NATIONAL RADIO ASTRONOMY OBSERVATORY

Engineering Memo No. 145

CALIBRATION OF THE STERLING MOUNT ON THE 300-FOOT TELESCOPE AT 1400 MHz

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I. Introduction

In the course of studying the pointing of the traveling feed (Engineering Memo No. 144), the only similar observations that I found for the Sterling mount were measurements of two sources by Ahlquist and Fisher (1972). So in April 1981 I checked the pointing of the Sterling mount at 1400 MHz using the cooled 21-cm receiver.

II. Right Ascension Pointing Curve

The 19 measurements are shown in Figure 1. The results of the fit are

$$\text{BDF} = 0.8556 \pm 0.0022,$$

and

$$\text{Offset} = -0.036 \pm 0.024 \text{ inches.}$$

As expected, the BDF is in excellent agreement with that determined for the traveling feed and the critical angle is greater than the 0°.5 limit of the Sterling mount (extrapolation of the result for the traveling feeds gives 0°.96).

The observed offset, while only 1.5σ, is of the same order (4") as that seen with the 6 cm receiver.

III. Hour Angle Dependence of Gain

These observations were also suitable for determining the dependence of the gain upon hour angle. As shown in Engineering Memo No. 144, the proper independent variable is, however, the geometrical angle of the beam or feed.

I will use the latter because it is readily available in the on-line computers for use in applying a gain correction. The final results for the two feeds, based upon 15 measurements each and normalized to one on the meridian, are shown in Figure 2. The two curves are in excellent agreement and their weighted average is

$$G = 1 - (8.06 \pm 0.88) \times 10^{-6} \gamma_F^2,$$

where γ_F is measured in seconds of time.

This result is very similar to that of Ahlquist and Fisher (1972). They found no dependence on declination but saw an indication of a slight asymmetry. I see no evidence of asymmetry: inclusion of a linear term increases the rms slightly and the linear coefficient is smaller than 1σ.

IV. Summary

1. I have redetermined the pointing curve of the Sterling mount at 1400 MHz. At this frequency the critical angle is outside its tracking range. This will not be the case at frequencies above 2700 MHz if extrapolating the result for the traveling feed is valid. (The maximum offset of $0^\circ.25$ that I use in my declination pointing observations at 6 cm is slightly smaller than the extrapolated value of the critical angle.)

2. The geometrical angle of the feed should be recorded for each data record in addition to the right ascension and declination. Then the analysis computer at the telescope or the 360 in Charlottesville could correct the individual records for the hour angle dependence of the gain before averaging them together for a scan. Observations by Wilkinson (1972), Manchester (1971), and Ahlquist and Fisher (1972) show that the coefficient scales with frequency. Of course, the above should not be extrapolated to lower values of the gain.

References

Ahlquist, J. E., and Fisher, J. R. 1972, "Pointing and Aperture Efficiency Studies of the Cooled 21 cm Receiver".

Manchester, R. N. 1971, "Polarization of Pulsars".

Wilkinson, D. T. 1972, "Letter on 250-500 MHz Feed".

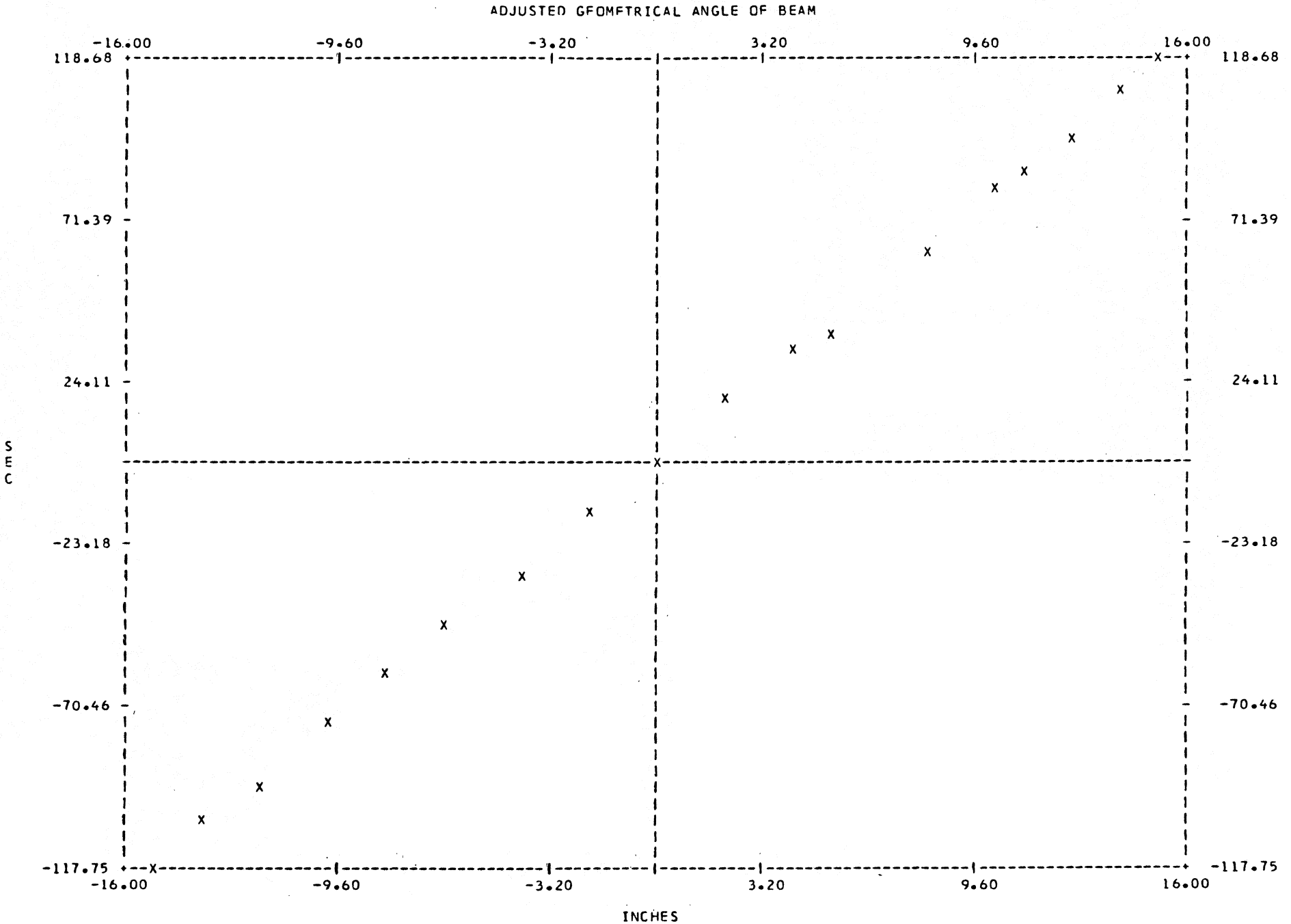
ADJUSTED GEOMETRICAL ANGLE OF BEAM
-16.00
-9.60
-3.20
3.20
9.60
16.00
118.68
71.39
24.11
-23.18
-70.46
-117.75
SEC
INCHES

