VLA Test Memo. No. 234
Holography status

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Abstract

We summarize the status of the surface panels at the VLA as of May 2003. Plots for each antenna are presented, and a table with rms values is included. We also show that the rms values increase after a 43 GHz receiver position is changed as part of the new feed-cone arrangement. This increase is most likely the result of surface errors in the secondary reflector. Holography-based antenna panel adjustments will have to be revisited after the completion of the EVLA antenna upgrades.

1 Introduction

In 1996 the process of making panel adjustments based on interferometric holographic measurements of surface deviations began using observations ranging from 8 to 43 GHz (Kesteven 1993). Adjustments done using 43 GHz holographic measurements have been demonstrated to improve antenna forward gain by a factor 2 to 4, with typical efficiencies for corrected antennas between 30% and 40% at 43 GHz (Butler 1998). With the installation of a receiver on antenna 9 in May 2003 the entire VLA is now outfitted with 43 GHz receivers. In parallel, 43 GHz holography has been used to readjust the antenna panels. This memo summarizes the current status of the panels for all antennas, and introduces a problem that has arisen due to the receiver position changes in the new feed-cone.

2 Status – May 2003

Figure 1 shows the surface deviations for all antennas based on 43 GHz holography in September 2001, October 2002, March 2003, and May 2003[1]. In all cases a strong celestial calibrator was observed through transit, and rasters of 33x33 or 37x37 pointings were used. For reference, the holographic measurements from 8 GHz to 43 GHz for all antennas over the last 8 years are kept in two large notebooks by R. Perley.

Table 1 lists the dates of antenna panel adjustments based on 22 and 43 GHz holography, plus the latest measurement of the rms surface deviations. As of May 2003 all antennas have had their panels adjusted using 43 GHz holographic measurements (except antenna 9), and the surface deviations are acceptable for quality performance at 7mm.

3 Receiver position changes

As part of the EVLA antenna upgrades a new feed-cone has been introduced with altered receiver positions (Ruff 2002). In the new feed-cone the 43 GHz receiver has moved by 27^o relative to its original position, from 112^o to 85^o.

It has been well demonstrated over the last decade that antennas for which panels have been adjusted remain 'fixed' for as long as monitoring proceeds, including the very first antennas from 1996. However, recent holography shows that some of the older antennas have larger rms surface deviations relative to previous measurements. Investigation shows that this rms increase occurs after movement of the 43 GHz receiver position. The obvious cause for such an increase is surface errors in the secondary, ie. the original holographic corrections removed the combined errors of the primary and secondary. Figure 29 shows an example of the change in the surface deviations as measured by holography for antenna 8 before and after the receiver move.

In most cases the increase in rms is about 30%, from (0.25 - 0.30) mm to (0.35 - 0.40) mm. Note that before any holography is performed the typical rms is > 0.5 mm. Table 1 lists the antennas for which this effect may be a problem (designated as '-R' in Table 1). The current array performs reasonably well at 43 GHz, and we do not recommend making further adjustments

[1] Antennas 9 is not included since it did not have a working 43 GHz receiver prior to the May 2003 holography observations.

to panels in the near-term. However, we do recommend that on completion of the EVLA antenna modifications the panels on all antennas be checked using 43 GHz holography, and adjusted where required.

References

Butler, B. 1998, VLA Test Memo. No. 212
Kesteven, M. 1993, VLA Test Memo. No. 169
Ruff, J. 2002, http://www.aoc.nrao.edu/ jruff/

Table 1: Holography Status: May 2003

Ant	Adjustment date K band	Adjustment date Q band	rms (date) mm
1	May98	Apr03	0.21 (May03)
2	Nov00	Apr01	0.26 (Oct02)
3	–	Mar96-R[a]	0.39 (Oct02)
4	–	Apr96-R	0.39 (Oct02)
5	Jan98	Feb03	0.32 (March03)
6	–	Apr96-R	0.26 (Oct02)
7	Mar98	Apr03	0.17 (May03)
8	–	Mar96-R	0.38 (March03)
9[b]	Dec97	–	–
10	May00	Aug01	0.25 (Oct02)
11	–	Sept01	0.21 (Oct02)
12		Jan97	0.22 (Oct02)
13	–	Feb97-R	0.36 (Sep01)
14		Mar97-R	0.21 (March03)
15	Aug02	Apr03	0.19 (May03)
16	–	Jan97-R	0.40 (May03)
17	Jul00	Sept01	0.29 (Oct02)
18	Oct99	Sept01	0.28 (Oct02)
19	Nov99	Oct01	0.27 (Oct02)
20	–	Mar96	0.43 (Oct02)
21	Jul98	Jul01	0.32 (Oct02)
22	–	Apr96-R	0.24 (Oct02)
23	Jul00	Apr02	0.24 (Oct02)
24	Jun00	Mar02	0.22 (Oct02)
25	–	Jun96-R	0.36 (March03)
26	Aug98	Oct01	0.26 (Oct02)
27	–	Apr96-R	0.34 (March03)
28	Jun00	Aug01	0.29 (Oct02)

[a]-R implies that we may need to readjust the panels due to move of receiver in feed-cone.

[b]43 GHz Receiver installed in May 2003. No 43 GHz holographic measurements have been made.

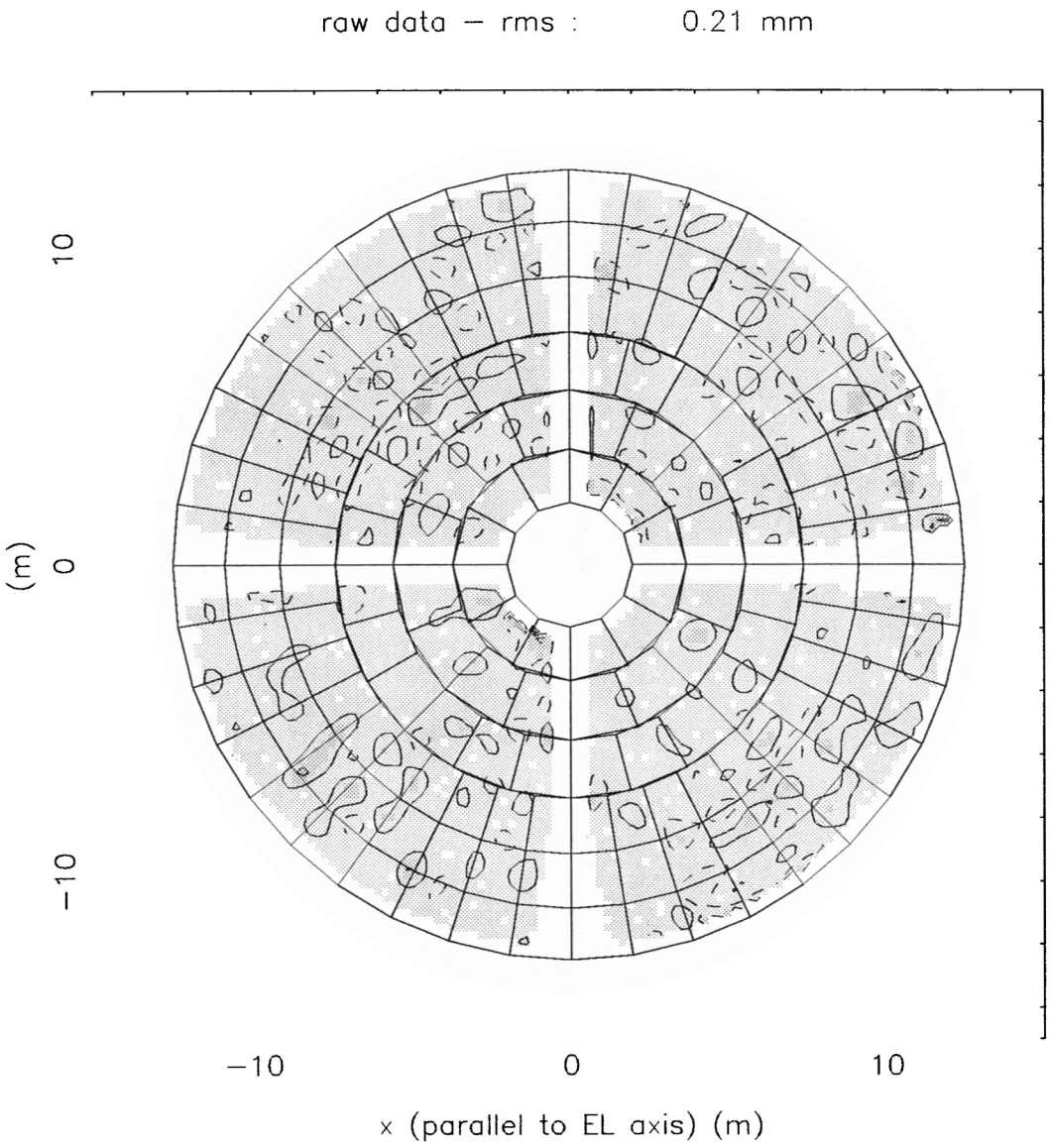


Figure 1: **Antenna 1** – The antenna surface deviations based on 43 GHz holography. The date of the measurement is give in column 4 of Table 1. Contours are: -3.25, -2.75, -2.25, -1.75, -1.25, -0.75, -0.25, 0.25, 0.75, 1.25, 1.75, 2.25, 2.75, 3.25mm. Negative contours are dashed.

