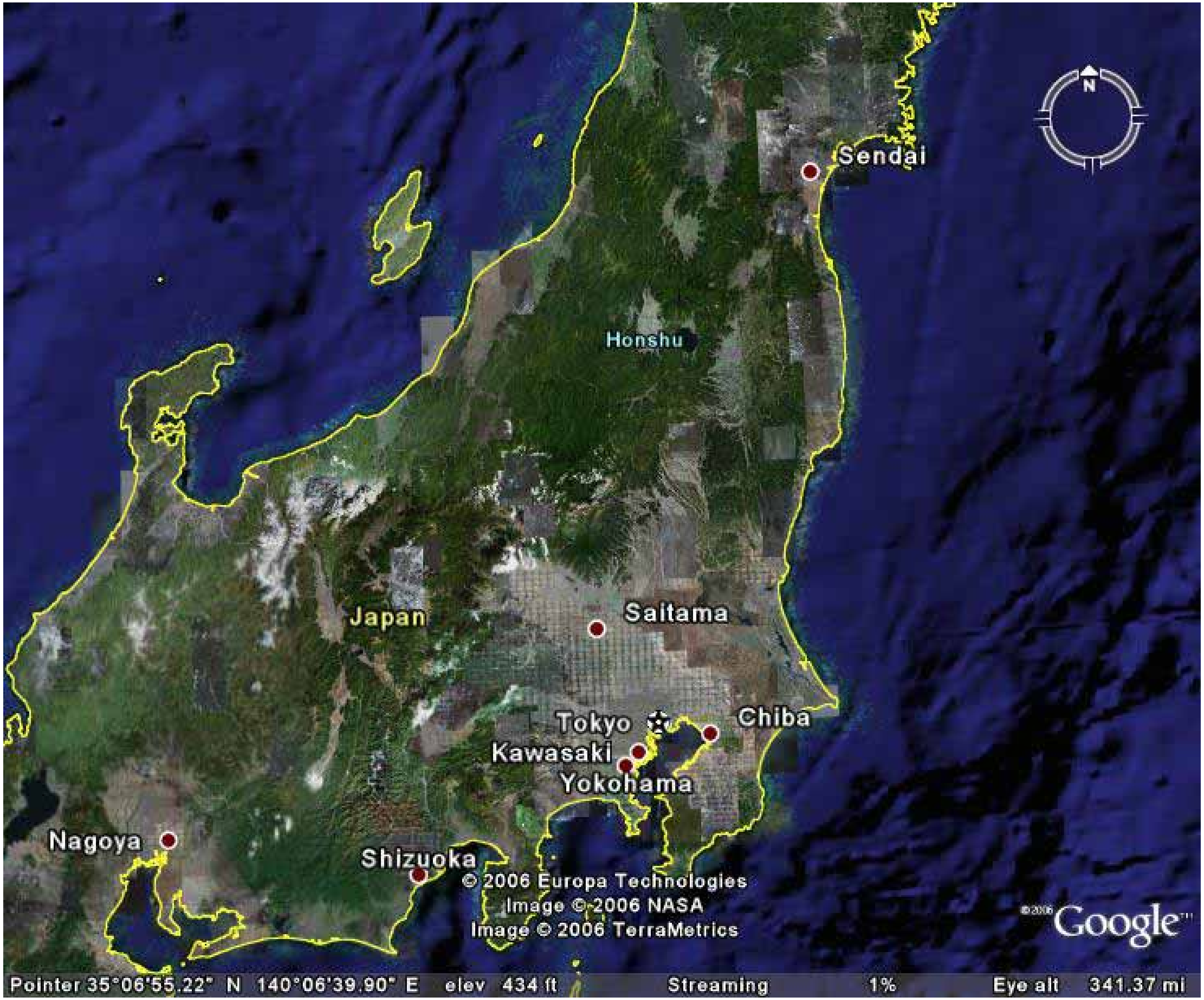
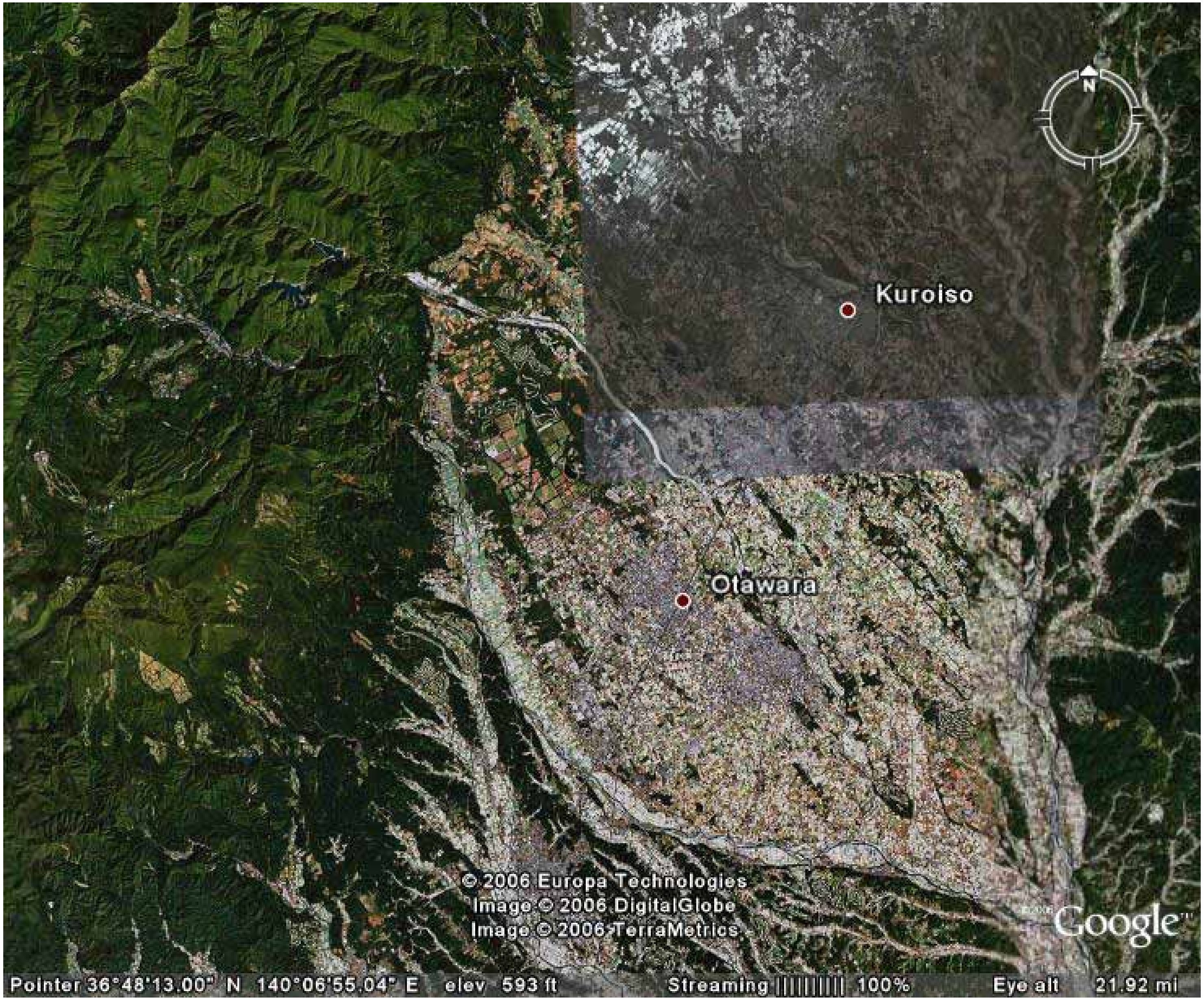
Image © 2006 TerraMetrics
Google
Pointer 32°58'39.58" N 137°57'49.12" E
Streaming |||||||||| 100%
Eye alt 740.41 mi


