NATIONAL RADIO ASTRONOMY OBSERVATORY

Engineering Memo No. 139

THE PERFORMANCE OF THE 300-FOOT TELESCOPE AT 1400 and 4760 MHz

Patrick C. Crane
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I. Observations at 1400 MHz

The present observations were taken at several epochs between November 1979 and September 1980 with the cooled 21-cm receiver on the 300-foot telescope. No significant modifications were made to the receiver during this time, and noise-tube temperatures of 6.6 K and 4.9 K for receivers 1 and 2, respectively, were used throughout; feed 1 was linearly polarized north-south and feed 2 east-west. The standard spectral-line setup was used; the analogue total-power outputs from the Model III correlator were detected digitally by the DDP116. The center frequency was 1400 MHz, and correlator bandwidths of 10 MHz were used. Each observation consisted of a drift scan approximately 4^m sec δ in duration; the integration period was 2^s and the noise tubes were fired for every fifteenth integration. The average pointing errors in right ascension were between 6" and 12".

The gain curves tabulated in Table 1 and plotted in Figure 1 were determined from 220 observations of 48 sources (declinations between -16° and 79°) by fitting fourth-order Chelyshev polynomials centered on the zenith. The rms undertainty is approximately 5%. The shapes of the two curves differ markedly--by as much as 20% at high declinations.

The average half-power beamwidths are tabulated in Table 2. Feed 1 has a slightly smaller HPBW in right ascension than feed 2 but has a considerably larger HPBW in declination.

When I rotated the receiver by 90°, I found that the two feeds exchanged gain curves and HPBW's. Apparently, the observed differences arise from the interaction of the linearly polarized feeds with the two feed support legs. This indicates that accurate measurements of source polarizations will be difficult.

II. Observations at 4760 MHz

The observations reported here were taken between July and September 1979 and in April 1980 with the 6/25 cm receiver on the 300-foot telescope. The instantaneous bandwidth was 580 MHz centered on 4760 MHz. The inputs to the two parametric amplifiers were switched at 50 Hz between two offset feeds (separated in right ascension by 7!3 for these observations and each right circularly polarized). The broadband signals were detected with a square-law detector and synchronously detected using an analogue standard receiver.

The gain curves determined from 579 observations of 96 sources (declinations between -13° and 80°) are tabulated in Table 3 and shown in Figure 2. The rms uncertainty is approximately 5%. The two curves are essentially the same, which is expected since both are RCP.

The observed half-power beamwidths are tabulated in Table 4. The HPBW's are the same within the errors, as expected.

Because of the dependence on polarization observed at 21 cm and the effects of lateral defocusing reported in Engineering Memo No. 143, the above results, while illustrative, apply only to the particular setup used.

As reported in Enginering Memo No. 143, tracking the focus to correct the lateral defocusing offers the chance to improve the gain at extreme declinations by a factor of 2-3.

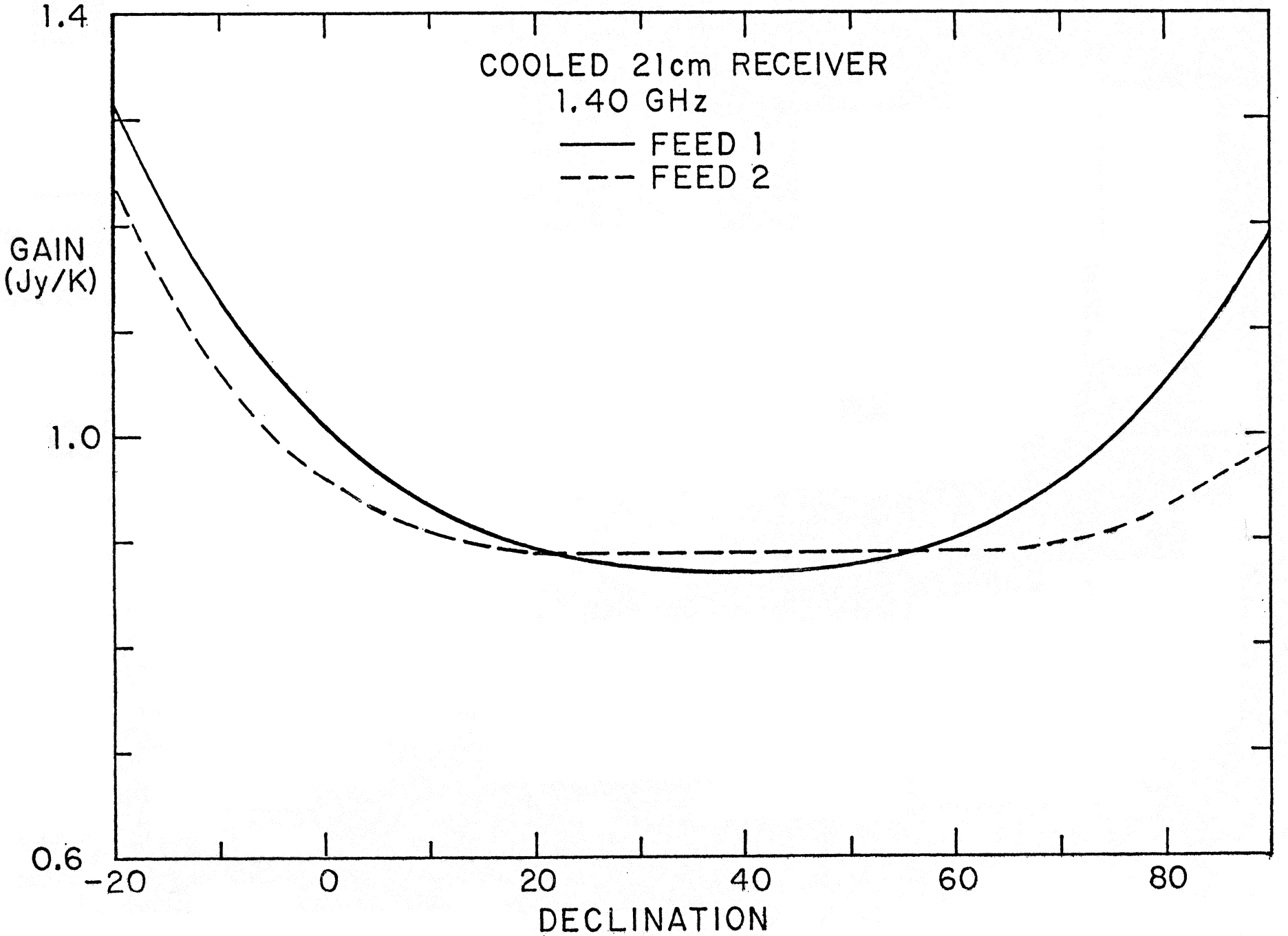
COOLED 21cm RECEIVER
1.40 GHz
FEED 1
FEED 2
GAIN
(Jy/K)
1.4
1.0
0.6
-20
0
20
40
60
80
DECLINATION

