R00109

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Optimum Feed Position calibration using beamshape for C9

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AIM

To find the Optimum position of the feed turret for C9 antenna at 325.5 MHz using sidelobe power equalization

Procedure

- C12 and C03 were made to track the source 3C123 while C04 and C09 antennae were scanning it in elevation from nearly -10 degree offset from the assumed position of 325.5MHz feed(270.0 deg) to +10 degrees.
- This provided 4 cross baselines for each of the two antennae viz. C04 and C09. The connections in the sampler panel are attached along with this report for reference. The useful baselines were,

  C04-C12: 02 03 14 15
  C09-C12: 06 07 16 17

- The antennae C04 and C09 were scanning 3C123 @2deg./m. speed and took nearly 10 minutes for one observation.
- Observations were made for different feed positions from -6 deg offset (276 deg turret position) to +8 deg offset (262 deg. turret position), in steps of 1.0 degree.
- LTA chosen for data acquisition was 2.1 secs.

ANALYSIS

- Powers in all the channels (0-170), within the 8 MHz band out of 12MHz,were added incoherently while rejecting bad channels and interferences that cause power in a given channel to exceed above a 3 sigma of the mean noise level across the 8NHz. band. This was done automatically in the program for each baseline for every record.
- This provided us with beam shape for each of the two antennae of interest, viz. C04, C09. To improve upon the signal-to-noise ratio for beamshape,in particular for the first sidelobes, a geometric mean of powers from all the 4 baselines for each pair, C4-C12 & C9-C12 was taken.
- Data being noisy and non-smooth in most of the cases, we tried to fit parabola for each of the first sidelobes and the main beam as all the powers were measured in dB

scale. This was done using Chi-square minimization.

- Once the fitting was done for the main beam and the two sidelobes on the either side, represented as L, M, R (for Left, Main, Right) lobes, the peak position and the peak powers were estimated for L,M,R lobes.

- This was done for all the different Feed Offsets.

- Finally the ratio of the sidelobe powers, L(P)/R(P) was plotted as a function of the feed offset. This was followed by fitting a monotonically decreasing polynomial of 3rd order with independent parameter being the feed offset and the dependent one as the ratio L(P)/R(P).

- Also, a plot of peak position of L, M, R was plotted as a function of the feed offset.

RESULTS

- Since C04 behaved erratic in most of the observations, no analysis was tried on the related baselines.

- C09 plots are available and analysis shows that the optimum position of the 325.5 MHz where sidelobe powers are equal corresponds to a feed offset of -2.9 degree,viz. the turret position of 272.9 deg. and not 270. degrees as is generally assumed.

EXTENSIONS

- The same procedure will be tried out for C02, C04 at 325.5 MHz. and then for all of them at other frequencies wherever possible.

Note

Copy of this report will be kept in the library.

Results from C9 Beamshape Calibration

Feed Offset	L(x) deg.	L(P) dB	M(x) deg.	M(P) dB	R(x) deg.	R(P) dB
-5.982	7.795	25.489	10.215	49.228	12.614	28.996
-5.015	6.525	25.648	9.143	51.416	11.527	30.466
-4.031	7.298	24.140	9.891	46.983	12.264	25.427
-2.326	7.252	19.985	9.596	40.042	11.963	18.028
-0.972	7.083	21.547	9.623	46.620	11.965	24.108
+0.001	7.096	20.542	9.469	40.460	11.758	16.599
+1.155	6.114	29.700	8.609	50.252	10.908	27.962
+2.122	9.325	25.727	11.681	45.755	14.039	20.487
+3.159	4.308	24.704	6.764	48.313	9.084	23.369
+4.003	7.619	25.840	10.060	46.513	12.433	21.823
+4.969	7.734	24.837	10.117	46.960	12.506	21.666
+6.024	8.947	28.455	11.344	49.985	13.795	25.235
+7.131	5.056	29.831	7.468	51.900	9.951	24.986
+8.151	8.014	25.980	10.399	46.922	12.939	20.828

L, M, R: Represent the Left, Main and Right Sidelobes.
x: Represents the scanning angle w.r.t. first data record.
P: Power in the lobe in dB scale.

See the attached note for details.

Ratio of the Sidelobe Powers as a function of Feed Offset

Feed Offset(deg.)	Ratio of Sidelobe Powers
-5.982	1.138
-5.015	1.189
-4.031	1.053
-2.326	0.902
-0.972	1.119
+0.001	0.808
+1.155	0.942
+2.122	0.796
+3.159	0.946
+4.003	0.845
+4.969	0.872
+6.024	0.887
+7.131	0.838
+8.151	0.802

Global Setups:
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Source Name: 3C123

Observations: 25-26/05/1995.

Tracking offsets for Antennae under use:

Used Az = Actual Az of the source + dAz
Used El = Actual El of the source + dEl

C03: dAz = -25' dEl = +47'
C12: dAz = -16' dEl = -19'
C04: dAz = -06' dEl = +77'
C09: dAz = -08' dEl = +04'

Sampler Settings:

S1U -> C03-130-USB: S1L -> C03-175-USB:
S2U -> C04-130-USB: S2L -> C04-175-USB:
S3U -> C09-130-USB: S3L -> C09-175-USB:
S4U -> C12-130-USB: S3L -> C12-175-USB:

- C03, C12 Tracking the Source.
- C04, C09 Scanning in elevation @ 2d/1m.
- Feed Offsets are varied from -6 to +8
- degrees in steps of 1deg.

