

# C-Band (4-6GHz) Receiver Baseline Experiments

## Project TBASERDN030505, May 5, 2003

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### Introduction

On the evening of May 5, baseline experiments were done using the C-band receiver with the GBT at the access elevation. The main goal was to study feed/LNA reflections by placing various metallic objects on the radome and recording the resulting baseline ripples. Because the hours prior to our experiment saw several rain showers, we were also able to see how water drops on the feedhorn radome affects the receiver performance.

The Spectrometer was used in an one-bank (A1), two sampler, 800MHz mode, with 30 second records. Optical fiber channels 2 and 4 were used, with CM1 and 5, and SF 1 and 5. LO1 was tuned to a center sky frequency of 5000 MHz, and 3000/1280 MHz filters were selected in the IF Rack.

### Effect of Water on the Radome

Two people (R. Norrod and T. Guthrie) went to the Receiver room about 7:30pm. R. Fisher operated the backend and analyzed the results in the Control Room. Several scans were taken before anything was disturbed. We then wiped off the feedhorn radome, which was about half covered with water droplets up to the size of a quarter. Figure 1 shows the receiver  $T_{cal}/T_{sys}$  spectra before and after drying the radome.  $T_{cal}$  is about 3.1K for both channels at 5000MHz, so it can be seen from the figure that the system noise went from about 40K to about 18K when the radome was wiped dry. Note also, the increased ripple in the spectra when the radome is wet. Figure 2 shows the spectral baseline, using the scan after the radome is dried as a reference scan, and a scan taken before the radome was dried as the signal scan.

### Metallic Reflectors at the Radome

Several scans were taken with the dry radome unperturbed. Figure 3 shows the baseline spectra obtained using two of these initial scans. The next step was to place a metal disk with diameter 2.5 inches, or area about 1% of the feed aperture (26 inches diameter), in the center of the dry feed radome. Figure 4

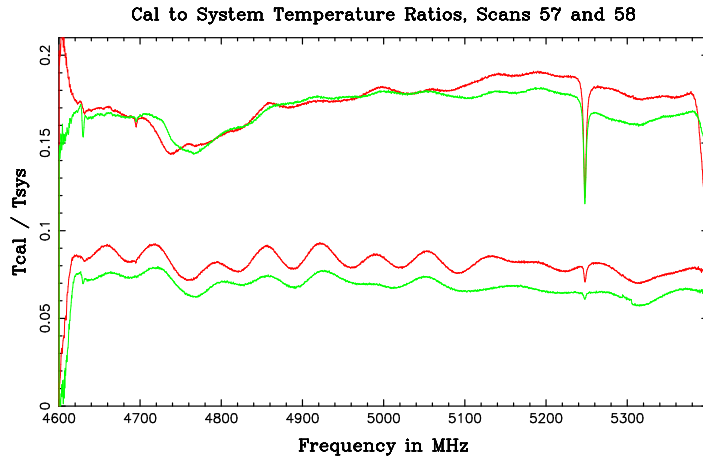


Figure 1:  $T_{cal}/T_{sys}$  for the wet radome (lower pair of traces), and the dry radome (upper pair).

shows the baseline ripple induced by the disk is up to 7% p-p. We then went to a dime, which has area about 0.1% of the feed aperture. The dime induced baseline ripple about 0.5% p-p, as shown in Figure 5. We then replaced the dime with a bit of copper tape having about 0.02% of the radome area. The effect of this is hard to distinguish (Figure 6), appearing about the same as the reference baselines. As a sanity check, we returned to the dime, and saw results similar to those before, Figure 7.

## Summary

It is interesting to note that the baseline ripple frequency with the metallic reflectors is about 120 MHz, while that due to water (Figure 1) is about 60MHz. The water is both a source of noise, and a moderately effective reflector. Noise from the water would travel down the feed, be partially reflected at the LNA, and travel back up the feed where it is reflected again. Therefore it sees two round-trips through the feed length, producing the 60MHz ripple. We believe that ripple with the metallic objects is due to noise leaving the receiver LNA or input losses, traveling up the feed where it is partially reflected. This noise sees only one round-trip through the feed, producing ripple peaks further apart.

