Effect of OMT Fin Shape on the ATNF L/S Horn Performance RPP No 3794

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1 Introduction

The aim of this measurement campaign was to measure the radiation pattern of one of the Australia Telescope Compact Array (ATCA) LS-Horn [1, 2] using two different profiles for the fins inside the OMT.

M.J. Kesteven found that the E- and H-planes of the radiation pattern of the 22-m-antennas were different at 2.378 GHz. After consultation with G.L. James, M.W. Sinclair and B.Mac.A. Thomas, one of the suggestions was that the profile of the fins could be creating this problem while exciting one or several unwanted propagation modes. It was then decided to test the radiation pattern of the LS-Horn using a different OMT. A frequency-range covering 2.100 to 2.600 GHz was decided but concentrating around 2.378 GHz.

The first set of measurements was taken using the OMT equipped with the "Constant-Cut-Off" fin profile, which is normally used with the LS-Horn of the Australia Telescope [2].

The second set of measurements was taken using the OMT equipped with the "Sin-SQuared" fin profile, which is normally used with the CX-Horn of the Australia Telescope [2].

The third set of measurements was taken using a "Circular-To-Rectangular" transition (no OMT) to measure the LS-Horn by itself. These patterns can therefore be used as a reference.

This measurement campaign took place at the CSIRO Division of Radiophysics using the "Outdoor Test Range" in September 1995. The set-up used for these measurements is shown in Fig. 1. A few ground-reflection problems were met and absorber was used to cover part of the ground between the source horn and the antenna under test. The three sets of measurement were done using the same set-up under the same conditions; the difference in the radiation patterns is therefore due only to the type of OMT (fin-profile) used.

As shown in Fig. 1, the radiation patterns were recorded on charts. These patterns were then digitized using the "Kurta-Digitizer" of the Electromagnetics &Antennas Group.

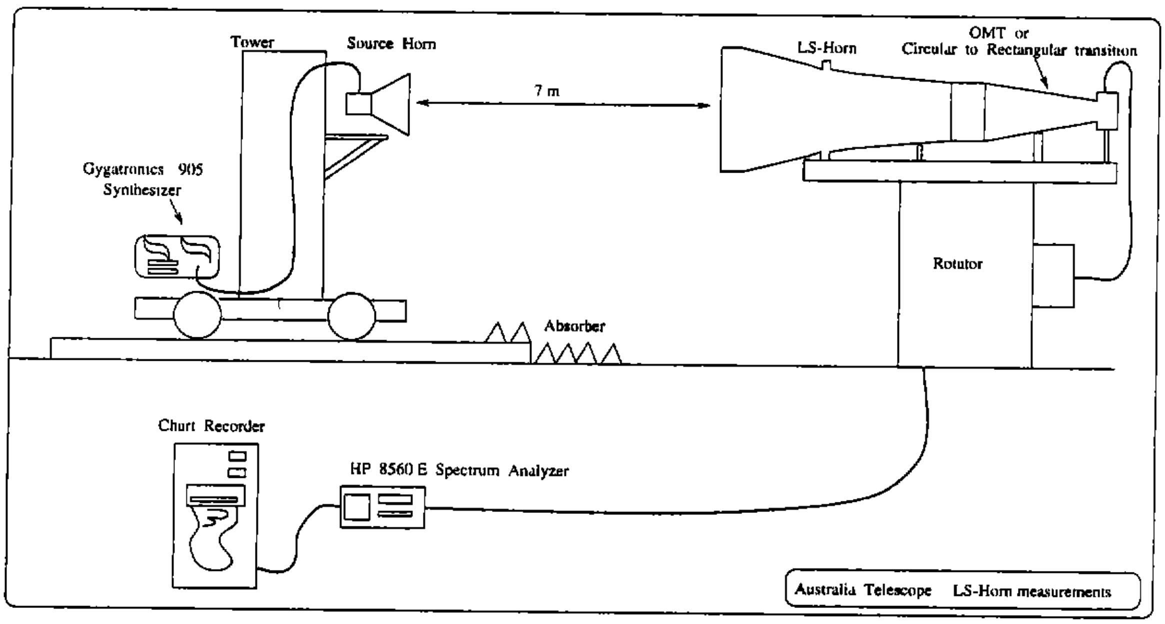

Figure 1: The set-up used to measure the LS-Horn : "Outdoor-Test-Range" of the CSIRO Division of Radiophysics.

2 Measurement of the LS-Horn radiation pattern with the "Constant-Cut-Off" OMT (CCO-OMT) and the "Sin-SQuared" OMT (SSQ-OMT) : Comparison

The following Table gives the figure and page numbers corresponding to the plot representing the comparison of the radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT at different frequencies.

Remark : For the comparison, the two radiation patterns were plotted next to each other, with that of the SSQ-OMT translated by 80 degrees.