- Useful Baselines[0-19] are:

02 03 06 07 14 15 16 17

- C04 Baselines: 02 03 14 15
- C09 Baselines: 06 07 16 17

Reference Position for 327MHz. Feed:
(C4: 270.001, C9: 270.001)

File: 3C123_FO+0.0_C4C9.1ta

- Feed Offset: +0.0 degrees.
- (C4: 270.001, C9: 270.001)
- True Offset: C4: +0.001
- True Offset: C9: +0.001
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO+2.0_C4C9.1ta

- Feed Offset: +2.0 degrees.
- (C4: 267.900, C9: 267.878)
- True Offset: C4: +2.100
- True Offset: C9: +2.122
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO-2.0_C4C9.1ta

- Feed Offset: -2.0 degrees.
- (C4: 272.150, C9: 272.326)
- True Offset: C4: -2.150
- True Offset: C9: -2.326
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO-6.0_C4C9.1ta

- Feed Offset: -6.0 degrees.
- (C4: 276.158, C9: 275.982)
- True Offset: C4: -6.158
- True Offset: C9: -5.982
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO+6.0_C4C9.1ta

- Feed Offset: +6.0 degrees.
- (C4: 263.853, C9: 263.976)
- True Offset: C4: +6.147
- True Offset: C9: +6.024
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO+4.0_C4C9.1ta

- Feed Offset: +4.0 degrees.
- (C4: 266.103, C9: 265.997)
- True Offset: C4: +3.897
- True Offset: C9: +4.003
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO+8.0_C4C9.1ta

- Feed Offset: +8.0 degrees.
- (C4: 262.007, C9: 261.849)
- True Offset: C4: +7.993
- True Offset: C9: +8.151
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO-4.0_C4C9.1ta

- Feed Offset: -4.0 degrees.
- (C4: 274.136, C9: 274.031)
- True Offset: C4: -4.136
- True Offset: C9: -4.031
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO-8.0_C4C9.1ta

- Feed Offset: -5.0 degrees.
- (C4: 275.173, C9: 275.015)
- True Offset: C4: -5.173
- True Offset: C9: -5.015
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO-3.0_C4C9.1ta

- Feed Offset: -3.0 degrees.
- (C4: 272.941, C9: 272.835)
- True Offset: C4: -2.941
- True Offset: C9: -2.835
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO-1.0_C4C9.1ta

- Feed Offset: -1.0 degrees.
- (C4: 270.954, C9: 270.972)
- True Offset: C4: -0.954
- True Offset: C9: -0.972
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

File: 3C123_FO+1.0_C4C9.1ta

- Feed Offset: +1.0 degrees.
- (C4: 269.003, C9: 268.845)
- True Offset: C4: +0.997
- True Offset: C9: +1.155
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

