NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO

VLA PROJECT

VLA TEST MEMO 114

RESULTS OF OBSERVING RUN NOV. 22-24

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1.0 POINTING

Approximately 6 hours of interferometer pointing for Antenna 1, 3 and 4 at C and U Band were made. Results are:

	ANT #1		ANT #3		ANT #4	
PARAMETER	TOTAL*	OFFSET*	TOTAL	OFFSET	TOTAL	OFFSET
A1 = -H1 N/S Tilt	+0'.26	+0'.25	+0.31	+0'.28	+0.27	+0'.27
A2 = H2 E/W Tilt	-0.50	+0'.17	+0.32	+0'.16	-0.06	-0'.06
A6 = Collimation Error	-2.04	-0'.50	-1.63	-0'.58	-3.31	-0'.01
A7 = Azim Enc. Offset	40.69	+0'.47	-0.22	-0'.88	-2.61	-2'.61
H5 = Elev. Enc. Offset	-0.81	-0'.34	-0.52	-1'.22	-1.84	+0'.64
(R-L) Elev. Diff	-0.17		-0.10		-0.20	
(R-L) Az Cos(e) Diff	-0.45		-0.50		-0.45	
RMS Elev	0.25		0.36		0.20	
RMS Az Cos(e)	0.23		0.42		0.25	
(U-C) Elev Diff		<0.4		+1.0		?
(U-C) Azi Diff		<0.4		+1.8		?

* TOTAL = Parameter Value Now

* OFFSET = Parameter Change From Previous Value

No pointing was made for Antenna 2 at L or K Band.

Remarks: 1) The RMS of Antenna 3 is significantly worse than Antenna 1 or Antenna 4.

2) The pointing offset between U and C Band for Antenna 3 is over 2.0 ARCMIN. Cause is unknown.

2.0 SOFTWARE FOR POINTING AND RELATED PARAMETERS

The only software available to handle pointing and related parameters is associated with the MODCOMPS. With four antennas, four frequencies, two channels, the multitude of parameters associated with pointing, focus, subreflector, delay center, and baseline should be determined quickly; otherwise significant degradation of observing can occur. With the present software, analysis takes many hours and it is usually done at the end of run. With sufficient organization a ~4-hour observing program could be designed to determine most of these parameters. However, software would then have to be written for the DEC-10 to analyze the data.

3.0 STATION COORDINATES

See VLA Test Memo 112

4.0 POLARIZATION PROPERTIES OF VLA ANTENNAS

See VLA Test Memo 113

5.0 TESTS WITH FOCUS OFFSETS

The phase behavior across the beam at C Band at several focus offsets was scrutinized. It is hoped that there may be a relationship between those across beam and focus error.

FOCUS SETTING	POINTING IN ELEV	POINTING IN AZIM	DX	DY	FOCUS (Radians)	ASMG (Radians)
	ARC MIN		(Meters)			
In 1.5 cm (AMP=1.22)	+0'.10±0.10	-0'.30±0.20	+0.30±0.10	+0.18±0.05	-0.04±0.02	-0.02±0.0
Nominal (AMP=1.21)	0'.00	0'.00	+0.70±0.10	+0.50±0.05	+0.03±0.02	+0.02±0.0
Out 1.5 cm (AMP=1.10)	+0'.10±0.10	-0'.30±0.20	+0.84±0.10	+0.90±0.05	+0.17±0.02	+0.09±0.0

DX is the azimuth beam illumination offset and is determined by the linear phase across the beam in the azimuth direction.

DY is the elevation beam illumination offset.

Focus is a measure of the second order phase term from the beam center.

Astigmatism is a measure of the asymmetry of the second order phase.

Above Table gives R pol only. L behaved similarly.

Remarks:

1) There was very little change in correlated amplitude. It is surprising that $\lambda/4$ change in defocussing position only changes the amplitude by <10% in voltage (<20% in power).

2) It was guessed that defocussing would produce a non-linear (2nd order) phase gradiant over the beam. The value observed is $\sim 6^0$ which is the 2nd order phase term at half power compared with beam center. This amount is reasonable considering the small decrease of correlated signal. Also it is 0 near amplitude maximum.

3) But the beam illumination offsets and astigmatism also changed. Why?

