Circular polarization 10GHz slot antenna

Agilent – Momentum&EMDS

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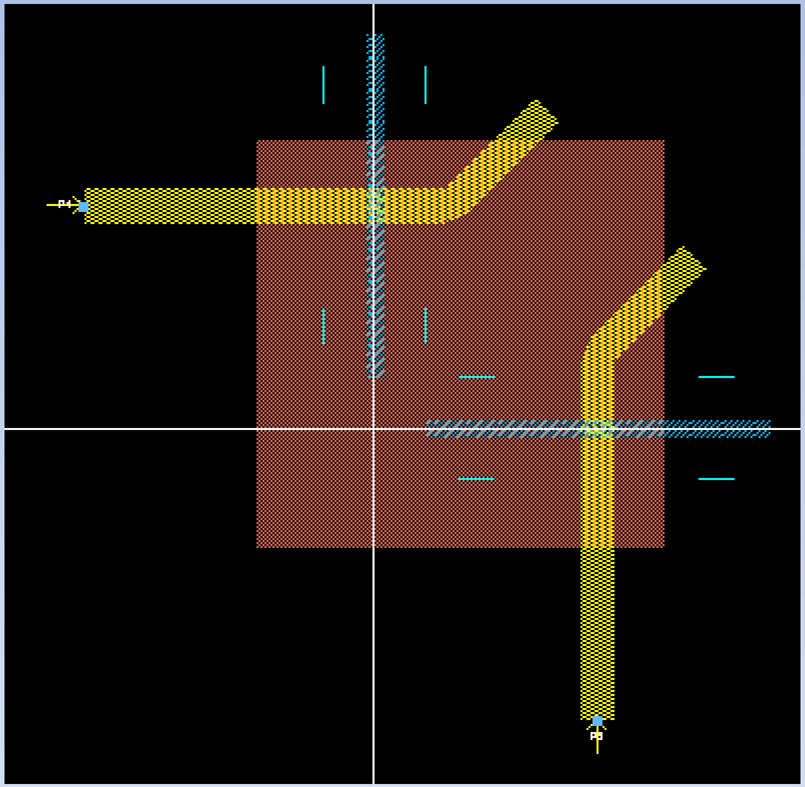
Objectives:

- Design a rectangular microstrip slot antenna
- Geometry: square 11.9x11.9 [mm]
- Two input ports: 50 [Ohm]
- Dielectric: Thickness 1.5 mm [air]
- Fed microstrip lines: w = 1 [mm]
- Slot geometry: 10x0.5 [mm]

Visualizations

- Return Loss versus frequency [dB]/[GHz]
- Antenna pattern: E vs. Phi at 10 GHz
- EMDS 3D antenna visualization
- Directivity and power gain
- Effective area
- Radiated power
- Efficiency
- E_left and E_right (circular polarization components)

Design antenna geometry



- Draw rectangle
- Draw transmition lines
- Connect ports
- Draw slots
- Draw via strips

Details

- The slots are orthogonal in space and are coupled with two feeding strip lines below ground plane.
- The excitation signals are 90 degrees out of phase in order to obtained circular polarization.
- The resonant frequency of this antenna is 10 GHz

Substrate design

- Five subtrate

  - Free space (Boundary open)

  - Antenna sub (1.5 mm)

  - Strip_top (0.3 mm)

  - Strip_bottom (0.3 mm)