Figure 1.

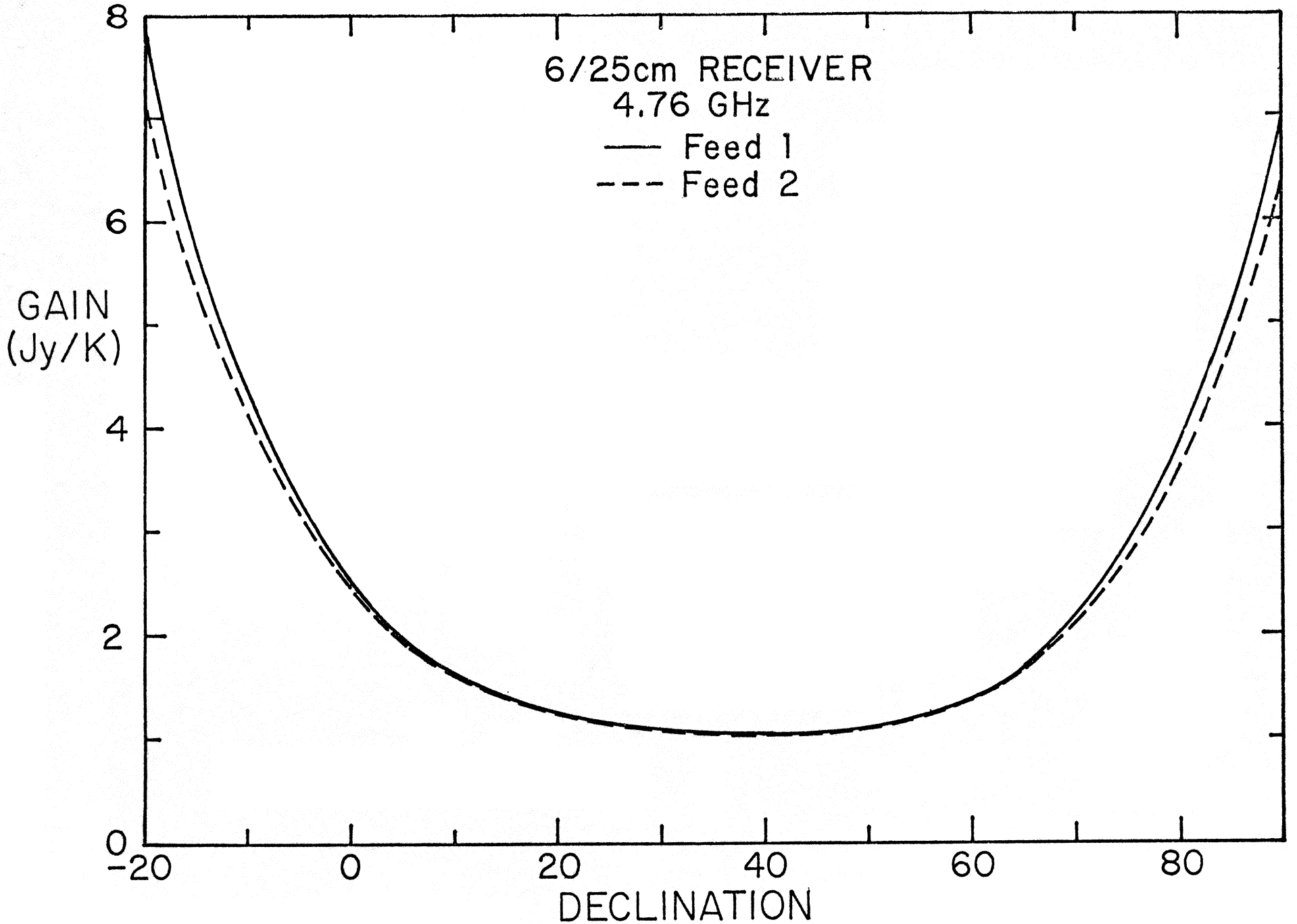
6/25cm RECEIVER
4.76 GHz
Feed 1
Feed 2
GAIN
(Jy/K)
8
6
4
2
0
-20
0
20
40
60
80
DECLINATION