4) The C Band feed on this Antenna (3), is of the old design and may lead to these spurious effects.

Conclusion: Need to do this again. Use better C Band feed, move more off focus.

6.0 TEST ON C BAND FEEDS TO REMOVE CIRCULARLY POLARIZED SIDELODES

Peter Napier adjusted the coupling and relative phase of the R-and L-circularly polarized feeds to decrease the sidelodes. Coupling was produced by inserting a pin inside the feed. The relative phase was changed using spacers.

No improvement in all combinations of coupling and phase shift. Azimuth R and L pointing differed by ~0.5 ARCMIN.

The cross-polarization remained <5% when pins were inserted to 0.2 inches. At 0.3 inch and 0.4 inch, the RL and LR response was 25% and 50% of the parallel hands.

7.0 PHASE STABILITY DURING RUN (C BAND)

a) RR-LL phase difference was small $\leq 10^0$ at C Band for most of run. Occasional jumps in 4L of $\sim 140^0$ near end of run.

b) General phase stability at C Band $\sim 60^0$ over three hours.

c) Phase closure holds to $\sim 2^0$. May be rounding problem in data display.

8.0 AMPLITUDE STABILITY DURING RUN (C BAND) (A FEW RANDOM CHECKS)

a) AMP(RR)/AMP(LL) stable to 2% over 6 hours. Some dependence on elevation probably due to pointing errors. Over 40 hours gave 6% drift.

b) General C Band sensitivity.

	1-2		1-3		1-4		2-3		2-4		3-4	
Correlator	R	L	R	L	R	L	R	L	R	L	R	L
Rel Resp	1.94	2.78	2.23	0.99	2.96	2.42	1.26	0.80	1.77	2.16	2.18	0.80

3L sensitivity down to 40% (voltage) of nominal

2R sensitivity down to 60% (voltage) of nominal

c) Amplitude closure

With four antennas $A_{12}/A_{13} = A_{24}/A_{34}$ for example at C Band with 50 MHz bandwidth, above equality not met with 15% errors. However, with 25 MHz bandwidth, above equality holds to ~4%. Cause: odd phase effects over bandpass, correlator problems, slow delay rate?

9.0 MISCELLANEOUS COMMENTS

a) Two subarrays were used for 2 hours.
Subarray 1 behaved normally (Antenna 1 and 2)
Subarray 2 (Antenna 3 and 4) had problems, I think
 1) Sub. 2 was asked to point holding No. 3 const. It did not.
 2) The data {a) obtained by EXEC AAP - there was no on-line data saved} has phases appropriate to subarray 1 and amplitudes of unknown origin.

There is a possibility the data is okay but it is being read improperly in the averaging program.
Check carefully again.

b) Other frequencies.
 1) L Band used a bit. Went to a low frequency of 1335 MHz to avoid interference at 1370 and 1395 MHz. Jim Dolan did not see the interference with LO receiver, however, it was somewhat obvious on the bandpass sweep display and produced correlated flux.
 2) U Band used a bit. Reasonably stable in amplitude with a 50% chance of all 3 elements working.
 3) K Band. Little useful data.

c) DEC reduction system.
Virtually useless in reduction. A listing of the 10^s data can now be obtained directly by DEC from Modcomp tape.
A factor of ~50 is gained in C.P.U. speed as opposed to listing from the data base.

d) Monitor data.
Monitor data can now be plotted on the line printer with

some convenience.

1) Dewar Temp No. 1 and No. 2 showed significant correlation to Diurnal Temp variation, but within 1^0 tolerance.

   Dewar Temp No. 3 very stable, No. 4 somewhat unstable.

2) Rack Temp No. 1 ~5^0C variation showed some correlation to diurnal temp variations.

   Rack Temp No. 2 3^0C variation with 8 hour time scale.

   Rack Temp No. 3 2^0C variation with 8 hour time scale.

   Rack Temp No. 4 2^0C variation with 8 hour time scale.

e) Problems with MODCOMP. Lost link quite often. Running "background" jobs is hazardous while observing.

f) Keeping the operator log with two subarrays is difficult.

g) What is the elevation limit of the telescopes and/or computer software limit. It is now 10^0-12^0 or so. Why don't we make it 5^0 elevation. But in any case make all the limits constant.