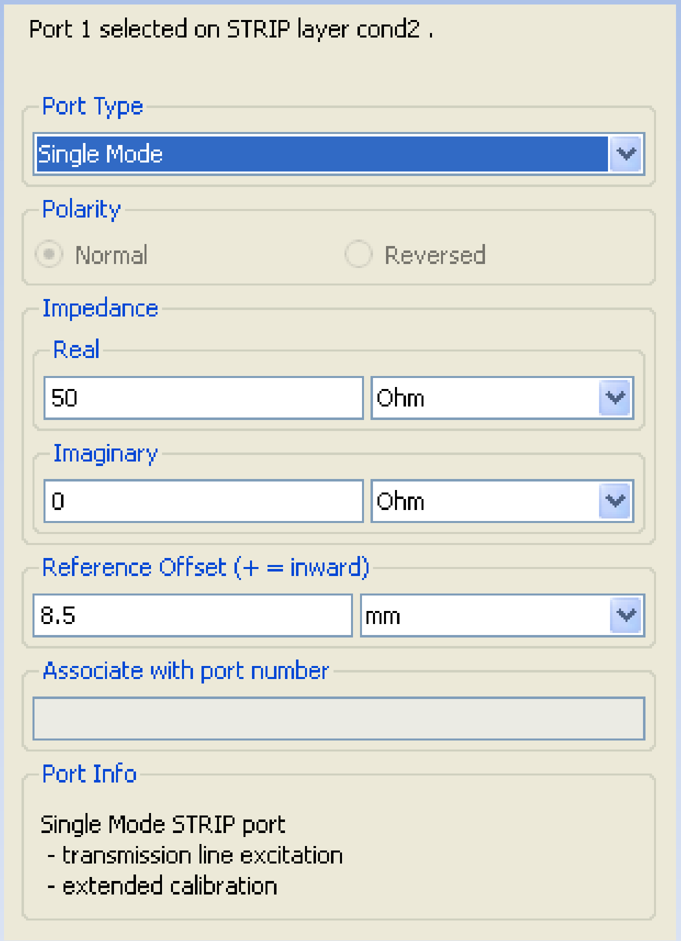
  - GND (closed)

Layout layers design

- Eight layouts
  - Free space
  - Strip conductor
  - antenna_sub
  - SLOT hole
  - Strip_top VIA dielectric
  - Strip cond2
  - Strip_bottom VIA dielectric
  - GND

Port type

- The port is calibrated to remove any mode mismatch at the port boundary.

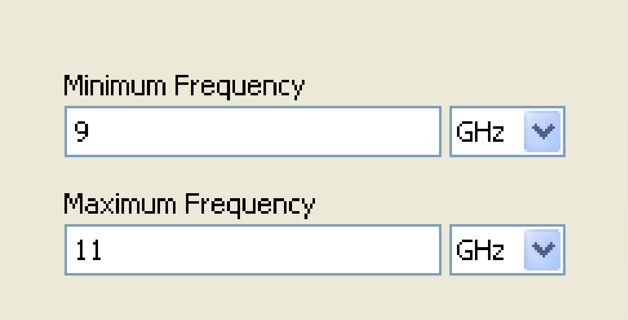


Precompute substrate

- In order to perform a simulation and to calculate a mesh, Green's functions characterizing the behavior of the substrate must be computed:
- If you intend to precompute a mesh before you simulate, you must precompute the substrate first.
- When the computations (Green's functions) are complete, the data is stored in a database, and it will be used in the simulation of any design that uses this substrate. If the substrate has been precomputed before and there has been no changes to the substrate, it will not be recomputed unless the frequency range has been extended. The frequency range can be set when using the Momentum mode, but not in Momentum RF mode. In RF mode, the frequency range (start-stop) is not requested. Since the RF mode uses the quasi-static Green's functions, they are calculated at quasi-static frequencies automatically chosen by the program. Substrate functions calculated in Momentum mode are reusable in RF mode if they are calculated from DC to some upper frequency.

