#92-9

NEROC Haystack Observatory

Westford, Massachusetts 01886 USA

Memorandum

To: Astronomy Group, SGH

From: Paul Charpentier PJC Oct 15, 1992

Subject: Pointing Accuracy Since Subreflector Installation
Pointing Series #3

After installing the subreflector in Sept 1992 data was taken to produce a new pointing bias model. The data was taken on Oct 1 and 2. The following summarizes the results of pointing measurements relative to the new pointing bias model. Figs 1 thru 4 depict the sky coverage for the four periods of pointing measurements taken thus far. The sources used were chosen by Joel Kastner from recent publications and we are confident that the positions are accurate. The figures show that we were able to obtain very good sky coverage with these updated source positions.

Figure 5 is a copy of data for pointing measurements for day 281 (Oct 7, 1992) taken from Joel's memo which is #2 in the pointing series. The conclusions of this memo were that the azimuth pointing was very good for this period, and that there is seemingly a sinusoidal dependence of elevation pointing with azimuth. The signature of this can be interpreted as an incorrect correction for antenna tower tilt. Based on this conclusion I have applied a tower tilt correction other than the one measured which minimizes elevation pointing error. The results for all the data since the pointing bias model was applied, as well as the raw results are summarized in Table 1. All measurements were taken at 43 Ghz. Table 2 summarizes the observation times, and Table 3 summarizes the sources used for each day and the weather conditions.

Analysis of the data shows that the azimuth pointing has been very consistent since the new pointing bias model was applied. The average rms of this data is under the 4" goal. The elevation pointing has had the same sinusoidal dependence as the day 281 data. Therefore I have included columns in Table 1 showing the measured tower tilt, the tower tilt which reduces the elevation rms to a minimum, and the minimum rms that results from the procedure. Figs 6 and 7 show raw elevation pointing data and the same data corrected for tower tilt. The rms after correcting for this new tower tilt is less 6". Entries for the day 288 elevation data are excluded since the experiment in progress at the time required vertical translation of the subreflector, which effects elevation pointing. It seems clear that we are in some way either incorrectly measuring tower tilt, or are only measuring a portion of it. The elevation offsets, which are a measure of the average pointing offset for a given data set from the pointing bias model, increase significantly between day 281 and 282, and seem consistent after that. A possible explanation is that the encoders were zeroed between day 281 and day 282 so that we would have feed offsets of zero as a reference point for variability tests in the future. It is possible that some error occured when the elevation encoder was zeroed.

We currently have 2 tilt meters on the azimuth axis of the antenna. Comparison of the reported tilt magnitudes of antenna from them agree to within .5"

It is recommended that the tilt meter calibration and the orientation of the tiltmeters be checked. If it turns out that the tiltmeters are calibrated properly, then, we need to measure tilts farther up in the structure. The Yoke arms are the next logical place to test.

On day 289 (Oct 15) we tested the tracking accuracy of the antenna. We performed continuous DSS measurements on Rleo between 11:30 AM and 1:00 PM local time. Rleo was at an elevation of approximately 45 deg. and an azimuth of 220. The sky conditions were "heavy clouds". The data are plotted in Figure 8. The results are a tracking accuracy of 1.5" and 1.7" for elevation and azimuth RMS's respectively.

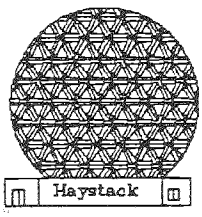


Fig 1

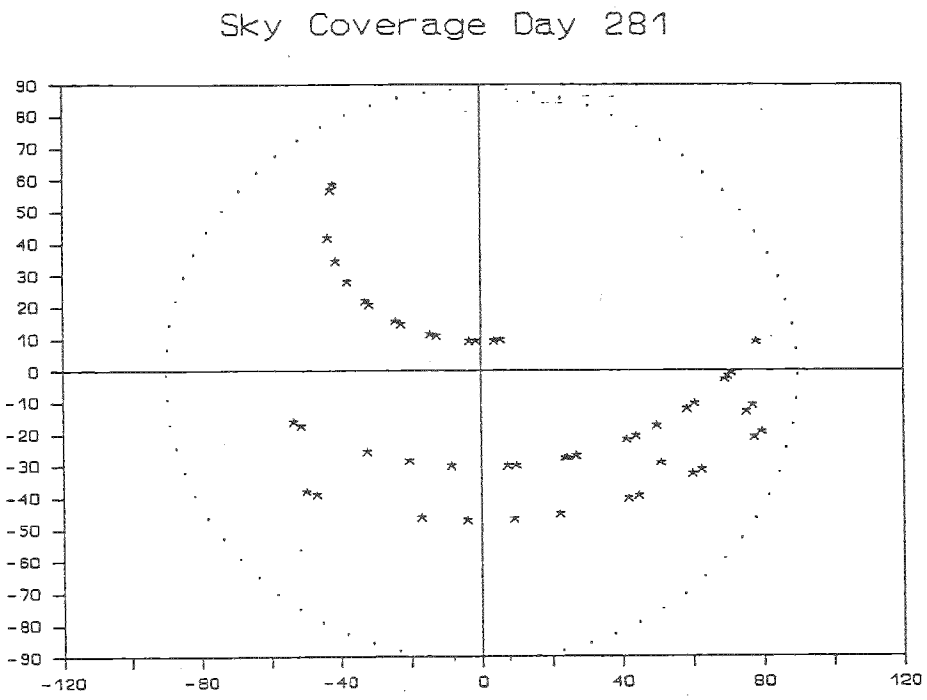

Sky Coverage Day 281
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-120
-80
-40
0
40
80
120