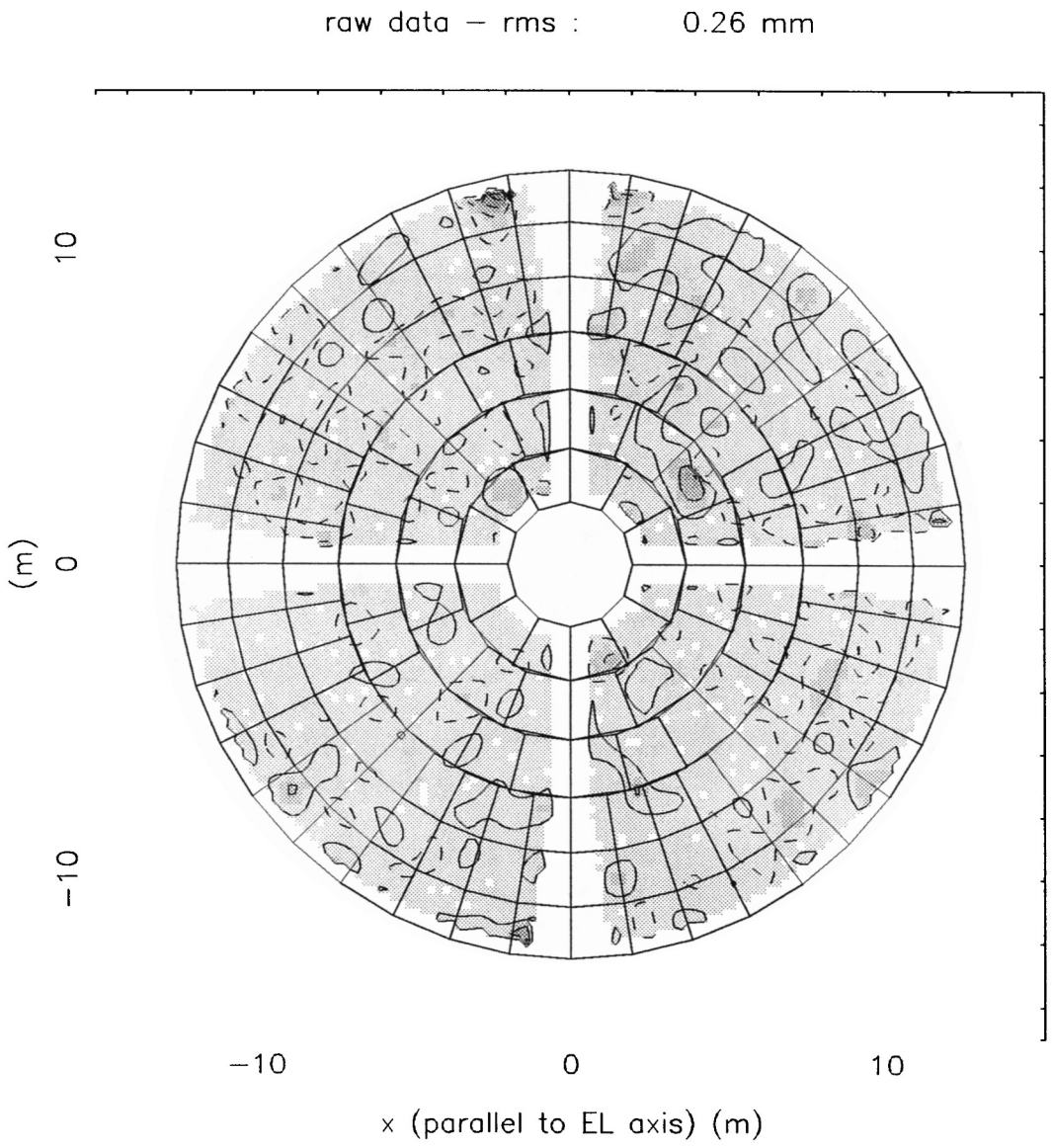


Figure 2: Antenna 2

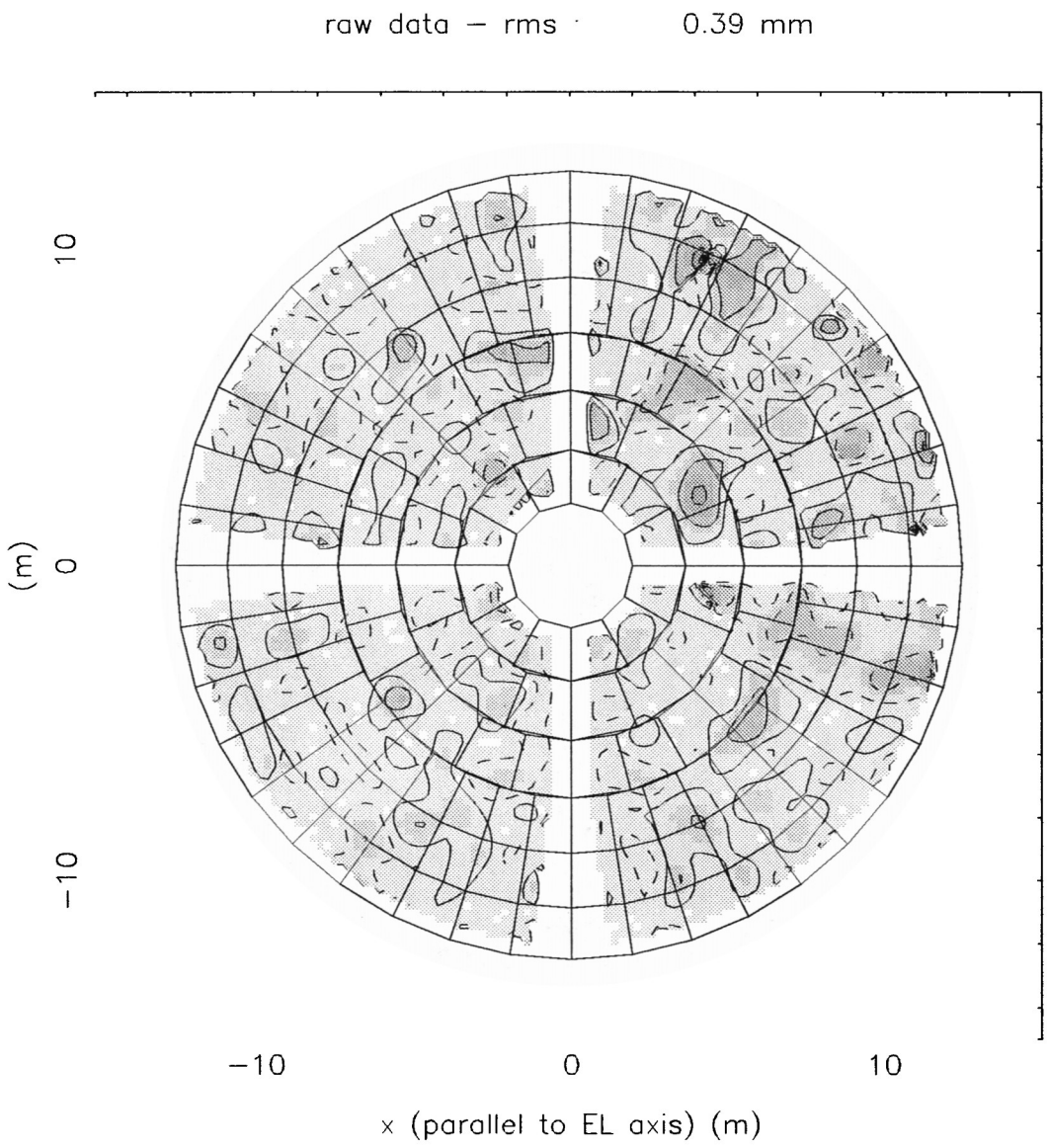


Figure 3: **Antenna 3**

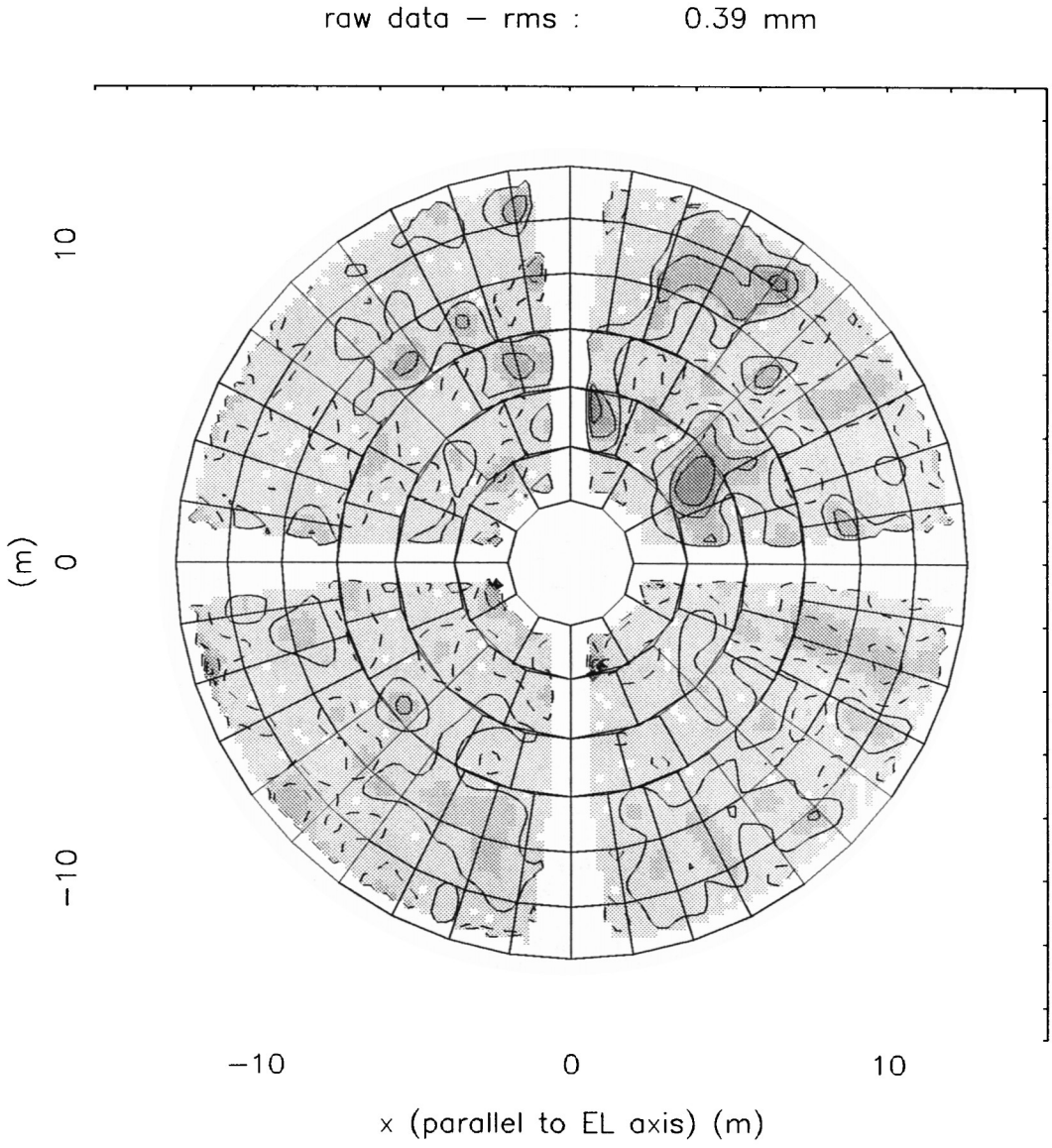


Figure 4: Antenna 4

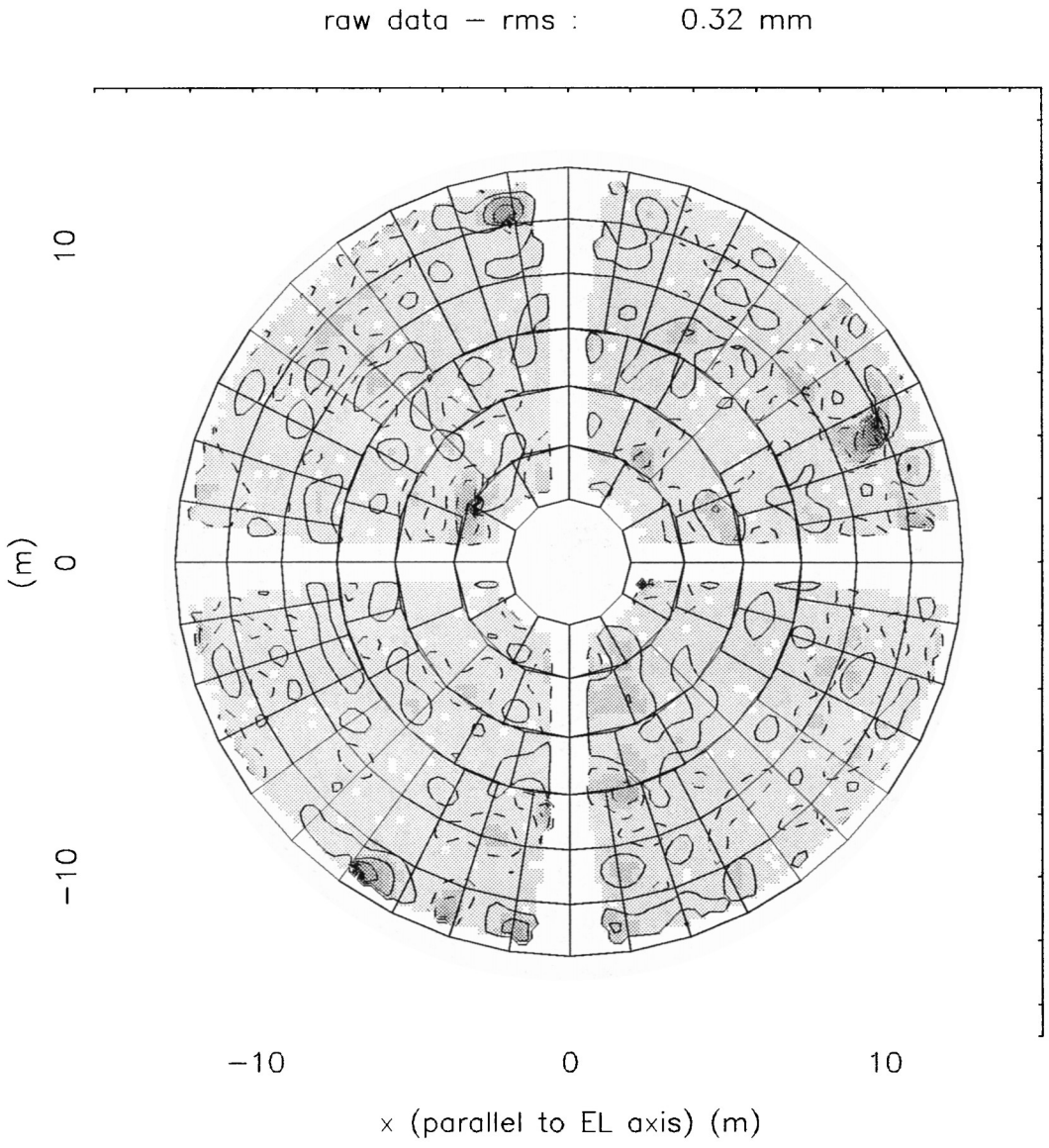


