Standing Wave Properties of the 2/3mm Receiver at the 12 Meter Telescope

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1 Introduction

For several years now, it has been noted that all three wave bands of the 2/3mm receiver have residual standing wave properties which adversely affect frequency switched observations. With the installation of the digital phase lock loop system for this receiver, it has been possible to do wide-bandwidth frequency-switched observations with switch throws of ± 20 MHz or more. Since standing wave intrusion affects wide-bandwidth observations more adversely than narrow-bandwidth measurements, it is now necessary to locate and remedy this standing wave problem.

2 Standing Wave Characteristics

Figures 1, 2, and 3 show frequency switched spectra obtained with the 2 MHz filter banks. A fit to all of the standing waves is shown for each waveband and polarization within that waveband. Note from these figures that:

- The standing wave amplitude ranges from 2 to 20 K.
- With the exception of the poor fit to 3mmlo channel 1, the standing wave frequency is 123 to 128 MHz. The standing wave frequency is related to the reflective path through the following:

  $$l = \frac{c}{2\nu} \tag{1}$$

  where l is the conductive path length, c is the speed of light (2.99792458×10^8 m s^{-1}), and ν is the standing wave frequency. Using Equation 1, a standing wave frequency of 123 to 128 MHz corresponds to a path length of 1.22 to 1.17 meters, respectively
- There are differences between the standing wave frequencies for the two channels of a given mixer pair. These differences could be due to uncertainties in the fits to the standing wave frequency, but could be due to slight differences between the lengths of the conducting paths for the standing waves corresponding to the two channels. Repeated measurements yield consistently the standing wave frequency differences shown in Figures 2 and 3 (I have not done repeated measurements of 3mmlo).

