Characterization of the Active, Inverted, Conical Sinuous Antenna

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We present the results of our continuing study of the inverted, conical sinuous feed over the 0.5–3 GHz band. Feed-amplifier integration is a very important factor to build a low loss, low noise system. Hence we are studying the feed and LNA as a single integrated unit for characterizing pattern and noise properties. Such a low loss, wideband system will be an essential part for the next generation radio astronomy arrays such as Frequency Agile Solar Radiotelescope (FASR).

The self-complementary, frequency independent nature of the planar sinuous geometry results in a nearly constant beam pattern and fixed phase center over more than a 10:1 operating frequency range. In order to eliminate the back-lobe response over such a wide frequency range, the sinuous pattern is projected onto a cone having an opening angle of 45 degrees and a ground plane is placed directly behind the cone's apex. This inverted, conical geometry assures wide bandwidth operation by locating each sinuous resonator a quarter wavelength above the ground plane. This feed was fabricated (see figure below) by first etching the sinuous pattern onto a thin, metalized polyester film which was then shaped around a low-loss foam support to form the conical structure.

A twin line calibration method was developed for measuring the terminal impedance of the feed using a VNA. A Low noise amplifier with Zopt close to antenna impedance was developed and mounted directly to the feed terminals near the ground plane. The noise temperature of the feed - amplifier combination was measured using the cold-sky and absorber method. This type of characterization of the combined unit allows to predict the possible ripple in noise and gain. Far-field beam patterns including the cross polarization of the feed - amplifier combination were measured on the outdoor antenna test range located at the NRAO Green Bank facility. The encouraging results of our initial investigation have provided the motivation for us to examine more advanced design ideas such as a very low noise cryogenic integrated unit consisting of a feed and LNA encompassed inside foam.

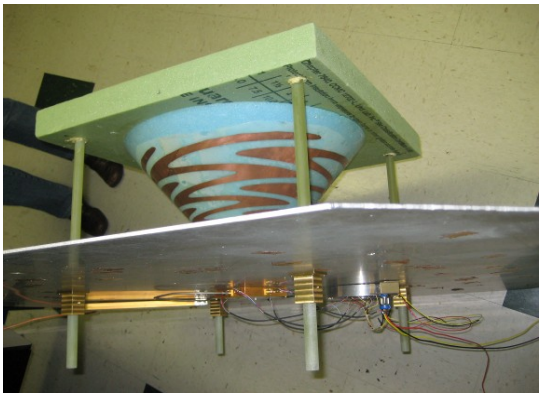

Figure 1: Conical Sinuous Antenna