Figure 5: **Antenna 5**

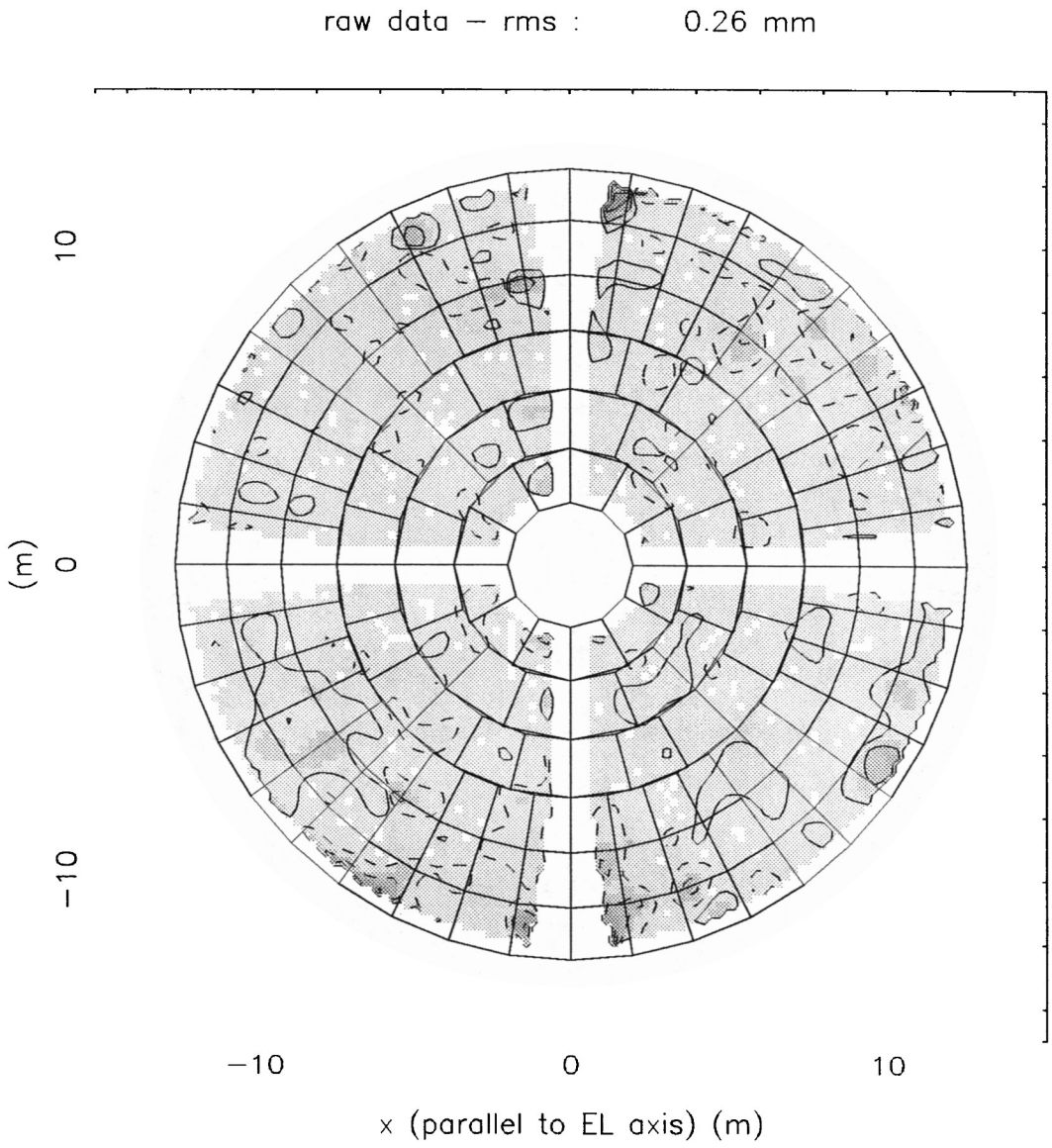
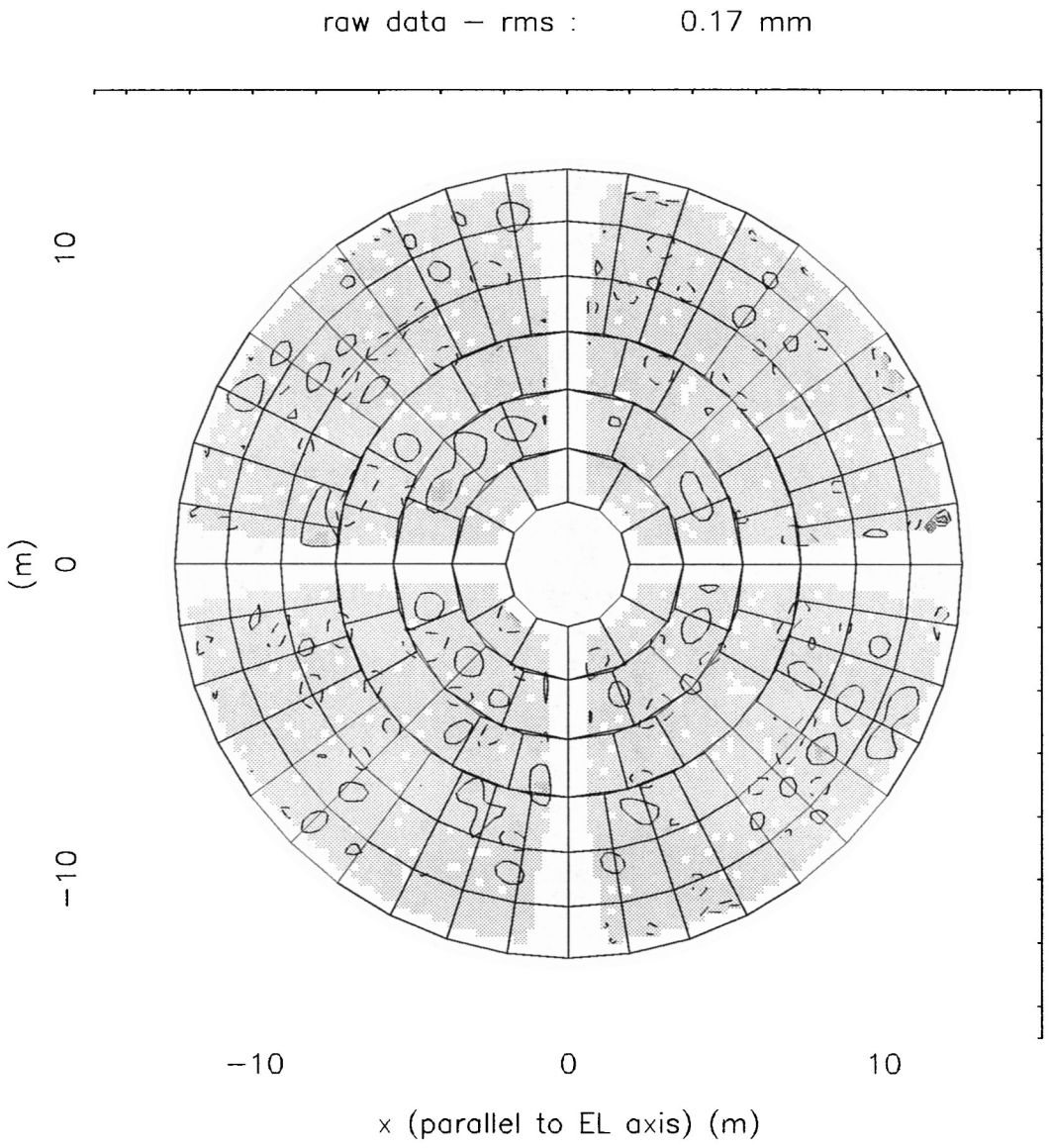


Figure 6: Antenna 6



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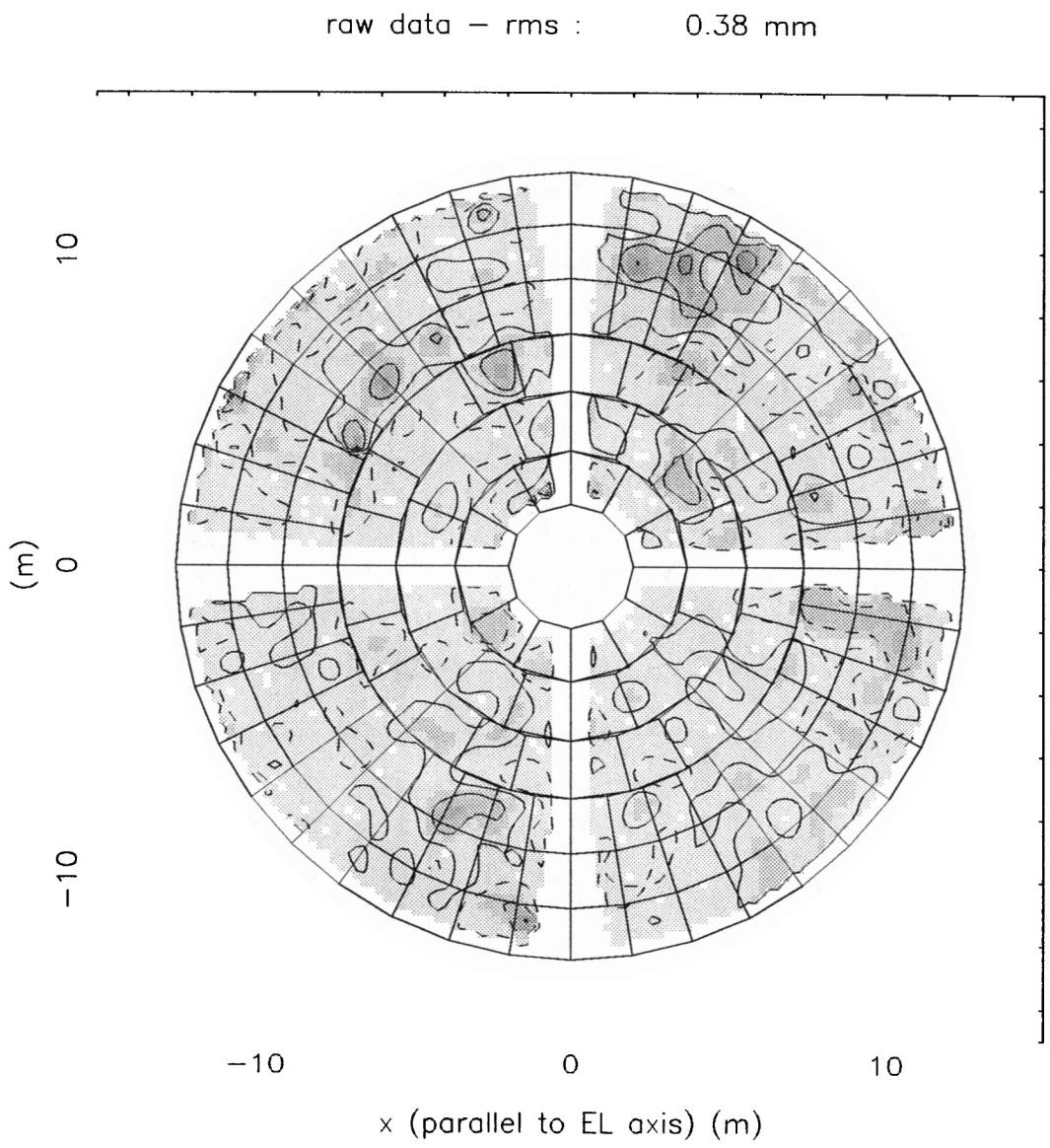