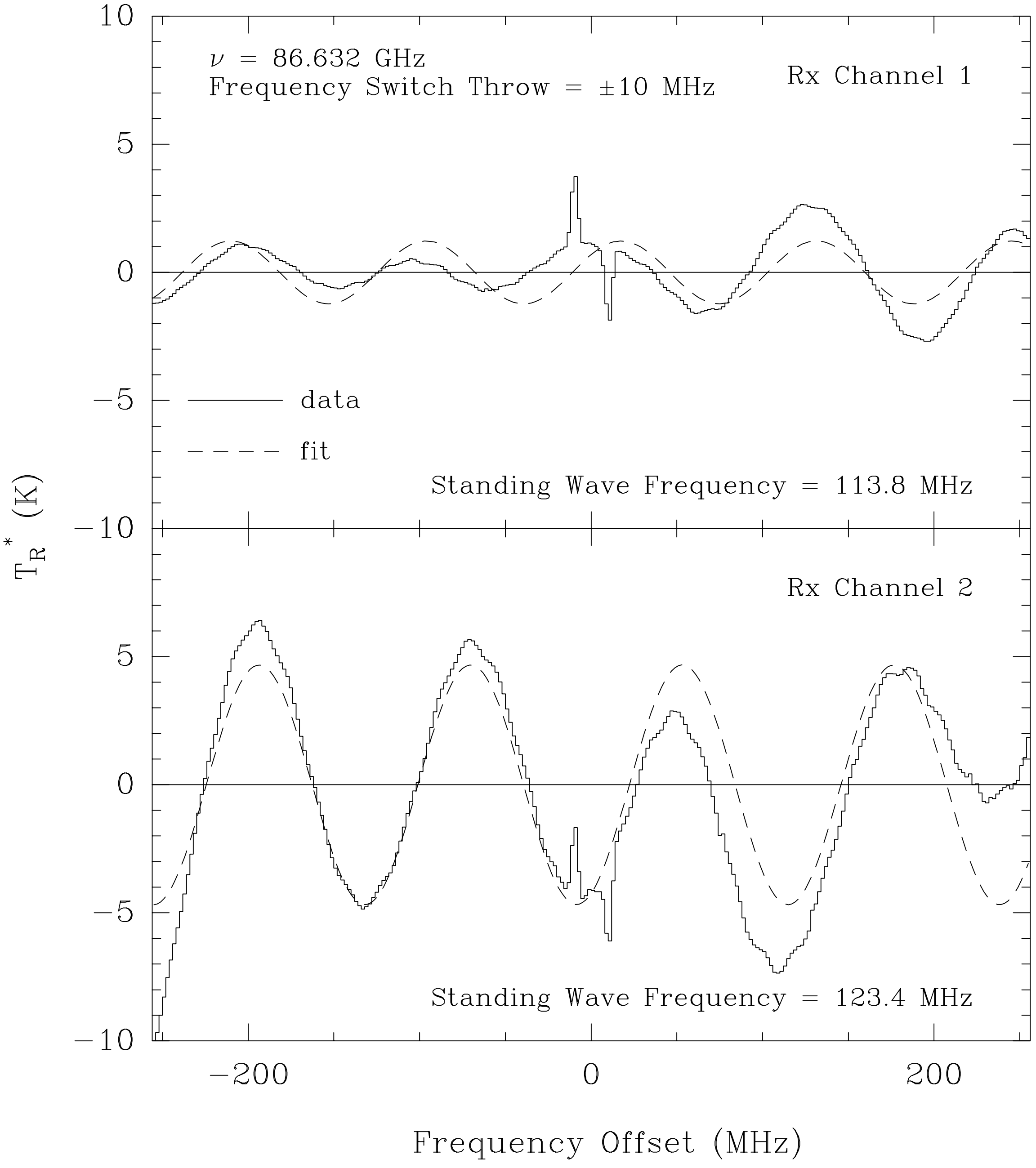

Figure 1: Frequency switched measurements with the 3mmlo mixer pair using the 2 MHz filter banks. Note that the fit to channel 1 is poor.

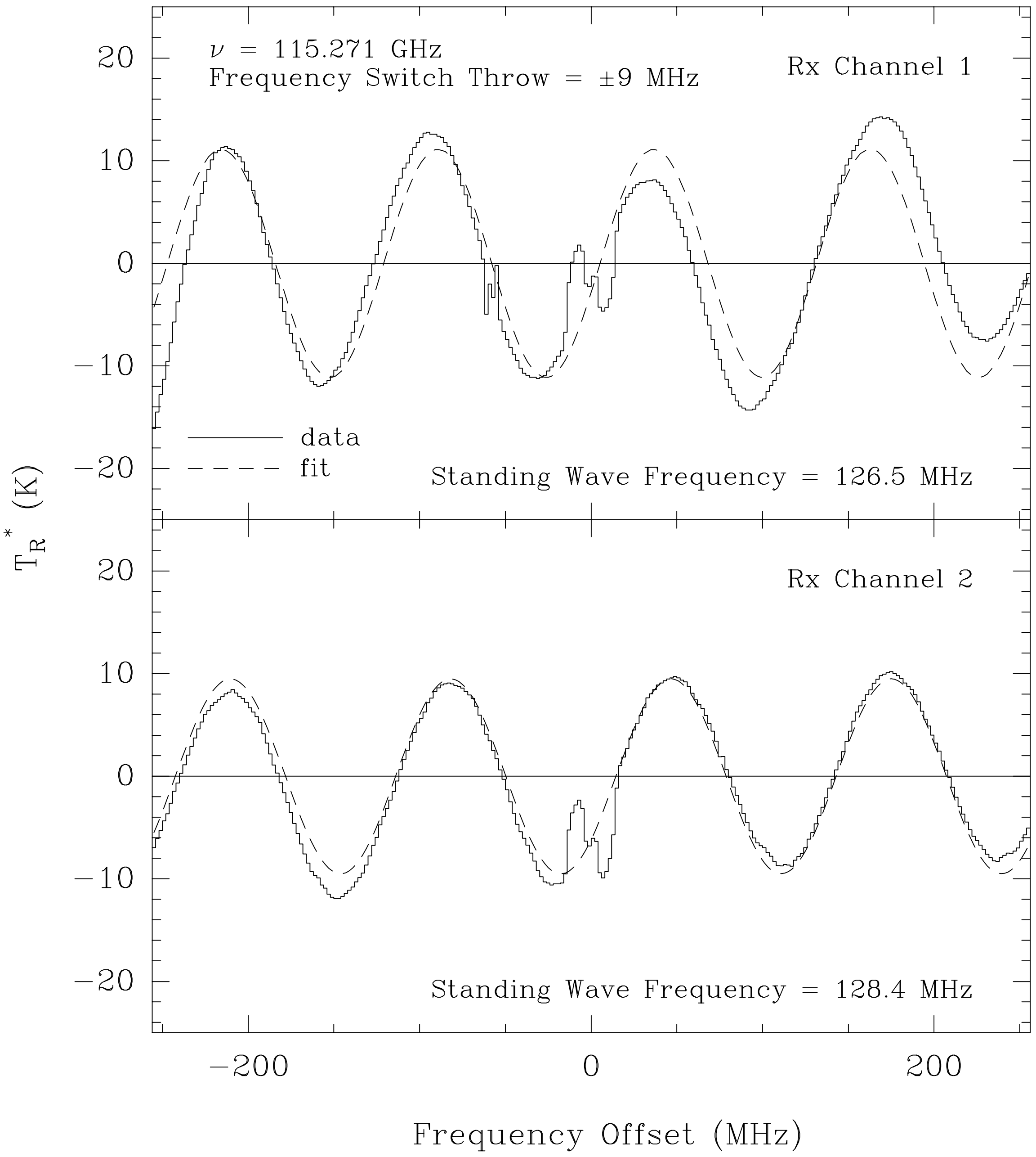

Figure 2: Frequency switched measurements with the 3mmhi mixer pair using the 2 MHz filter banks.