Freq (GHz)	Figure No	Page No
2.100	2	5
2.200	3	5
2.300	4	6
2.370	5	6
2.378	6	7
2.390	7	7
2.400	8	8
2.500	9	8
2.600	10	9

3 Radiation pattern of the LS-Horn using a simple Circular-To-Rectangular (CTR) transition

As a reference, the LS-Horn radiation pattern was measured without any OMT, using only a CTR-transition. The following Table gives the figure and page numbers corresponding to these radiation patterns for various frequencies.

Freq (GHz)	Figure No	Page No
2.100 and 2.200	11	9
2.300 and 2.370	12	10
2.378 and 2.390	13	10
2.400 and 2.500	14	11
2.600	15	11

4 Conclusion

It appears that the horn by itself is behaving well in the [2.100-2.600] GHz frequency band, as well as the horn with the SSQ-OMT. On the other hand, when using the CCO-OMT, pattern asymmetry is quite marked at the higher frequencies, especially above 2.170 GHz, making the CCO-OMT unsuitable for use at these frequencies where a wide field of view is required.

5 Acknowledgements

Thanks to J.T. Barron, A. Bish, G.J. Gay, K.J. Greene, G.L. James, M.J. Kesteven, M.J. MacDonald, R.E. Shields, M.W. Sinclair, K.W. Smart, B.Mac.A. Thomas, M.A. Wilkes for their involvement in these measurements.

6 Bibliography

References

[1] Journal of Electrical and Electronics Engineering, Australia. Special Issue : The Australia Telescope. Vol. 12, No 2, June 1992.

[2] G.L. JAMES. "The feed system". Journal of Electrical and Electronics Engineering, Australia. Vol. 12, No 2, June 1992, pp 137-145.

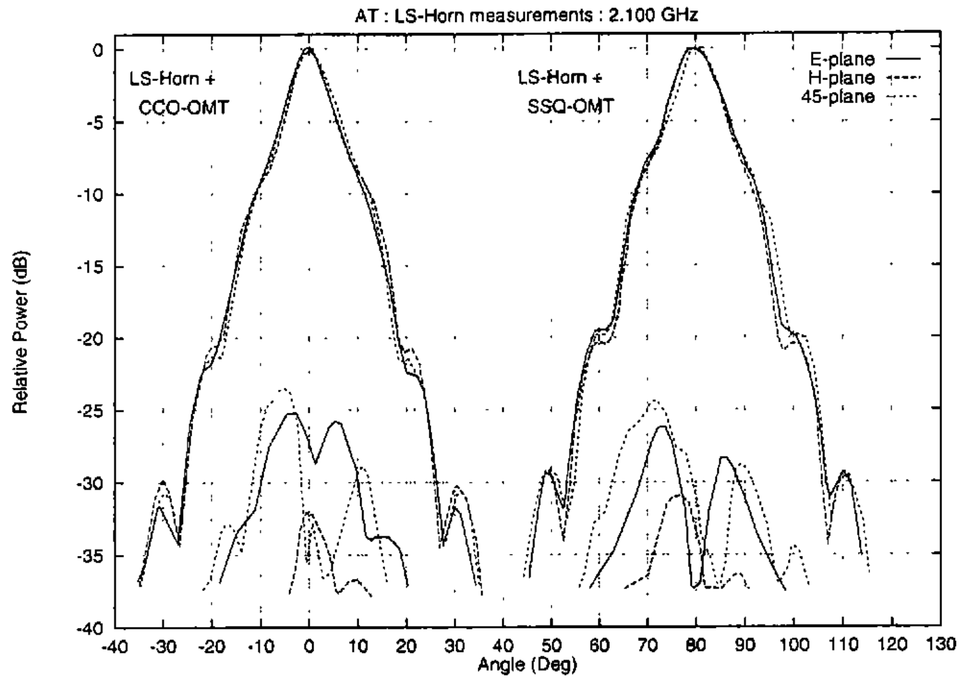

Figure 2: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.100 GHz.