Sendai
Honshu
Japan
Saitama
Tokyo
Chiba
Kawasaki
Yokohama
Nagoya
Shizuoka
© 2006 Europa Technologies
Image © 2006 NASA
Image © 2006 TerraMetrics
Google
Pointer 35°06'55.22" N 140°06'39.90" E elev 434 ft
Streaming
1%
Eye alt 341.37 mi


Niigata
Honshu
Nagano
Maebashi
Mito
Japan
Saitama
© 2006 Europa Technologies
Image © 2006 TerraMetrics
Google
Pointer 36°04'05.95" N 141°04'45.75" E elev 0 ft
Streaming |||||||||| 100%
Eye alt 155.33 mi

Karasuyama
© 2006 Europa Technologies
Utsunmiya
Image © 2006 TerraMetrics
Google
Pointer 36°33'27.63" N 140°28'04.45" E elev 136 ft
Streaming |||||||||| 100%
Eye alt 60.19 mi


Kuroiso
Otawara
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Image © 2006 TerraMetrics
Google
Pointer 36°48'13.00" N 140°06'55.04" E elev 593 ft
Streaming |||||||||| 100%
Eye alt 21.92 mi

N
Otawara
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Image © 2006 TerraMetrics
Google
Pointer 36°53'24.13" N 140°01'02.44" E elev 749 ft
Streaming |||||||||| 100%
Eye alt 40434 ft


N
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Image © 2006 TerraMetrics
Google
Pointer 36°54'59.51" N 139°57'42.79" E elev 944 ft
Streaming |||||||||| 100%
Eye alt 17337 ft


N
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Google
Pointer 36°55'22.43" N 139°59'06.11" E elev 931 ft
Streaming |||||||||| 100%
Eye alt 6811 ft

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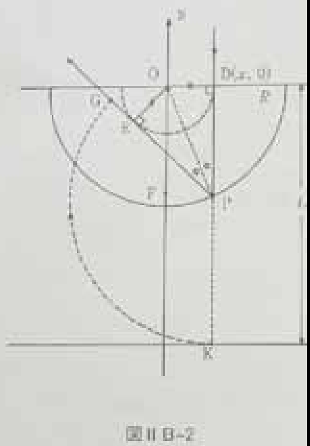
Image © 2006 DigitalGlobe
Image © 2006 TerraMetrics
Google
Pointer 36°55'38.05" N 139°58'36.74" E elev 945 ft
Streaming |||||||||| 100%
Eye alt 3443 ft
N

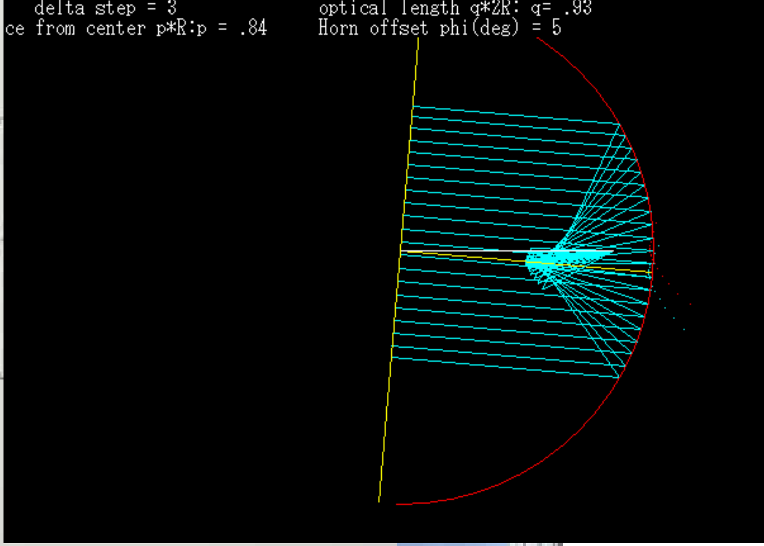

30m固定球面鏡
観測室
8素子20m固定球面鏡
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Google
Pointer 36°55'40.69" N 139°58'50.00" E elev 946 ft
Streaming |||||||||| 100%
Eye alt 1610 ft