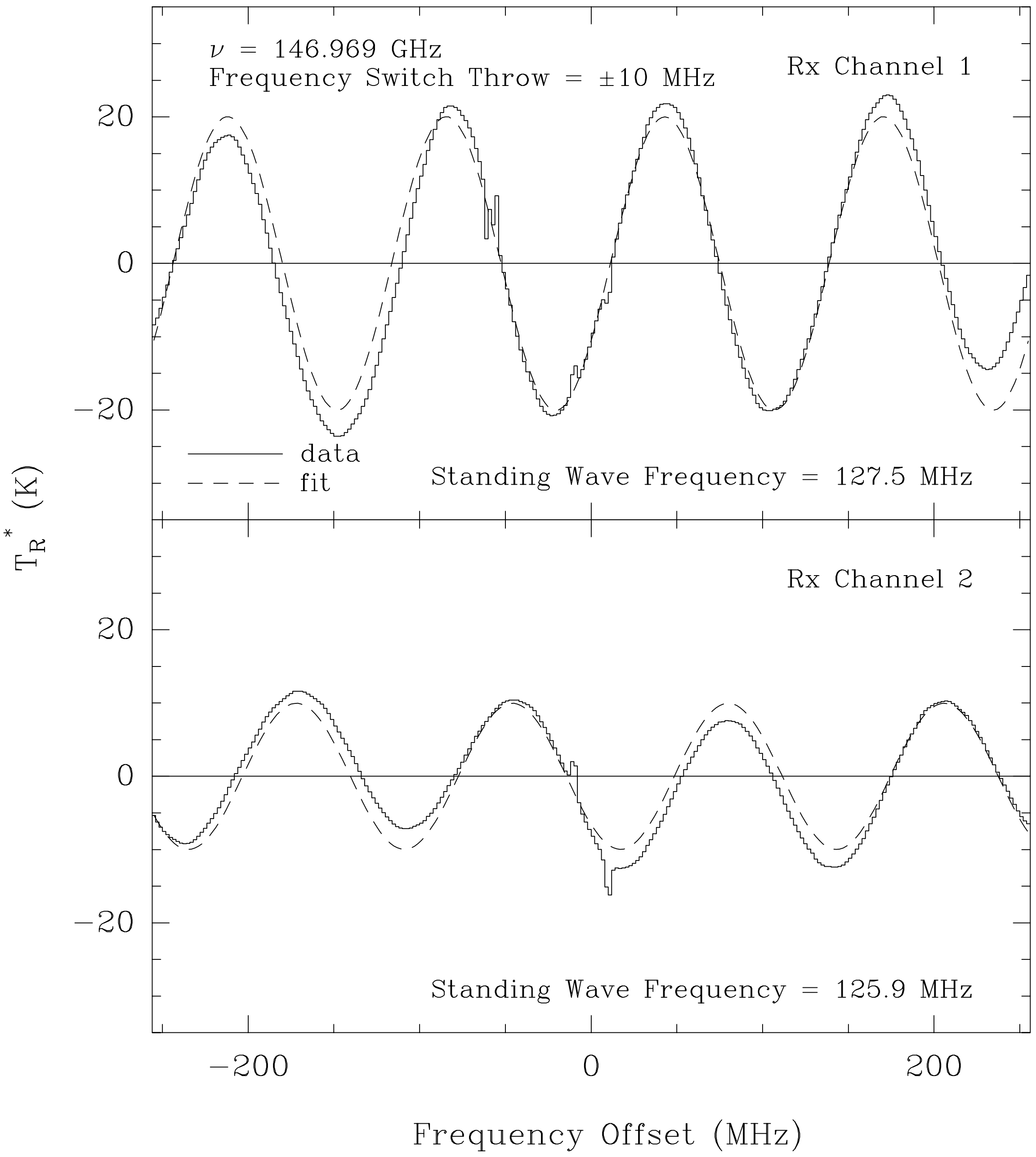

Figure 3: Frequency switched measurements with the 2mm mixer pair using the 2 MHz filter banks.

3 Summary

The obvious question is **what path corresponds to the measured standing wave frequency?**

1. Feed-to-Subreflector? The subreflector is located at a distance of 8.53 meters from the feeds of the 2/3mm receiver. Using Equation 1, this path corresponds to a standing wave frequency of 17.6 MHz.
2. Feed-to-Cross Grid Absorber? The absorber at the bottom of the cross-grid is located a distance of 1.17 meters from the feeds of the 2/3mm receiver. Using Equation 1, this path corresponds to a standing wave frequency of 128.1 MHz.
3. Feed-to-Gortex Receiver Cover? The Gortex cover at the top of the receiver box is located a distance of 1.37 meters from the feeds of the 2/3mm receiver. Using Equation 1, this path corresponds to a standing wave frequency of 109.2 MHz.

It appears that the most likely culprit for the reflection point which leads to the standing wave is the absorber at the bottom of the cross-grid. Tests of this hypothesis will be made in the coming months to try to diagnose and eliminate this standing wave.