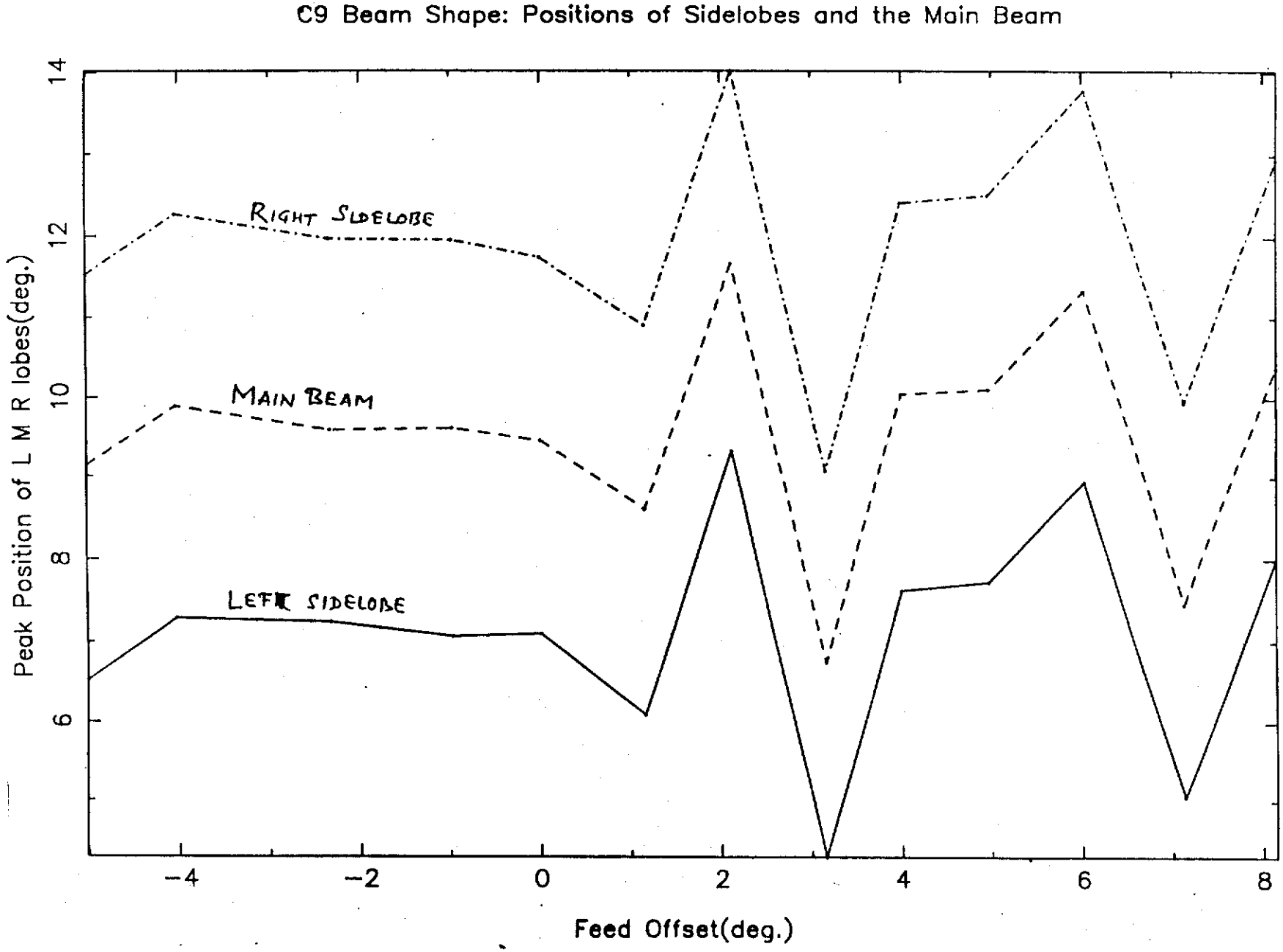
File: 3C123_FO+3.0_C4C9.1ta

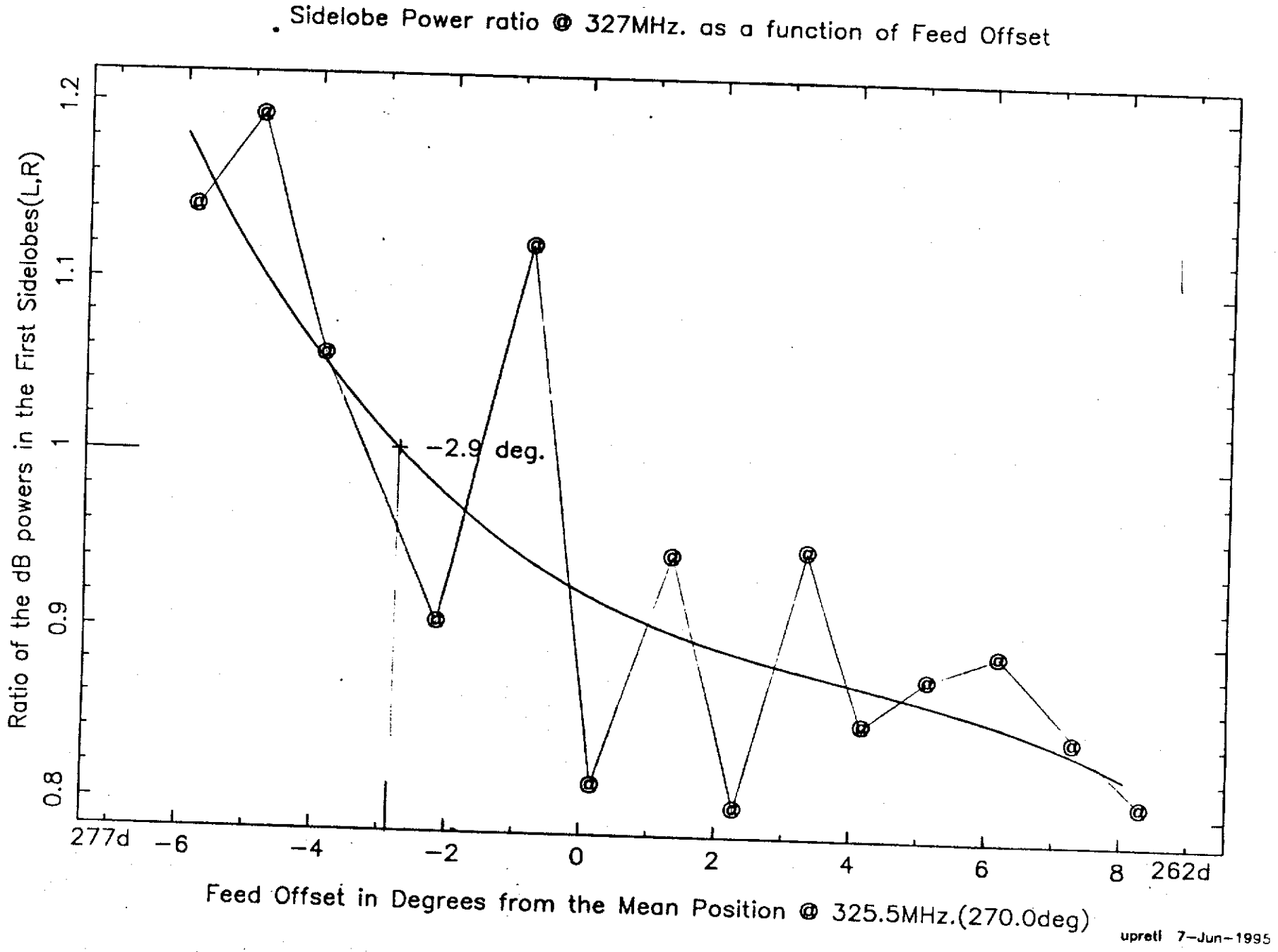
- Feed Offset: +3.0 degrees.
- (C4: 266.929, C9: 266.841)
- True Offset: C4: +3.071
- True Offset: C9: +3.159
- Scanning rate: 2d/1m.
- Scanning: -7d to +10d.

