

Receivers for the Green Bank Telescope

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National Radio Astronomy Observatory
Green Bank, WV

100 meter Diameter

Unblocked Aperture

Active Surface

Operates from ~100 MHz to 100 GHz

Fully Steerable

>85% of total sky covered $\delta \geq -46^\circ$

Pointing to 1"-2" accuracy

Surface good for 3mm work

Point source sensitivity of ~120 meter
diameter conventional telescope

Active Instrument Development Program

Site Protected by a 13000 km²
Radio Quiet Zone



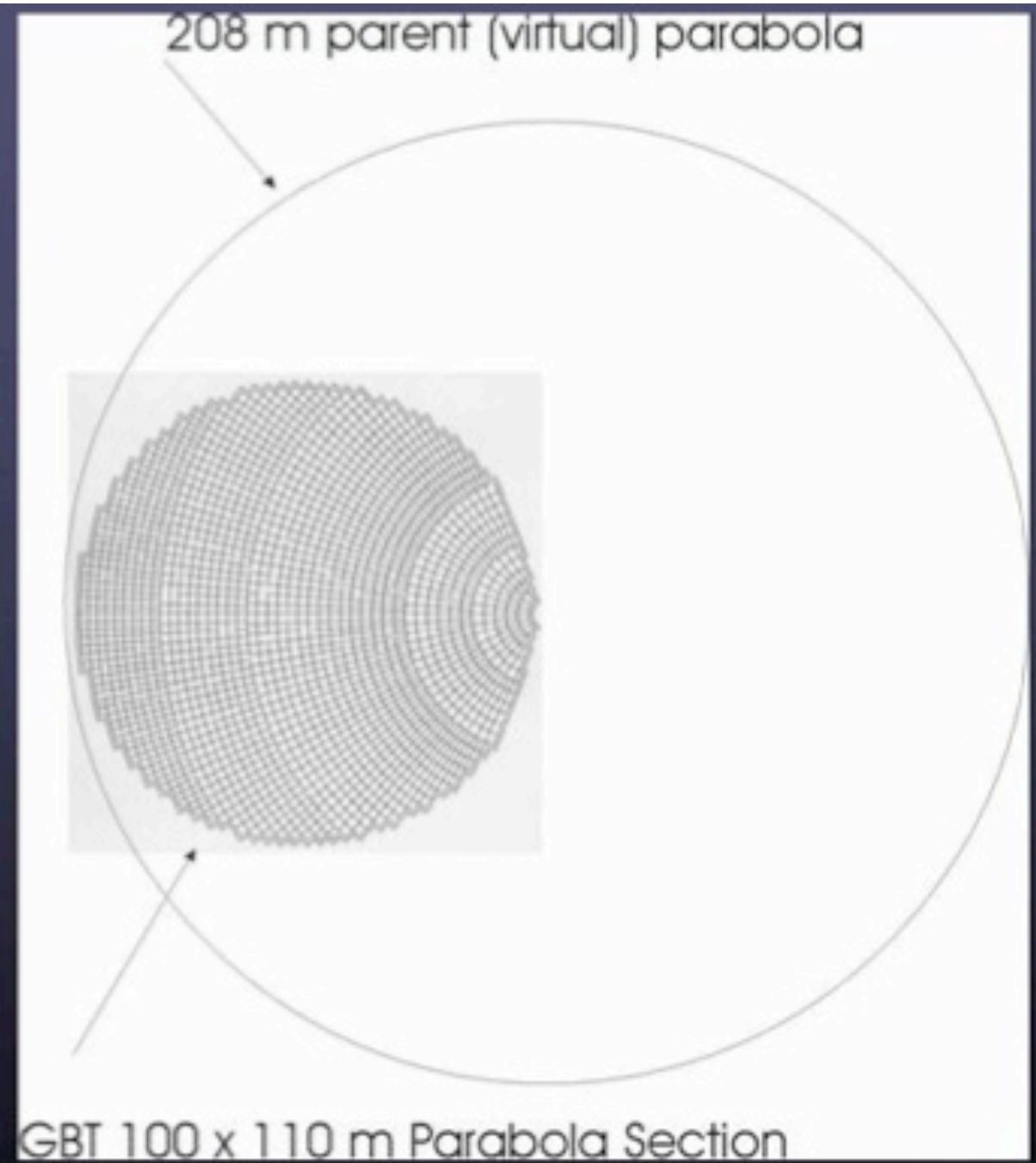
The NRAO

A National Lab
for
Radio Astronomy
located in
Green Bank, WV

NRAO budget reduced by
~10% over the last two
years



The Offset Parabolid



The Active Surface

currently rms $< 240\mu$ at night, the goal is 210μ
Aperture efficiency at 85 GHz $\sim 35\%$

