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Optics And Feed Design For ngVLA

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This paper discusses the Next Generation Very Large Array (ngVLA) antenna configuration. Optics designs of the double-offset Gregorian antenna with different subreflector opening angles are shown. Compatible feed designs will be presented and simulated performance will be discussed.

Understanding the formation of Solar System Analogues, probing initial conditions for Planetary Systems, charting the assembly, structure and evolution of Galaxies, tests of gravity using Pulsars in the Galactic Center, understating formation of Black Holes etc., are the main science goals for the ngVLA [1]. In order to target these science goals, the ngVLA requires about 10 times the sensitivity of the Very Large Array (VLA). The proposal calls for 214 eighteen-meter antennas distributed over an area with minimum extent of 300km (E-W) by 500km (N-S) in the western New Mexico region. The front ends will cover the 1.2–50.5GHz and 70-116GHz frequency range with maximum sensitivity implemented in six bands, balancing cost and performance [2].

The baseline design uses a double-offset Gregorian antenna with an 18m main reflector and a 3.2m subreflector. This configuration provides sufficient real estate for housing all the receivers and feed horns without causing any blockage. The subreflector has an opening angle of 110°. The feed horn that effectively illuminates this subreflector is an axially corrugated horn with flare angle (half angle) of 55° (Figure. 1). The aperture diameter is about three wavelengths. Telescopes operating at centimeter wavelengths, typically have subreflector opening angles varying between 20° and 40°. Compact/profile corrugated horns for these subreflector angles have aperture diameters varying between 11λ to 5.8λ. These horns are too big to fit on an 18m antenna and is the reason for the large opening angle on the ngVLA antenna. We have analyzed Gregorian antennas with subreflector angles between 80° and 110°. Axially corrugated horns for these designs are less than 4λ in diameter. Measured patterns of these horns will be presented. Calculated efficiency for the different cases will be compared at L- and Ku-bands.

Figure 1. Axially Corrugated Horn.

1. A. Bolatto et.al., "Key Science Goals for the Next Generation Very Large Array (NGVLA): Report from the NGVLA Science Advisory Council," *ngVLA Meno #19*, 27, November 2017.

2. R. Selina and E. Murphy, "ngVLA Reference Design Development & Performance Estimates," *ngVLA Memo #17*, 18, July 2017.