Memorandum

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cc: J. Webber

From: J. Effland, K. Xiluri, R. Groves

Date: 10 January 2000

Subject: Cold Load Measurements

Relative noise power from the conical cold load is presented in this memo as a function of distance from the Dewar. The attached graphs show noise power increasing rapidly with distance, and the increase varies with frequency, which suggests that optical system changes are required. Receiver noise temperature measured both manually and with the chopper wheel is also shown.

The mixer installed in the Dewar for these measurements was UVAVIII-L765C-2-B3-1-BM371G-02. The lens was found in the lab and has no identifying markings on it. It was installed in the Dewar a few months ago.

Cold Load Noise Power vs. Distance

Noise power changes as a function of the cold load's distance from the Dewar were measured using Pan's conical cold load. The data were measured by referencing the HP436 power meter to 0 dB while holding the conical cold load against the Dewar window, then recording the relative noise power after moving the cold load a measured distance from the window. The load was dipped in liquid nitrogen for each distance measured.

To check for load heating effects and for measurement repeatability, the cold load was returned to the Dewar window immediately after measuring the noise power at each distance, and the relative noise power was recorded. The noise power when the load was returned to the Dewar window was never more than .02 dB from the initial value. Measurements at each distance were repeated three times and averaged.

Figure 1 shows the data measured at 230 GHz, and it suggests that wide-angle scattering of the beam occurs. We expected an almost constant cold load noise power when the load is near the Dewar window, but Figure 1 shows that the load's effective noise temperature increases immediately when it is moved away from, but still near, the Dewar. The solid curve is the subtended half angle *vs*. distance for the conical load, which has an opening of 8.8 cm.

Figure 2 shows the data measured at 270 GHz and plotted with the same scale as Figure 1. The general shape of curve is similar, but the beam appears better focused because the noise power increases slower as a function of distance.

Noise power *vs*. distance was also measured with the circular section of pyramidal load that has a 14.5-cm diameter. This cold load is normally used with the small chopper wheel. The load heated rapidly, and the variance in data was large, rendering the measurement useless.

These measurements will be repeated when new lenses become available.

Automated and Manual Receiver Temperatures

Figure 3 shows receiver noise temperature for this same mixer when measured manually with the conical load and automatically with the chopper wheel and large pyramidal load sheet. The effective noise temperature of the automated load was determined from a least squares analysis that minimized receiver noise temperature discrepancies between the conical cold load and the pyramidal cold load used with the chopper wheel. When the receiver noise temperature using the conical cold load was held fixed as the reference, the effective temperature of the pyramidal load was found to be 97.1K.

The residual discrepancies are large (± 8K at 201 GHz), and they also vary with frequency. However, the repeatability of the automated measurements is poor (± 3K), as shown by the three measurement points at 270 GHz. The data variance may have resulted from the software reading the power meter while the chopper was moving. The software has just been enhanced to wait until the chopper wheel is in position prior to reading the power meter, and this new software will be used when the next mixer is tested.