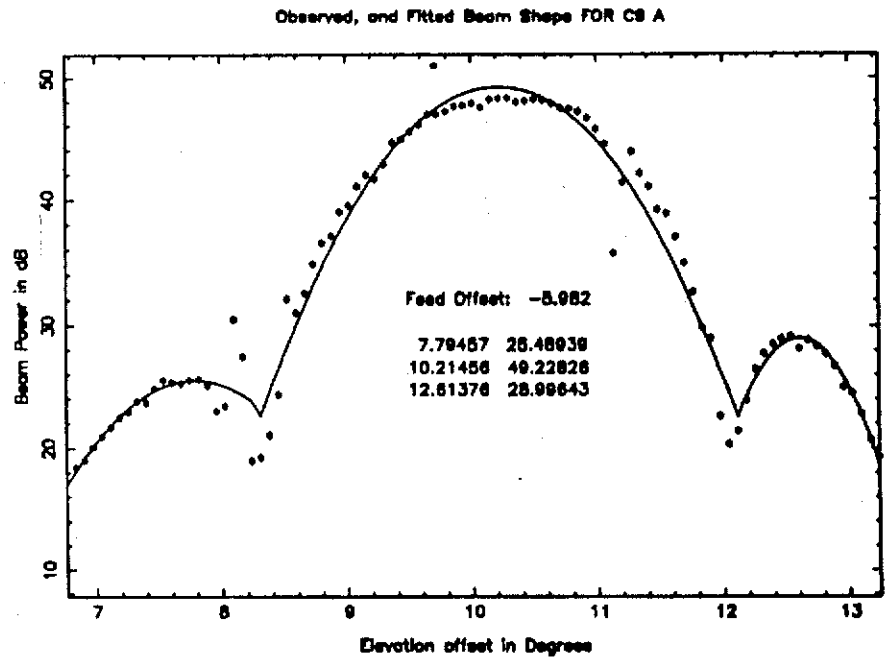
File: 3C123_FO+5.0_C4C9.1ta

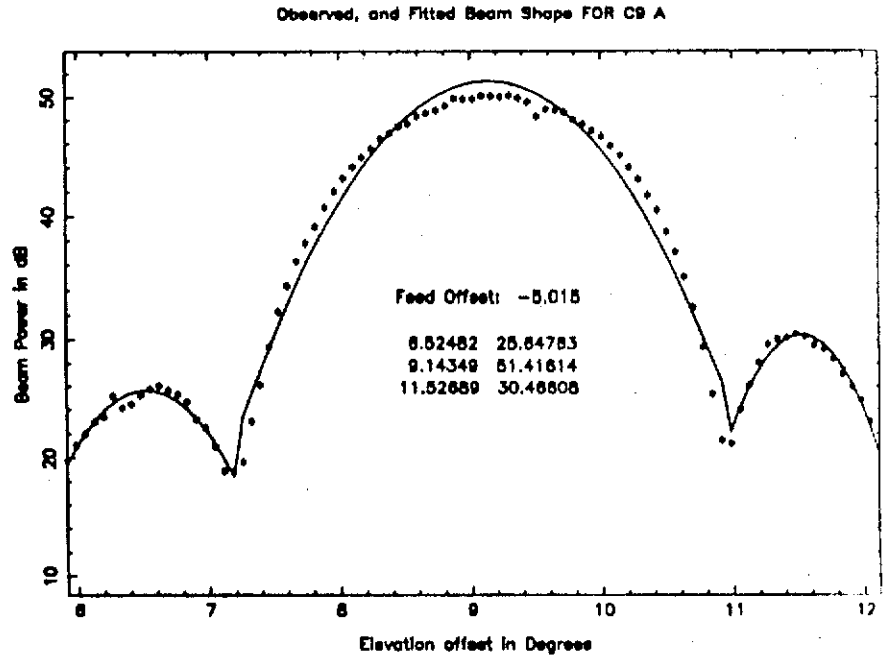
- Feed Offset: +5.0 degrees.
- (C4: 265.101, C9: 265.031)
- True Offset: C4: +4.899
- True Offset: C9: +4.969
- Scanning rate: 2d/1m.
- Scanning: -10d to +10d.