Fig 2

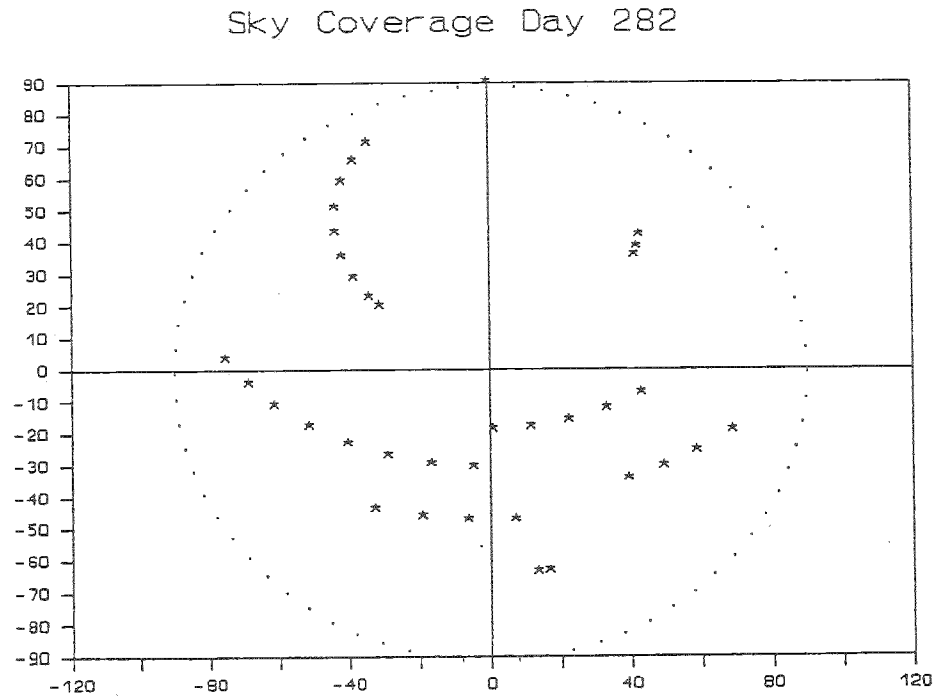

Sky Coverage Day 282
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-120
-80
-40
0
40
80
120

Fig 3

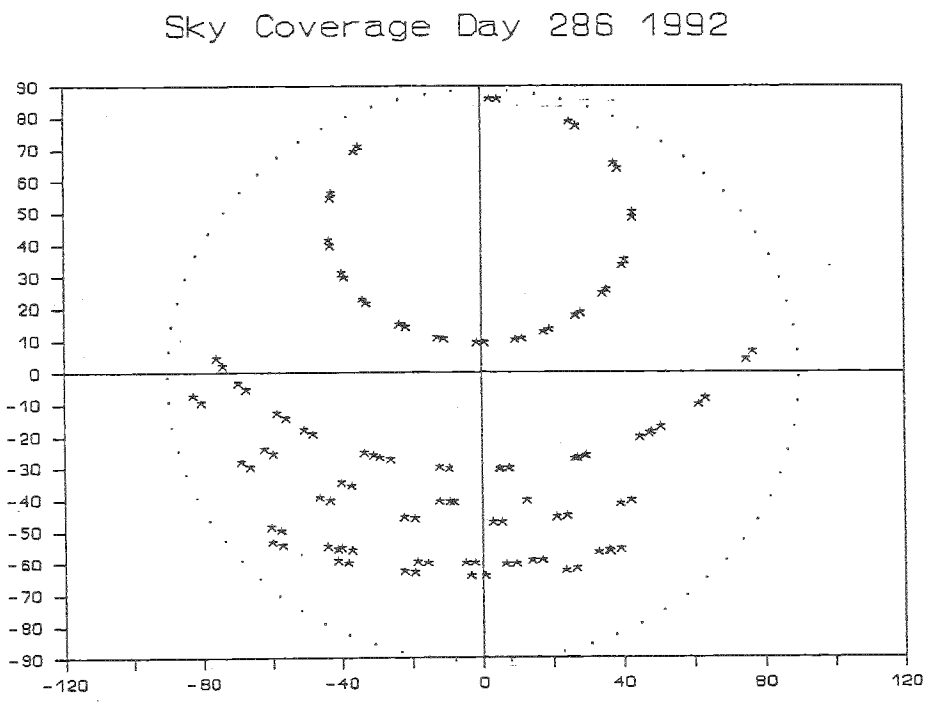

Sky Coverage Day 286 1992
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-120
-80
-40
0
40
80
120