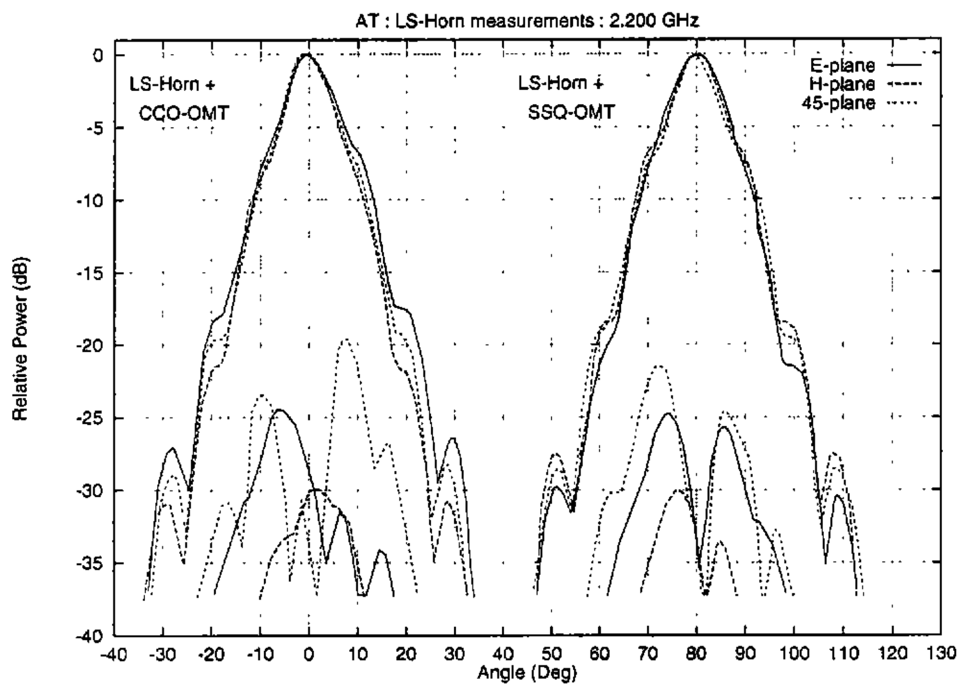

Figure 3: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.200 GHz.

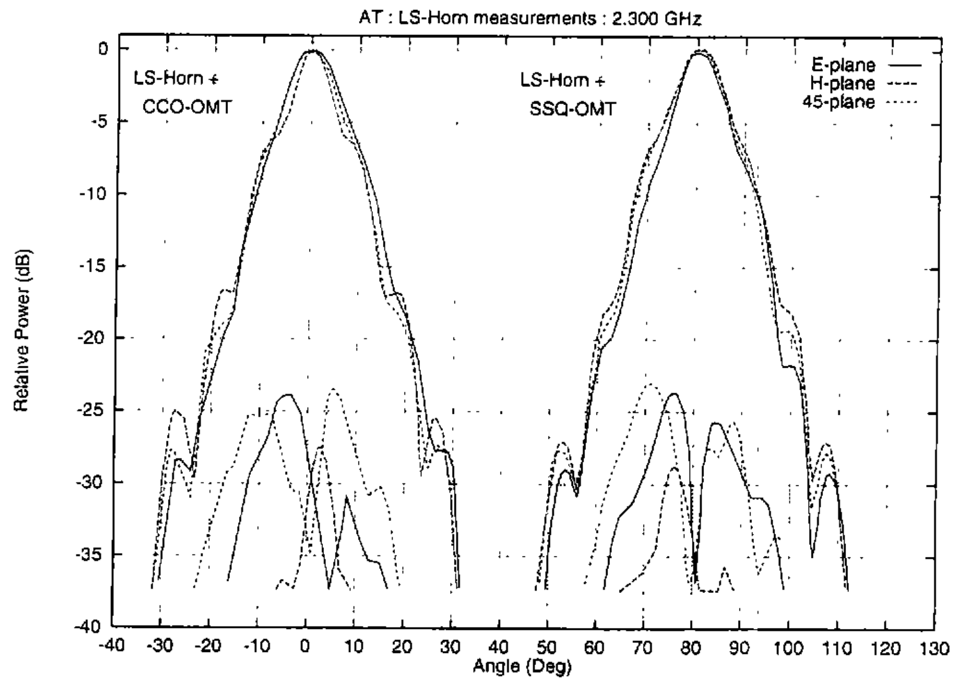

Figure 4: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.300 GHz.

