#93-11

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To: Holographers

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Subject: Optimum illumination of Haystack

There is some evidence that the small scale roughness (structure just barely resolved in the high res. maps and smaller surface roughness) is largely responsible for the lower radiometric efficiency. [The best holographic maps have an rms of about 8.5 mils while the highest efficiency from radiometric measurements corresponds to a rms of about 10.5 mils.]

The larger than expected beamwidth (see memo dated 22 April 1993), the holographic data (see attached plot made by Rich for map 272), and the sun scans (see memo dated 24 April 1992), all suggest that the small scale rms increases rapidly towards the edge of the dish. The SGH panel survey (5 September 1989) only went out to a radius of 45 feet and found an 8 mil rms at that radius. Reading the monthly reports of North American Aviation (NAA) (see attached page), it appears that NAA had considerable difficulty with the "large ends" of the outer panels and, therefore, it wouldn't be surprising if the rms increases rapidly towards the edge of the dish. If this is in fact the case, then there is probably more advantage in under-illumination than previously thought. Rich's study of the optimum illumination used only the variation of rms with radius determined by holography. While Rich concluded, on this basis, that under-illumination would not significantly increase the efficiency, a sharp increase of small scale rms at the edge of the dish could change this conclusion. If the rms at the outer part of the antenna increases quadratically from 6 mils at the splice plate to 12 mils at a radius of 45' to 30 mils at the edge then the aperture efficiency at 115 GHz will increase from 11% with the standard 10 dB taper to 13% with a 17 dB taper. [The beam efficiency is increased by an even larger amount.] Tests using the curved mirror on the offset beam could help determine whether under-illumination is advantageous.

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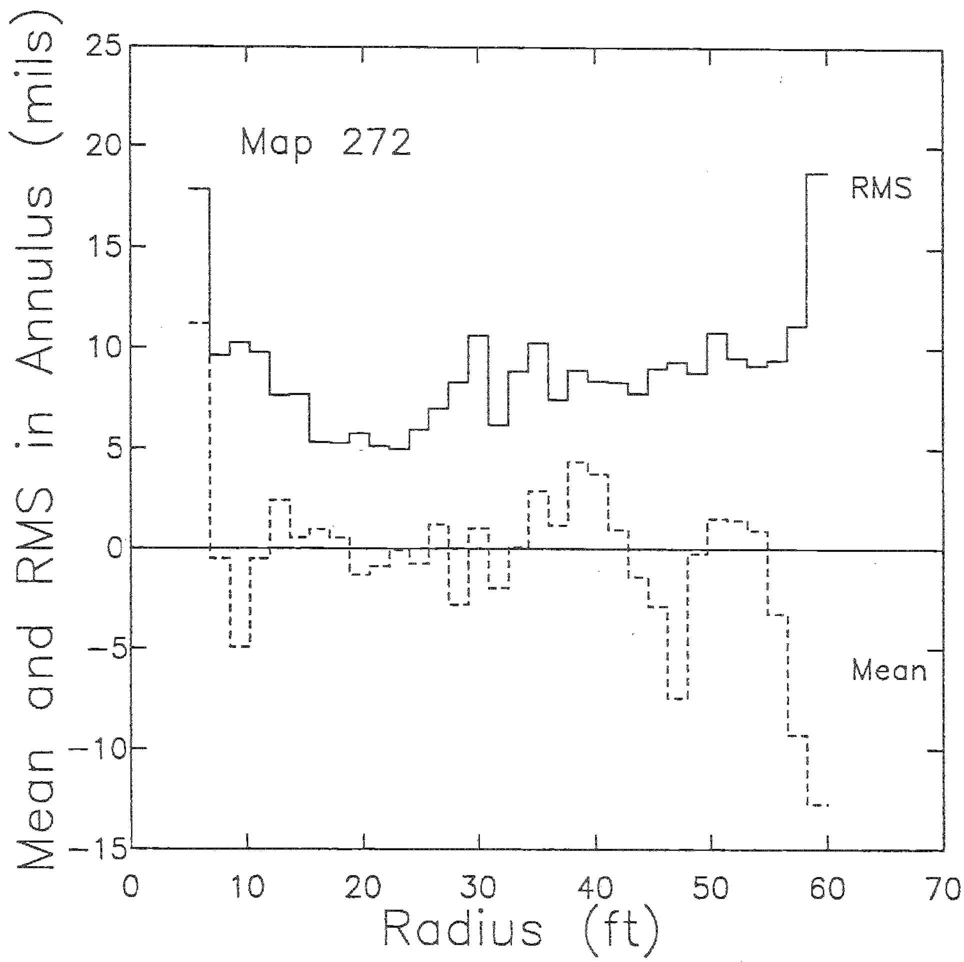
Map 272
RMS
Mean
Mean and RMS in Annulus (mils)
Radius (ft)
25
20
15
10
5
0
−5
−10
−15
0
10
20
30
40
50
60
70

3.1.1 Parabolic Reflector Panels

3.1.1.1 Outer-row Panels

Several outer-row panels have been bonded to date. Measurements of panel surface contours indicate maximum deviations on the order of .100 inches at the large end of the panels. Constraints imposed on the panel in the measuring fixture had resulted in the lower preliminary deviations reported in the previous bi-monthly report. As a result, production of additional outer-row panels has been delayed while a thorough appraisal of the tool and bonding technique is being made. This should not have any adverse affect on the schedule since the inner-row panels pace the program.

A joint effort by representatives from Engineering, Manufacturing, Quality Control, and Tooling has been initiated to resolve this problem. An evaluation of all the factors involved in the production of these panels is being made to establish the significant contributions to the observed deviations.

At present it appears that temperature gradients across the thickness of the panel are responsible for the majority of the distortion. Concentrated effort will continue to be devoted on the problem until quality production panels can be achieved.

3.1.1.2 Inner-row Panels

No significant refinement in either inner-row panel manufacturing technique or measuring technique has been made during this reporting period. However, Engineering has maintained continual surveillance on the inner panel production to help insure quality panels.

3.1.2 Reflector Back-up Structure

During this reporting period the installation of ring-to-panel fittings was completed. Measurements of the ring joint locations after this operation showed only slight changes from their previous position. Tension rod loads showed a significant change which was attributed to weld shrinkage of the upper ring caps and to environmental changes. All tension rods were readjusted to their previous load levels prior to the performance of