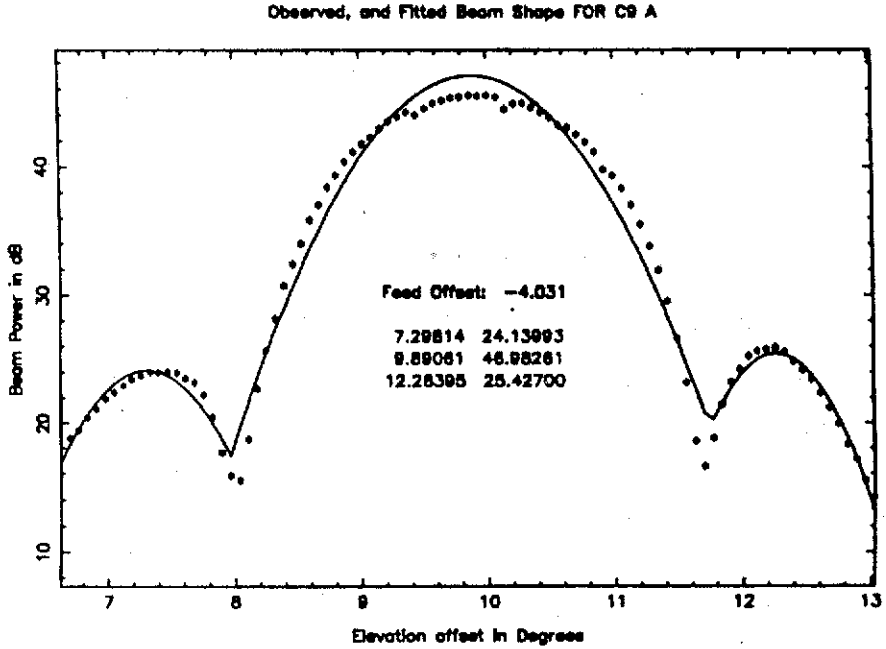
File: 3C123_FO+7.0_C4C9.1ta

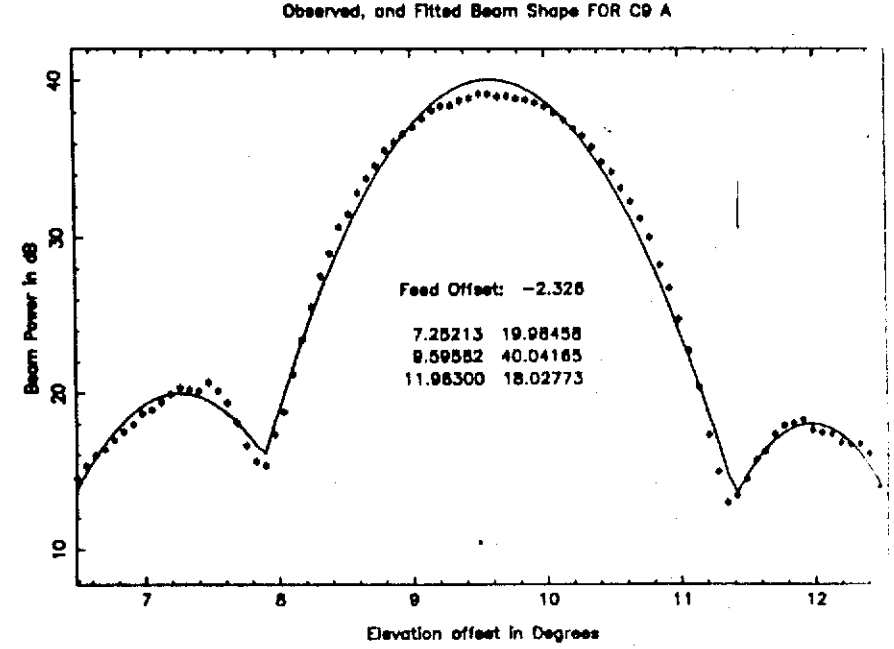

C9 Beam Shape: Positions of Sidelobes and the Main Beam
Peak Position of L M R lobes(deg.)
14
12
10
8
6
RIGHT SIDELOBE
MAIN BEAM
LEFT SIDELOBE
−4
−2
0
2
4
6
8
Feed Offset(deg.)