Fig 4

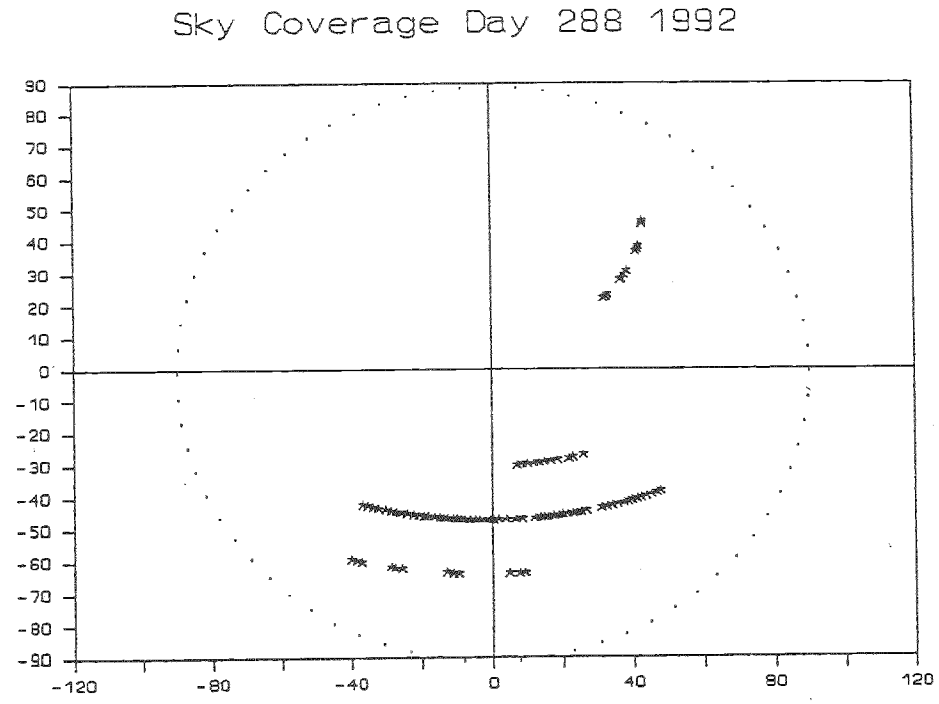
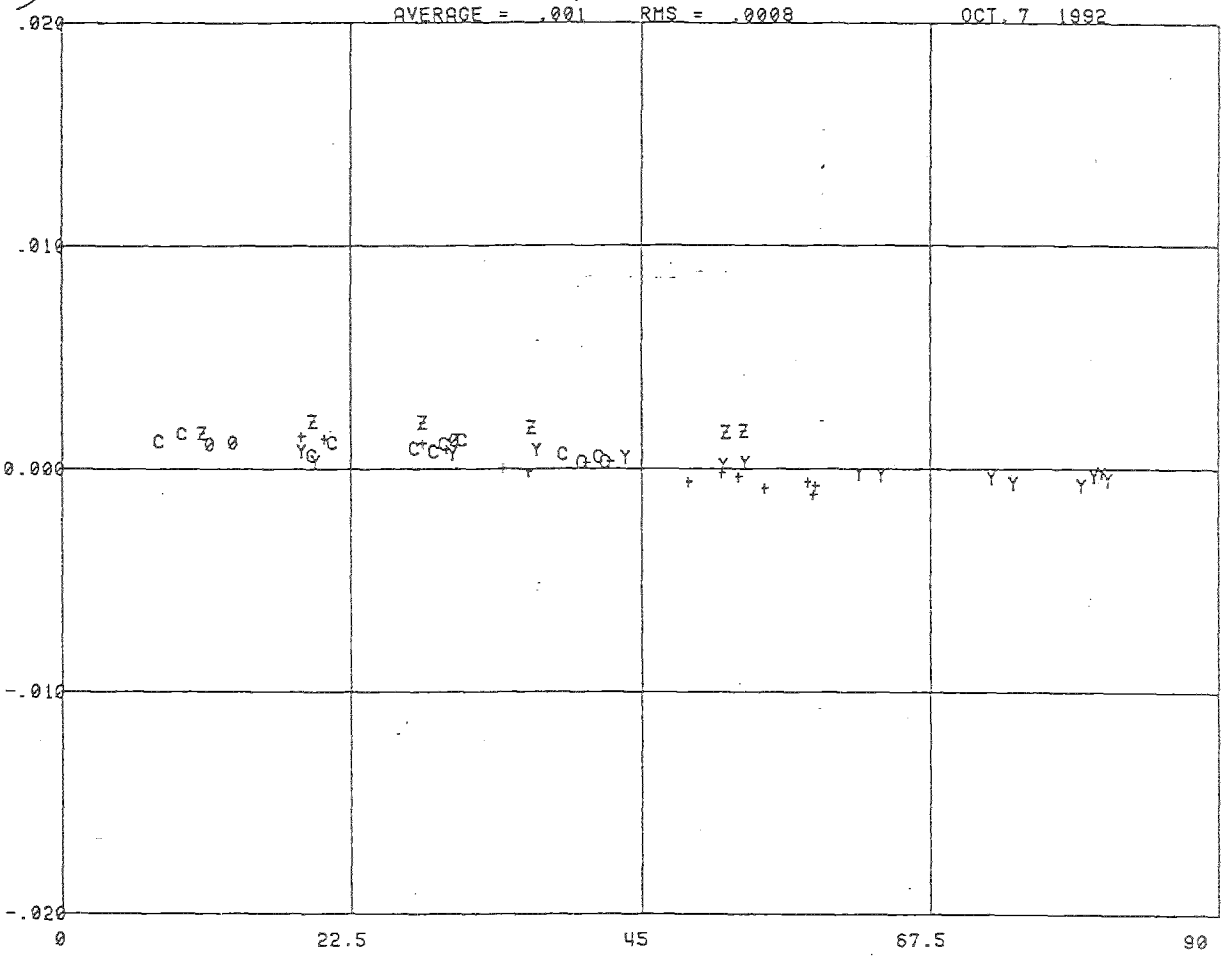