Figure 8: Antenna 8

Figure 9: **Antenna 9 – No data**

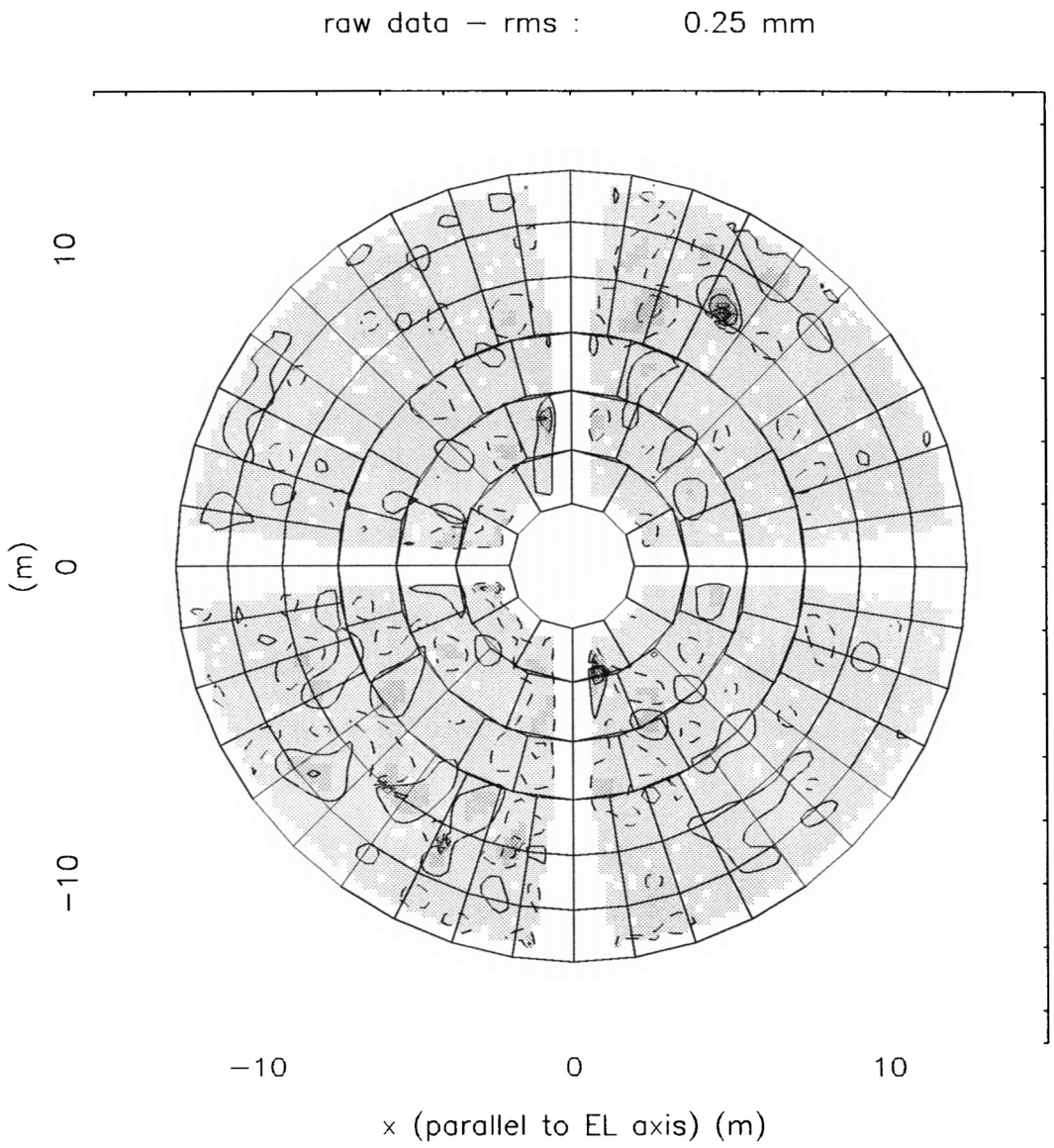


Figure 10: **Antenna 10**

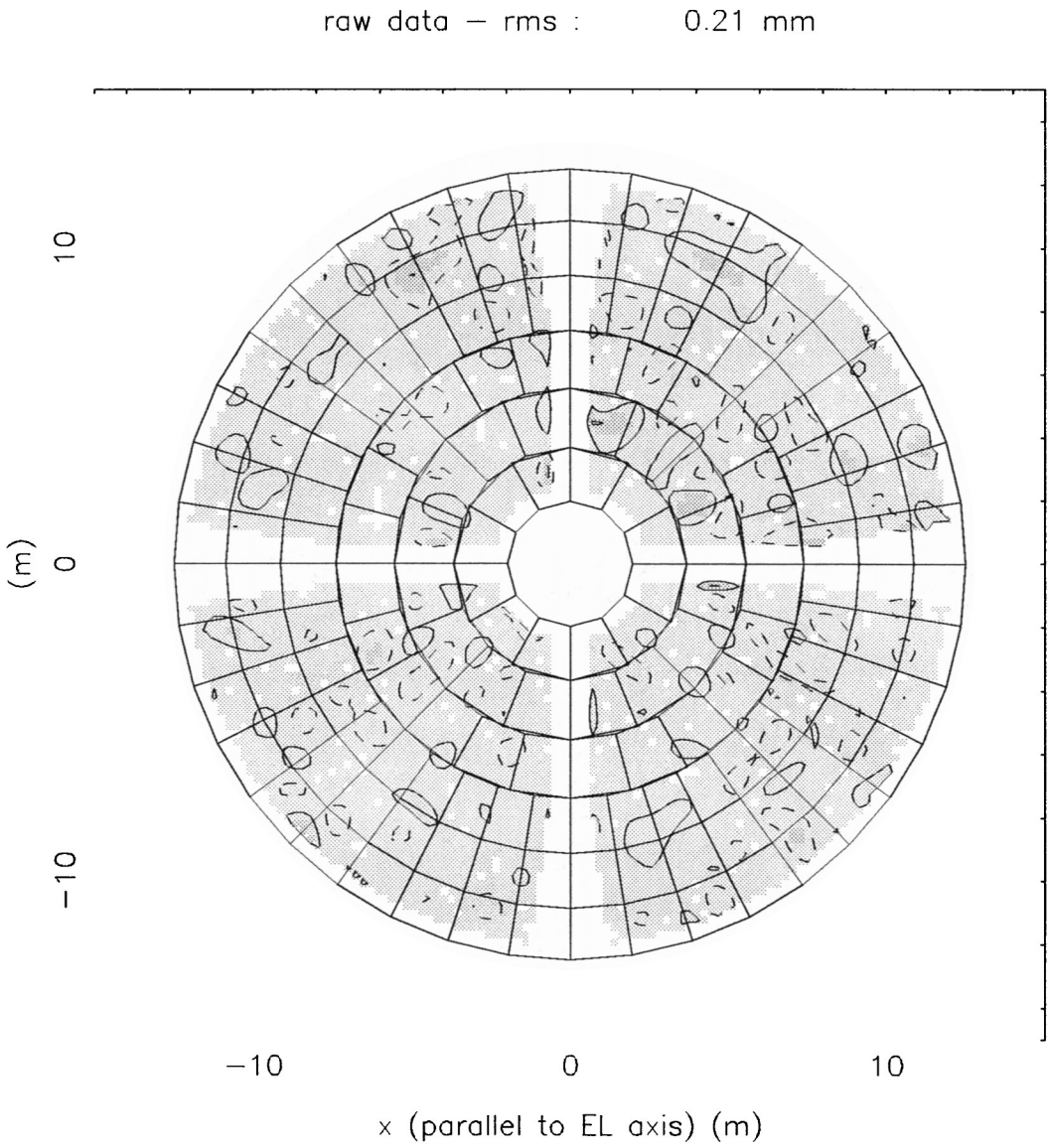


Figure 11: Antenna 11

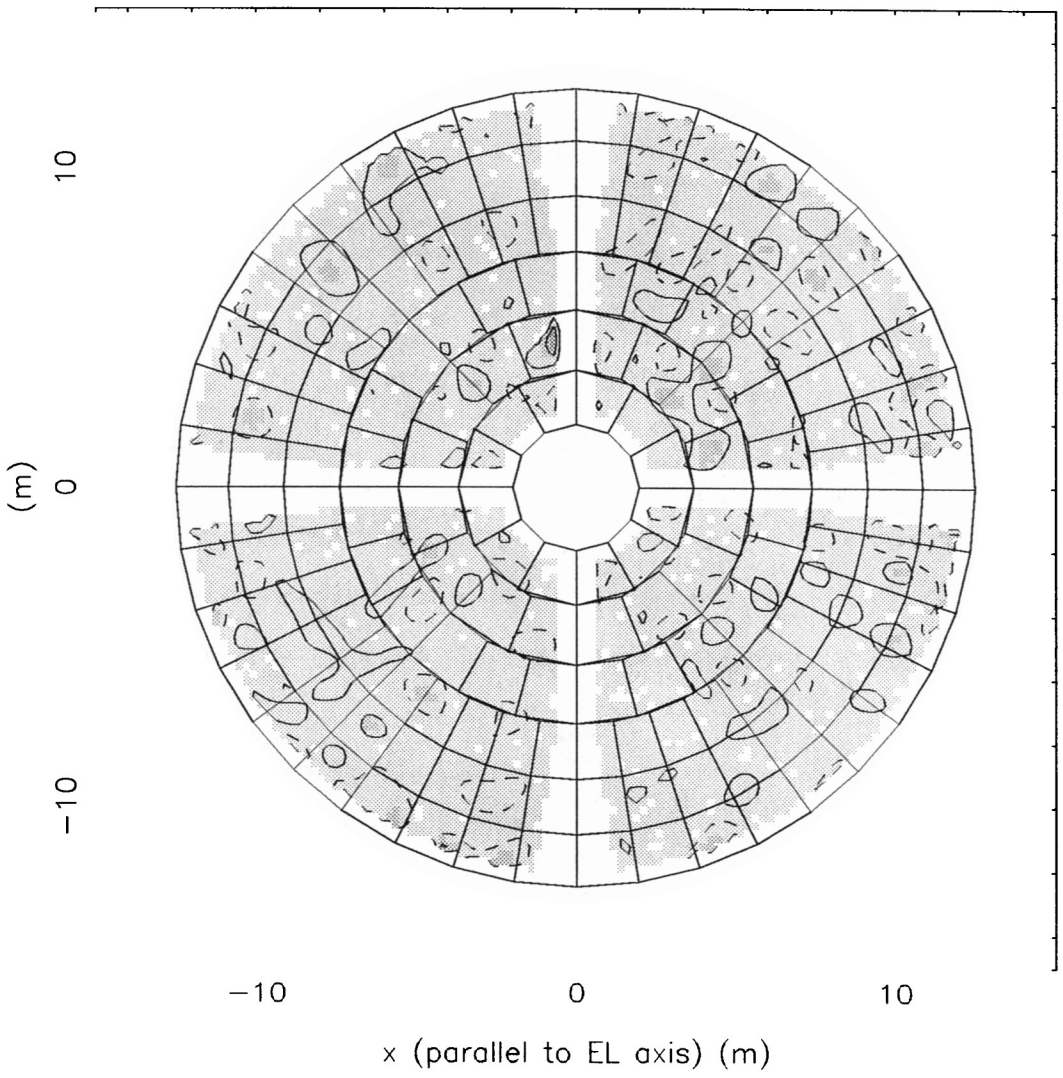


Figure 12: Antenna 12

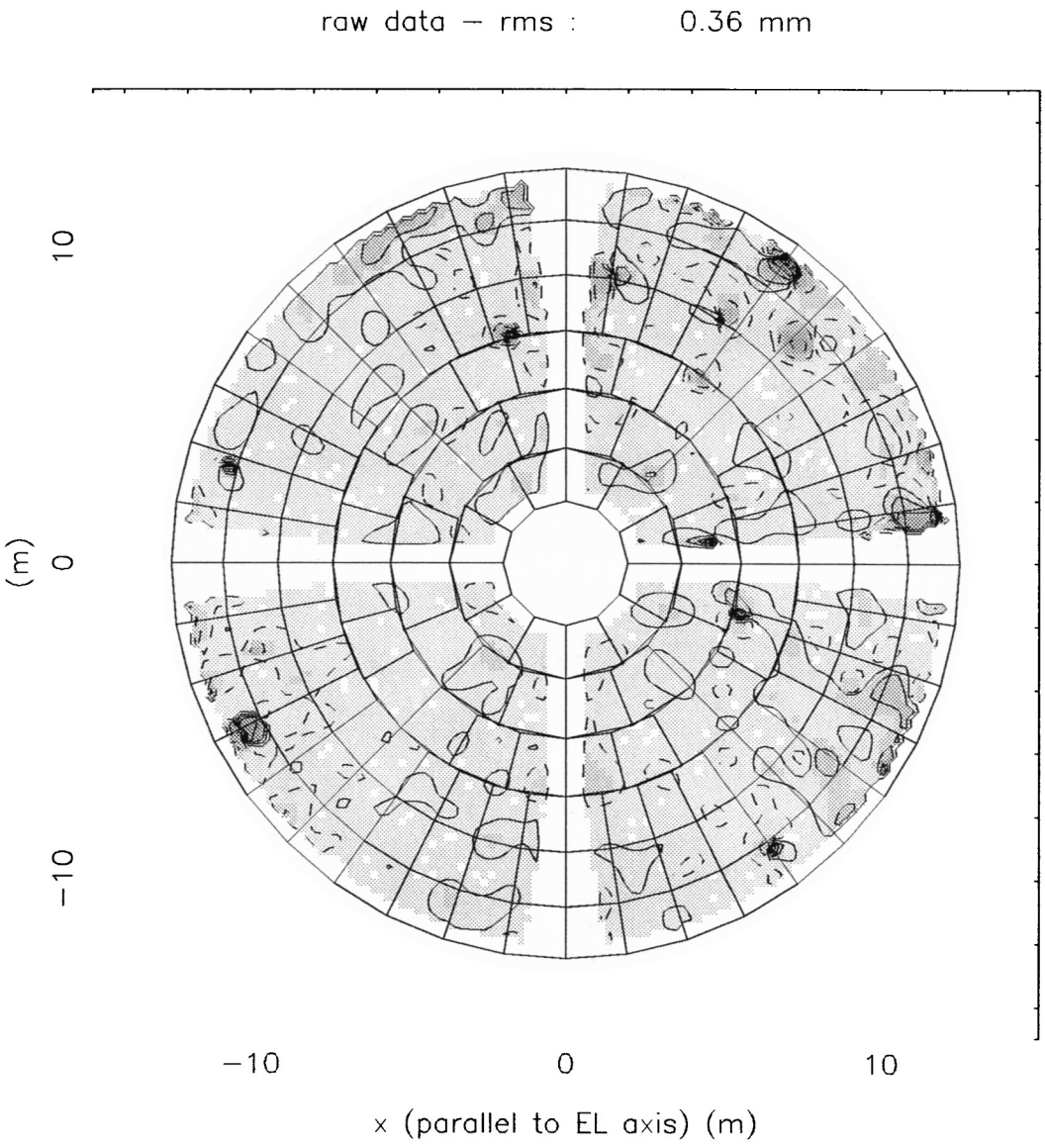


Figure 13: Antenna 13

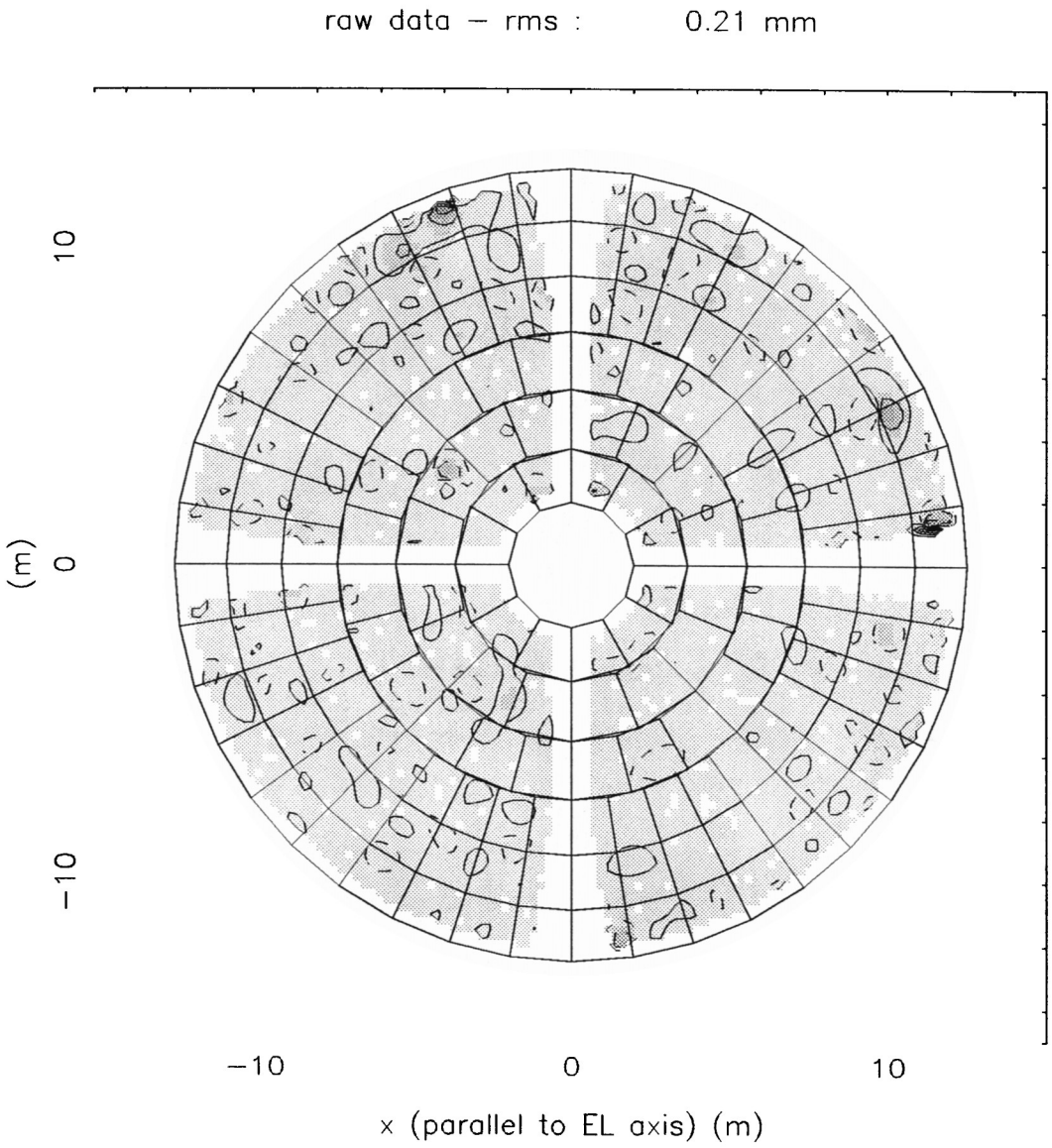
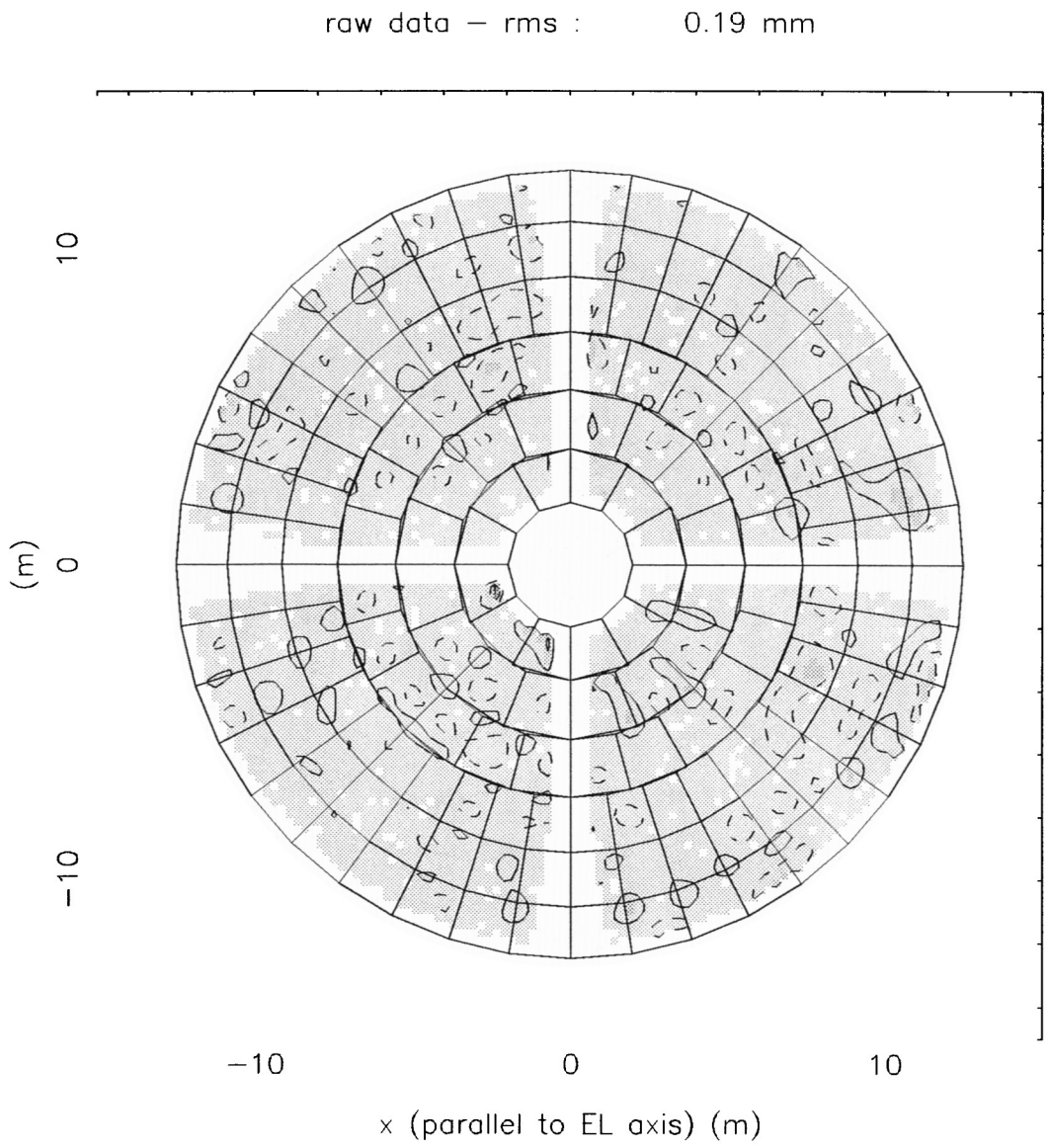