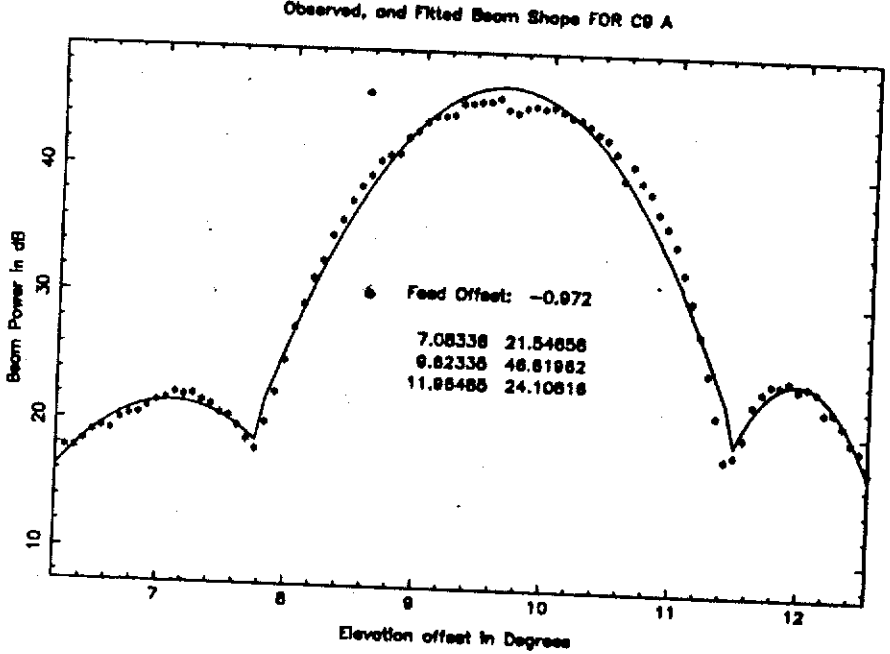

Sidelobe Power ratio @ 327MHz. as a function of Feed Offset
Ratio of the dB powers in the First Sidelobes(L,R)
1.2
1.1
1
0.9
0.8
−2.9 deg.
277d
−6
−4
−2
0
2
4
6
8
262d
Feed Offset in Degrees from the Mean Position @ 325.5MHz.(270.0deg)
upretl 7-Jun-1995

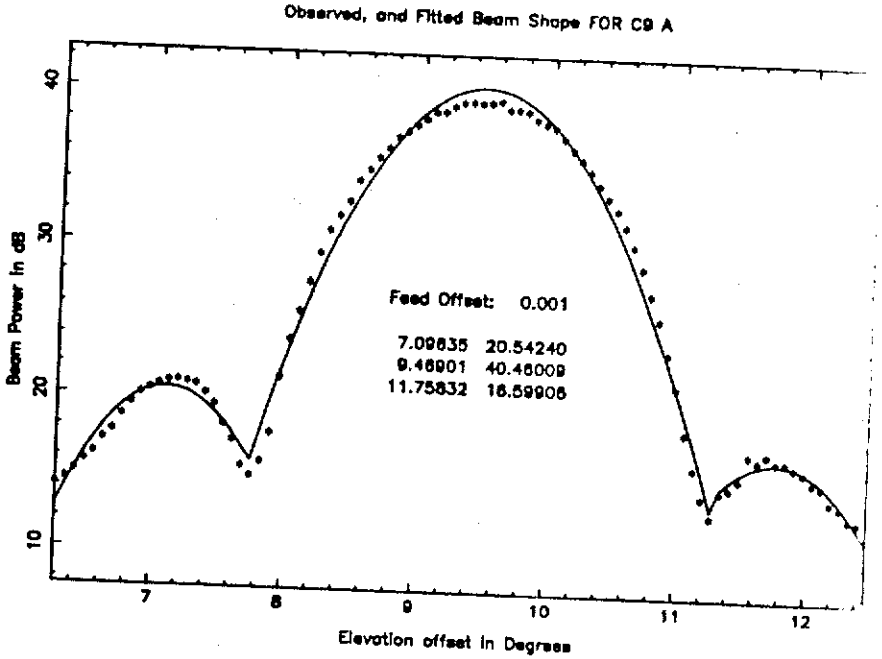

Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: -5.982
7.79457 28.48939
10.21456 49.22826
12.61376 28.99643

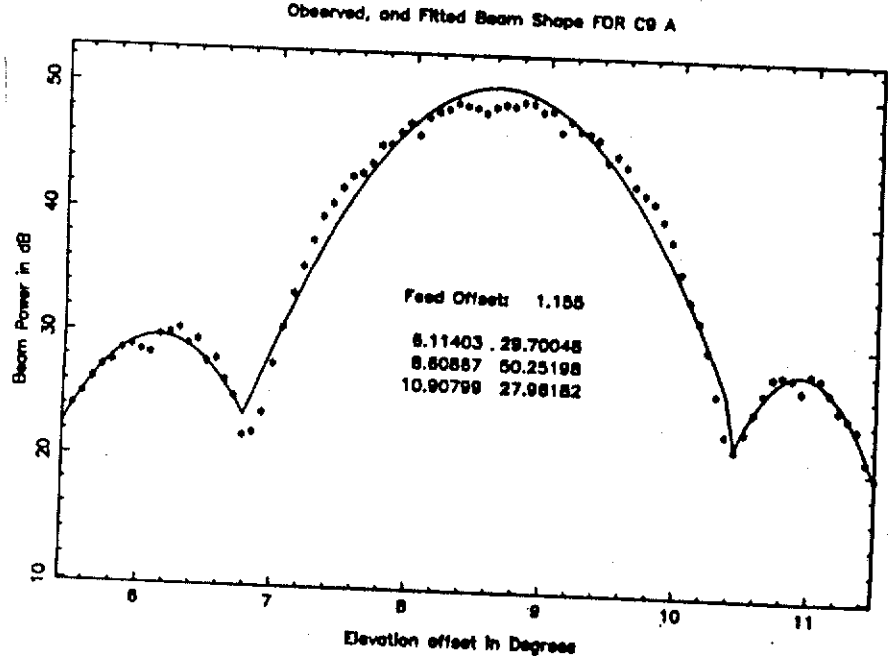

Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: -5.015
6.52482 25.64783
9.14349 51.41614
11.52689 30.46808