Sky Coverage Day 288 1992
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-120
-80
-40
0
40
80
120

Fig. 5

AZIMUTH POINTING ERROR (mdeg) VS ELEVATION



281 92 (mdeg) tilt 9.2 @ 81 43 GHz

ELEVATION POINTING ERROR VS AZIMUTH

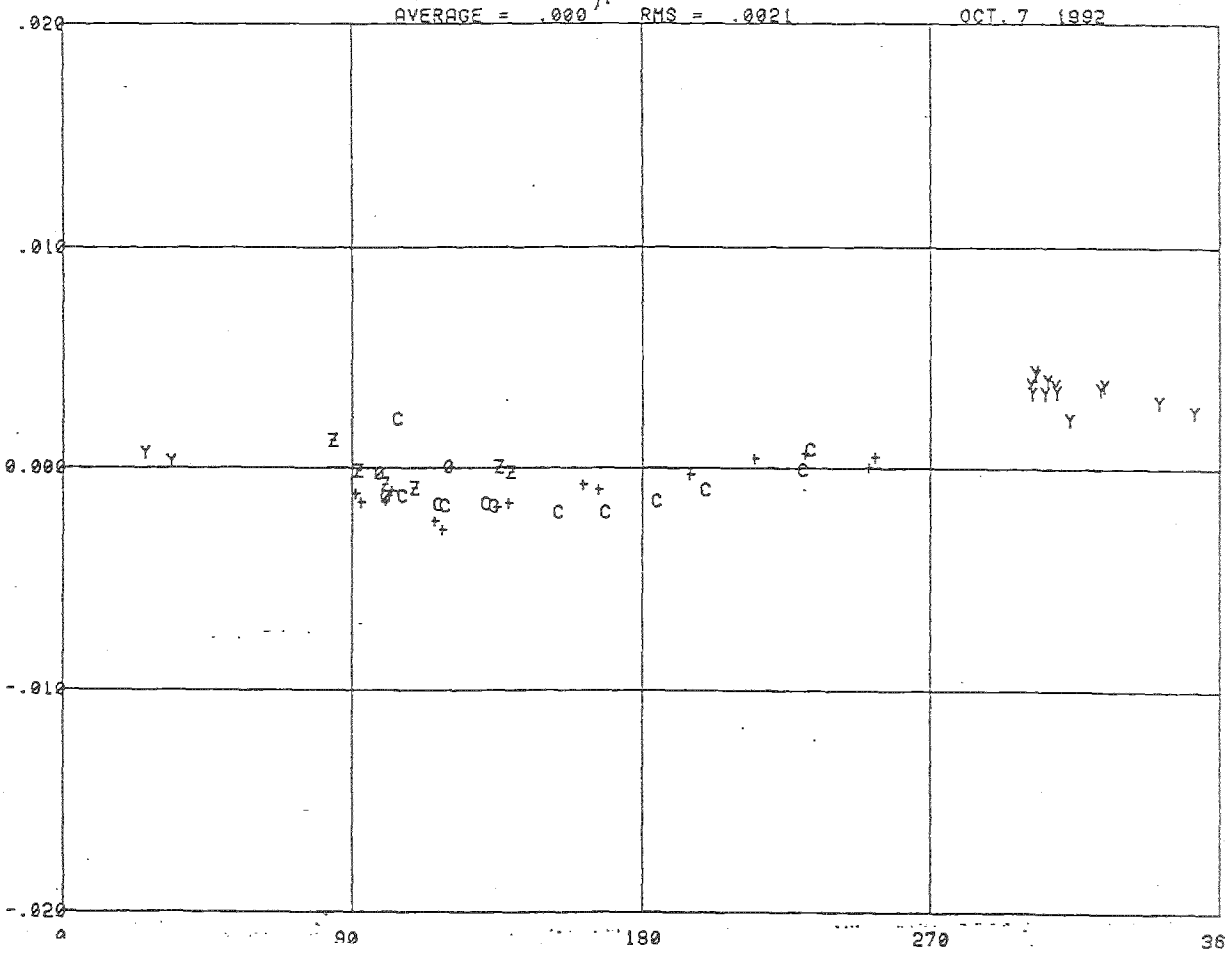


Table 1
Pointing Performance

(arcsec) RMS's, OFFSETS, and TILT

