VLA Test Memo 228

Test Observations of August 12, 2001
David Hogg
September 10, 2001

These are notes of system performance as measured in the course of the test observations on August 12, 2001.

A. EDITING BASED PRIMARILY ON CLOSURE PROBLEMS reported during the course of the calibration.

These were summarized in an earlier note but are repeated here for completeness. All times are given in UT.

1. AT THE STANDARD 50 MHz CONFIGURATION:

Antenna 17 was in the barn. Antenna 7 was out of service (form# C106095). Antenna 22 was out of service (form# C106087). Antenna 12, IF A was reported to be out (form # C106086) but the data are present and nominally are good.

Times 21 30 0 - 21 32 25: Edit out antenna 10. The amplitudes are 10% of what they should be, and what they return to at 21 32 40. Note however that there was a power glitch in the period 21:30 - 21:36 which might have caused problems.

Times 00 00 0 - 00 25 48: Edit out Antenna 28. IF A less than 0.1%, IF C about 1% but most of the data were flagged on-line. IF B and D are similar. There is no operator note of a problem.

2. AT THE EXPERIMENTAL 70 MHz CONFIGURATION:

Times 215300 - 215630; 231030 - 231310; 233310 - 233610; and 235433 - 235810: there are numerous closure errors reported. However, the closure errors are dominated by errors in Antenna 8, IF C.

Time 002330 - 002800: The closure errors are dominated in all IF's by Antenna 23, though others are also poor. Curiously 8C was not mentioned as being a problem.

B. EDITING BASED UPON MORE DETAILED INSPECTION OF THE DATA, using LISTR or in the mapping stages.

1. There are a number of individual integrations which have somehow become corrupted. Mainly these were "first-point" problems, though one was associated with the power glitch and another with antenna #12, which was reported to be in difficulty.

2. There is a serious problem with the entire array at 50 MHz in the time period 0/22:17:10 - 0/22:34:35. The first part of the period (22:17:10-22:20:20) is data on the calibrator 1221+282, and in the calibration process there were large numbers of closure errors (for A,B,C, & D there were 91, 96,88, and 85 errors respectively, out of a possible total of 276. The same calibrator at 22:44:03-22:47:20 seemed to be fine, with average closures 0.6% and 0.4 degrees, and no instances greater than 5% or 5 degrees.

I decided to simply not use the first calibration scan, and calibrate the associated source NGC 4151 against the second scan alone. Nominally all went well, but when I tried to map the NGC4151 data base I found serious problems, with dynamic range (peak-to-rms) less than 100. Selfcalibration provided only a limited improvement. After further inspection I found that the characteristics of the data from 22:23:03 to 22:34:35 were much different than from 22:34:40 to the end at 22:42:20. I conclude that whatever nuked the calibrator source also carried forward into the mapping source, and fixed itself at about 0/22:34:35. Nothing was mentioned in the operator logs, and there is no single antenna, or small number of antennas, which are obviously worse than the rest.

The calibrator at 70 MHz observed during this time range (1224+035.W 21:53:00-21:56:30) appears to have not been involved. However, the mapping source NGC4579.W (21:57:00-22:16:20) was difficult to self-calibrate, although eventually I did get a solution. Perhaps the problem began sometime during this source.

It has been suggested that perhaps there was a problem with interference. The cal source was observed at an elevation of 80 degrees and the array may as a consequence be especially susceptible.

3. When I mapped the 70 MHz blank field BLANK70.W I found that antenna 8C was bad, even though it had not been noted as giving closure problems on the associated calibrator 0217+738.W observed 002330 - 002800. However, even after editing out 8C the rms on the map of IF C was about 165 microJy/beam, instead of the 90-100 microJy seen on the other IF's. Examination showed that 15C was also poor, though not as poor as 8C, and I edited 15C out on this scan as well.

