A NOVEL MM-WAVE DUAL REFLECTOR ANTENNA WITH OMNIDIRECTIONAL RADIATION PATTERN

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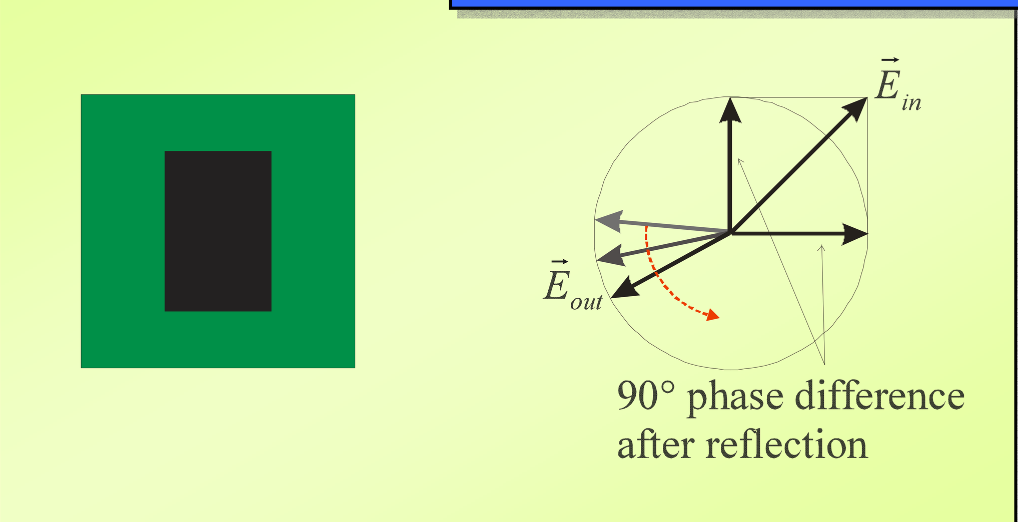
Circular Polarization

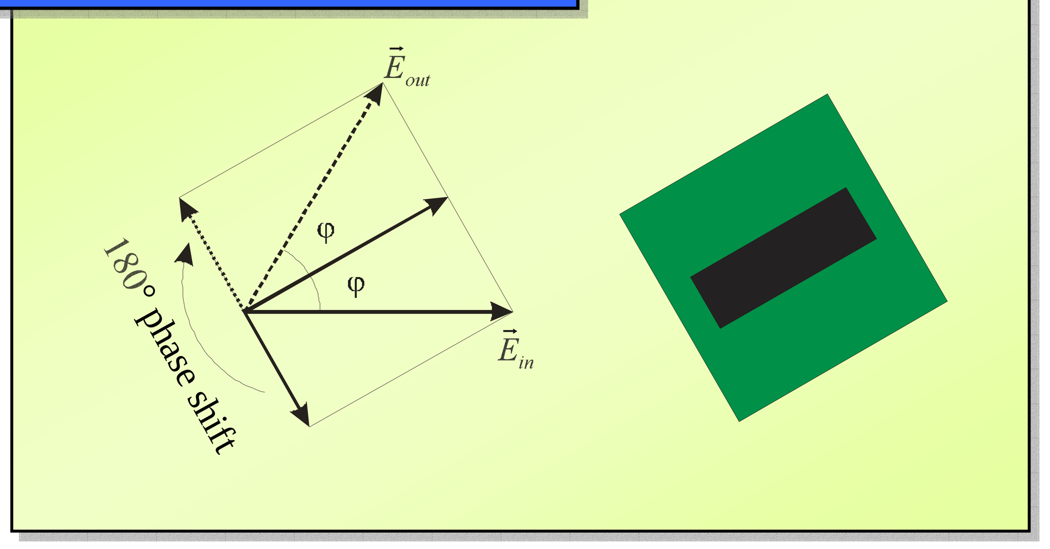
- The patch axes of the reflect array are tilted by 45° with respect to the incident electric field vector.
- The electric field can be decomposed into two components parallel to the patch axes.
- The patches are selected in such a way that a phase difference of 90° occurs between the reflection phase angles of these two components. → Superposition leads to a circular polarized wave.
- Depending on the sign of the phase difference, a right-hand or a left-hand circular polarized wave is obtained.
- For each phase angle difference several length-width-combinations are found. This can be used to set the absolute phase and to transform the incident spherical wave into an outgoing plane wave.