Day	RMS Az	RMS El	OFFSETS Az	OFFSETS El	TILTS meas	TILTS calc	CORRECTED El RMS	#points
281	3.0	7.6	1.8	1.7	32.8@81	40.2@75.5	3.2	49
282	4.1	9.3	3.3	12.4	31.7@83	38.8@72	4.9	34
286	4.3	8.5	4.5	14.4	29.7@80	37.4@70	5.7	112
288	2.5	---	2.3	---	-------	-------	---	89

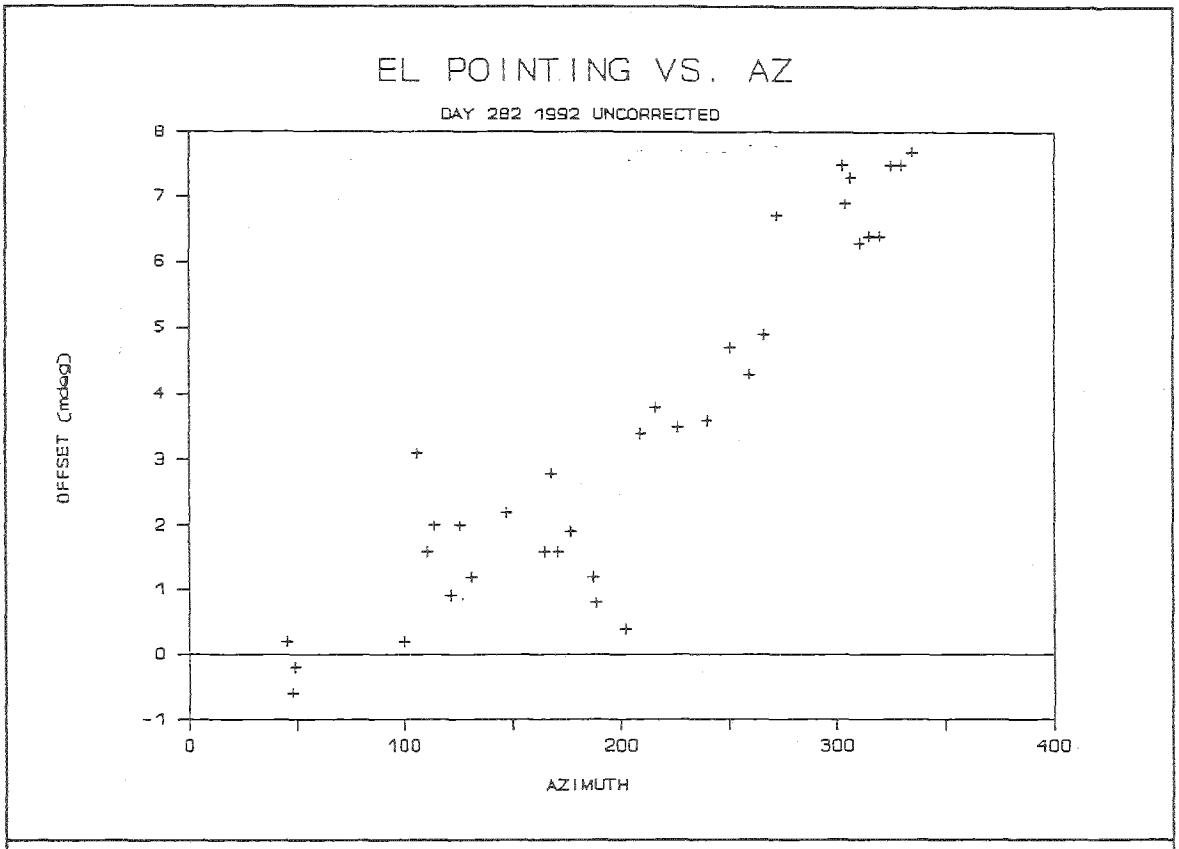
Table 2
Observation Times (UT)

Oct 7	281 2 -	281 12
Oct 8	282 7 -	282 14
Oct 12	286 14 -	287 13
Oct 13	287 20 -	288 12