The world's largest telescope operating at mm wavelengths

2209 actuators



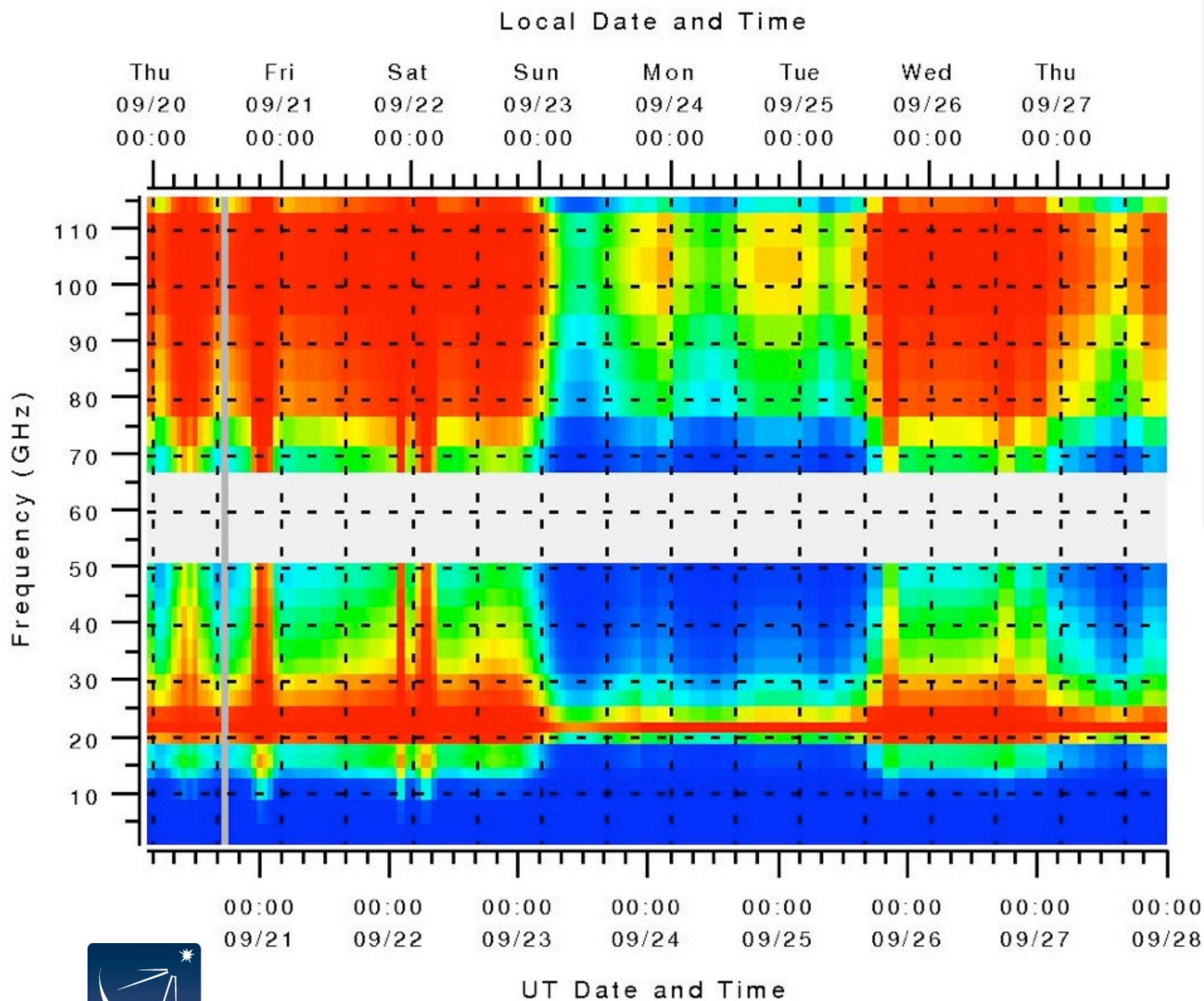
Receivers cover
0.32 GHz - 100 GHz

Many projects are run each day



DSS Overview

Efficiencies from Atmospheric Opacities (EffAtmos)



- ~6600 hours a year scheduled for astronomy
- Dynamic Scheduling matches the project to the weather
- In 2010 1776 hours were used at frequencies above 18 GHz