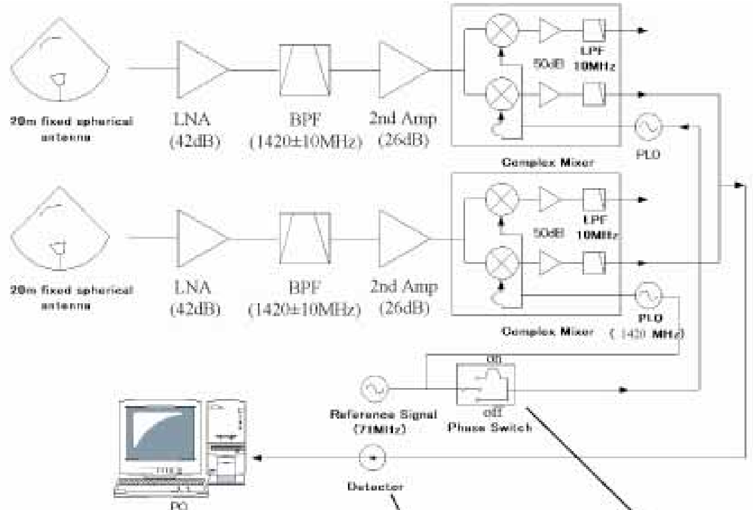
8素子20m固定球面鏡

Radio Transients Surveys

- 20mφ×8 elements＋30mφ
  Multi-beam surveys
- Observable latitude：
  20mφ: +32deg< δ <+42deg
  30mφ: +19deg< δ <+55deg
- Observing frequency：
  1.42±0.02GHz
- Sensitivity：～300mJy
  (1sec integration, 2素子干計)

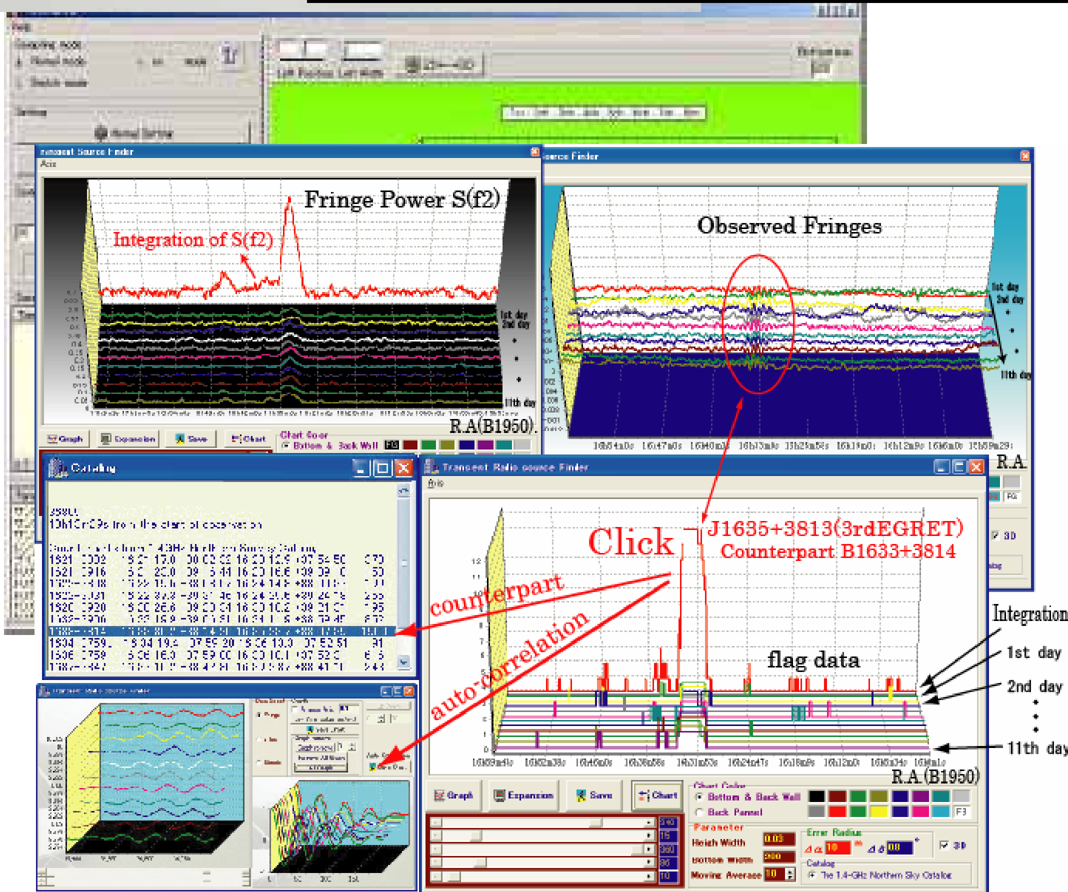






Detector

Phase Switch



Radio transients detected at Waseda Nasu Observatory

- We started surveying for radio transients at 2004.