Linear Polarization

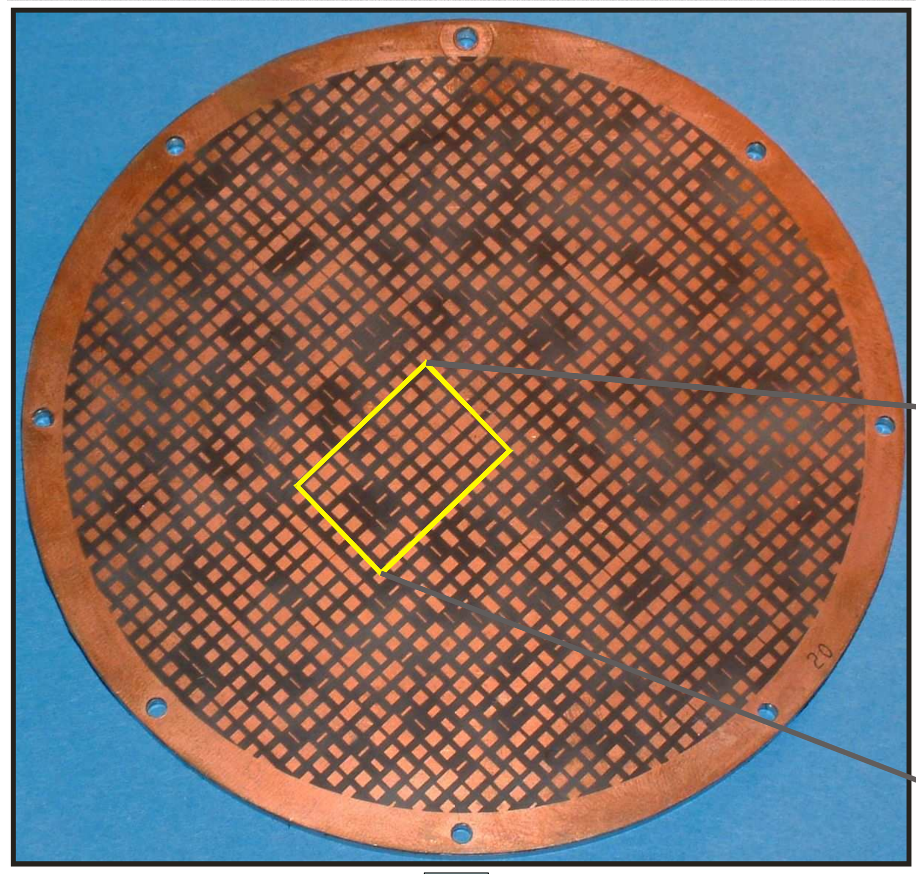
- The patch axes of the reflect array are tilted by φ with respect to the incident electric field vector.
- The electric field can be decomposed into two components parallel to the patch axes.
- The patches are selected in such a way that a phase difference of 180° occurs between the reflection phase angles of these two components.
- Superposition of the two reflected field components leads to a reflected wave with a rotated linear polarization of 2φ.
- For each phase angle difference several length-width-combinations are found. This can be used to set the absolute phase and to transform the incident spherical wave into an outgoing plane wave.

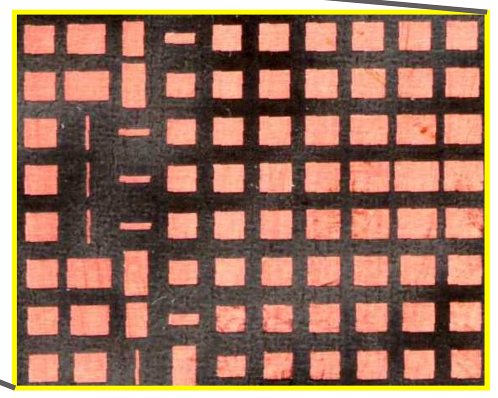
Single cell/patch and vector decom-position of incident and reflected electric field for 90° (left) and 180° (right) of reflection phase angle difference.