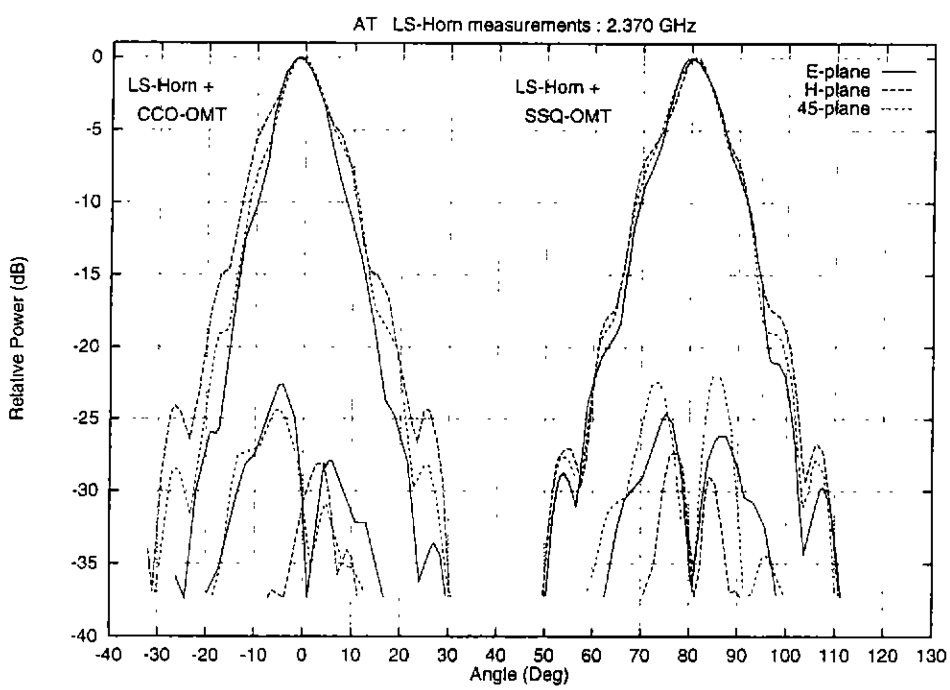

Figure 5: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.370 GHz.

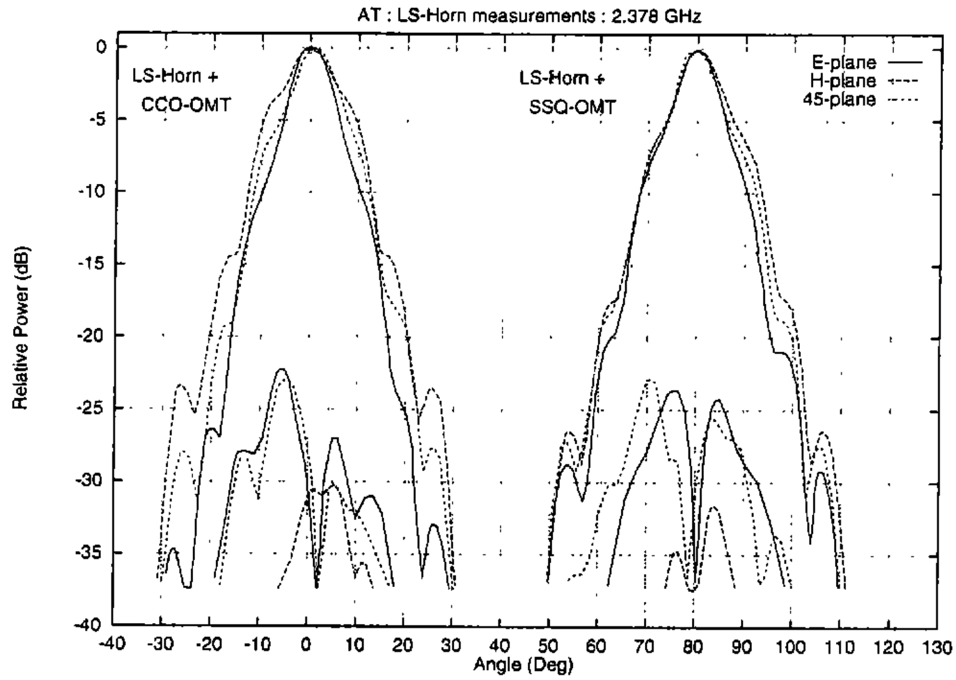

Figure 6: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.378 GHz.

