Chaotic Cavity and Time Reversal

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Geometry description

CAD files in common formats (IGES, ACIS, …) are available on request. Please contact the chairmen.

The cavity geometry is described on Fig. 1 and Fig. 2. Dimensions are given in meters. It is a square cavity, with a quarter of a sphere in one corner. This cavity has an input port (1) on one side and 2 output ports (2 and 3) on the opposite side.

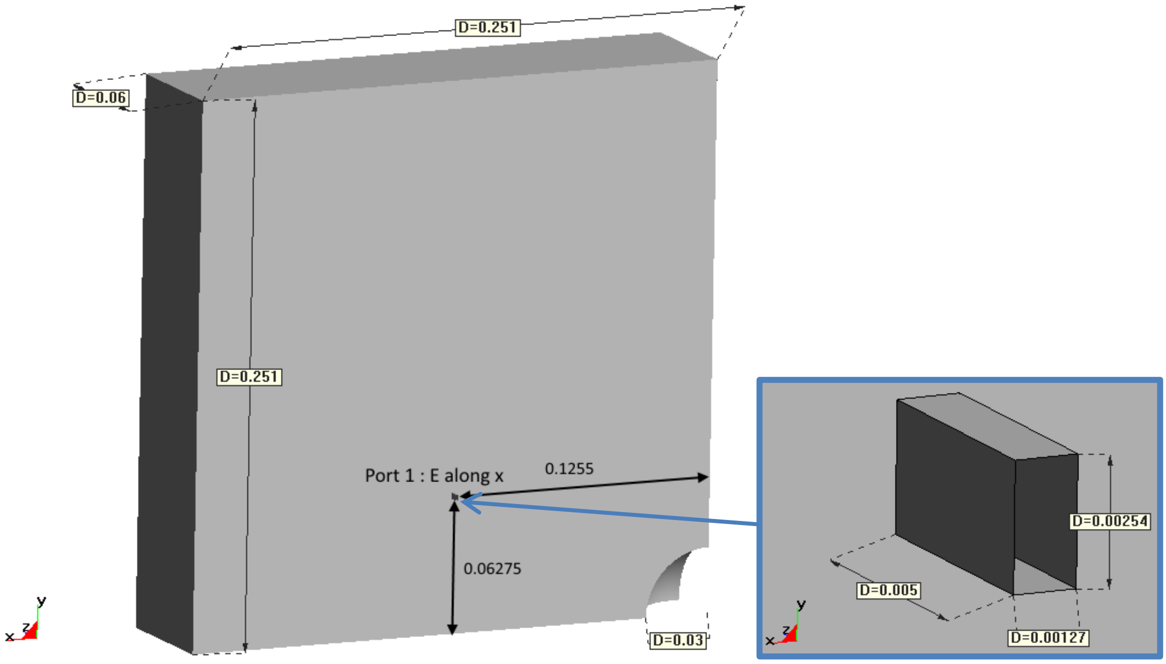

Figure 1 : Cavity geometry and port 1 center position (left), focus on port 1 size and polarization (right).

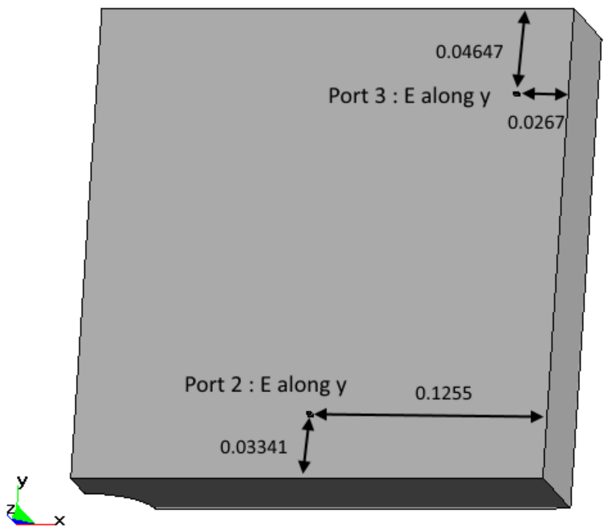

Figure 2 : Port 2 and port 3 center positions. Except for position and polarization, ports 1, 2 and 3 are identical.

Material properties

The conductivity of the cavity walls is 1.6e7 S/m. This value can be considered as an effective conductivity, lower than the bulk conductivity of the metal, taking into account the surface roughness or other imperfections.

Operating frequency

The cavity is designed to operate from 89.5 to 94.5 GHz. The input signal is a 92 GHz carrier modulated by a Gaussian pulse :

$$signal(t) = e^{-0.5\left(\frac{t-t_0}{a}\right)^2} \sin(2\pi f_0(t-t_0))$$

with f_0 = 92 GHz, a = 0.125 ns and t_0 = 0.625 ns.

Requested outputs

1) With the signal described above and applied at port 1, compute the output signals at port 2 and 3. The signal is defined as the amplitude of the main component of the E field in the center of the port. All ports are terminated with a matched load. The simulated duration is 1000 ns. The time step is not specified.
   Hint : apart from generating the output of step 2), this calculation will be used by the chairmen to estimate the quality factor of the cavity.

2) Apply time reversal on the output of port 3 computed at step 1) :
   $signal_{new}(t) = signal_{port3}(-t + 1000ns)$
   Append zeros from 1000 ns to 1010 ns. Use this new signal at port 1 and compute the output signals at port 2 and 3. The simulated duration is 1010 ns.
   Hint : according to time reversal, a stronger pulse is expected at port 3 around 1000 ns, while no pulse is expected at port 2.

For both computations, the signals obtained at each port must be provided. There are no requirements on the format as long as it is an ASCII file with the time at the first column and that the other columns are clearly described.