Design, Realization and Measurements of a Conical Metahorn with Symmetric Radiation pattern and Low Cross-Polarization

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Horn antennas with symmetric radiation properties and low cross polarization are desirable for efficient illumination of parabolic antenna. Symmetric patterns can be obtained by exploiting the hybrid modes, supported by equivalent impedance walls, e.g. implemented as metallic corrugated surfaces, at the price of increasing the horn weight and bulkiness. An alternative solution, resulting in a lighter and more compact structure, consists in introducing engineered printed metasurfaces in the horn sidewalls (Q. Wu *et al*., "Design Synthesis of Metasurfaces for Broadband Hybrid-Mode Horn Antennas With Enhanced Radiation Pattern and Polarization Characteristics," *IEEE TAP*, Vol. 60, No. 8, August 2012.).

A recent project of the European Space Agency, entitled "High-performance horns with customisable radiation properties", applied the idea to design a high performance Ku-band metahorn. A modal-field based design approach provided physical insight on metahorn behavior, thus better control on geometry and performances. The approach uses an adiabatic local mode approximation was used to derive the modes, leading to a quasi-analytical description overcoming the intrinsic non-separability in conical structure with arbitrary impedance walls (Erik Lier, Per-Simon Kildal, "Soft and Hard Horn Antennas", IEEE Transactions on Antennas and Propagation," vol. 36, no. 8, August 1988).

Measurements on a prototype are in good agreement with simulations, confirming the accuracy of the design procedures and the effectiveness of the metasurface horn concept.

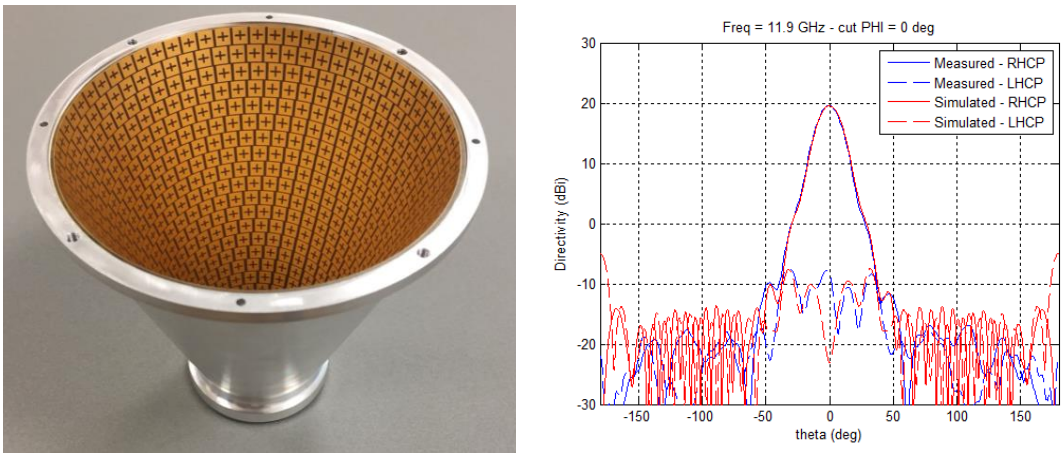

Figure 1. Picture of the realized metahorn and relevant simulated and measured radiation patterns at 11.9GHz.