

CORRUGATED HORN ANTENNA NOISE TEMPERATURE CHARACTERISATION FOR THE NRL WATER VAPOR MILLIMETER-WAVE SPECTROMETER PROJECT

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Introduction: The goal of the Water Vapor Millimeter-wave Spectrometer (WVMS) project is to measure water vapor in the middle atmosphere (between about 40 and 80 km), in parts per million. Since water vapor is the primary source of the hydroxide (OH) radical and other hydrogen compounds, it is important in controlling ozone chemistry. The WVMS instrument is a microwave radiometer which measures water vapor emission at 22 GHz.

The signal which is being measured is very weak, approx. 0.2 K line amplitude. For this reason it is important to have as much power as possible in the main beam. Otherwise systematic errors occur coming from the increase in antenna temperature originated from radiation which is received by the sidelobes coming from sky and ground brightness temperatures, [1].



Fig.1: Water Vapor Millimeter-wave Spectrometer (WVMS-5) under operation at Mauna Loa Observatory (Hawaii)

In this paper the antenna noise temperature for two different corrugated horn antennas (old model and new

model) for NRL WVMS is being characterized. The whole optical system will be simulated with Tica's GRASP software, and the corrugated horns with Mician μ Wave Wizard software. Spherical wave expansion from Mician μ Wave Wizard will be exported to Tica's GRASP to connect both results.

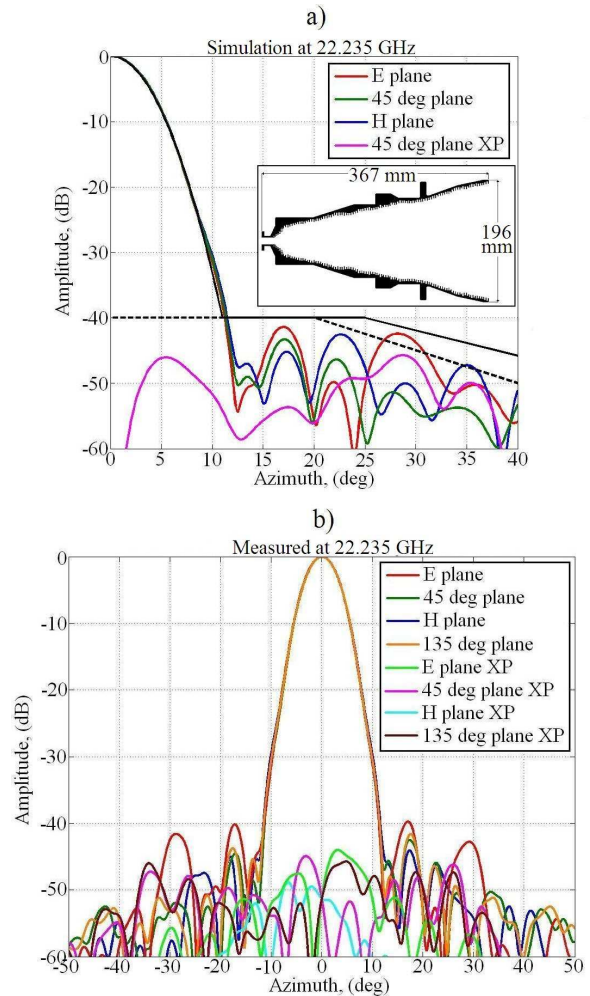


Fig.2: Simulated a) and measured b) far field radiation pattern of new model corrugated horn antenna [2], [3]

Although simulated data will be used in this characterization, both corrugated horn antennas have been manufactured and their measured radiation patterns are really similar to the simulated ones, so no significant difference is being expected from simulated results.

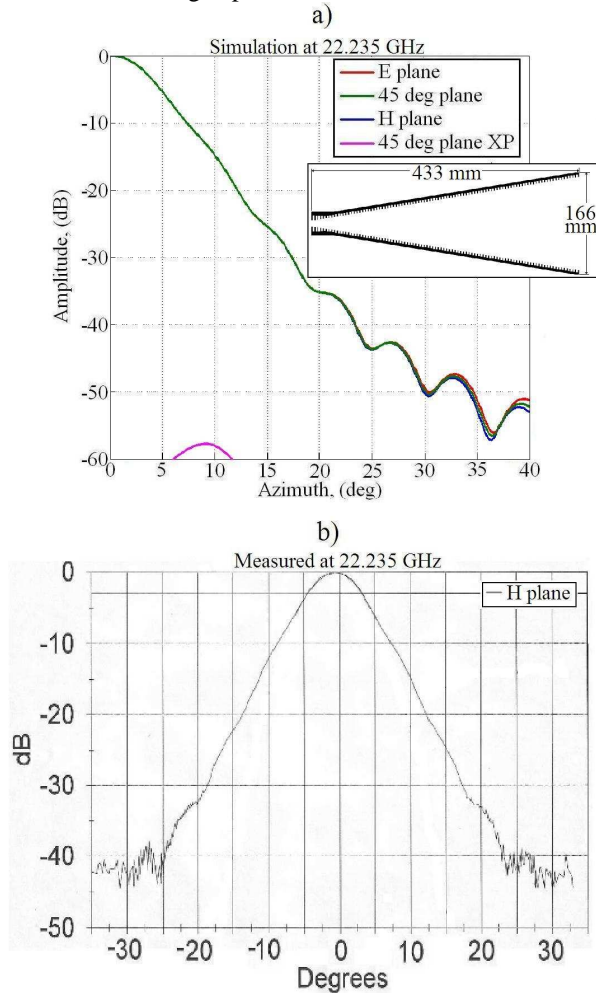


Fig.3: Simulated a) and measured b) far field radiation pattern of old model corrugated horn antenna

A numerical integration will be done from the resultant GRASP full spherical radiation pattern to calculate the antenna brightness temperature seen from each corrugated horn antenna.

This numerical integration will contain the effects of sky brightness temperature, ground brightness temperature taking into account ground absorption and reflection and atmospheric loss contributions at the frequencies of operation of the spectrometer, [4], [5].

The scenario selected for the integration will be a flat surface model at a certain altitude above sea level.

Individual contributions to the total antenna noise will be evaluated in a table for both corrugated horns so an idea of the principal contributions can be extracted.

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