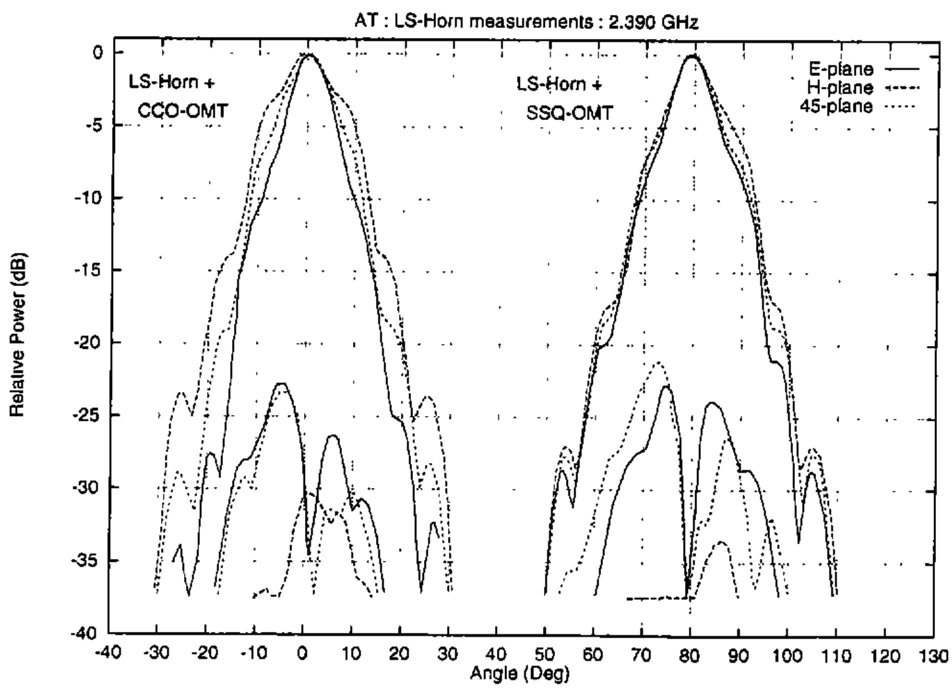

Figure 7: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.390 GHz.

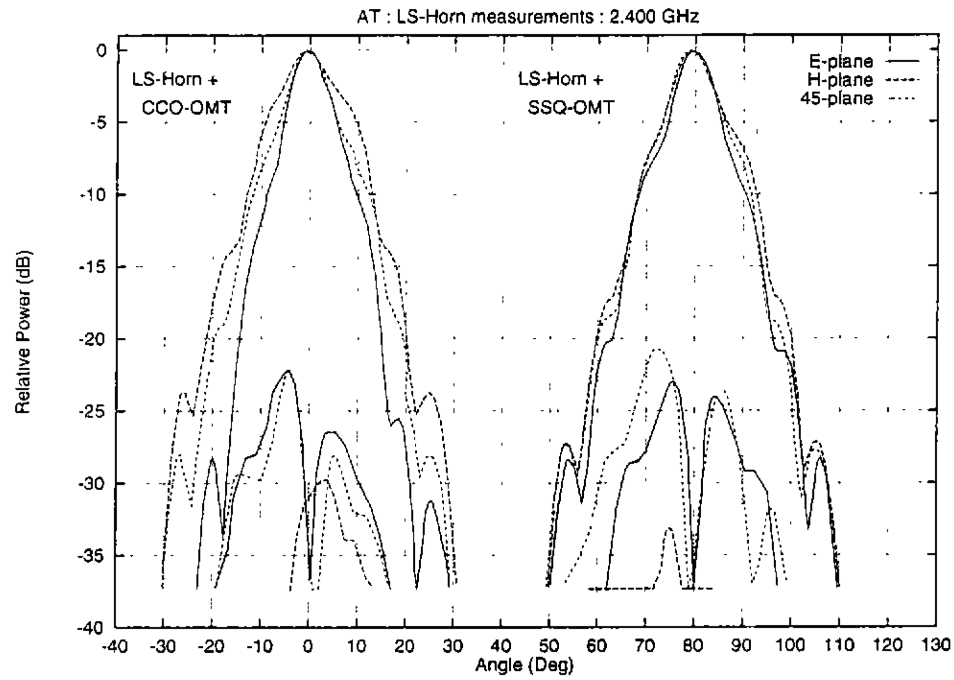

Figure 8: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.400 GHz.

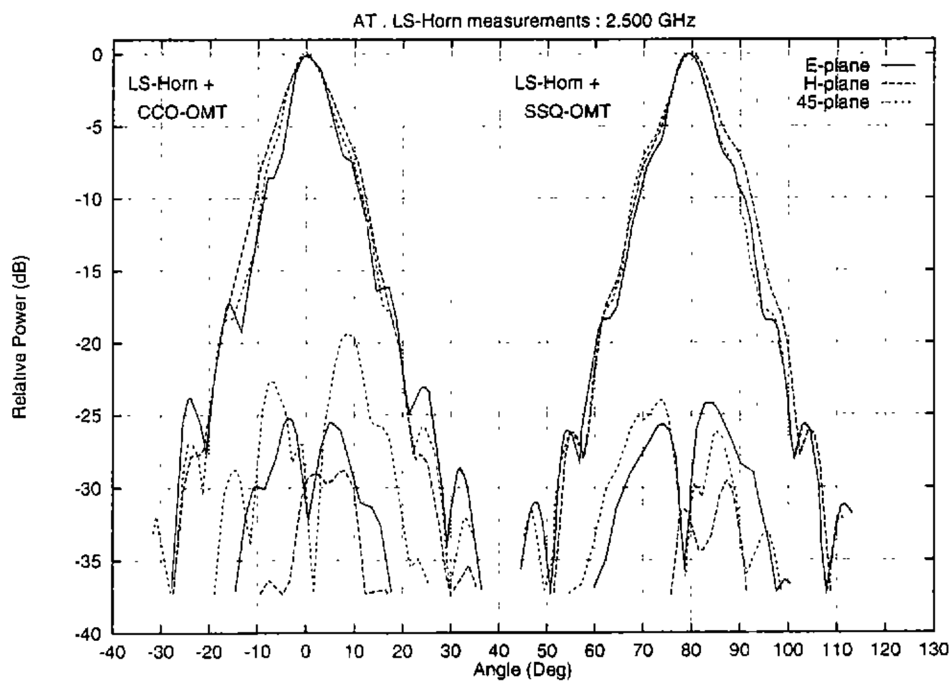

Figure 9: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.500 GHz.