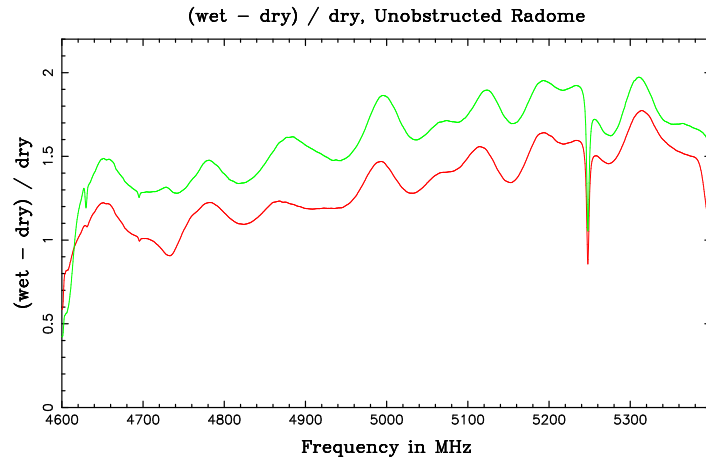


Figure 2:  $(Wet - Dry)/Dry$  baseline using scans taken before and after water was wiped from the feedhorn radome.

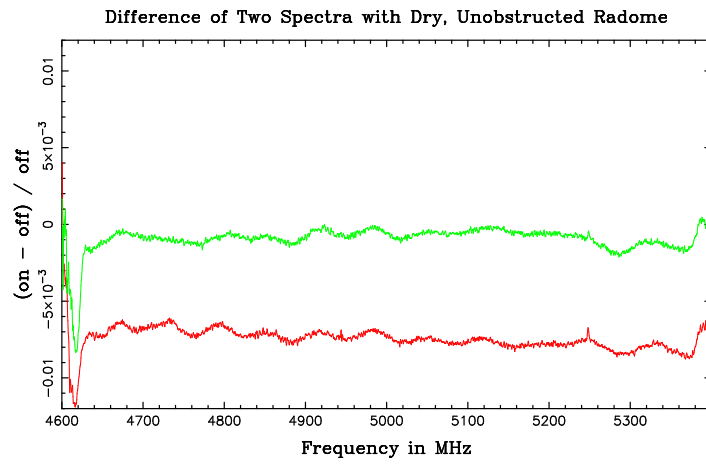


Figure 3:  $On - Off/Off$  spectra for two five-minutes scans taken with unobstructed dry radome. For all figures, red is X polarization data; green is Y.

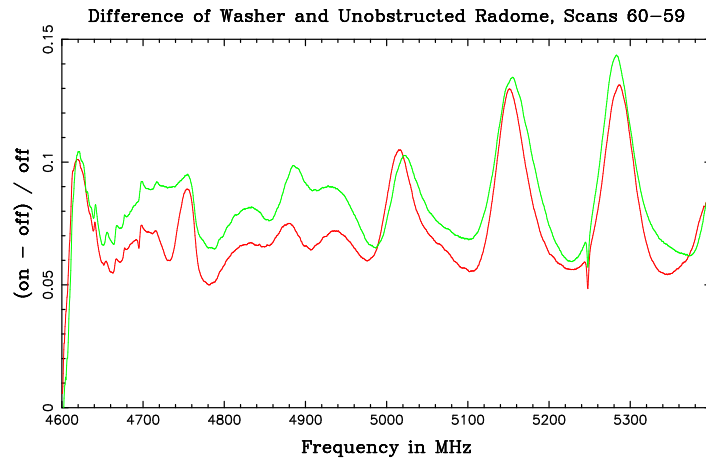


Figure 4: The baseline spectrum differencing an undisturbed scan and a scan with a metal disk covering about 1% of the feed radome area.