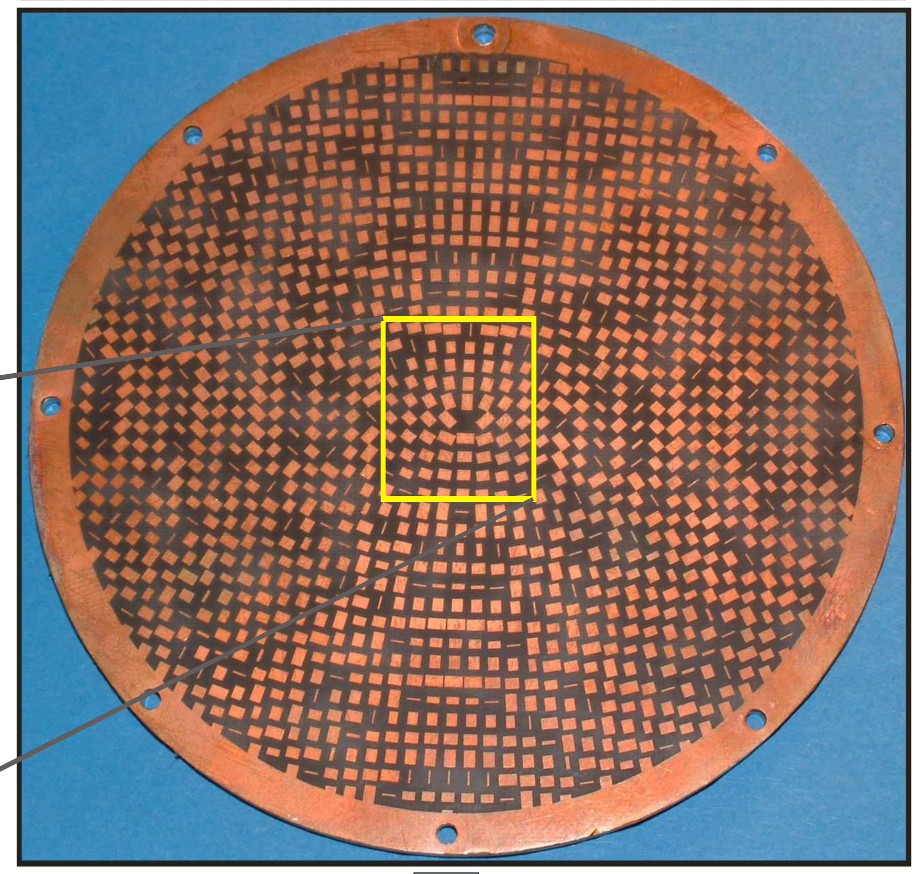


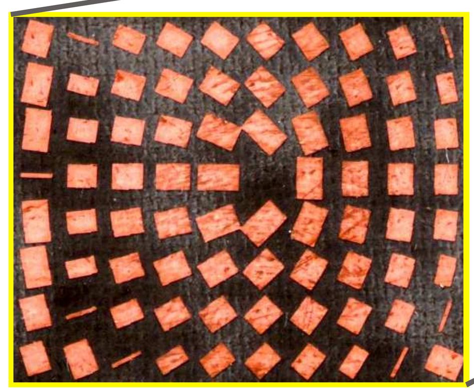
Photograph of top reflector for circular polarization