Ron Maddalena,
prognosticator

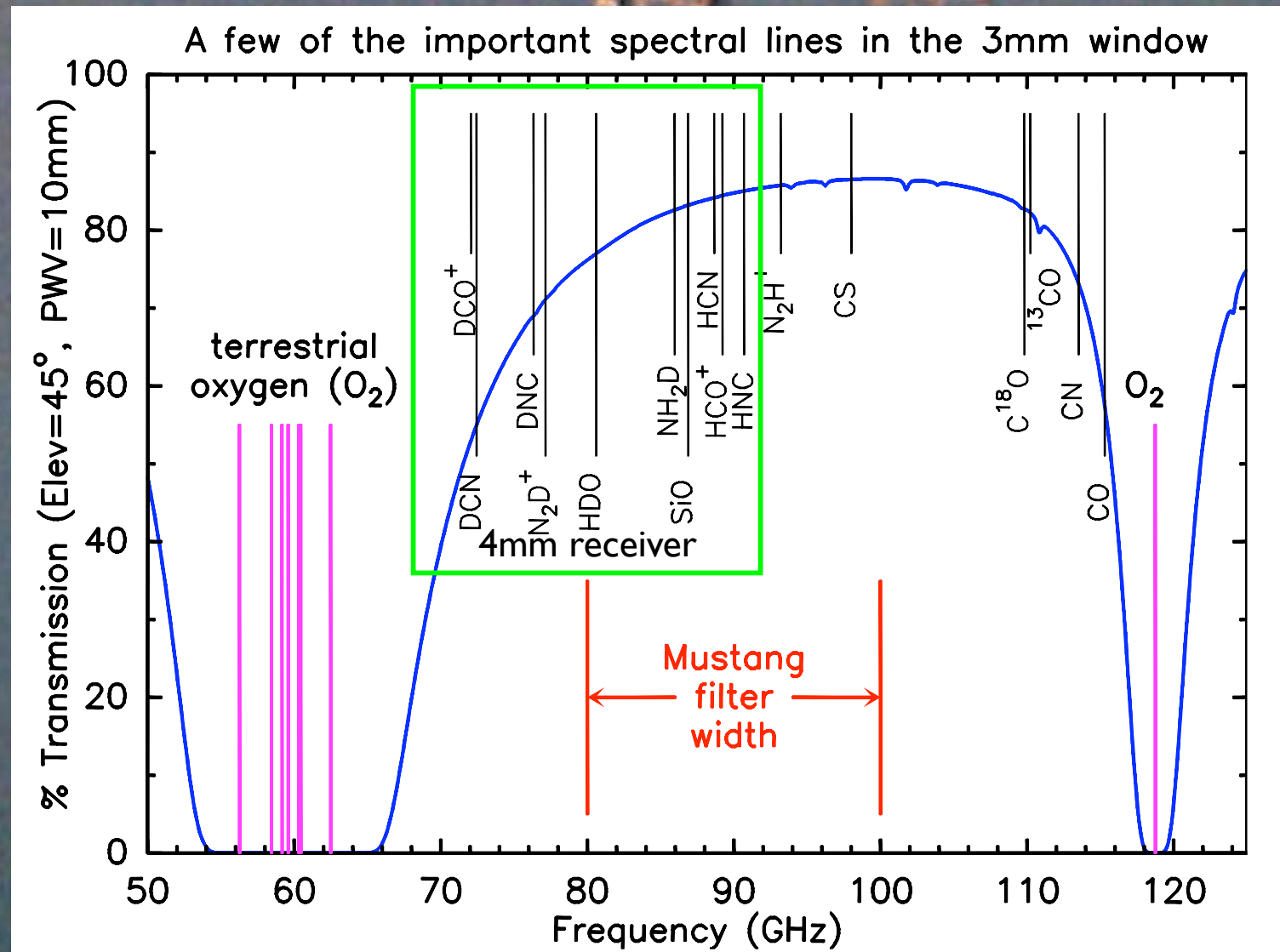
Coming this year:
Spectroscopy and VLBI
at 67-93 GHz!