-Insert the frequencies domain to precompute substrate

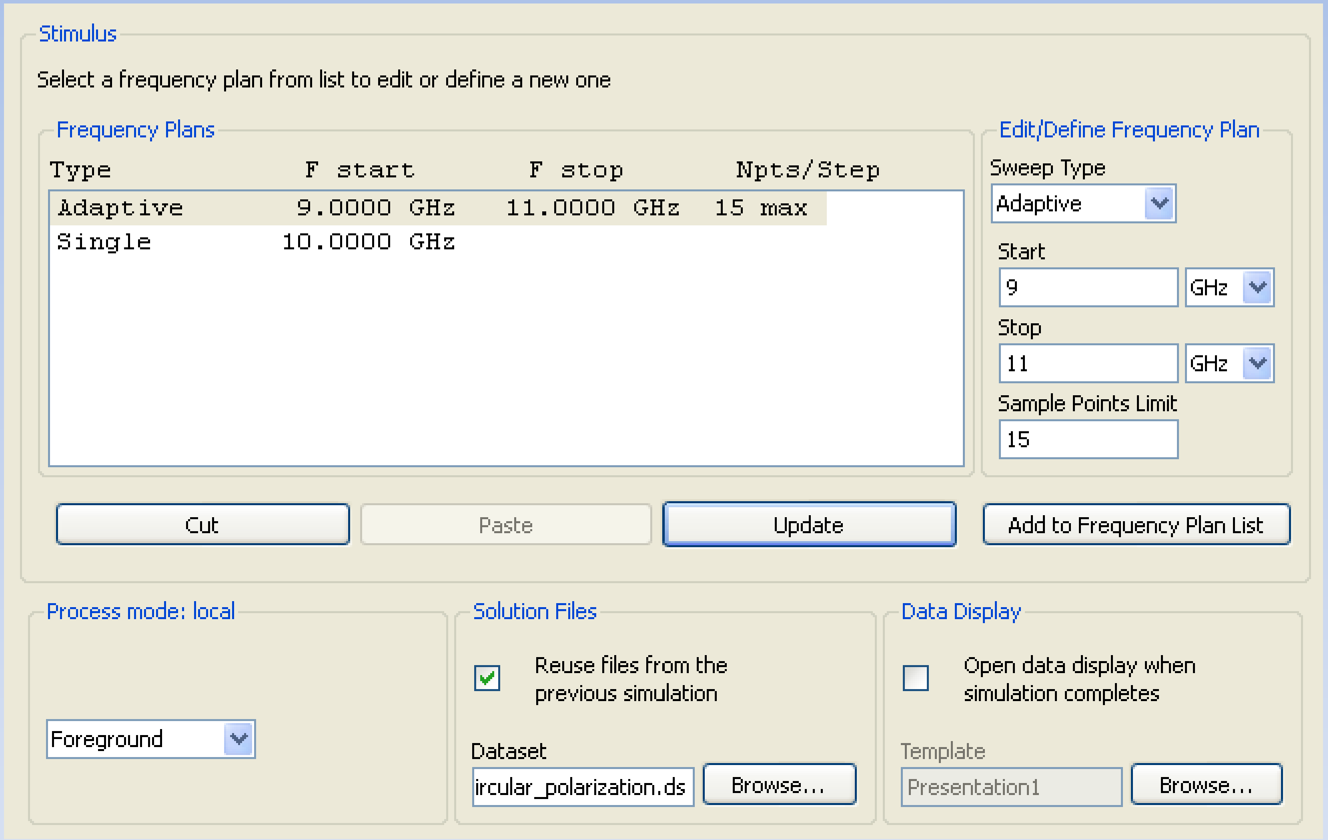
- Precompute mesh at 10 GHz



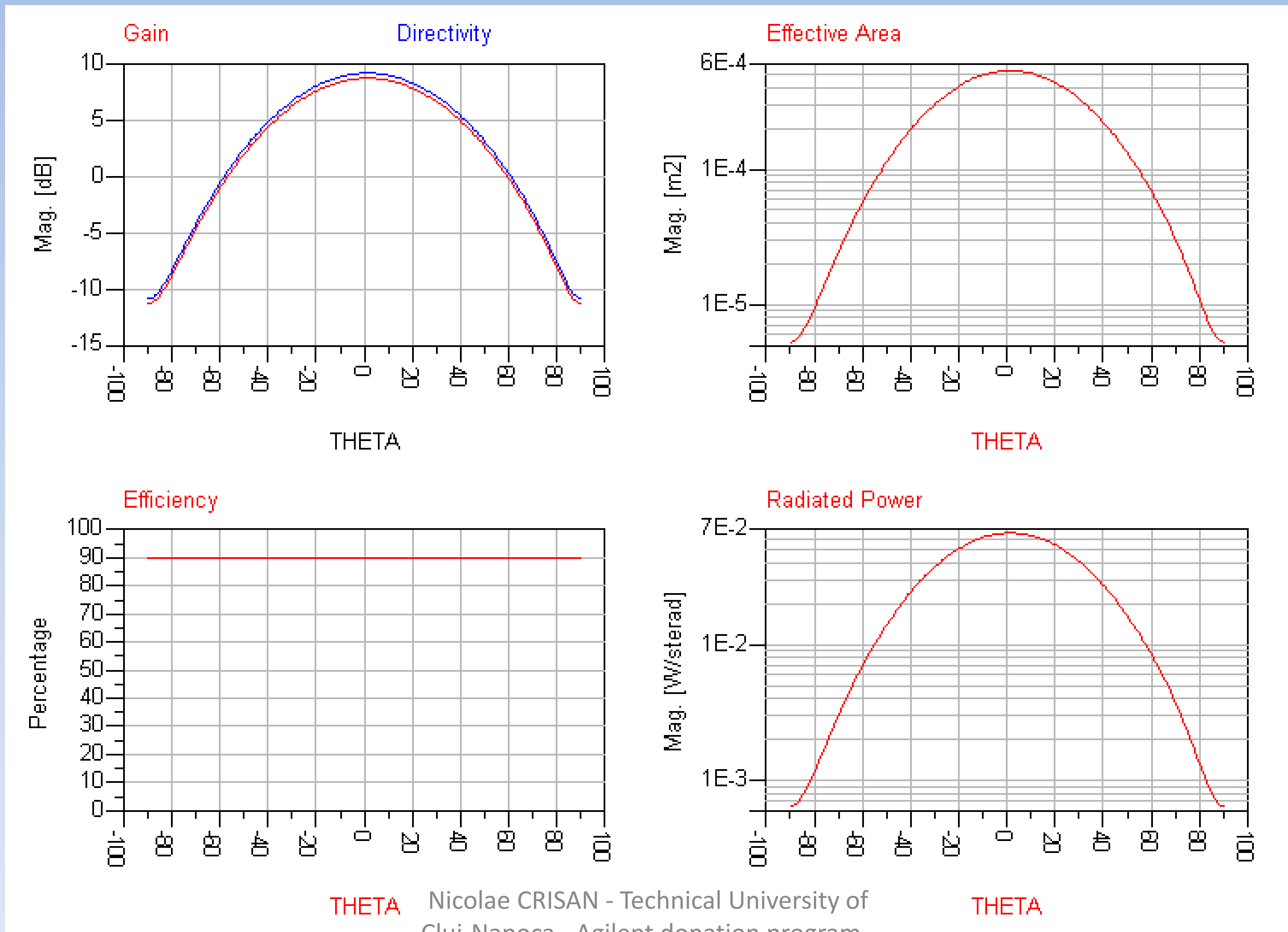