- Some radio transients have been detected.

- 1 - 3Jy（**推定継続時間**：4m-48hr, 24hr-72hr）

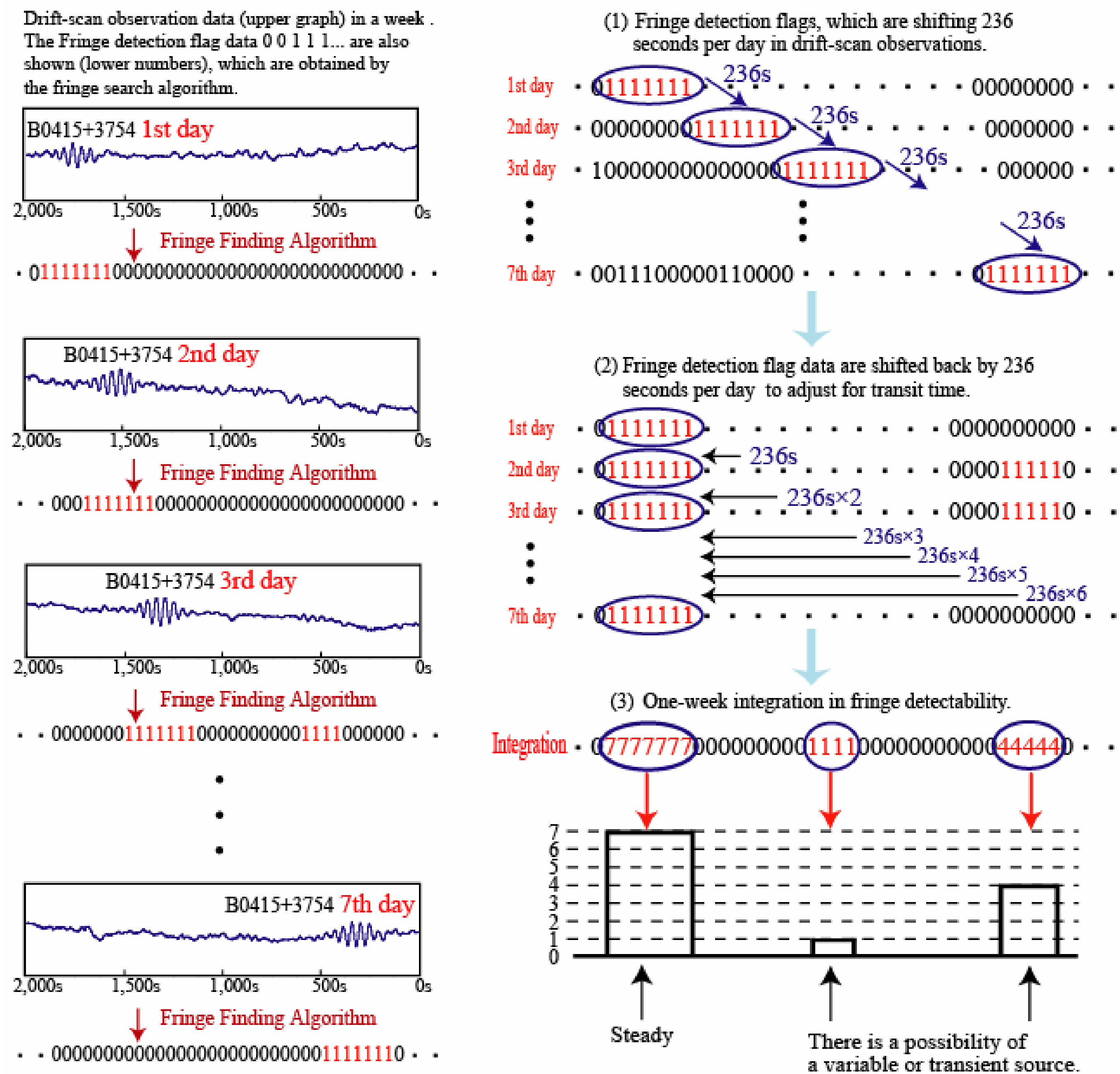
  Kida et al. 2008 Matsumura et al. 2007