No other large telescope
has coverage in this band

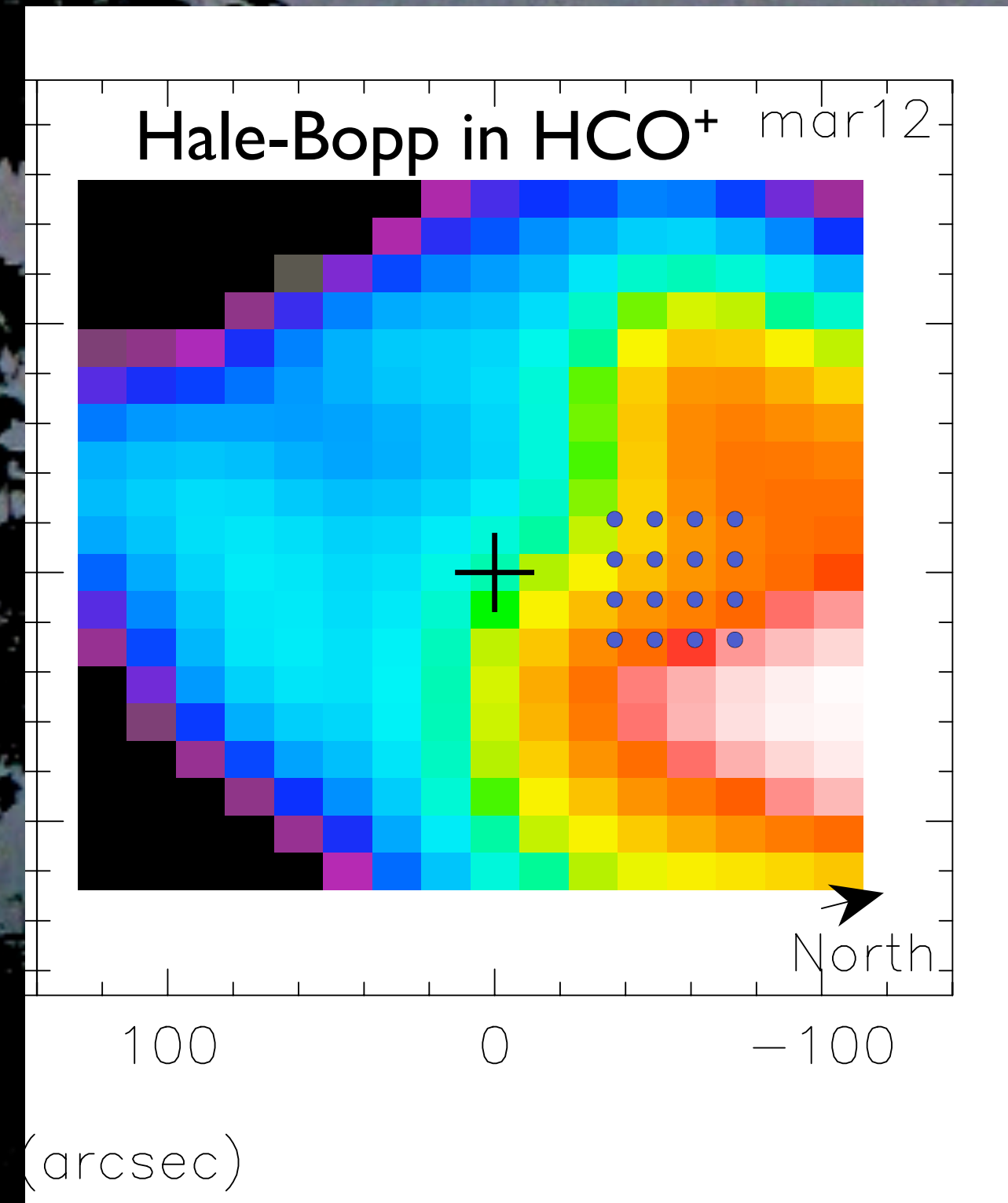


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Potential for spectroscopy of
comets with a 16 pixel camera
at 67-93 GHz!