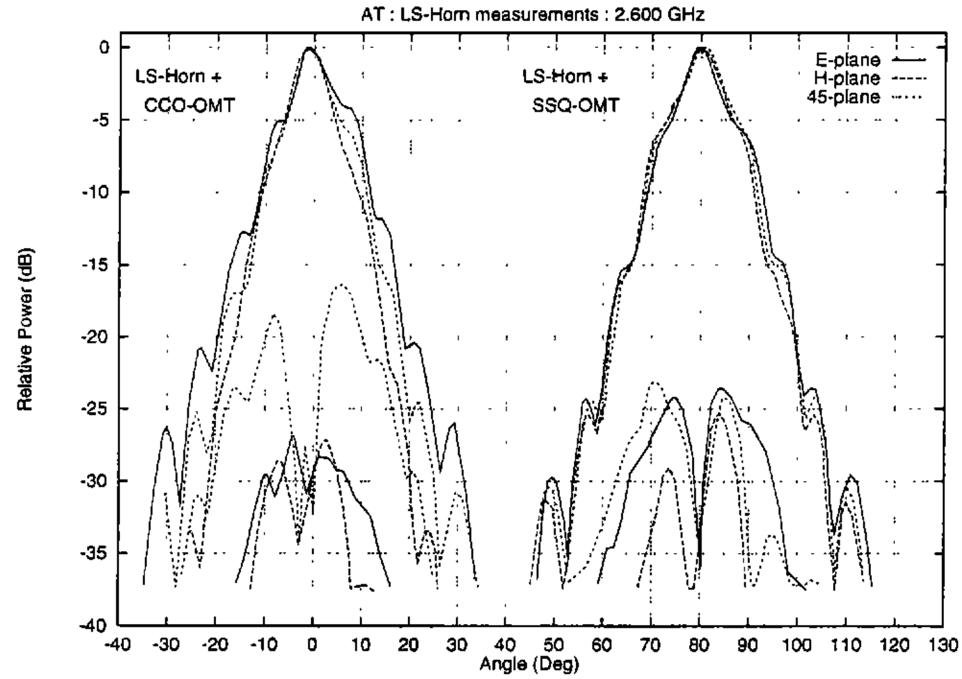

Figure 10: Radiation patterns of the LS-Horn using the CCO-OMT and the SSQ-OMT : Comparison at 2.600 GHz.

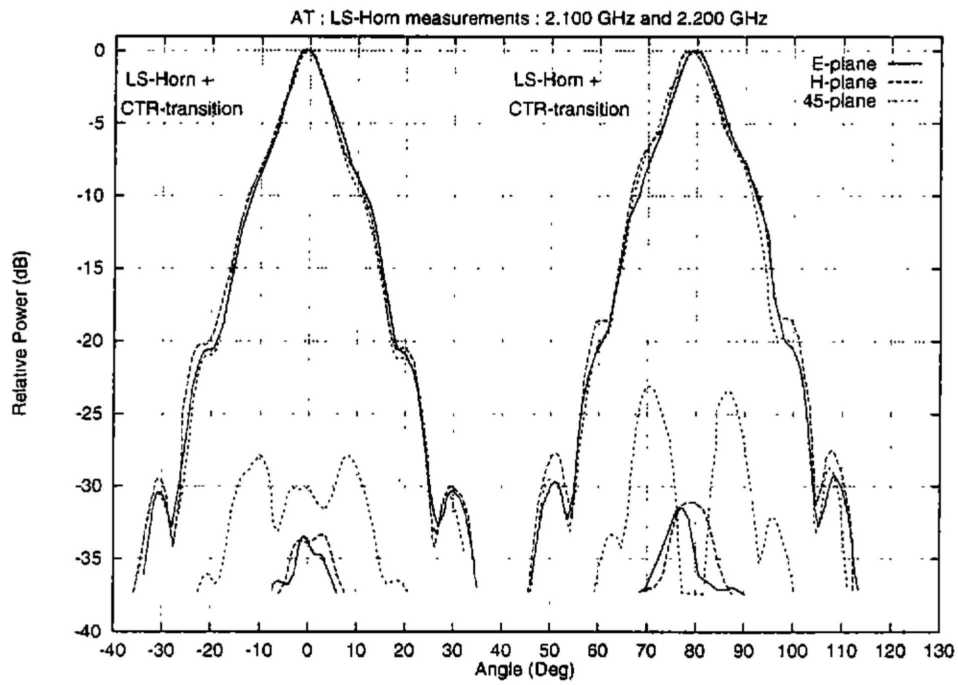

Figure 11: Radiation pattern of the LS-Horn using the CTR-transition : Patterns at 2.100 GHz and 2.200 GHz.