Figure 14: Antenna 14



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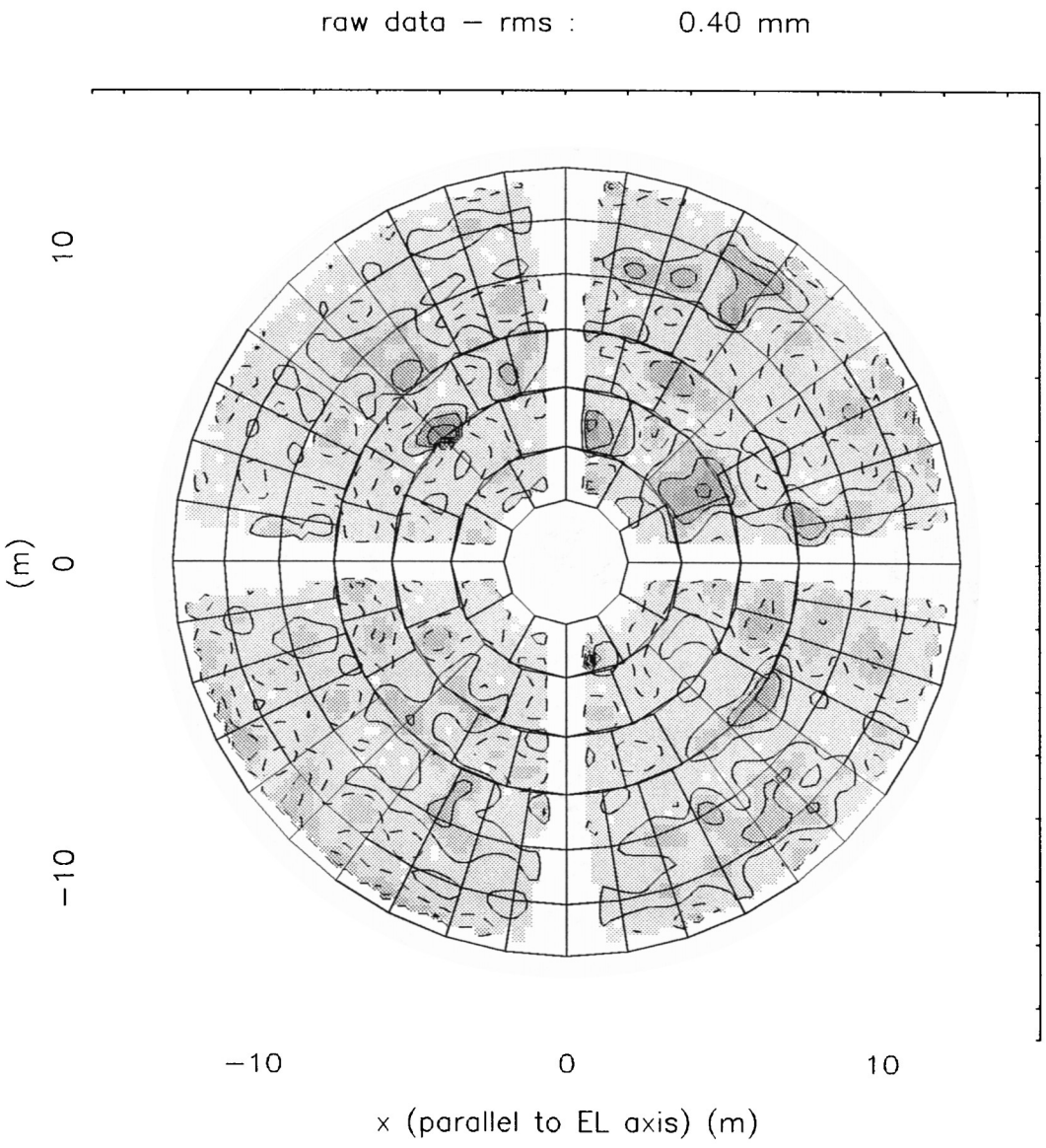

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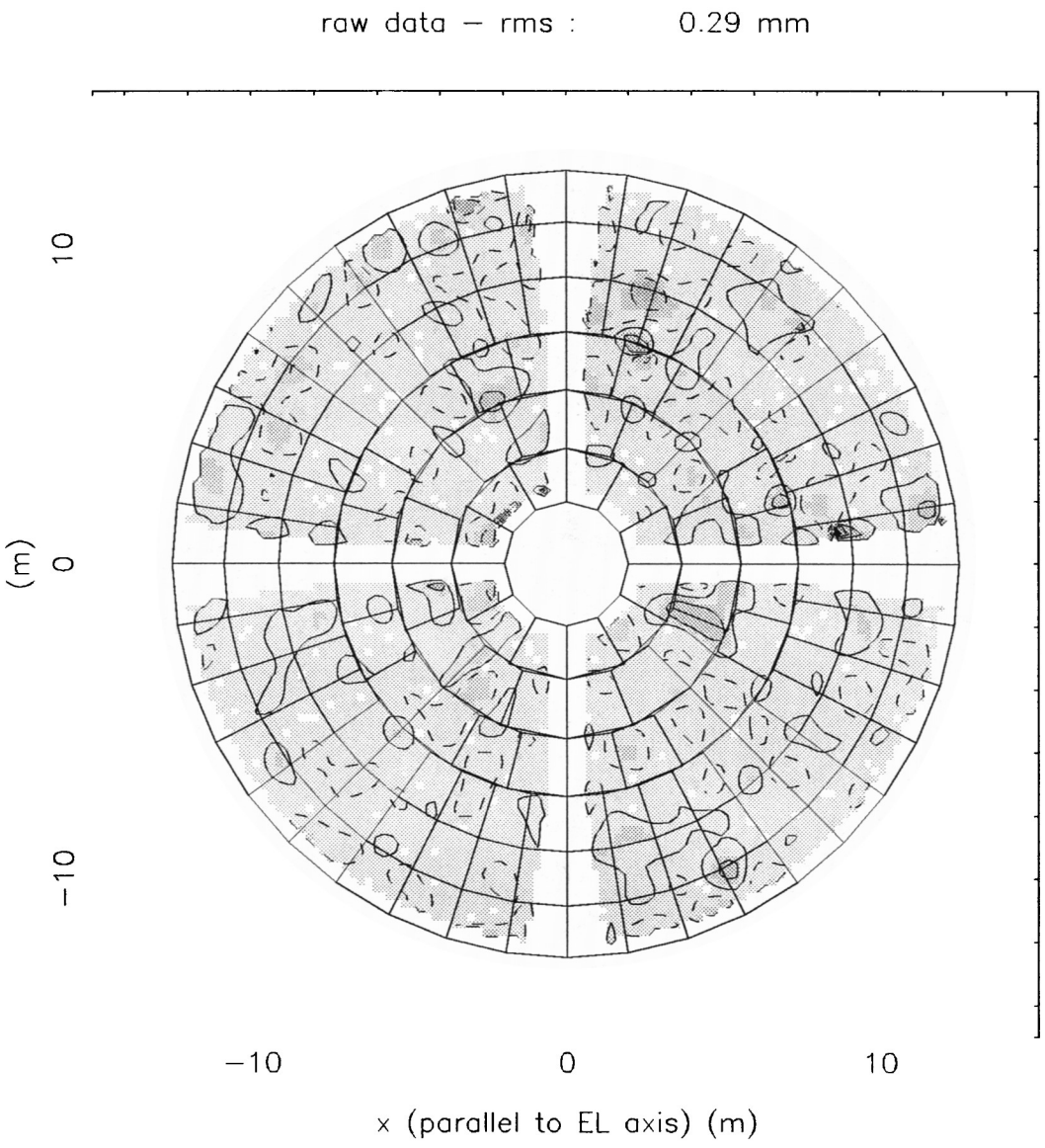

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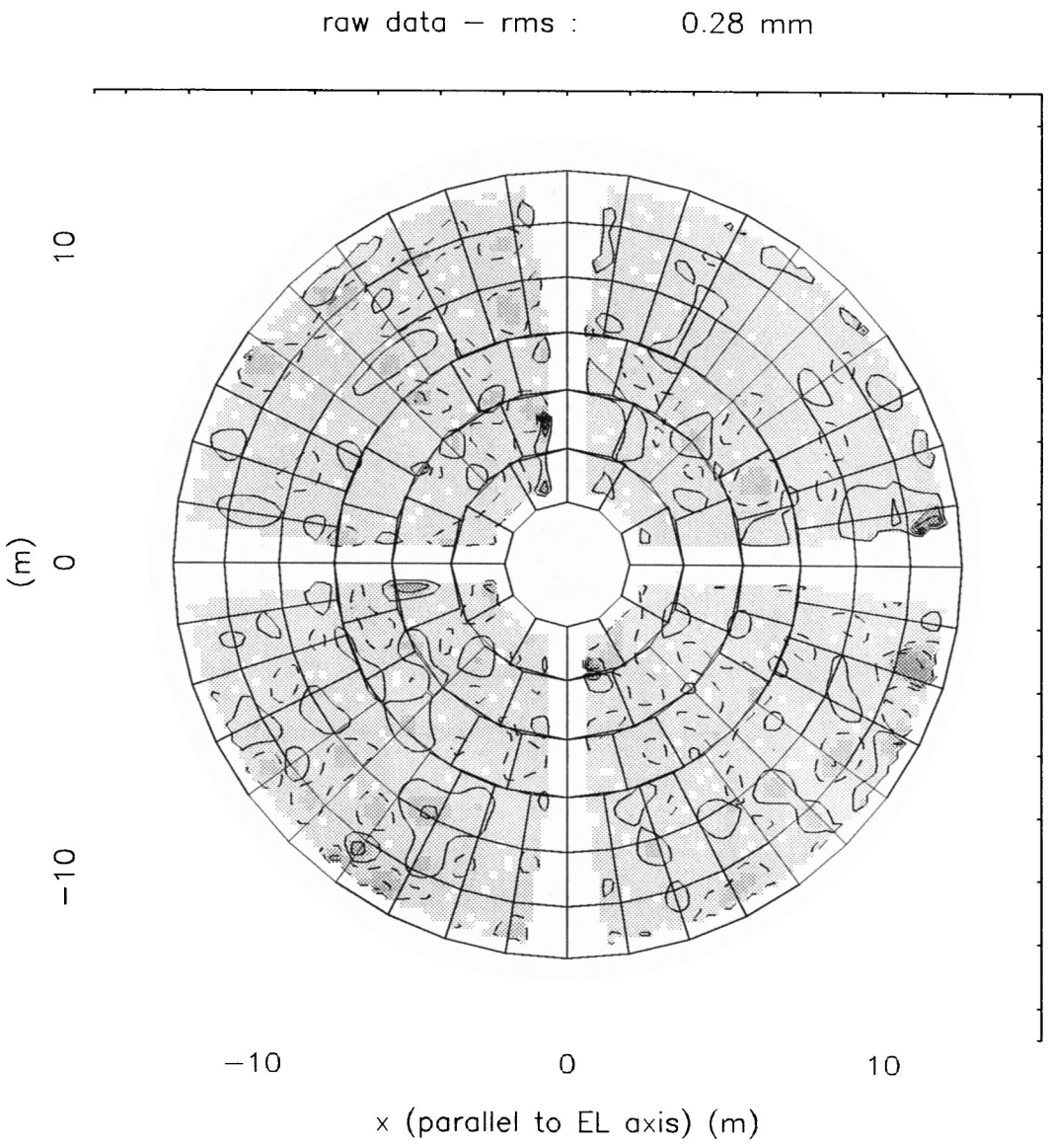

