MASSACHUSETTS INSTITUTE OF TECHNOLOGY

HAYSTACK OBSERVATORY

WESTFORD, MASSACHUSETTS 01886

18 May 1994

Telephone: 508-692-4764
Fax: 617-981-0590

To: Millimeter-wave VLBI Group

From: Alan E.E. Rogers AEER

Subject: Another standing wave from radome reflections

During tests of the 7mm receiver, a standing wave with 4.8 MHz was observed in addition to the 12 MHz reflection from the subreflector and 8.7 MHz from the radome seen at 3mm. In fact, the 4.8 MHz is stronger than the 8.7 MHz for the 7mm system. After many tests and a look at the theory this is now understood.

Panel reflections

In Memo #10 of this series, I discussed the reflection from a radome panel in the sidelobe of the feed. The path loss for this reflection is

$$L_1 \; \Gamma \; G_T^2 \, A_f \, / \left(4d^2 \lambda^2\right) \approx 10^4 \lambda^2 \; \Gamma \; G_T^2 \, / \left(4d^2\right)$$

where A_f = effective area of feed $\approx$ *100* λ^2
d = distance to the panel = 17m
G_T = taper gain on the panel
Γ = panel reflectivity

Another path (suggested by Rich Barvainis) is a reflection of the outgoing plane wave beam from a radome panel near the edge of the subreflector and back into the feed. For this reflection the path is:

Feed to subreflector	=	38.4
Subreflector to vertex	=	44.4
Vertex to radome	=	61.0
Radome to feed	=	55.0
2 X feed to recvr.	=	3.0
		201.8´ or about 4.9 MHz.

The path loss is

$$L_2 = \Gamma A_f \, G_T / \left(\pi r^2\right) \approx 10^2 \lambda^2 \; \Gamma \, G_T / \left(\pi r^2\right)$$

where r = radius of antenna = 18m

At 7mm $\Gamma \approx 0.5$ and a feed with 10 dB taper L_1 and L_2 are -55 and -65 dB respectively. With a 20 dB taper L_1 and L_2 are -75 and -75 dB. Thus a highly tapered feed strengthens the reflection of the outgoing plane wave over that from the feed spill-over. These loss calculations assume flat radome panels. The actual standing wave strengths observed in the beam switch mode are shown in Figure 1 and depend strongly on the antenna azimuth and elevation. In the double-Dicke mode the subreflector standing wave is almost perfectly canceled and the radome standing waves are significantly reduced.

Beam SW -

17 MAY 1994

35.079 GHz

Standing Waves -

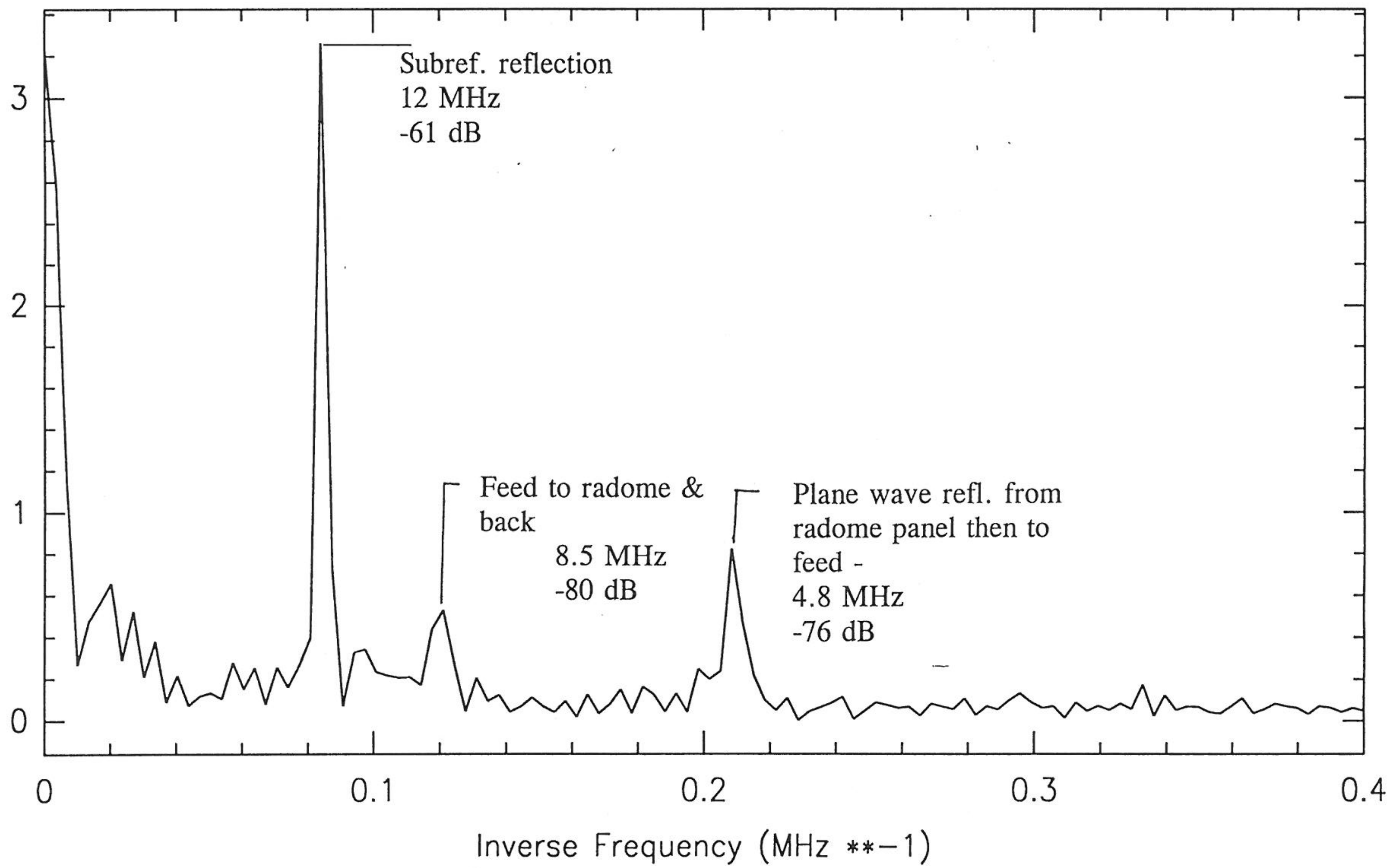

Figure1. Observed Standing Waves