A High Performance, Offset, Shaped Antenna Design For The New Generation VLA Project

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Modern radio astronomy is moving toward arrays of smaller receiving elements used in large numbers to achieve both high sensitivity and high spatial resolution. The key enabling technology for this trend is the massive computing power needed to process the enormous data streams from the receive elements into synthesized beams and images. The New Generation Very Large Array is a project under development to be sited at present VLA location in New Mexico plus extended locations around the core location. The antennas comprising the array are key elements, largely determining the achievable performance of the array and are a major part of the project cost. This presentation will review the optical design and simulated performance of an offset, shaped antenna design targeting the ngVLA application.

There are many specifications defining a high performance antenna for radio astronomy but the most important is G/T, the gain of the antenna divided by the system noise temperature. Maximizing G/T is key to achieving optimum system performance. The size of the aperture for the ngVLA antennas has been set by a system level tradeoff study and is fixed at 18 meters. High gain with that aperture size is achieved by having nearly uniform aperture illumination. Minimizing system temperature is equally important and is achieved by reducing all sources of spillover which can pick up ground noise. In conventional conic antennas the goal of high aperture efficiency and low system noise are conflicting, improving one degrades the other. The use of shaped reflectors permits the achievement of both simultaneously. In addition, the use of an offset geometry eliminates all sources of blockage and associated scattering, further enhancing G/T.

The presentation will review the ngVLA design, including some aspects of the shaping process. Simulated performance including efficiency, noise temperature tipping curves, sidelobe levels and cross polarization will be shown.