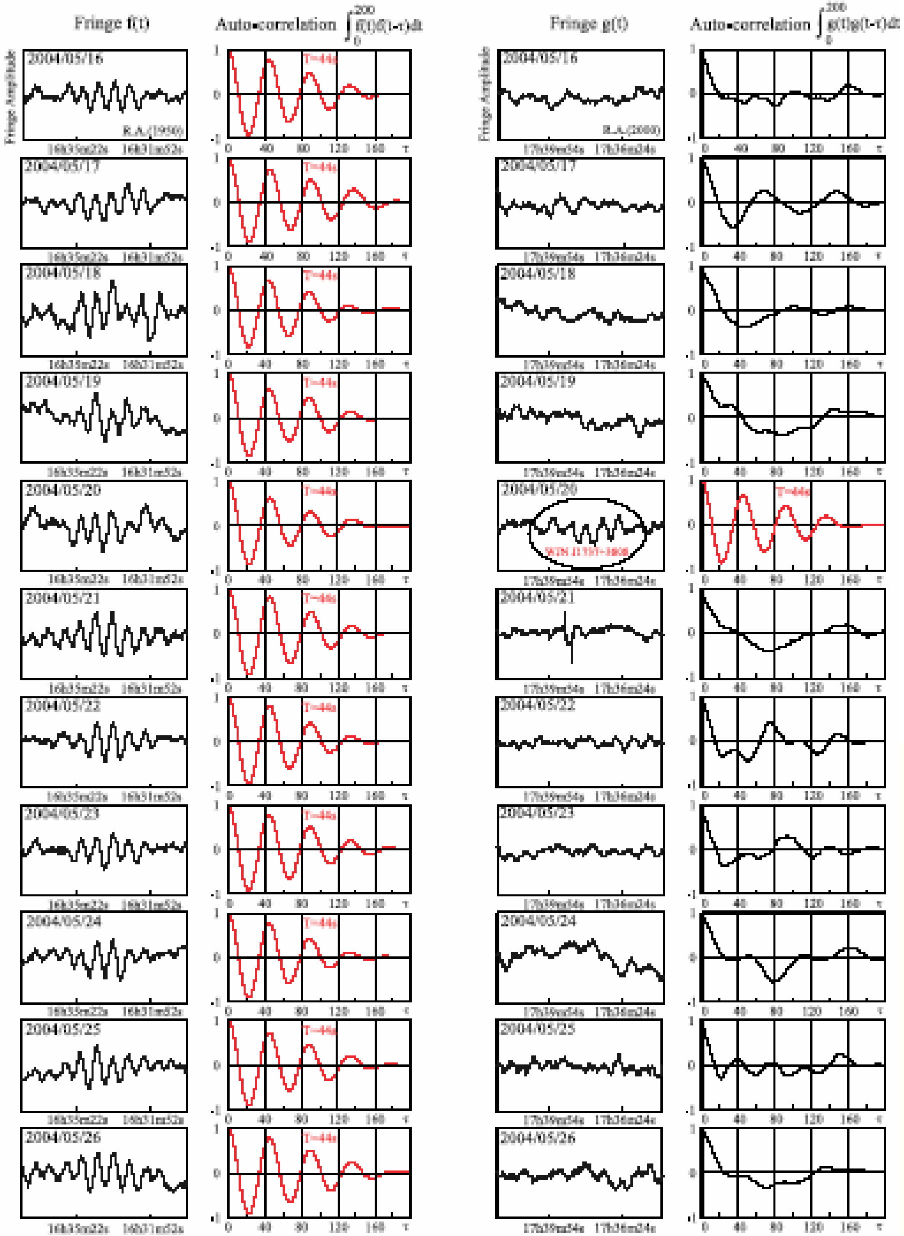
  Kuniyoshi et al.2007 Niinuma et al. 2007

