

HOLOGRAPHY 001

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To: Holography Group

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Subject: Astigmatism correction for holography feed offset

1] Past History

In the 1990's we made holographic measurements with a feed offset of $x = -26$ inches (26 inches to the right of center when viewed from inside the box). In order to correct for the errors of the feed offset we tilted the subreflector about an axis centered at the prime focus by an -1.49 degrees and applying a pointing offset of -0.12 degrees.

2] Tilting about an axis at the prime focus

Tilting the subreflector about an axis at the vertex of the subreflector by an amount equal to half the feed angle offset centers the illumination but introduces substantial coma distortion. The coma can be corrected by also applying a translation of the subreflector vertex. If the amount of translation makes the subreflector rotate about the prime focus the coma is minimized leaving only a small amount of astigmatism. (see holography memo 91-6)

3] New antenna and subreflector

The new antenna has a non deformable subreflector with the original dimensions specified for the 120' haystack dish (see holography memo 92-10). The holography feed is now mounted 29 inches (feed offset of $y = -29$ inches) below the center of the box. Using a ray tracing program I show that half the path length error for the following parameters which minimize the error

Antenna elevation offset -0.134002 degrees

Subreflector tilt -1.6547 degrees

Focus correction 0.02 inches

The rms of half the path length error (shown in Figure 1) is 68 microns and the astigmatism dominates.

In the 1990's we made no correction for this astigmatism because the error is small and any residual astigmatism rigged into the antenna was easily corrected by the deformable subreflector. In order to obtain the highest accuracy for the new antenna we plan to make corrections to the holography for

- a) Radome diffraction
- b) Subreflector diffraction including the residual astigmatism

c) Holography feed phase

Sample corrections for a) and b) are shown in Figure 2 and 3.

4] Open questions

a) Holography feed phase – currently being measured.

b) Change in the offset of the main dish vertex from the elevation axis. Drawings of the new antenna are currently being studied. It is assumed that the elevation axis passes precisely through the geometric center of the radome.

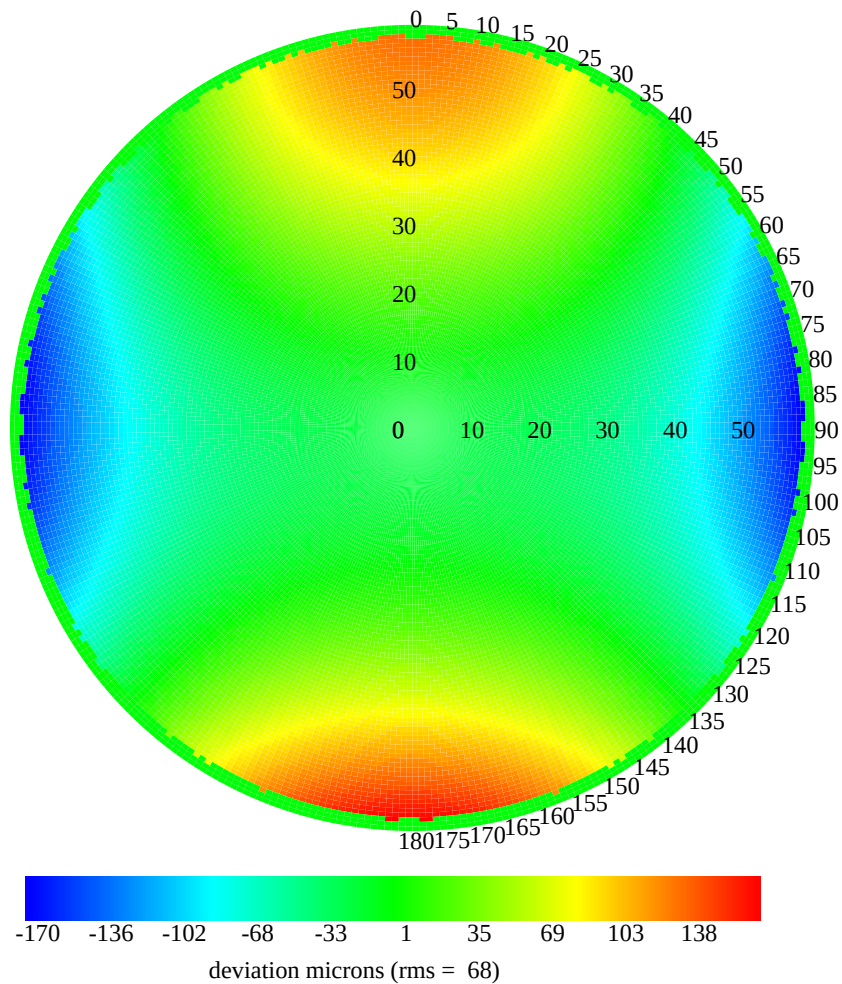


Figure 1. Ray trace of path length errors which result from feed offset corrected by optimum tilt about prime focus.