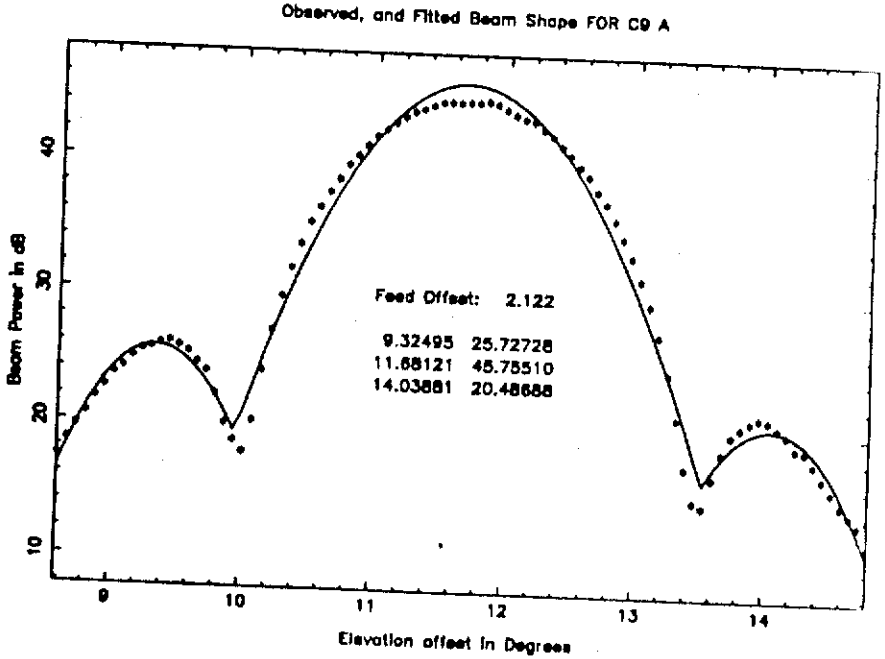

Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: -4.031
7.29814 24.13993
9.89061 46.98261
12.28395 25.42700

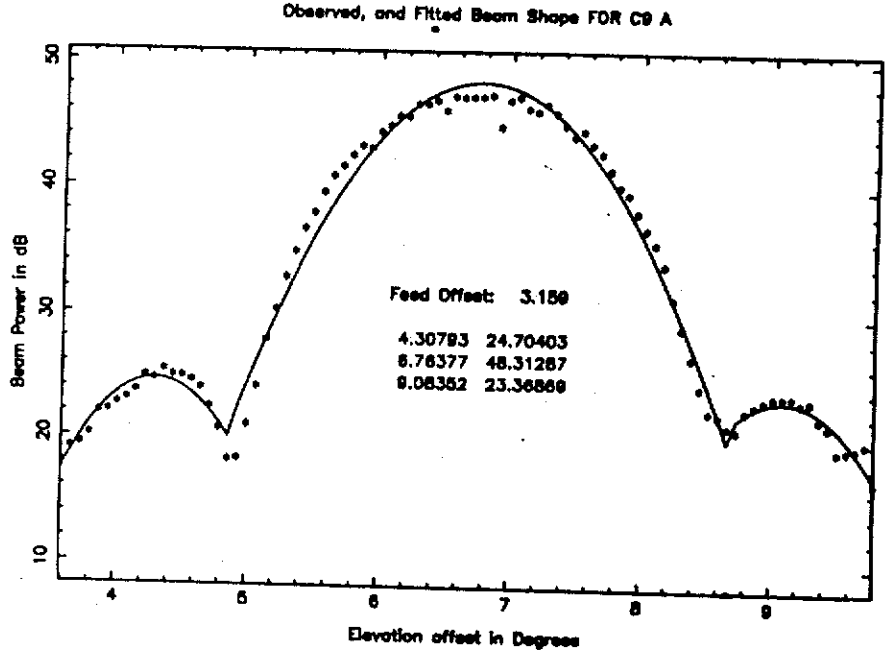

Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: -2.326
7.25213 19.98458
9.59582 40.04165
11.98300 18.02773

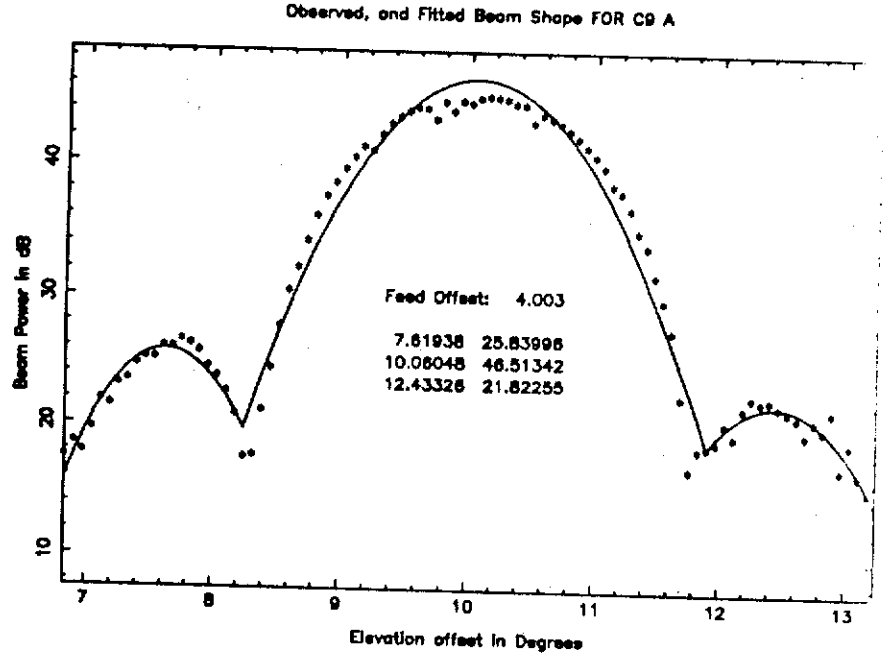

Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: -0.972
7.08336 21.54656
9.82336 46.61962
11.96486 24.10618