- High Galactic latitudes

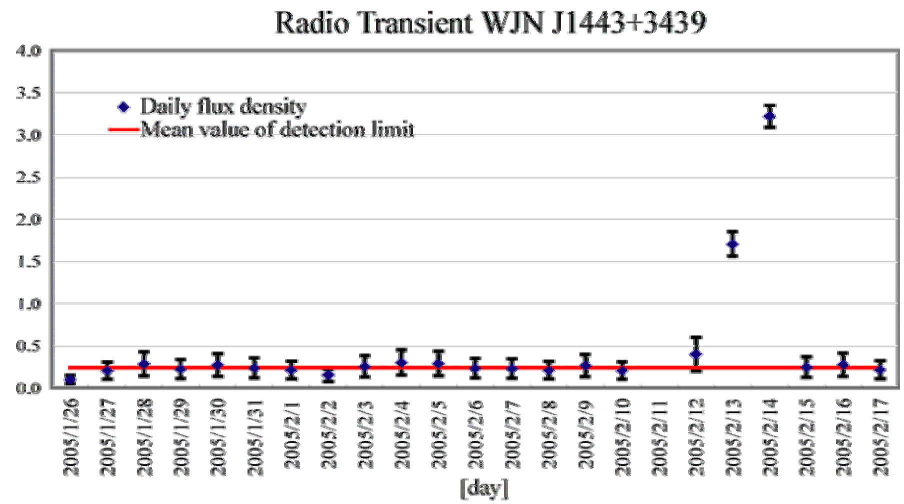
I Fringe Search

II Burst Search

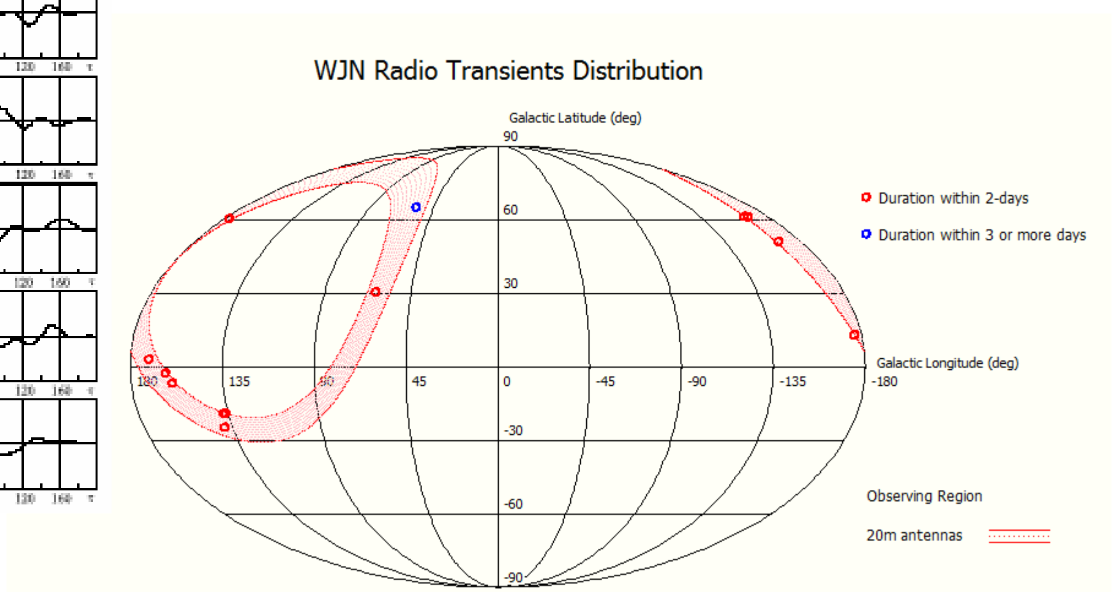




Kuniyoshi et al. 2007



Niinuma et al. 2007



Thank you