GBT Performance

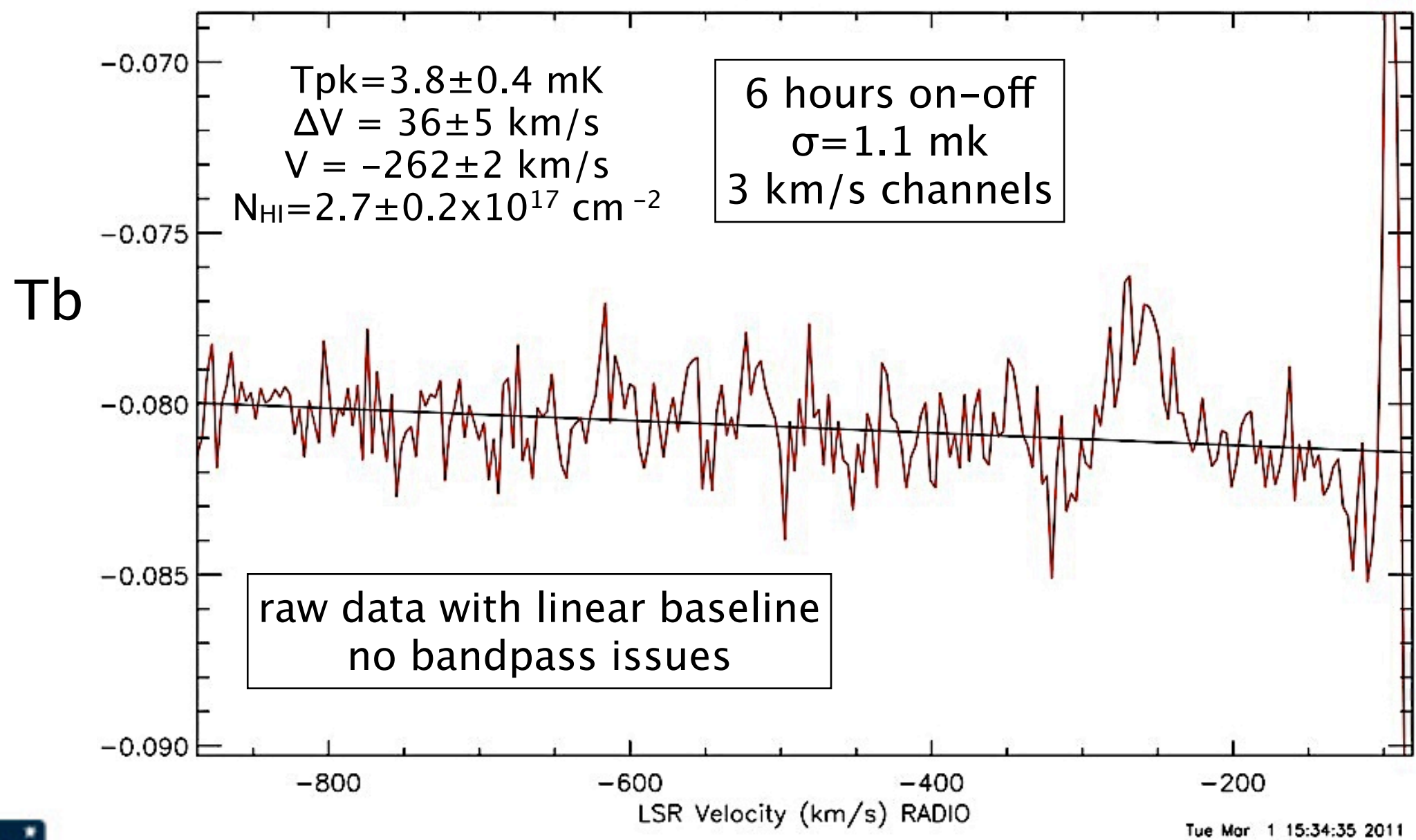
Freq (GHz)	Tsys (K, $z_a=0$)	η_a %	K/Jy	SEFD (Jy)
1.2-6.0	20	70	2.0	10
10-16	25	65	1.85	15
20.0	40 ^a	65	1.85	20 ^a
45.0	70 ^a	60	1.70	40 ^a
85.0	100-125 ^a	>35	1.00	100-125 ^a

^a) In median winter weather



GBT spectrum of the M31-M33 stream

Scan 2757 V : -425.0 RAD1-LSR F0 : 1.42041 GHz Pol: I Tsys: 18.16
2010-08-05 Int : 05 40 33.4 Fsky : 1.42255 GHz IF : 0 Tcal: 1.47
Nicole Free LST : +20 02 50.5 BW : 12.5122 MHz AGBT10A_043_29 OnOff
01 00 00.00 +39 29 59.9 **Braun0100+395** Az: 63.5 El: 33.9 HA: -4.95



GBT Proposals for 6-month Semester 13A

~GBT Usage

>600 proposers in 2012

- Pulsars 30%
- VLBI 10%
- Continuum 5%
- Spectroscopy 55%

Freq (GHz)	Proposals	Hours Requested
0.3-1.1	19	2239
1.1-1.7	28	1684
1.7-2.6	6	98
4.0-6.1	7	162
8.0-10.0	4	81
12.0-15.4	2	25
18.0-27.5	31	1077
26.0-39.5	9	282
38.2-49.8	9	298
67-93 + M	19	494
SUM	134	6420 (2151)