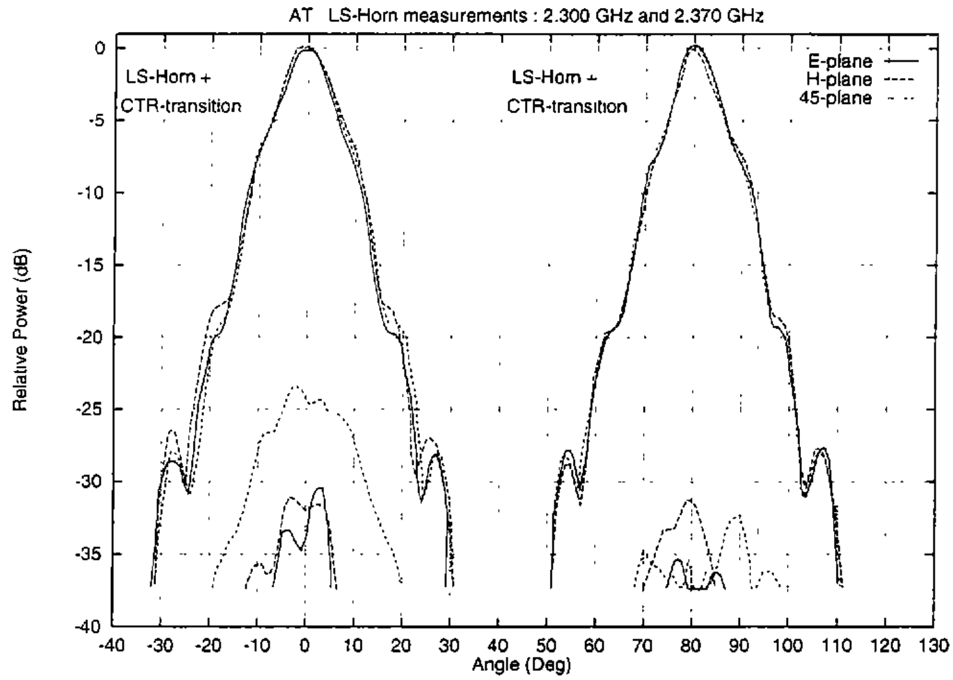

Figure 12: Radiation pattern of the LS-Horn using the CTR-transition : Patterns at 2.300 GHz and 2.370 GHz.

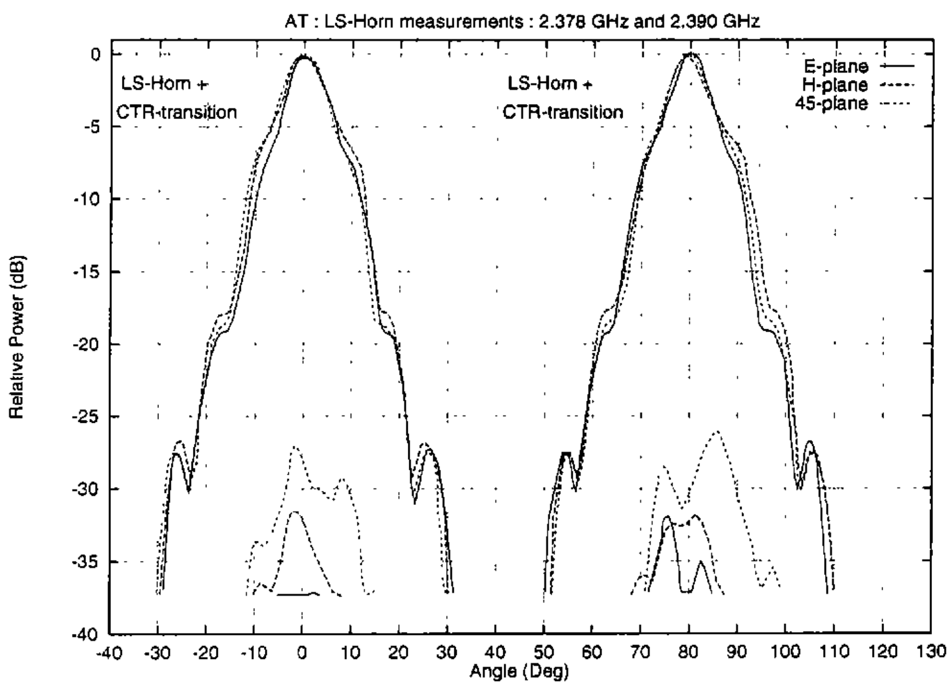

Figure 13: Radiation pattern of the LS-Horn using the CTR-transition : Patterns at 2.378 GHz and 2.390 GHz.

