Spline-Profile Diagonal Horn Transmitter at 104 GHz Suitable for LLAMA Observatory Holography Measurements

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The Large Latin American Millimeter Array (LLAMA) is a joint scientific and technological project of Argentina and Brazil whose goal is to install and to operate a radio observatory in the Argentine Andes, at 4800m of altitude. LLAMA observatory is a single dish 12m parabolic antenna made by Vertex company, as APEX telescope.

Currently, we are designing the holography facilities and devices to guarantee the functionality of the antenna. Holography measurements requires a narrow bandwidth and a strong phase uniformity to ensure the accuracy of the manufacture specifications in a parabolic antenna surface. The antenna as delivered may have the panels mis-adjusted such that the total error is as large as 100μm; Final adjustments should be done by the LLAMA team.

The basic specification is that the final surface should be accurate to 20μm, computed as the RSS of various contributions. Using the holography recommendations from ALMA [1], it is also required to allow for 10μm of RMS error in panel setting knowledge (and 2μm of error in setting the panels to the desired places.

This paper is about the design and characterization of the transmitter horn's holography system. The transmitter's beam width is determined by the need to illuminate the 12 m antenna with reasonable uniformity. Variations in phase, if uncorrected, lead directly to errors in the reflector surface deviations being measured. It is expected that the horn can be made to produce a far-field spherical wave to the required tolerance within the part of the beam being used.

Corrugated horns have traditionally been the preferred choice with the best performance but are expansive and impractical to manufacturing when the frequency is increased. We are using the Gibson Model [2], a split-block diagonal horn optimized for 104GHz [3]. The performance of this antenna is less than a corrugated horn, but optimizing the depth profile, the performance can be improved significantly using only a uniquely simple milling machine.

Fig. 1. Mechanical model of the Spline-Profile Diagonal Horn Antenna.

In this paper we will show the model, the design, the measurements procedures and the results of the characterization. Furthermore, we will compare the results with the previous specifications of the horn transmitter and discuss it.

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