VEGAS(pectrometer) Specifications

- Spectra can be measured from 8 dual polarized beams.
- 8-bit Analog to Digital Converters will be used.
- Digitized bandwidth : 1.5 GHz (usable bandwidth 1.25 GHz).
- Number of digitally tuned sub-bands within 1.5 GHz bandwidth : 8.
- Number of sub-bands per beam when processing signals from 8 dual polarized beams: 8
- Total bandwidth that can be processed from a dual polarized beam : 10 GHz.
- Number of sub-bands per beam when processing signals from a dual polarized beam : 64
- Maximum number of spectral channels: 32768.
- Maximum spectral dump rate : every 0.5 msec.

NRAO + CASPER (UCal Berkeley)



GBT Recent Receiver Developments

- C band upgrade to cover 4.0-8.0 GHz (under development)
- X band upgrade to cover 8.0-11.6 GHz (done)
- K band Focal Plane Array 7 pixels 18-26 GHz (done)
- W band 4mm 2 pixel 67-93.3 GHz (first version available)
- Ku wideband 11.0-18.0 GHz (under construction)
- MUSTANG v1.5 -- Bolometer array at 3mm (under construction, Univ. Penn)
- FLAG 1.4 GHz beam-forming receiver -- 7 beams $T_{\text{sys}}=35$ K (testing, BYU)
- [\[800 MHz multipixel feed array \(development, ASIAA Taiwan\)\]](#)
- 3mm 16 pixel array 85-116 GHz (mostly development, S. Church, Stanford)
- 3mm beam-forming array (development only, N. Erickson Univ. Mass.)
- 0.8-2.0 GHz Pulsar receiver (under study)

FLAG -- Focal Plane L-Band Array for the GBT

B. Jeff, K. Warnick et al (BYU)

J.R. Fisher, R. Norrod, A. Roshi (NRAO)



Goals

- 19 dual polarized elements. Cryogenic PAF system
- $T_{\text{sys}} \sim 20$ K; Aperture efficiency ~ 75 to 80 %
- 7 beams; spacing 0.5 FWHM to 1 FWHM
- Frequency coverage – 1300 to 1800 MHz; Backend for processing signals