Table 3
Sources and Weather

Day	Sources	Weather
281	Iktau,Rcas,Oric2,Rleo,Jupiter	Clear
282	Mars,Rcas,Iktau,Oric2,Vxsgr Jupiter	Clear
286	Jupiter,Rleo,Rcas,Venus,Vxsgr, Saturn,Iktau,Oric2	P Cloudy
288	Vxsgr,Rcas,Rleo	Clear

Fig 6


EL POINTING VS. AZ
DAY 282 1992 UNCORRECTED
OFFSET (mdeg)
AZIMUTH
8
7
6
5
4
3
2
1
0
-1
0
100
200
300
400

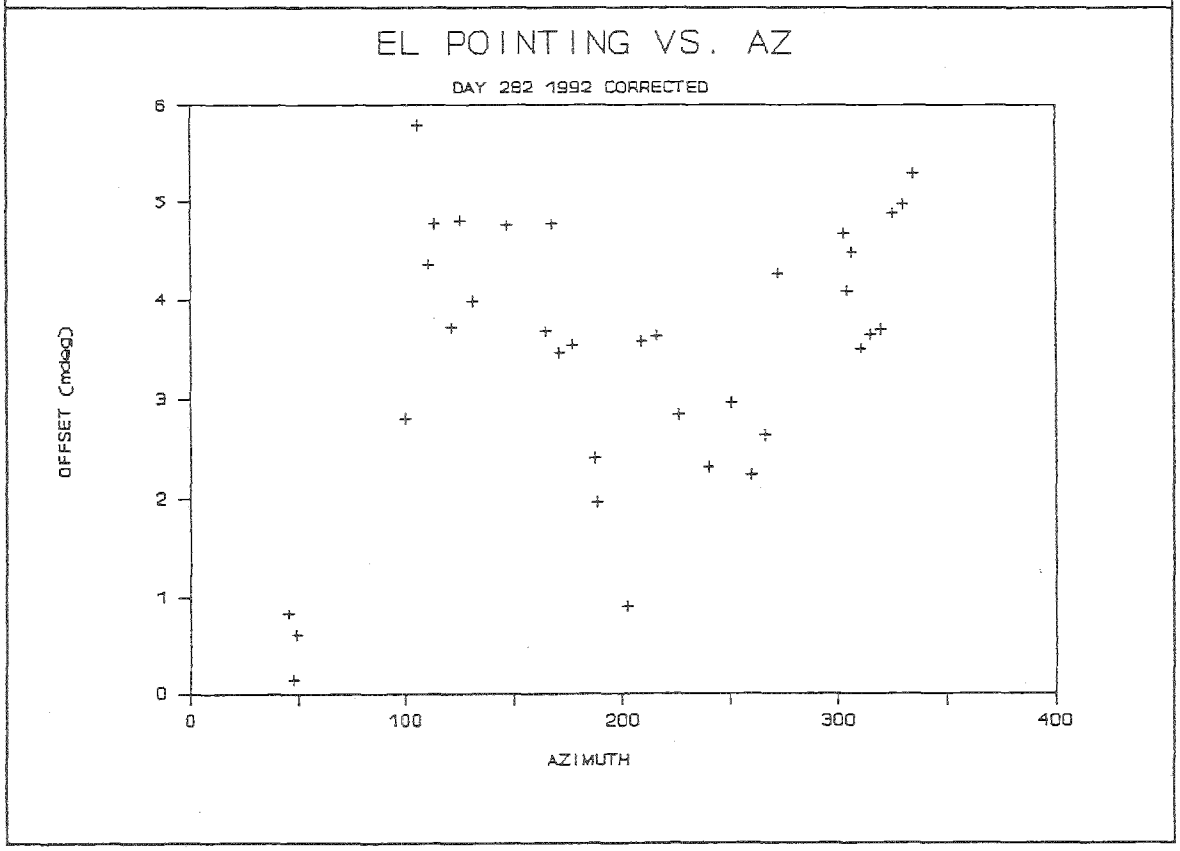
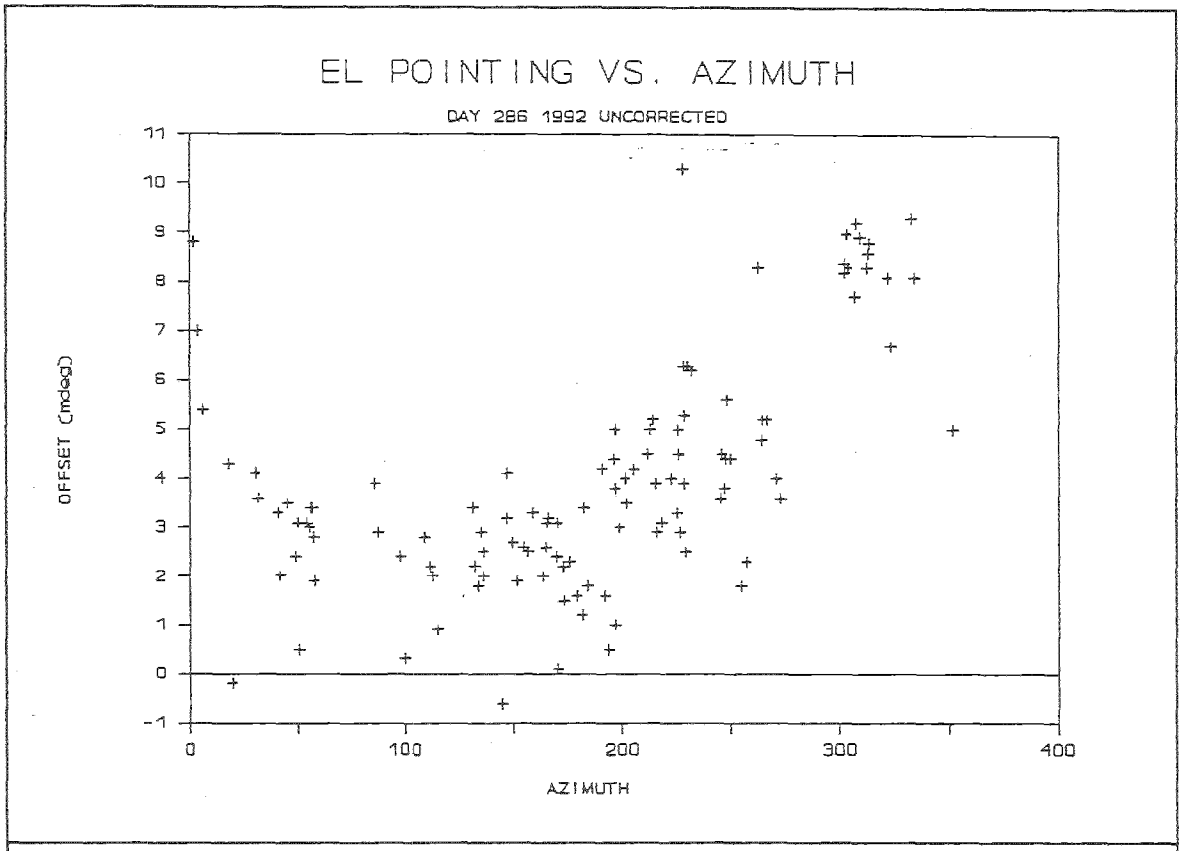