C. THE RESULTS ON THE BLANK FIELD

Table 1 summarizes the results on the blank fields. For the standard configuration "50 MHz data" I assumed an effective bandwidth of 43 MHz following Perley in the VLA Observational Status Summary of August 2,2000. In the tabulation of rms for an individual correlator I used the AIPS task UVHGM to assess the real part of the visibility. Since my measurement of the numerical value of the rms is a bit crude, I overplotted the histograms for the individual IF's and saw that they were essentially equal, as indicated in the table. The maps were made with natural weighting, and the rms was evaluated in the central one-fourth of the map (typically a region 256 x 256 cells, the cells being 0.5 x 0.5 arcsec, and the beam 7 x 3 arcsec). The analysis of the experimental 70 MHz observations was made in the same fashion. The effective bandwidth was assumed to be 70 MHz. There are slight differences in the expected rms values on the maps because of the editing which I did.

Neither for the 50 MHz nor the 70 MHz observations do we achieve the theoretical sensitivity. I checked the system temperatures in the TY extension tables and they appear to be around 35 K, with the exception of a half-dozen antennas.

The rms on a correlator for IF's B,C, and D is lower than the corresponding value at 50 MHz by a factor of 0.86, compared with the expected improvement of 0.78 based on the bandwidth ratio. As in the past IF A is poorer at 70 MHz, in this case by a factor 1.06. Interestingly the higher rms in the correlators of IF A is not reflected in the corresponding maps.

The rms of the V map of all data at 70 MHz is better than that of the 50 MHz data by a factor 0.85. Thus the 70 MHz system does give a map with lower noise, even after the additional editing which is required, but the noise is not as low as we had hoped. The lost data is about a 9% effect, but it appears as if the maps of IF C still are poorer even after the editing, and this is probably limiting the improvement as well.

D. THE RESULTS ON THE SEYFERT GALAXIES

J. Ulvestad identified three Seyfert galaxies which span a range in flux density. We observed each of the objects at 50 MHz and at 70 MHz. The data were processed as described above, except that the maps were made with a robustness of zero (in AIPS terms). In addition, on the stronger sources NGC 4579 and NGC 4151 self-calibration was employed. The same level of self-calibration was used on the two sources, and on each source at the two bandwidths. The results are given in Table 2. In all cases I failed to reach the expected noise level, though for NGC 4565 and NGC 4579 at 50 MHz the shortfall is 9% and 7% respectively, about what is seen with the blank field. The shortfalls at 70 MHz are factors of 1.54, 1.19, and 1.43 suggesting that we are not able to self-cal the 70 MHz data with the same degree of effectiveness as at 50 MHz, in the presence of a source, even one as weak as 4 mJy. I consider the bad result at 50 MHz on NGC 4151 to be an anomaly arising for a yet as unexplained reason (see above).

Table 1.
Summary of Data from the Blank Fields

A. Standard Configuration 43 MHz Blank50

		RMS Values			
		Visibilities (mJy)		MAP (micro Jy/beam)	
STOKES	IF	OBS	EXP	OBS	EXP
RRI	A	24.9	23.7	93	87
LLI	B	~RRI		97	87
RR2	C	~RRI		91	87
LL2	D	~RRI		93	87
V1	AC	~V		72	61
V2	BD	~V		63	61
V	ALL	17.9	16.8	48	43

B. Experimental Configuration 70 MHz Blank 70.W

		RMS Values			
		Visibilities (mJy)		MAP (micro Jy/beam)	
STOKES	IF	OBS	EXP	OBS	EXP
RRI	A	22.7	18.6	79	64
LL1	B	21.4	18.6	86	70
RR2	C	~LL1		79	67
LL2	D	~LL1		81	67
V1	AC	~V		61	50
V2	BD	~V		59	50
V	ALL	15.1	13.2	41	35

Table 2.
Summary of Data for Seyfert Galaxies

QUANTITY	N4565	N4565W	N4579	N4579W	N4151	N4151W
Peak (mJy)	3.11	3.51	27.0	26.2	50.9	66.0
Total (mJy)	3.18	3.59	28.9	28.2	64.3	84.0
$\Delta\alpha$ ($''$)	-0.08	+0.08	+0.06	-0.23	-0.22	-0.23
$\Delta\delta$ ($''$)	+0.01	-0.06	+0.37	-0.50	+0.09	+0.06
RMS (μJy/bm)	50.9	55.2	48.0	43.6	119.4	52.1
Expected RMS	46.6	35.8	44.9	36.7	48.4	36.5
Peak/RMS	61	64	562	600	426	1267