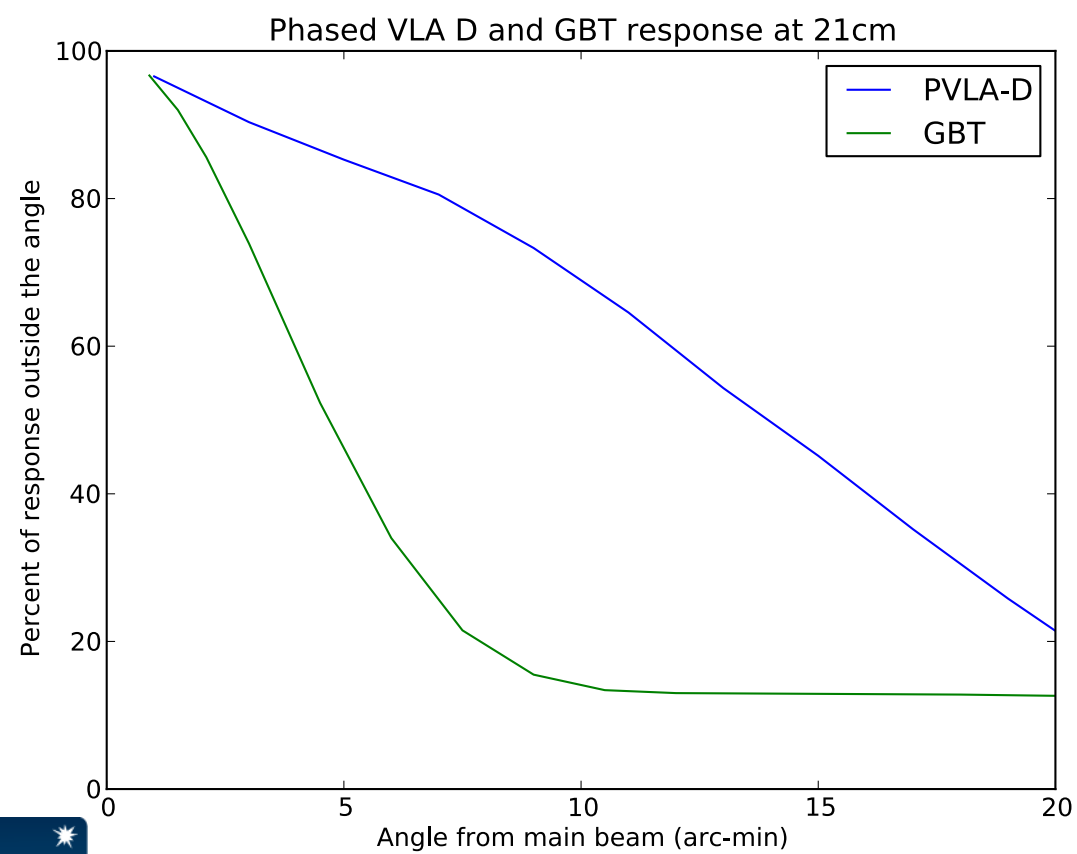
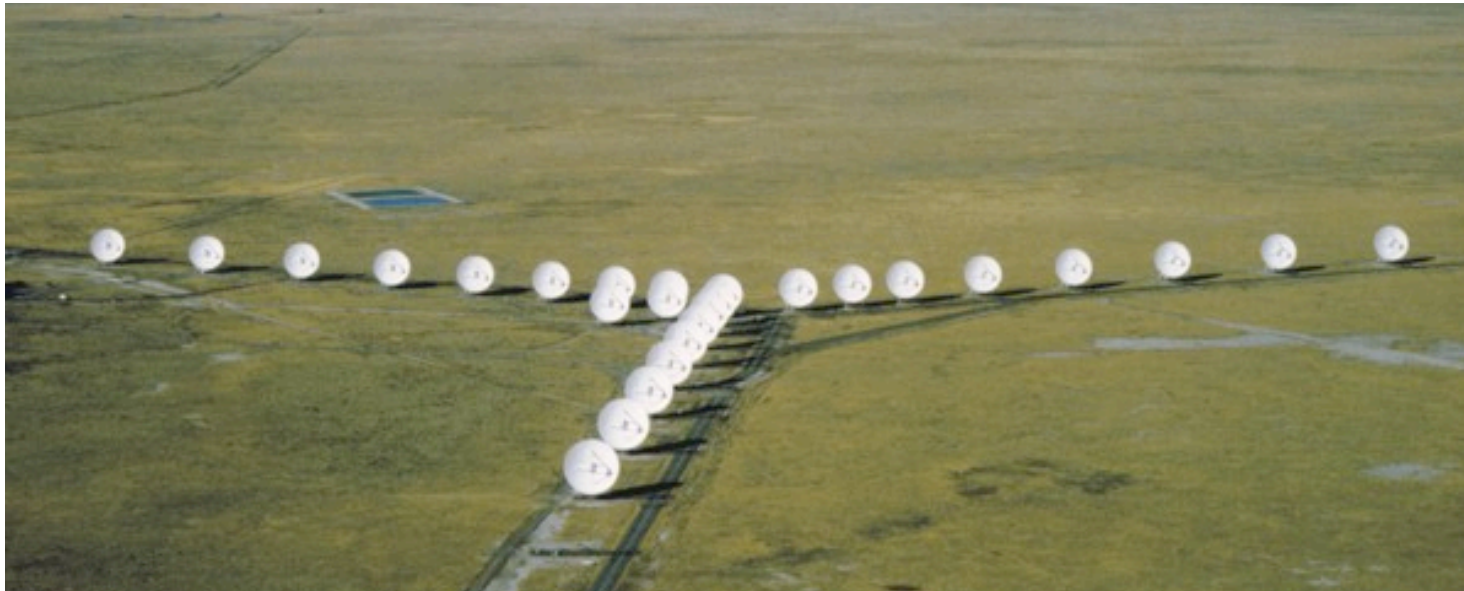
Green Bank 2012