EL POINTING VS. AZ
DAY 282 1992 CORRECTED
OFFSET (mdeg)
AZIMUTH
6
5
4
3
2
1
0
0
100
200
300
400

Fig 7


EL POINTING VS. AZIMUTH
DAY 286 1992 UNCORRECTED
OFFSET (mdeg)
AZIMUTH
11
10
9
8
7
6
5
4
3
2
1
0
-1
0
100
200
300
400

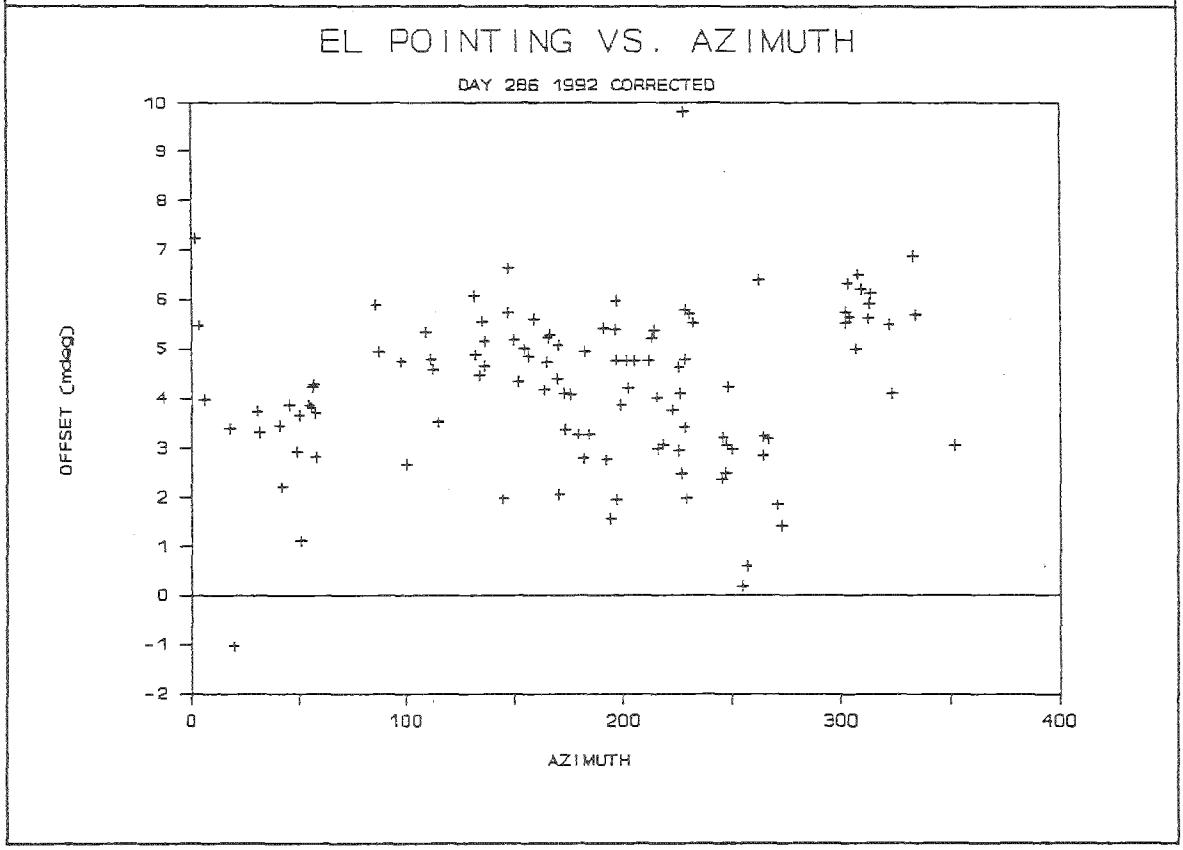
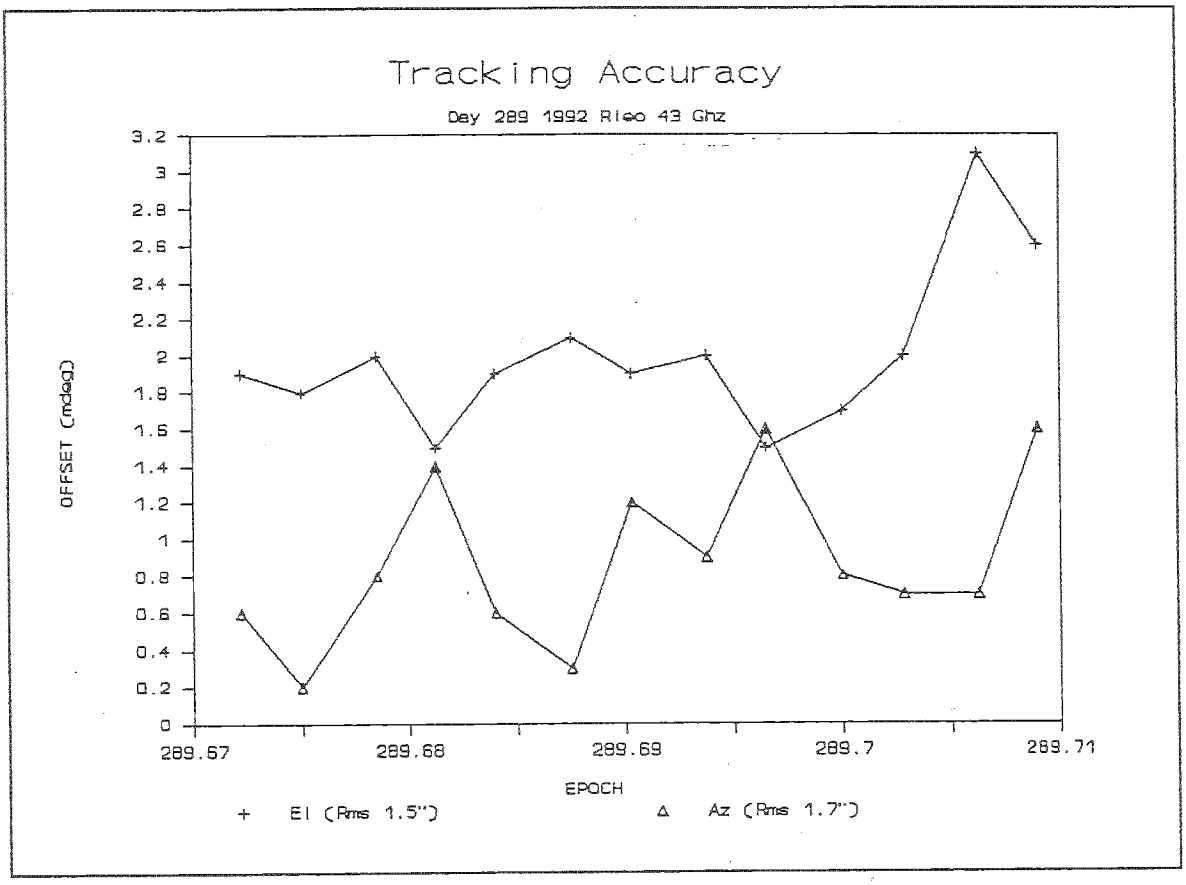

EL POINTING VS. AZIMUTH
DAY 286 1992 CORRECTED
OFFSET (mdeg)
AZIMUTH
10
9
8
7
6
5
4
3
2
1
0
-1
-2
0
100
200
300
400

Fig 8


Tracking Accuracy
Day 289 1992 R1∞ 43 Ghz
OFFSET (mdeg)
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
289.67
289.68
289.69
289.7
289.71
EPOCH
+ El (Rms 1.5")
Δ Az (Rms 1.7")