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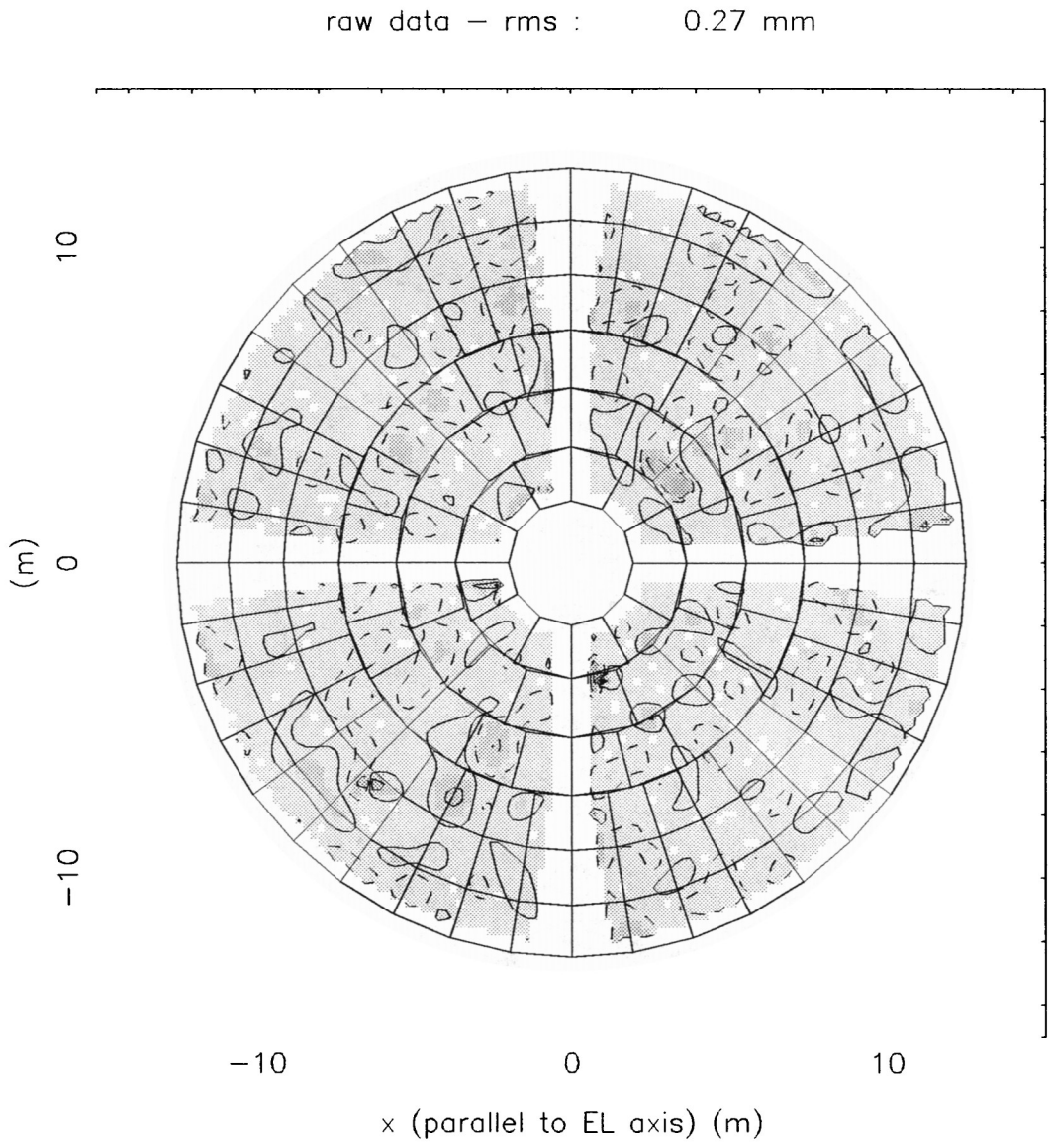

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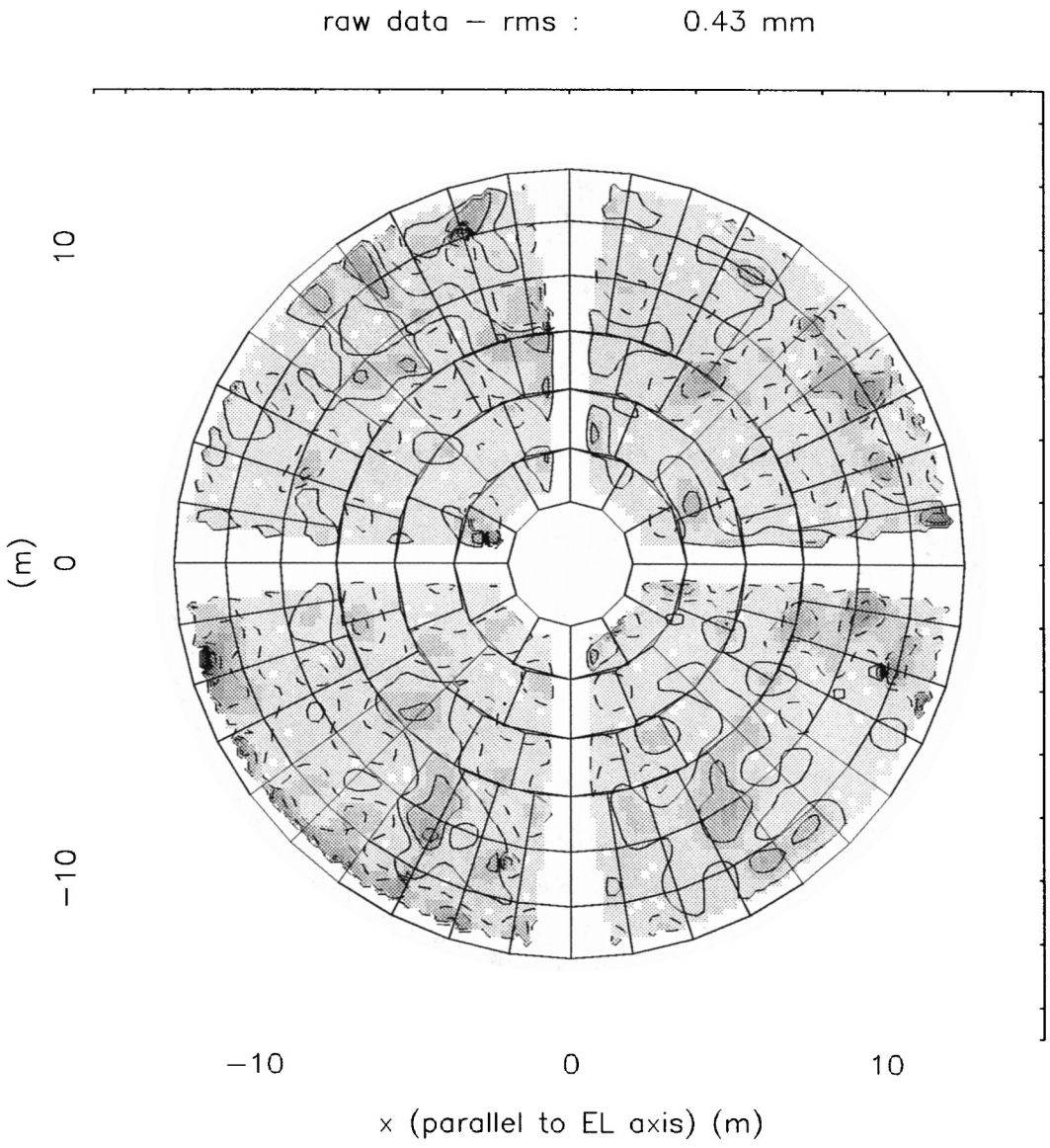
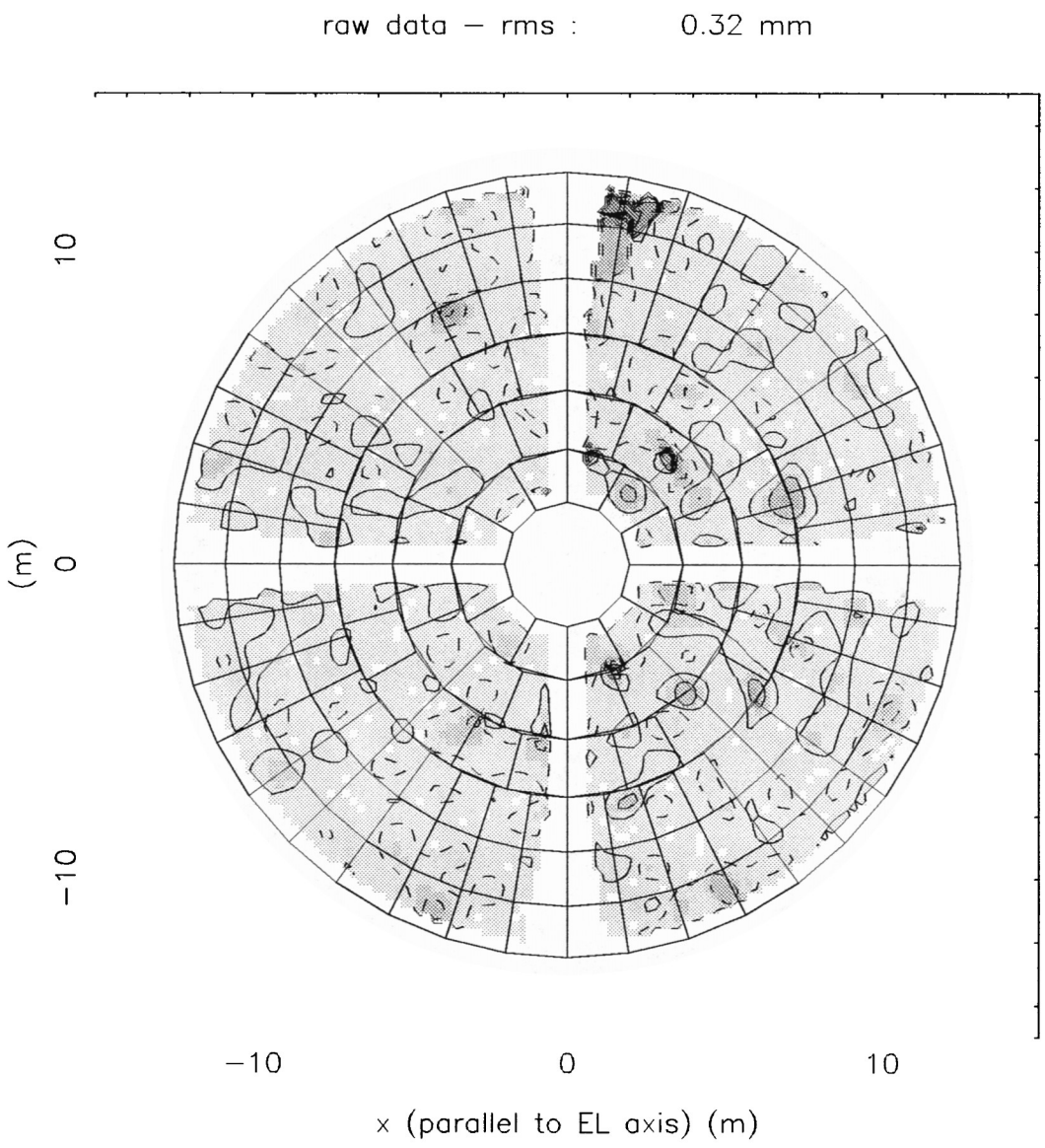


Figure 20: Antenna 20



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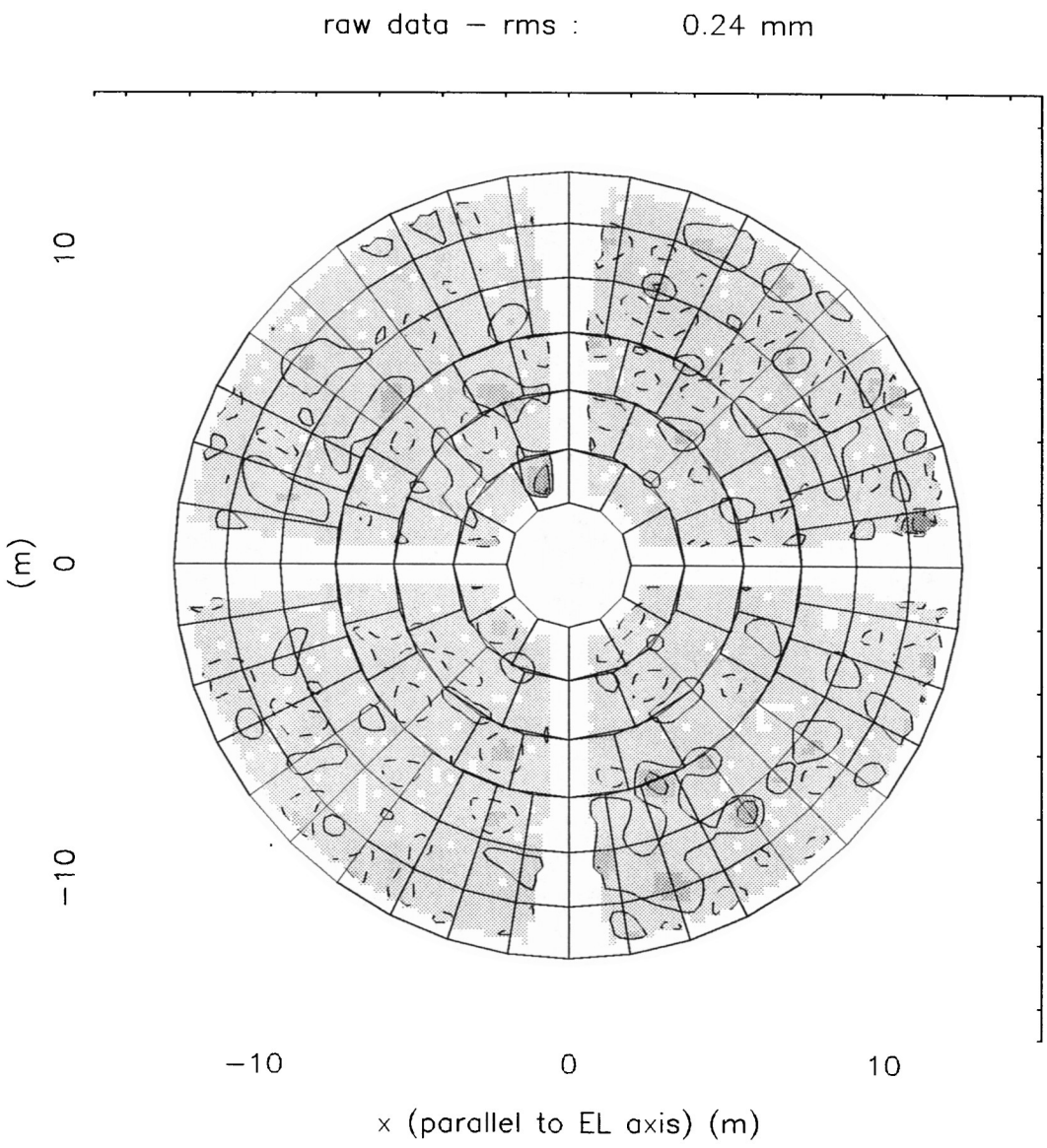