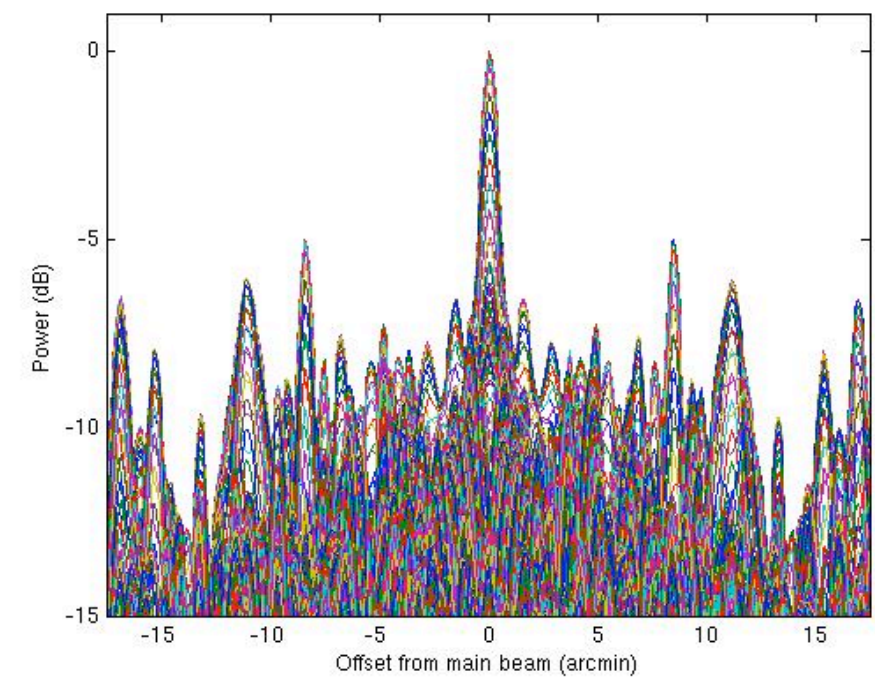
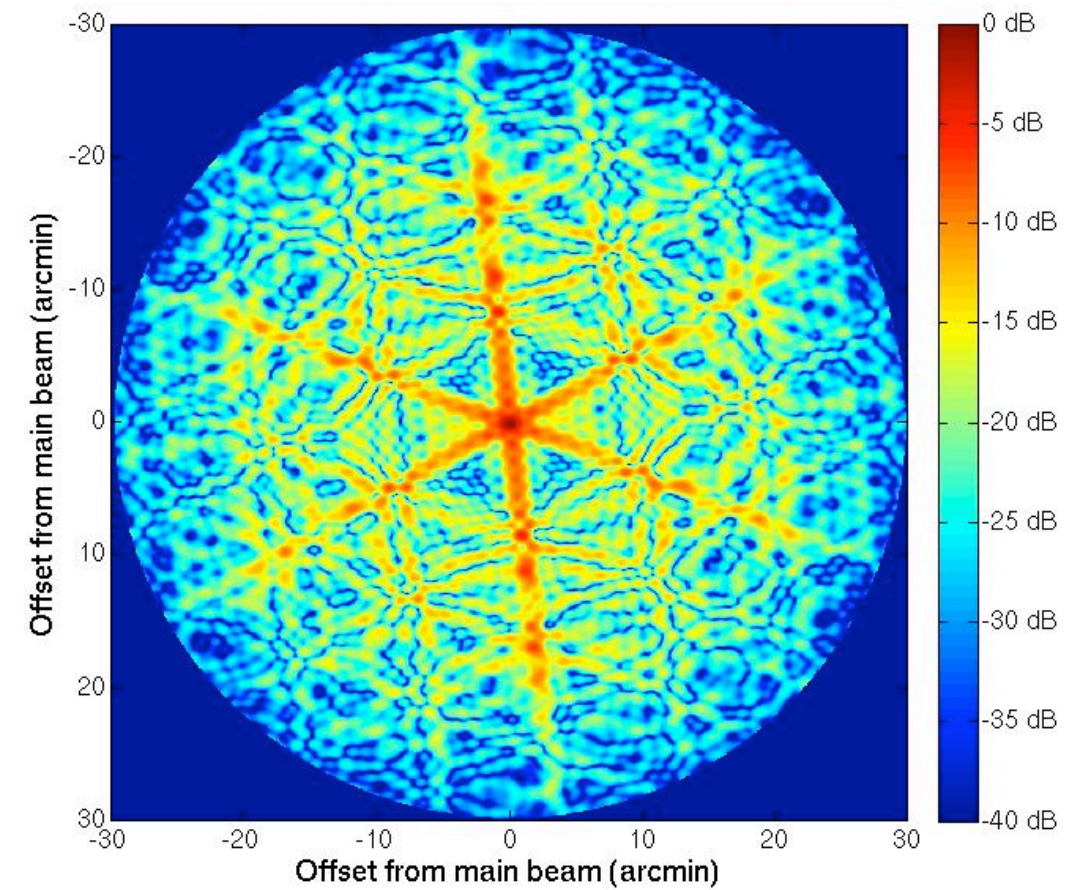
www.aui.edu



The VLA as a “phased” array



Point Spread Function



Point Source Sensitivity