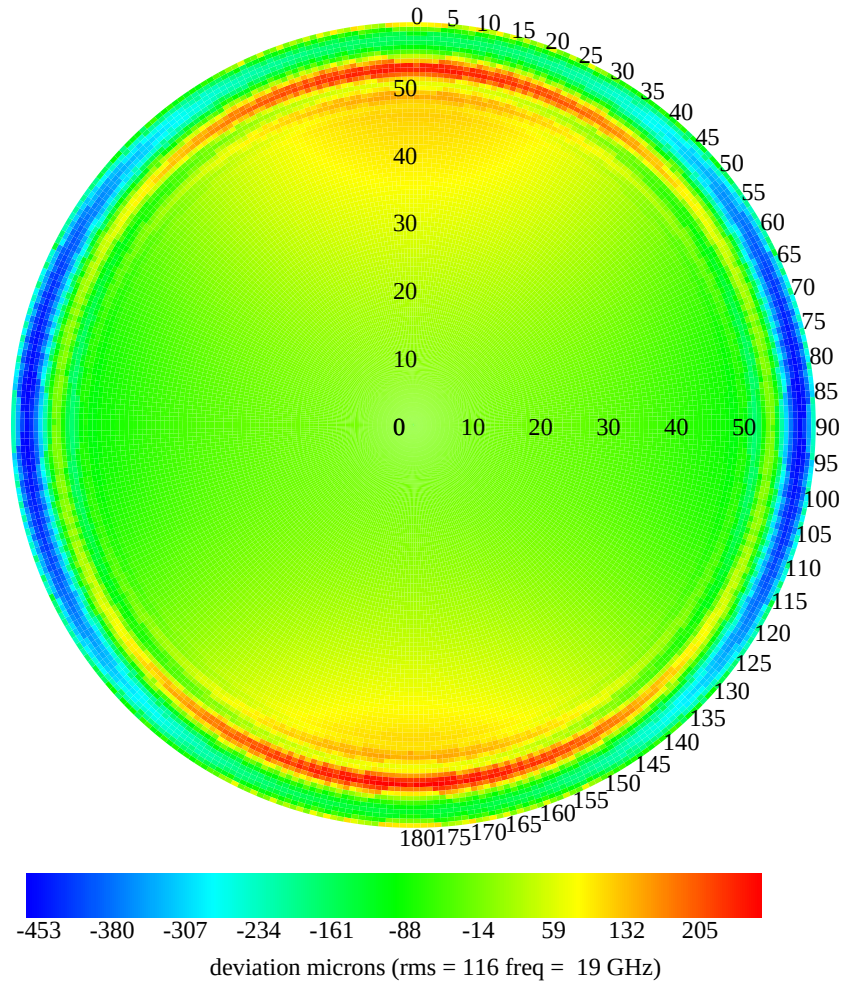


Figure 2. Path length errors from EM simulation at 19 GHz of offset feed. Deviations plotted are half the phase error converted to microns. The effects at the extreme edges of the dish are due to diffraction from the edge of the subreflector.

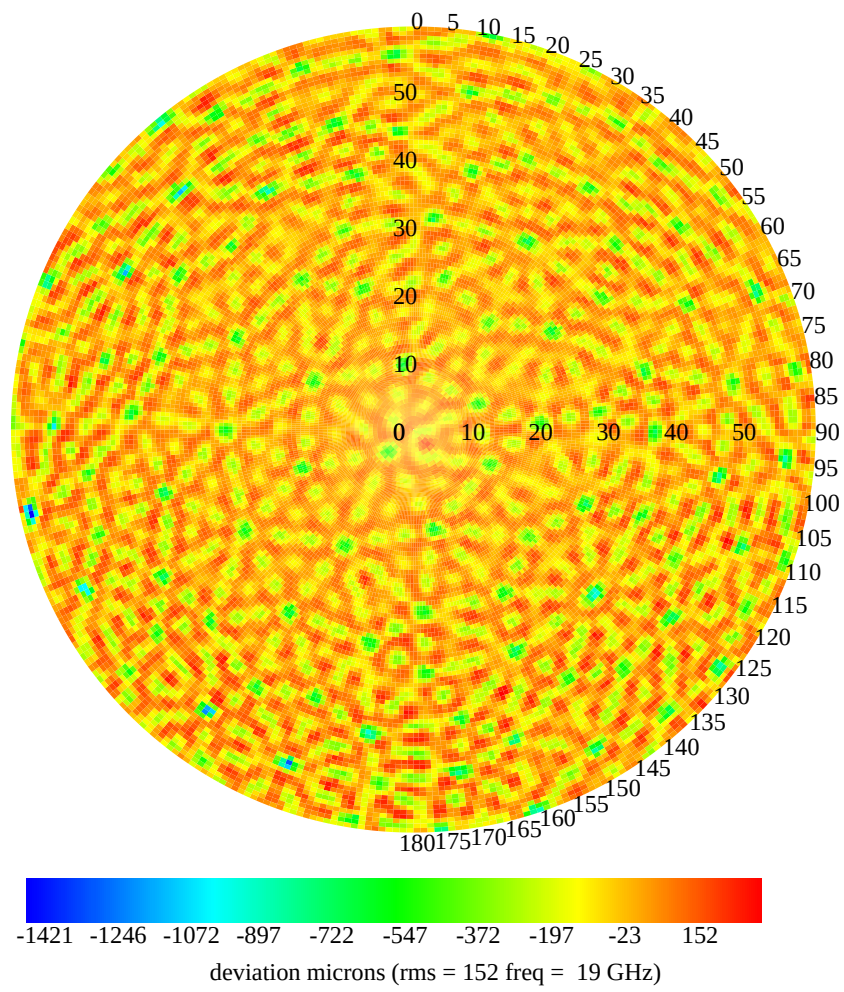


Figure 3. EM simulation of the phase errors due to the radome diffraction at 19 GHz.