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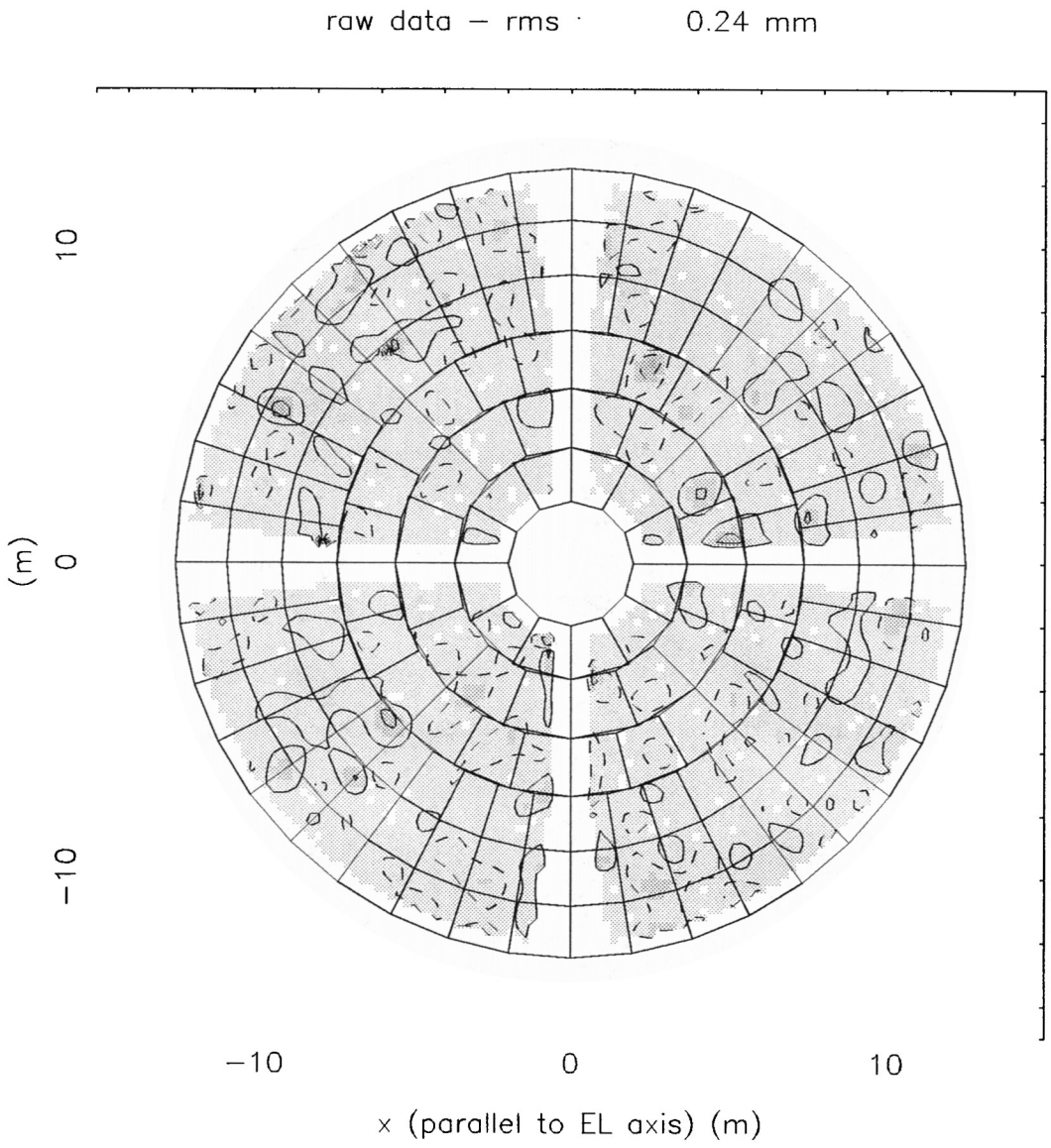

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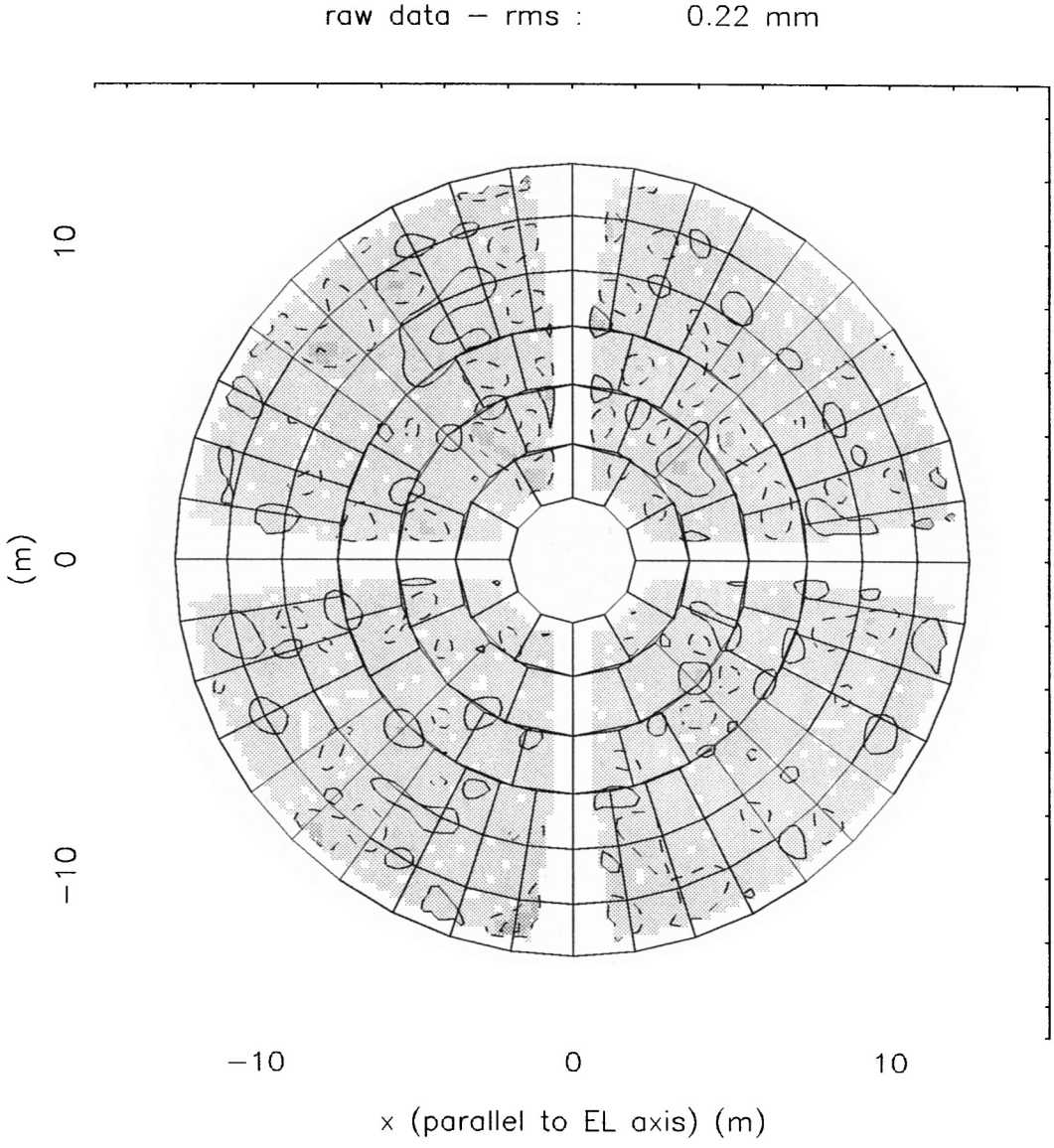

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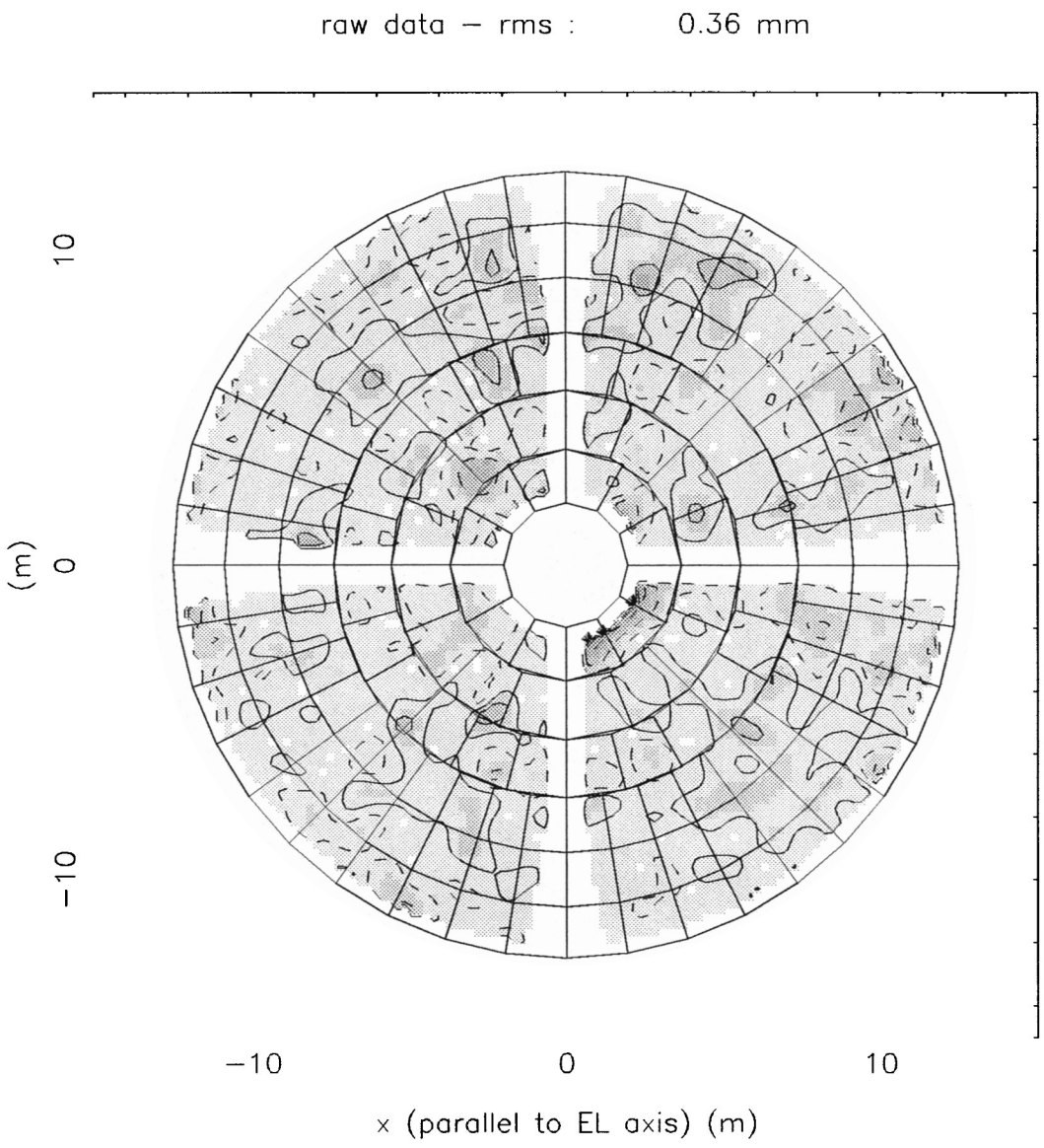