Simulation setup – S parameters

- Select start and stop frequencies
- Step
- Single
- Or number of points

- Run simulation



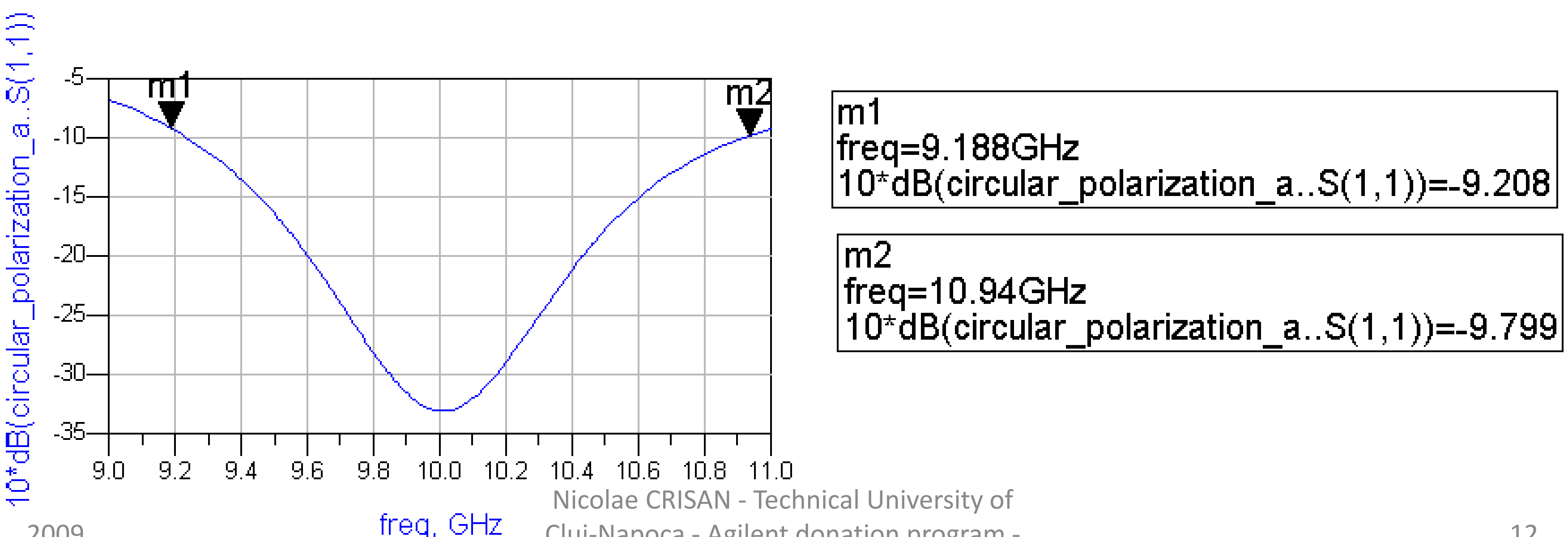
Simulation results



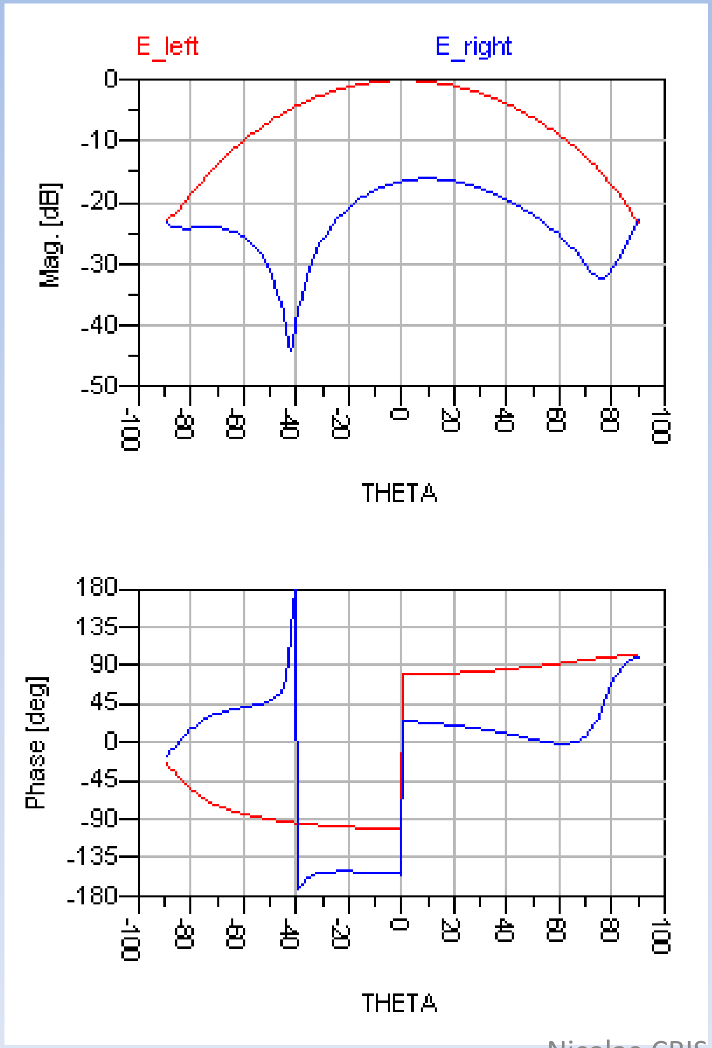
Measurements

- Bandwidth measurement with RL (Return loss at – 10 dB)

