VLA TEST MEMORANDUM 109

Some Results of Single Dish Observations with Antenna No. 1

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February 1976

An extensive series of single dish observations have been made with Antenna No. 1. Observations were made in sessions lasting about 40 hours (less the time taken to start observations and any breakdowns or reorganizations during the observing sessions). We will describe some preliminary results of observation sessions beginning January 20, January 27, February 3 and February 10. These observations were made without any major modifications to the hardware or software, to the best of our belief. The edited subset of observations which we wish to discuss includes about 700 determinations of pointing error at 6 cm, and about 100 measures of 2 cm gain. Our conclusions are listed below.

1. We derive the following pointing parameters:

East-west component of tilt	-6.31 ± 0.6 minutes of arc
North-south component of tilt	6.40 ± 0.8
El Encoder single period	0.14 ± 5.8
Harmonic error + feed sag	0.70 ± 5.8
El collimation + encoder offset	-1.32 ± 7.5
Az Encoder single period	0.02 ± 1.7
Harmonic error	0.04 ± 1.0
Axis perpendicularity	0.97 ± 6.0
Az collimation error	-3.00 ± 7.7
Az encoder zero	$-59^{\circ}\ 12'.29 \pm 5'.9$

It should be noted that the errors on some of the parameters are very high. This is a consequence of effectively using the theory only as an interpolation formula. These parameters are sufficiently correlated with others that the error on the solution of any one is very high, but the combination, evaluated over the regions where we have observed, is actually well determined. This is especially true of the axis perpendicularity, azimuth collimation, and azimuth encoder zero parameters. The high correlation between these quantities may be resolved by observations at elevations greater than 90°, but this capability has been temporarily suppressed because of software problems.

Feed sag corresponds to the even component of elevation error + 0.14 ± 5.8 minutes of arc - and is undetectable. The odd term + 0.7 ± 5.8 minutes - we believe to be real, despite its large formal error. There is no reasonable physical origin for this term.

2. RMS pointing errors are about 18" in elevation and 11" in azimuth. The corresponding peak errors are about 35" and 20". The remaining deviations on both axes are systematic trends with time, but show no obvious systematic variation with any other parameter. The time dependence does not appear to be a systematic time-of-day effect but seems to be rather random with a typical time scale of the order of two hours.

3. The two cm (14.3 GHz) behavior of the antenna is exemplary. The efficiency of the antenna was not determined in this series of measurements, because the noise injection, and hence the system temperature, was uncalibrated. However, the antenna gain did not vary with elevation, to within the accuracy of measurement, about 3%. The receiver noise temperature increased with zenith distance, by about 10^{o} at 15^{o} elevation. This corresponds to a $3^{o}.5$ zenith temperature--perhaps a bit lower than one would expect. Therefore the possibility exists that the cal is attitude dependent by up to 3%, corresponding to a similar reduction in gain at low elevations.

4. The two cm focus varies with elevation in a fashion compatible with a sin (elevation) curve. The total range is about 3.7mm. In the natural units of the positioning system, the best focus is at

$$-107 + 50 \sin (\text{elevation}).$$

The identical focus may be used at 6 cm with no detectable loss of gain.

5. The accuracy of the subreflector rotation system is sufficient that alternating 6 cm and 2 cm observations does not significantly increase the scatter of the pointing deviations.

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