12 Meter Telescope Dome Material Transmission Measurements

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1 Introduction

When it is necessary to close the 12 Meter Telescope dome due to high winds or proximity of the program source to the Sun, observers often decide to observe through the dome fabric. The measurements below give some indication as to how much loss one can expect when observing through the dome.

2 The Measurements

Between May 1996 and March 1999 a series of measurements of the 12 Meter Telescope dome RF transmission were made. In May 1996 measurements of the CO 2$\rightarrow$1 (230.538990 GHz) emission from IRC+10216 were used to estimate the amount of loss due to the dome and due to the dome door. In March 1999, measurements of the loss through various dome fabrics being considered for the dome cover replacement where made at 230.538990 GHz. These measurements were made at the exit window of the 1mm receiver box using hot and cold loads. Table 1 lists the results from these measurements.

Table 1: Dome Material Loss Measurements

Fabric	T_A^* Without Attenuation (K)		T_A^* Through Dome (K)		Loss (dB)
Current Dome	8.7		6.1		1.6
Dome Door	8.7		4.2		3.2
Fabric	Without Fabric		With Fabric		
	V_h (mV)	V_c (mV)	V_h (mV)	V_c (mV)	Loss (dB)
Current Dome Fabric	2.623	1.670	2.626	1.840	0.84
Orange Sample L1030SDUP	2.623	1.670	2.628	1.825	0.75
Eide Sample 21299[1]	2.623	1.674	2.628	1.948	1.47

NOTE: Measurements where made when $T_{amb} = T_h = 13$ C and assume $T_{cold} = 80$ K

[1]This material will replace the current dome fabric in July 1999.

Note that in this analysis we used the following relations:

$$
\begin{aligned}
Y &\equiv \frac{V_h}{V_c} \\
L &\equiv loss \\
T_{rx} &= \frac{T_h - YT_c}{Y - 1} \\
T_{sys} &= (L-1)T_{amb} + LT_{rx}
\end{aligned}
$$

Table 1 indicates that half of the loss for astronomical measurements is due not to the dome material but to other blockage in the dome structure. Since the dome fabric is supported by steel tubes, these are likely to be the structures which produce the additional attenuation. This is consistent with the attenuation characteristics of the dome door, which is covered with a much more radiometrically transparent fabric but attenuates astronomical measurements much more severely. Given this, we predict that measurements through the new dome cover will be attenuated by approximately $1.47 + 0.8 \sim 2.3$ dB.