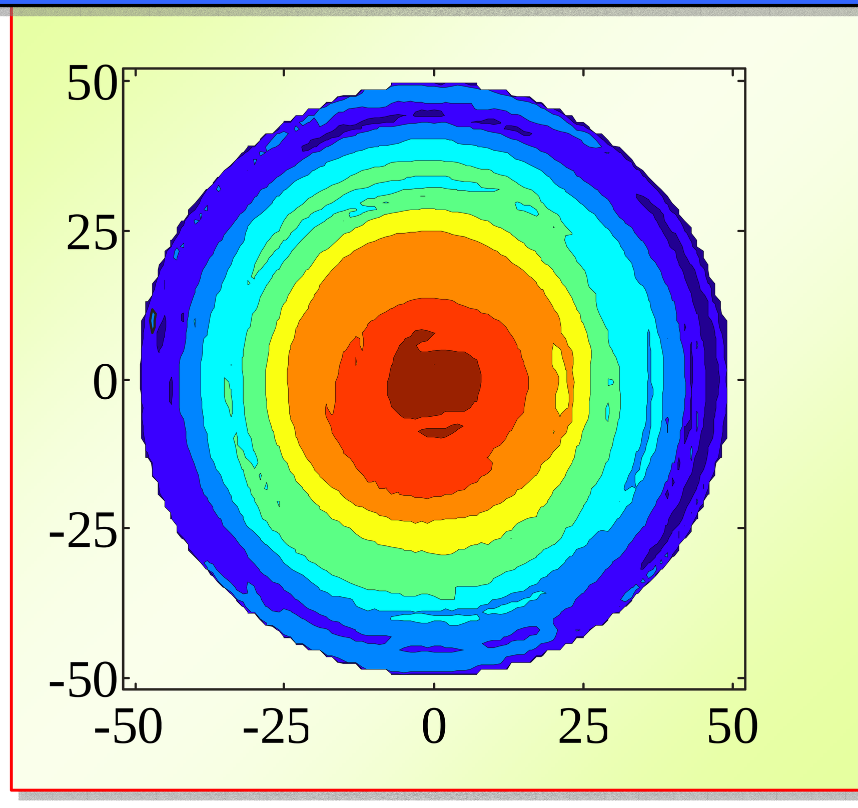


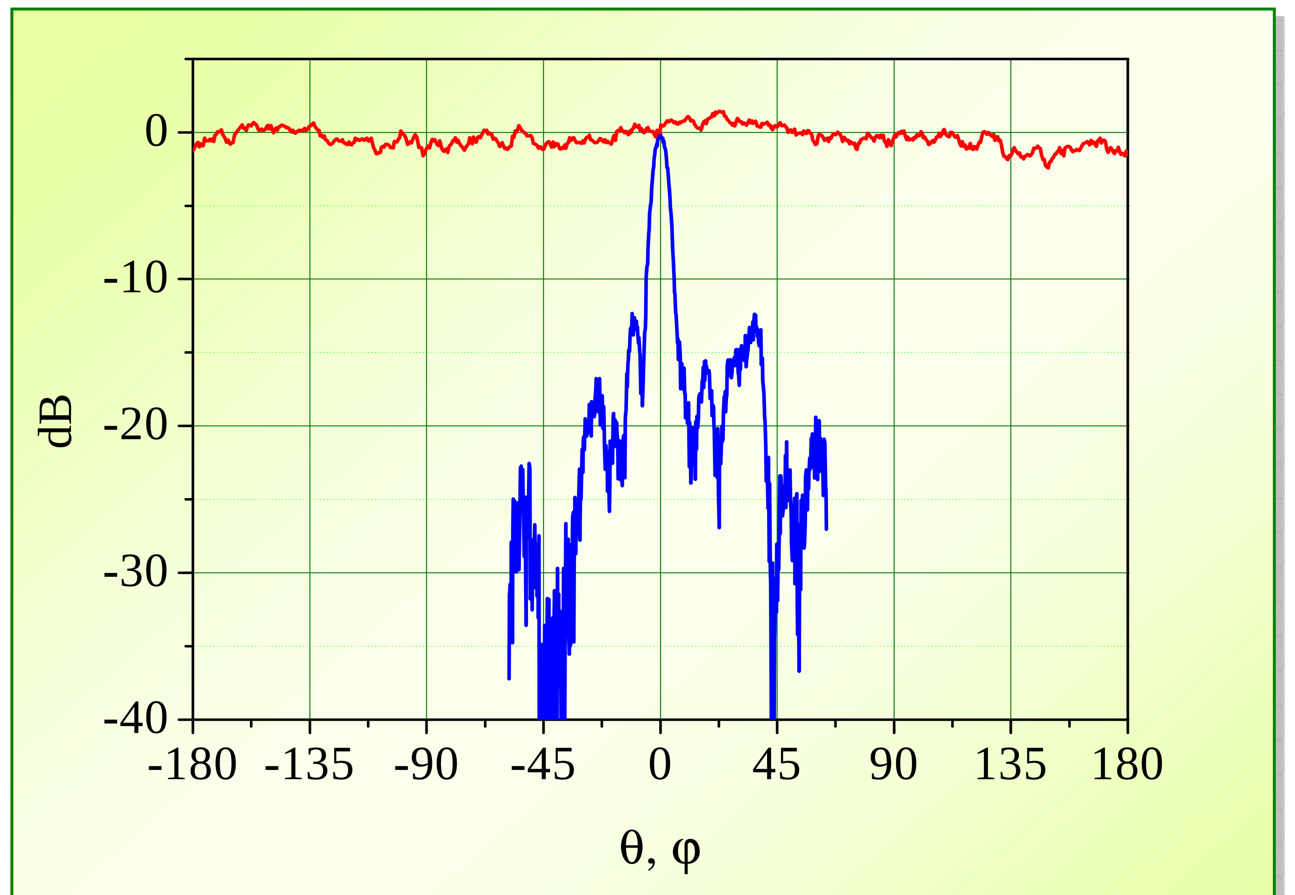
Photograph of top reflector for linear polarization