Figure 1.

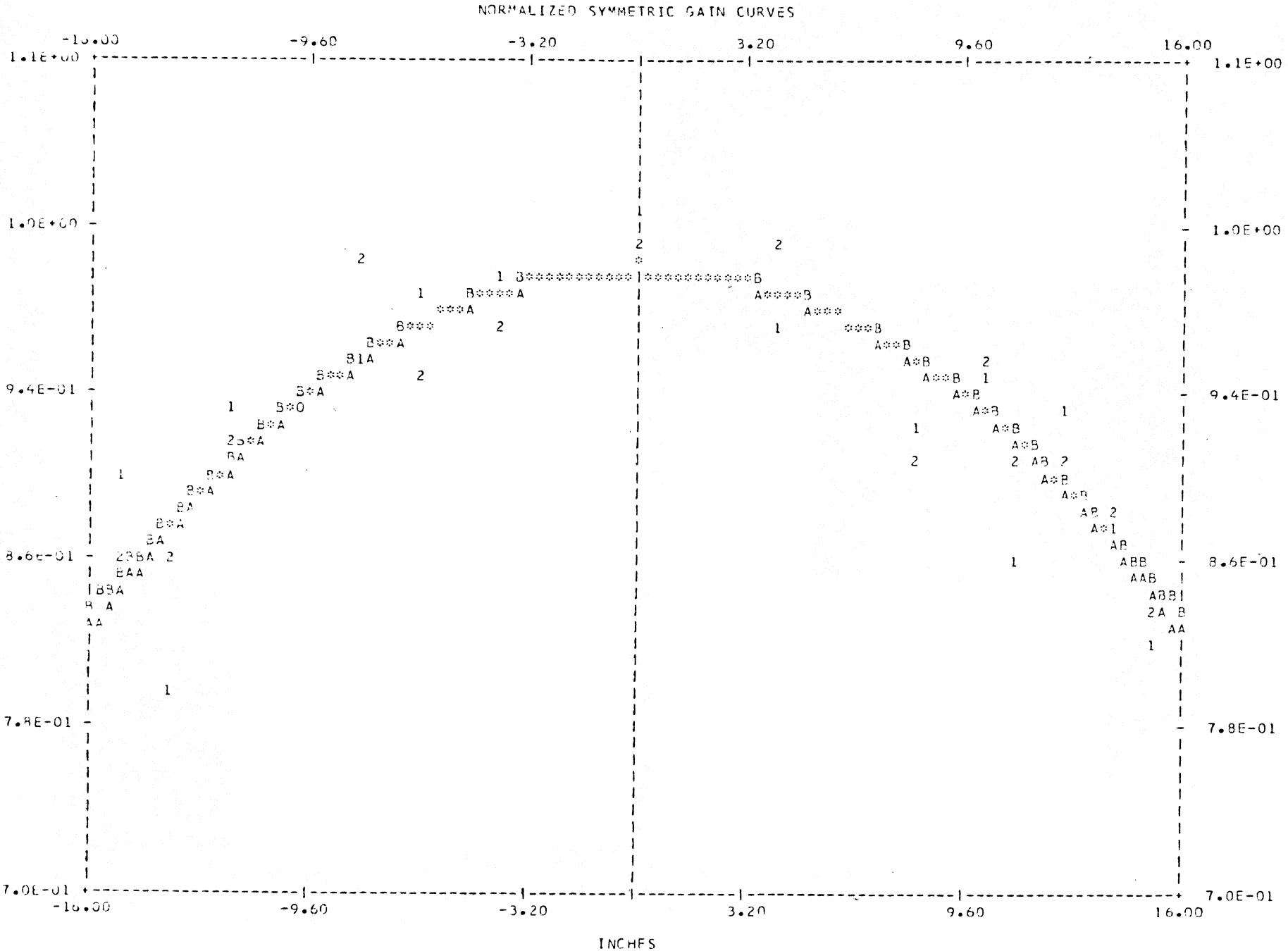
NORMALIZED SYMMETRIC GAIN CURVES
-16.00
-9.60
-3.20
3.20
9.60
16.00
1.1E+00
1.0E+00
9.4E-01
8.6E-01
7.8E-01
7.0E-01
INCHES

Figure 2.