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17 May 1993

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To: Holographers

From: Alan E.E. Rogers AEER

Subject: Radome effects on baseline ripple and continuum sensitivity

1] Radome granularity from Meeks and Ruze

Meeks and Ruze[1] have estimated that radome scattering will produce variations in the forward gain at the level of $\pm 0.2\%$. That is for a continuum point source of 10°K the variations will be ± 0.02°K. They estimate background noise variations to be ± 0.07°K. They expect variations to occur with a characteristic scale of 1.5° of antenna motion.

2] Radome panels

The method of Meeks and Ruze can also be applied to the radome panels. The basis for their estimates is a $\pm 1.5\%$ variation in geometrical blockage. The radome reflection loss at 86 GHz is about 1.2 *dB* which in turn results in about 30°K of added ground noise. If the reflection loss varies by $\pm 0.2\%$ then there will be ± 0.6°K variations in the ground noise pick-up.

3] Weinreb effect

The receiver radiates noise and L.O. leakage which when reflected back adds in voltage to the receiver noise and L.O. producing gain added noise variations. Because of the addition of voltages relatively low levels of reflection can cause a problem. The use of circular polarization can be used to reduce this problem because most of the energy comes back from the subreflector or radome panels after a single reflection which reverses the sense of circular polarization. A reflection of -60 *dB* (approximately that expected from the subreflector) can produce variations as large as 0.1% of the system temperature. At 86 GHz the reflection from the subreflector are expected to be about -60 *dB* (without a spoiler). Reflections from the radome panels may be comparable or larger than those from the subreflector especially if the feed over-illuminates the subreflector (as happens at 86 GHz).

4] Tests

To isolate the various mechanisms there are several useful tests as follows:

a] Compare continuum fluctuations on a retrace of the radome (Joe Carter has already done this test and finds some correlation indicating that at least some of the continuum fluctuation comes from the radome).

[1] Meeks and Ruze "Evaluation of the Haystack Antenna and Radome", IEEE Trans. on Ant. and Prop., AP-19, No. 6, Nov. 1971.

b] Correlate continuum fluctuation with subreflector motion. (At 86 GHz I recently found 2K change with quarter wavelength change in subreflector motion indicating the presence of a substantial contribution from the subreflector. Joe Carter has already reported the presence of a 12.3 MHz baseline ripple consistent with a standing wave from the feed to the subreflector.) Include tests at a wide bandwidth to determine if L.O. leakage is involved. (If L.O. leakage is involved the subreflector dependence will be independent of bandwidth.)

c] Correlate continuum fluctuations with radome panel motion by reversing radome pressure.

d] Compare baseline ripple on cold sky with that on a strong background source like the moon.

e] Compare ripple and fluctuations using linear with those using circular polarization.

f] Measure angular scale of fluctuations which are correlated with antenna pointing angles.

5] <u>Fixes</u>

a] <u>Subreflector shift</u> - Use the traditional method (developed many years ago at Haystack) of adding scans with quarter wavelength subreflector shift.

b] <u>Frequency switching</u> - Use Joe Carter's method of canceling the ripple by using a frequency shift equal to an integral multiple of the ripple periodicity.

c] Install spoiler or vertex-plate on the subreflector (see memo dated 16 February 1993).

d] Use circular polarization to reduce the effects of reflections from the subreflector.

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