Measured electric field strength on the planar reflector



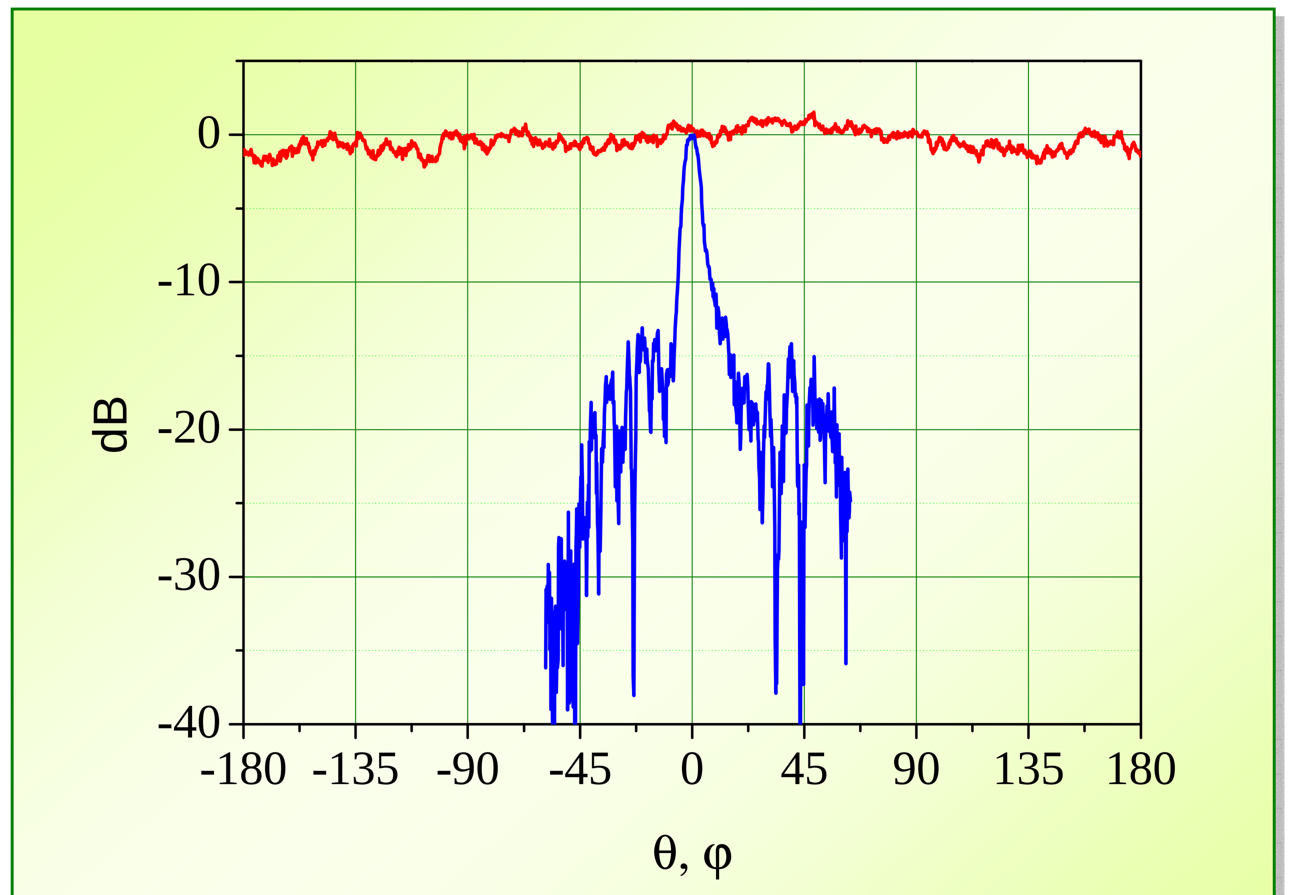


Far field radiation diagram of the omnidirectional antenna with circular polarization

Experimental results

Antenna diameter is 100 mm, focal length (distance between top of cone reflector and planar reflector) is 35 mm, reflector substrates are 0.254 mm thick with a dielectric constant of 2.2. The feed has a diameter of 3.8 mm. The azimuth and elevation radiation patterns of two antennas, one with circular polarization (left side), the other one with linear polarization (right side) are shown. A side lobe level of -12 dB in elevation is achieved for both antennas. The 3 dB-beamwidth is 6.1° for the circular polarization and 6.7° for the linear polarization. Due to unsymmetries in the feed radiation, there is a variation of ±1.8 dB for both antennas in azimuth where omnidirectional radiation occurs (see reflector illumination measurement above).

For the antenna with circular polarization, the sense of the polarization simply can be changed by changing the polarization of the feed (twisting by 90°), for the linearly polarized antenna, switching from vertical to horizontal polarization can be achieved in the same way.



Far field radiation diagram of the omnidirectional antenna with linear polarization