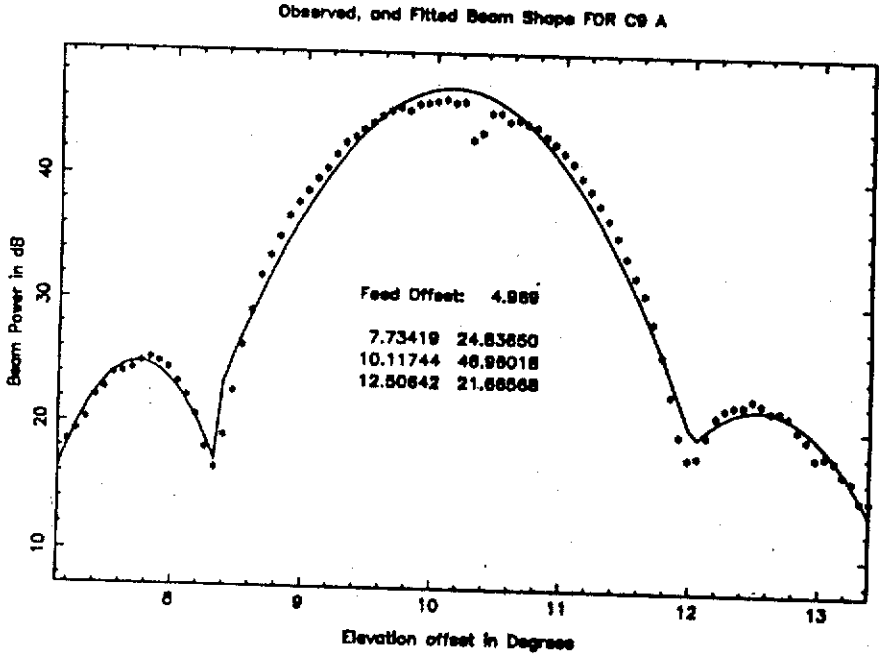

Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: 0.001
7.09835 20.54240
9.46901 40.46009
11.75832 16.59906

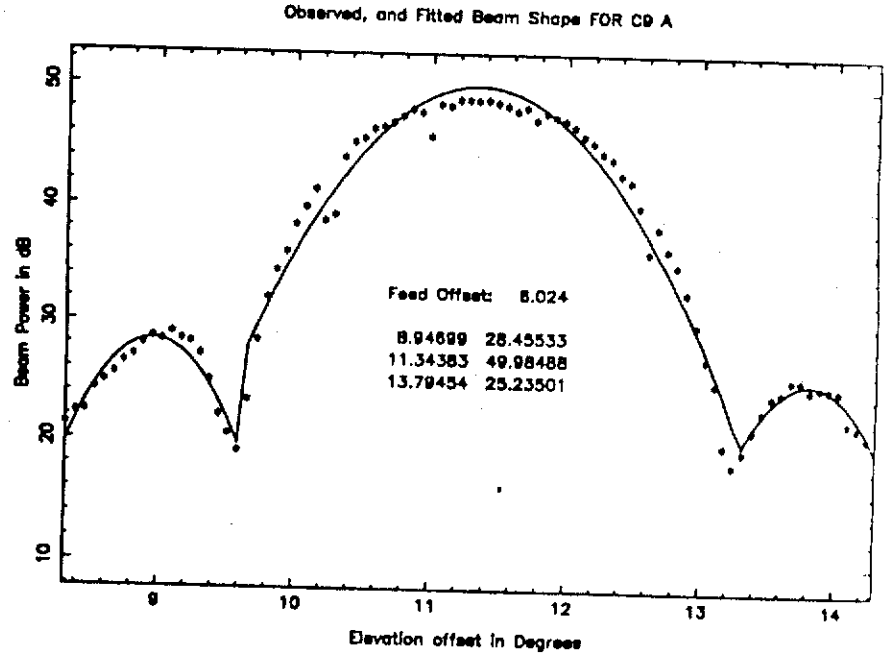

Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: 1.155
8.11403 29.70045
8.60887 50.25198
10.90799 27.98182


Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: 2.122
9.32495 25.72728
11.68121 45.75510
14.03881 20.48688


Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: 3.159
4.30793 24.70403
6.76377 48.31287
9.08352 23.36869


Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: 4.003
7.61938 25.83996
10.06048 46.51342
12.43326 21.82255


Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: 4.989
7.73419 24.83650
10.11744 46.98018
12.50642 21.66868


Observed, and Fitted Beam Shape FOR C9 A
Beam Power in dB
Elevation offset in Degrees
Feed Offset: 8.024
8.94699 28.45533
11.34383 49.98488
13.79454 25.23501