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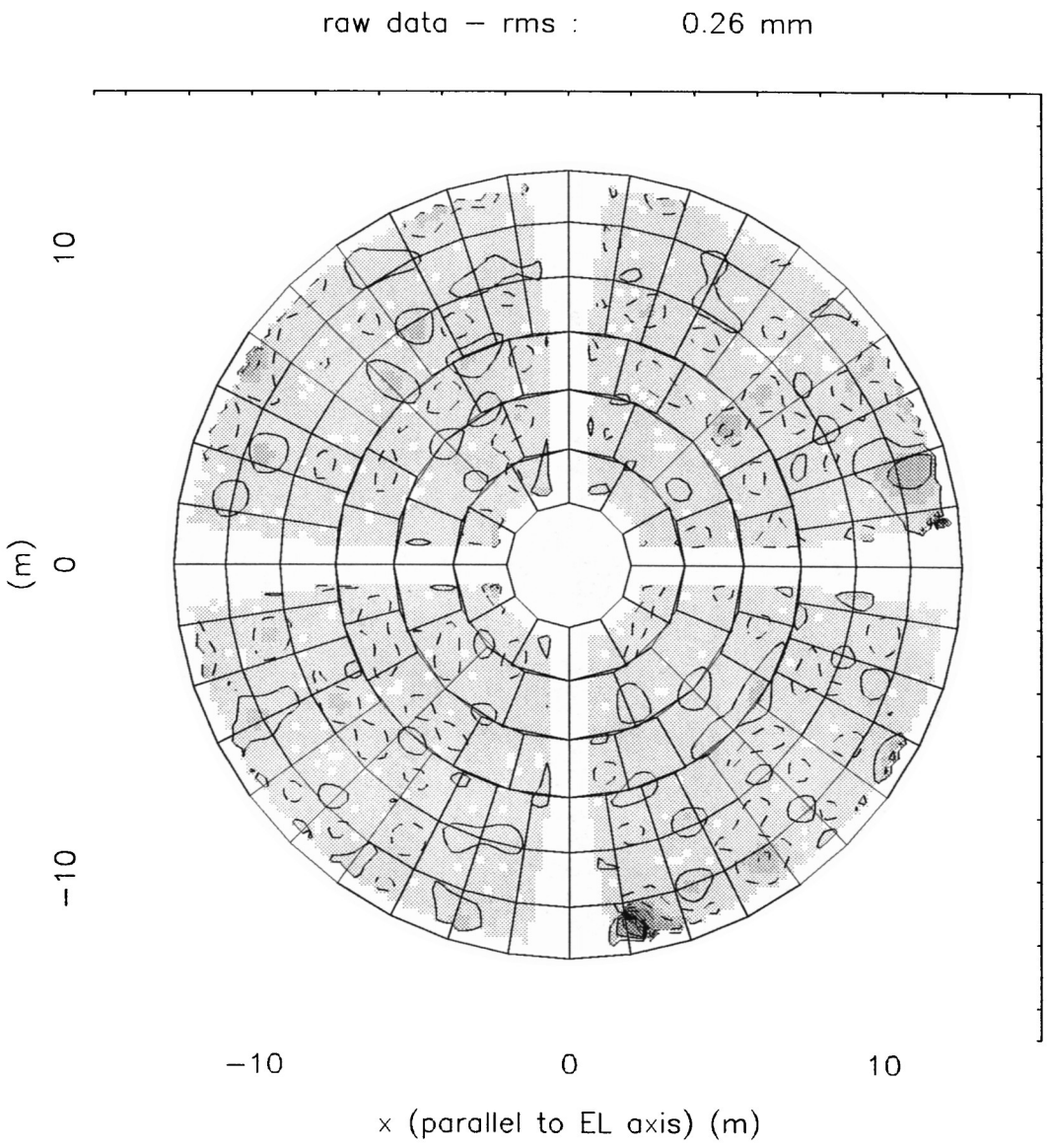

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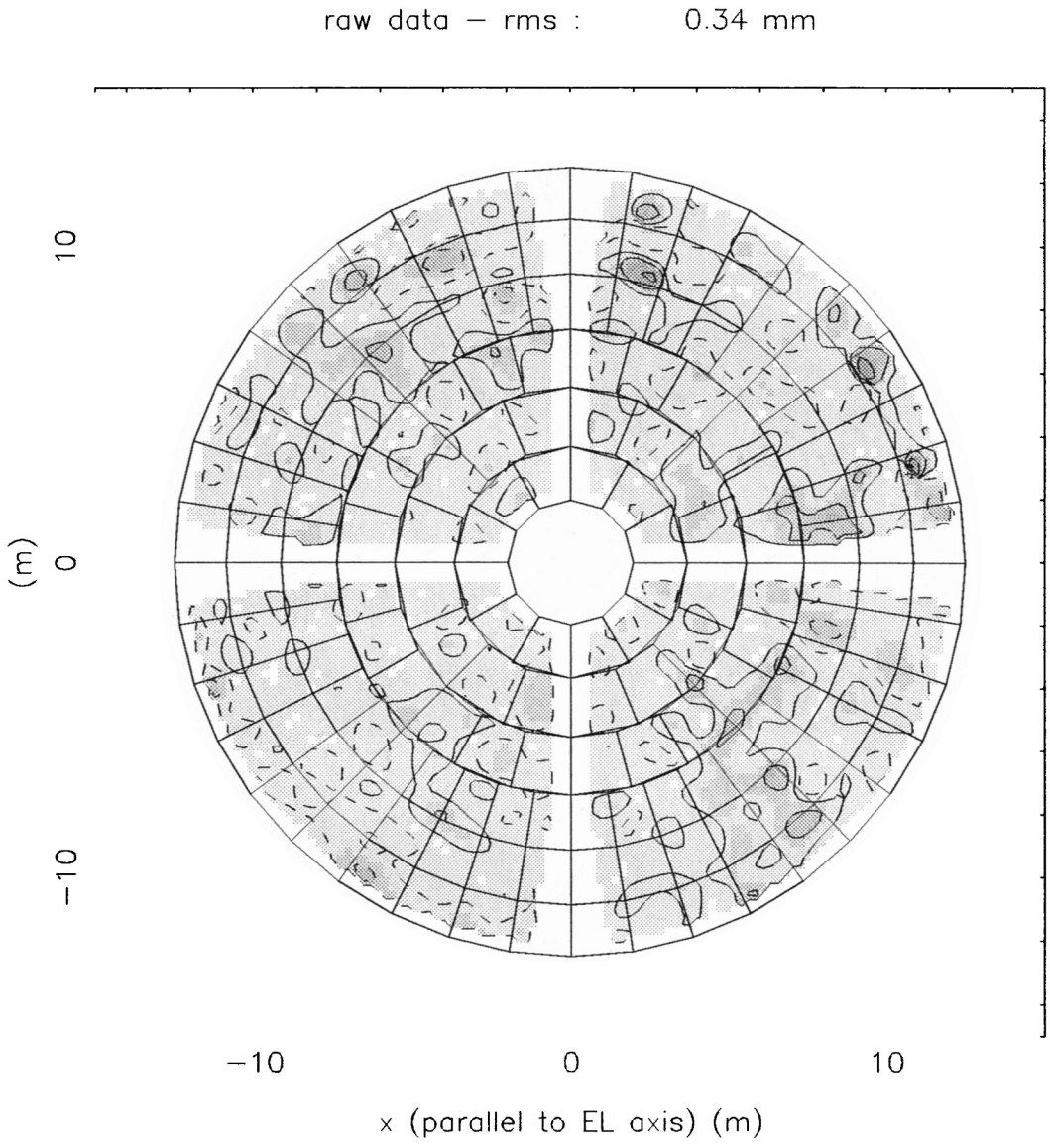
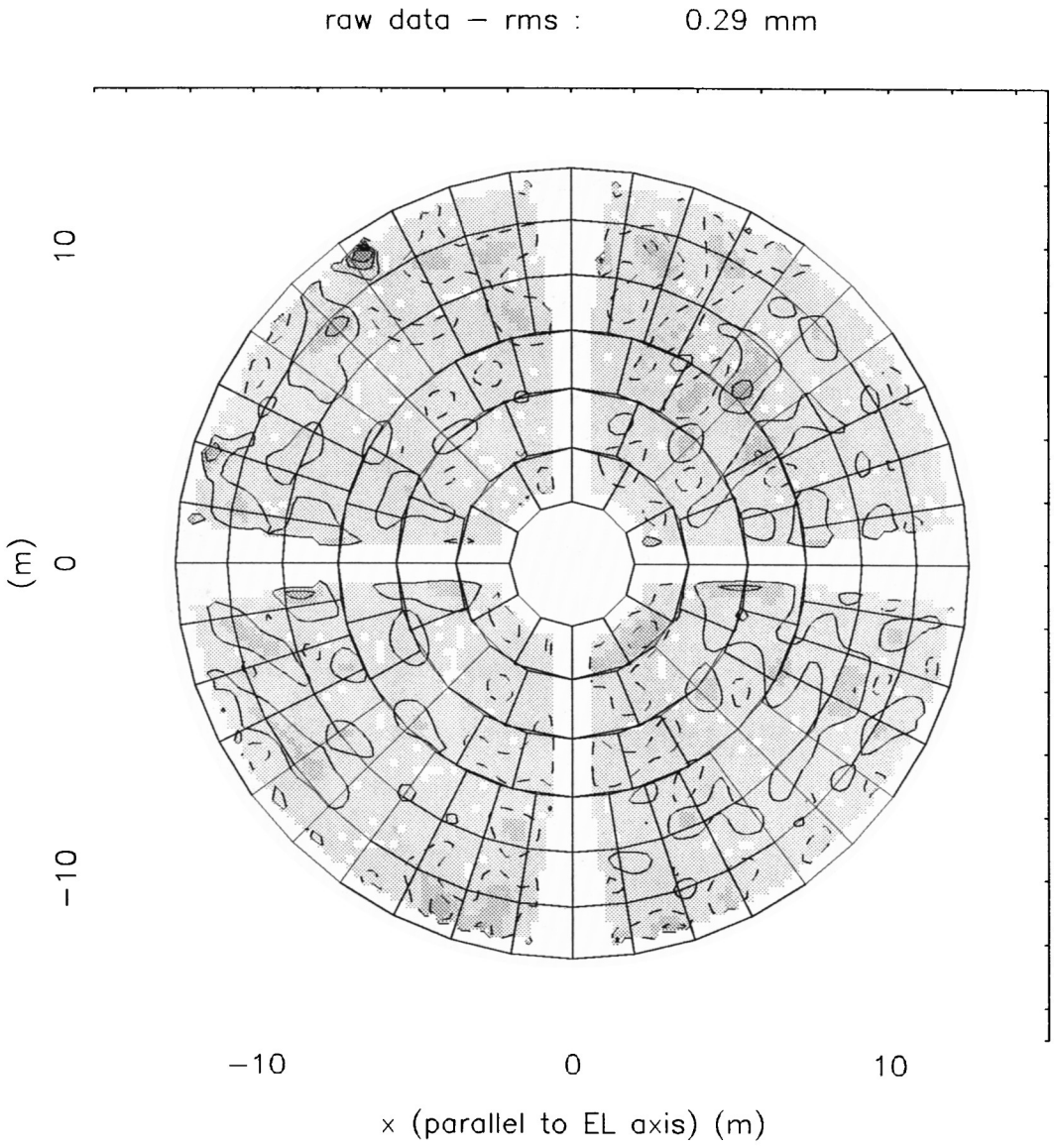


Figure 27: Antenna 27



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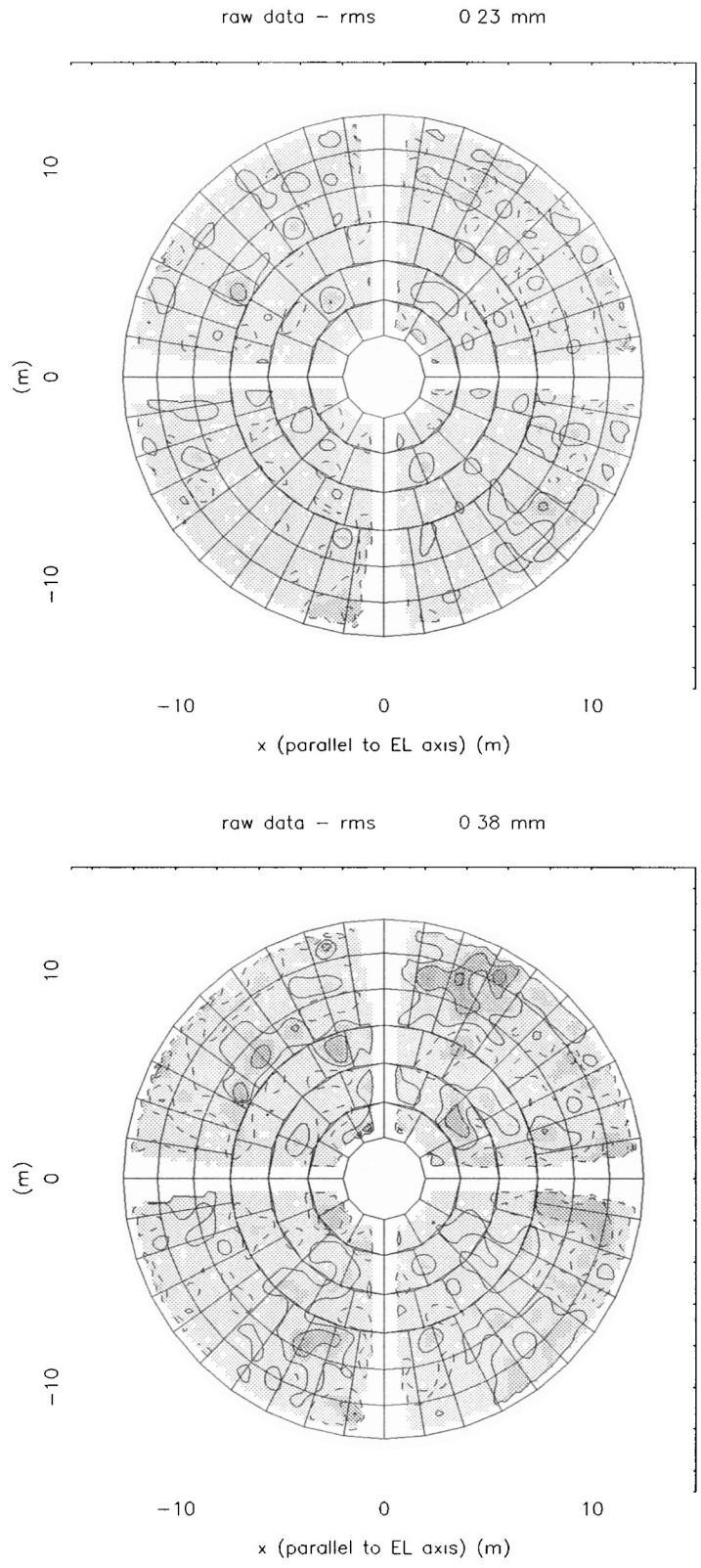

Figure 29: The upper frame shows the surface deviations based on 43 GHz holography for antenna 8 for measurements made in February 2001. The lower frame shows the surface deviations on antenna 8 for measurements made in March 2003.