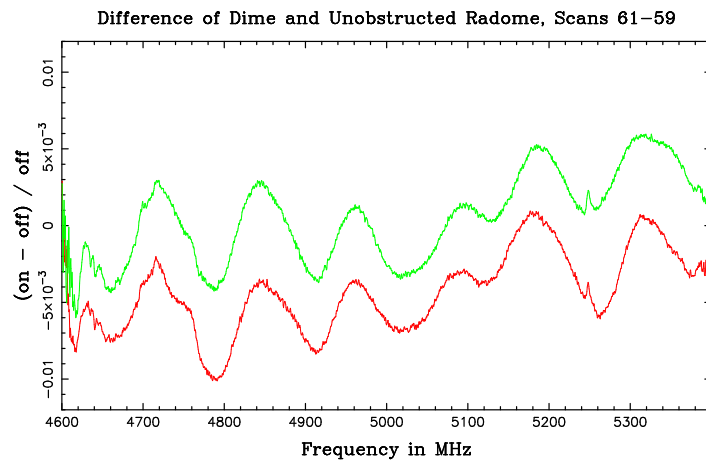


Figure 5: The baseline spectrum differencing an undisturbed scan and a scan with a dime covering about 0.1% of the feed radome area.

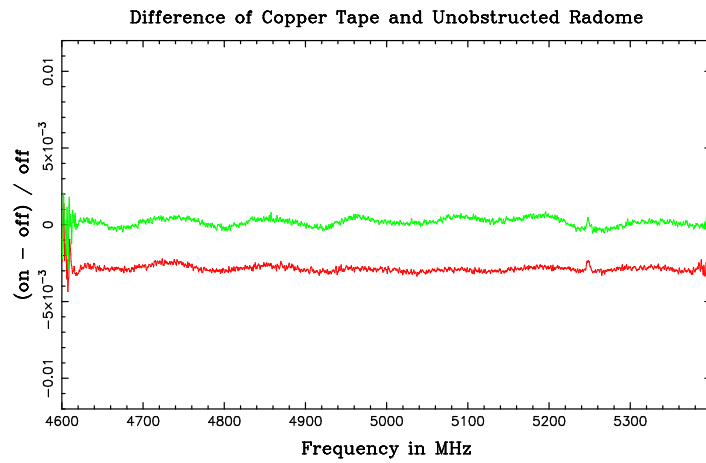


Figure 6: The baseline spectrum differencing an undisturbed scan and a scan with a bit of copper tape covering about 0.02% of the feed radome area.

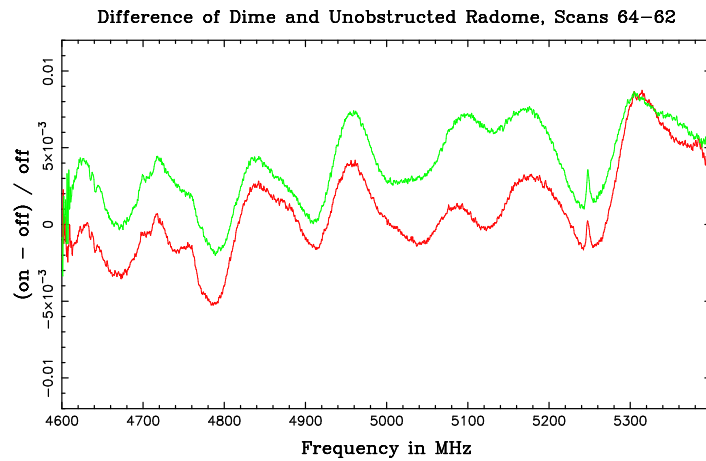


Figure 7: A repeat of the dime test, differencing two new dime off, dime on scans.