-Place m1 and m2 markers manually
- For the resonance the return loss is minimum
- The antenna efficiency is very high 90% so the gain is almost equal to the directivity



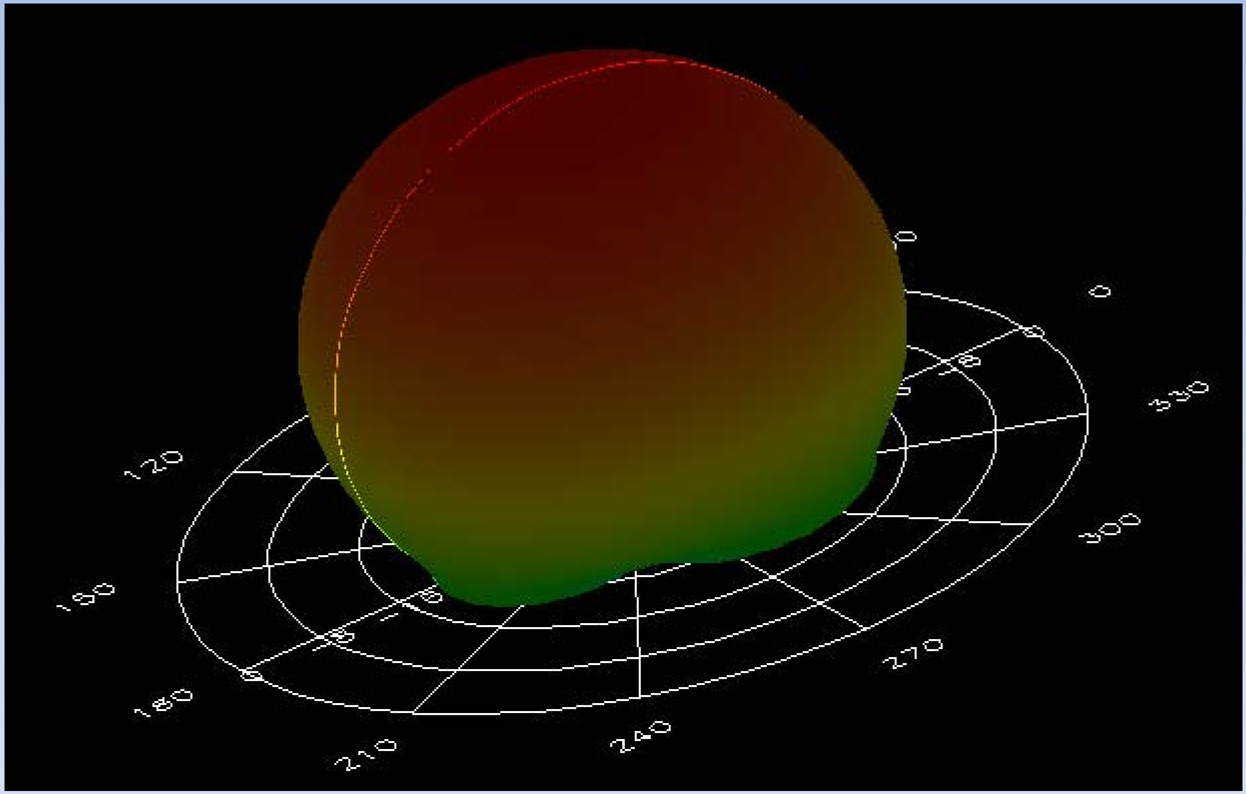
Circular polarization components



- E (RHCP) – right handed circular polarization
- E (LHCP) – left handed circular polarization

3D radiation antenna pattern

- E field
- Far – field region
- Sweep Phi angle (height light line)



References

- Agilent tutorials and help materials
- Nicolae Crisan, ‘’Antene si circuite pentru microunde’’, Ed. Risoprint Cluj-Napoca, 2008

Thank you