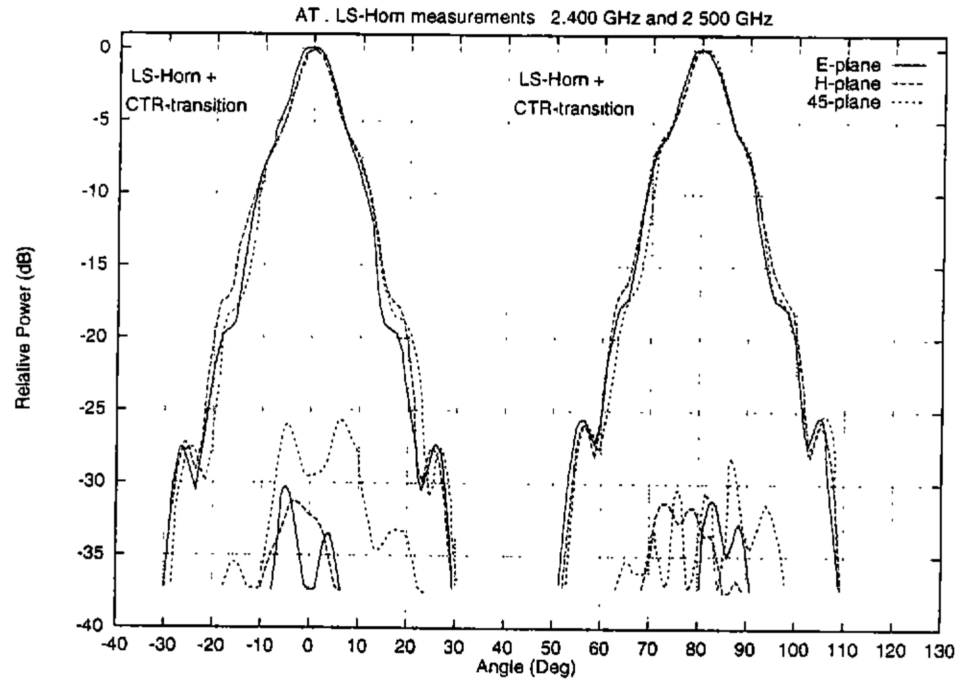

Figure 14: Radiation pattern of the LS-Horn using the CTR-transition : Patterns at 2.400 GHz and 2.500 GHz.

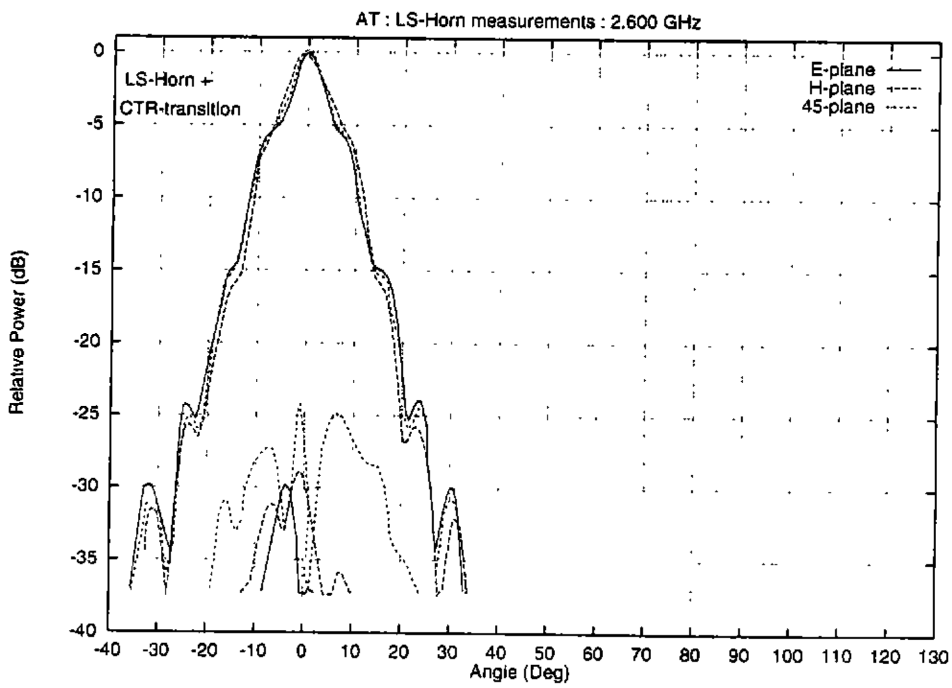

Figure 15: Radiation pattern of the LS-Horn using the CTR-transition : Patterns at 2.600 GHz.