Figure 2.

Table 1. 300-Foot Gain Curves at 1.40 GHz

Declination	Feed 1	Feed 2
-20°	1.31 Jy/K	1.23 Jy/K
-15	1.21	1.14
-10	1.13	1.06
-5	1.06	1.00
0	1.01	0.96
5	0.97	0.93
10	0.94	0.91
15	0.91	0.90
20	0.90	0.89
25	0.89	0.89
30	0.88	0.89
35	0.87	0.89
40	0.87	0.89
45	0.88	0.89
50	0.88	0.89
55	0.89	0.89
60	0.91	0.89
65	0.93	0.89
70	0.96	0.90
75	1.00	0.91
80	1.04	0.93
85	1.11	0.96
90	1.19	0.99

Table 2. 300-Foot HPBW in Declination at 1.40 GHz

Declination	Feed 1		Feed 2	
	α	δ	α	δ
-20°	10!60	12!46	10!62	10.82
-15	10.16	12.29	10.25	10.79
-10	9.84	12.13	9.99	10.76
-5	9.63	11.98	9.82	10.73
0	9.50	11.85	9.73	10.71
5	9.43	11.73	9.68	10.69
10	9.41	11.64	9.68	10.68
15	9.41	11.55	9.70	10.67
20	9.44	11.48	9.73	10.66
25	9.47	11.43	9.77	10.65
30	9.50	11.39	9.81	10.65
35	9.52	11.37	9.84	10.66
40	9.53	11.36	9.85	10.67
45	9.53	11.37	9.85	10.68
50	9.52	11.39	9.84	10.69
55	9.51	11.43	9.82	10.71
60	9.50	11.48	9.80	10.74
65	9.50	11.55	9.77	10.76
70	9.52	11.64	9.76	10.79
75	9.59	11.74	9.77	10.83
80	9.70	11.85	9.81	10.86
85	9.89	11.98	9.90	10.91
90	10.18	12.13	10.06	10.95

Table 3. 300-Foot Gain Curves at 4.76 GHz

Declination	Feed 1	Feed 2
-20°	7.74 Jy/K	7.09 Jy/K
-15	5.83	5.42
-10	4.38	4.15
-5	3.31	3.19
0	2.54	2.49
5	2.00	1.99
10	1.64	1.64
15	1.40	1.41
20	1.26	1.26
25	1.17	1.17
30	1.12	1.11
35	1.10	1.08
40	1.08	1.07
45	1.09	1.08
50	1.14	1.13
55	1.23	1.22
60	1.41	1.40
65	1.71	1.68
70	2.18	2.11
75	2.87	2.73
80	3.85	3.60
85	5.18	4.77
90	6.96	6.32

Table 4. 300-Foot HPBW at 4.75 GHz

Declination	Feed 1		Feed 2	
	α	δ	α	δ
-20°	6!57		5!87	
-15	5.21		4.80	
-10	4.22		4.02	
-5	3.54	5!13	3.48	3!86
0	3.10	4.81	3.13	3.79
5	2.85	4.50	2.92	3.68
10	2.72	4.21	2.81	3.53
15	2.69	3.94	2.78	3.39
20	2.70	3.71	2.79	3.26
25	2.74	3.51	2.81	3.16
30	2.77	3.34	2.84	3.10
35	2.79	3.22	2.85	3.08
40	2.78	3.14	2.84	3.12
45	2.75	3.11	2.82	3.21
50	2.70	3.12	2.78	3.35
55	2.64	3.17	2.73	3.54
60	2.59	3.27	2.69	3.75
65	2.58	3.40	2.69	3.98
70	2.65	3.56	2.74	4.22
75	2.84	3.76	2.88	4.43
80	3.18	3.98	3.16	4.60
85	3.75		3.60	
90	4.60		4.26	