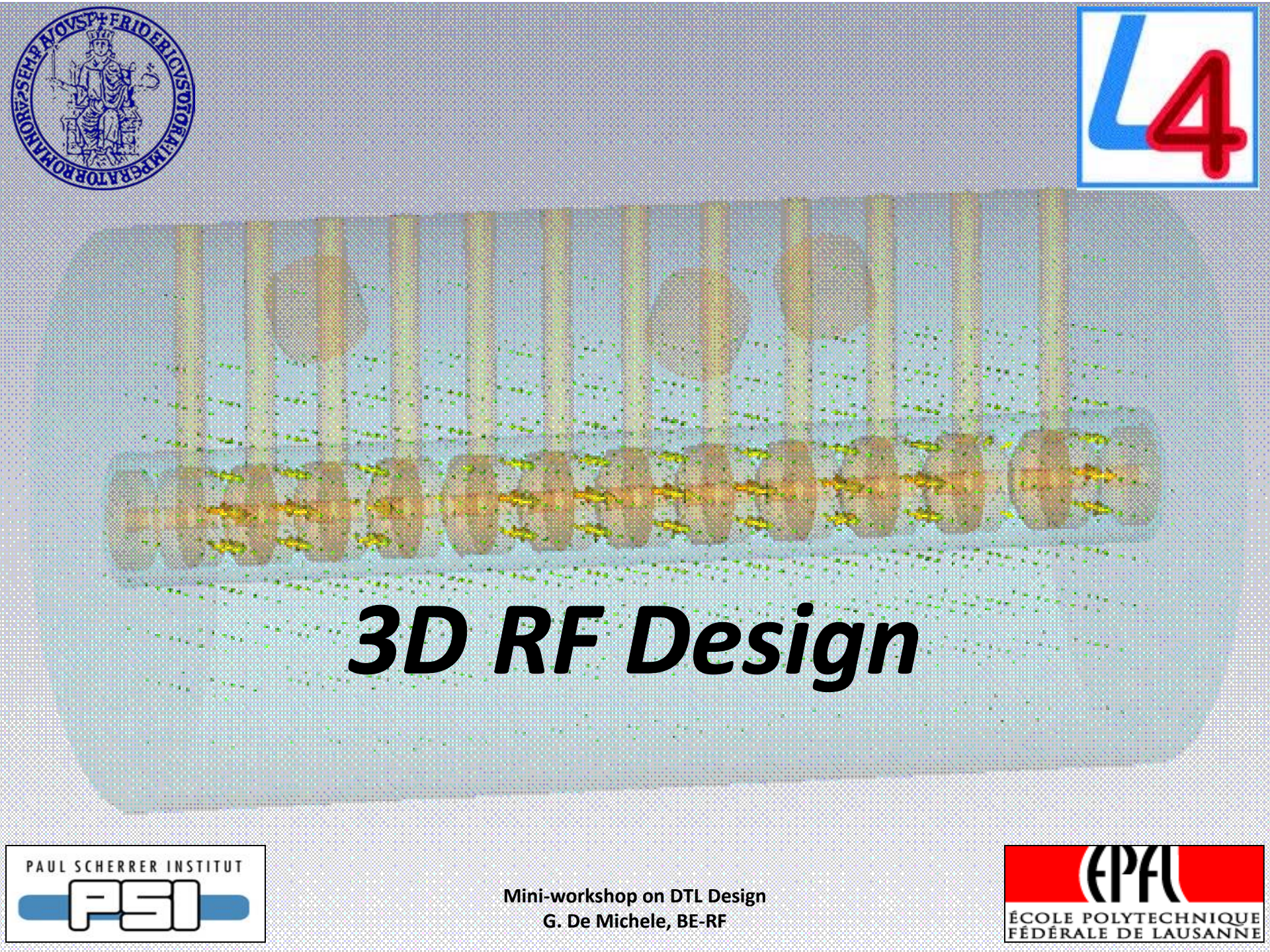
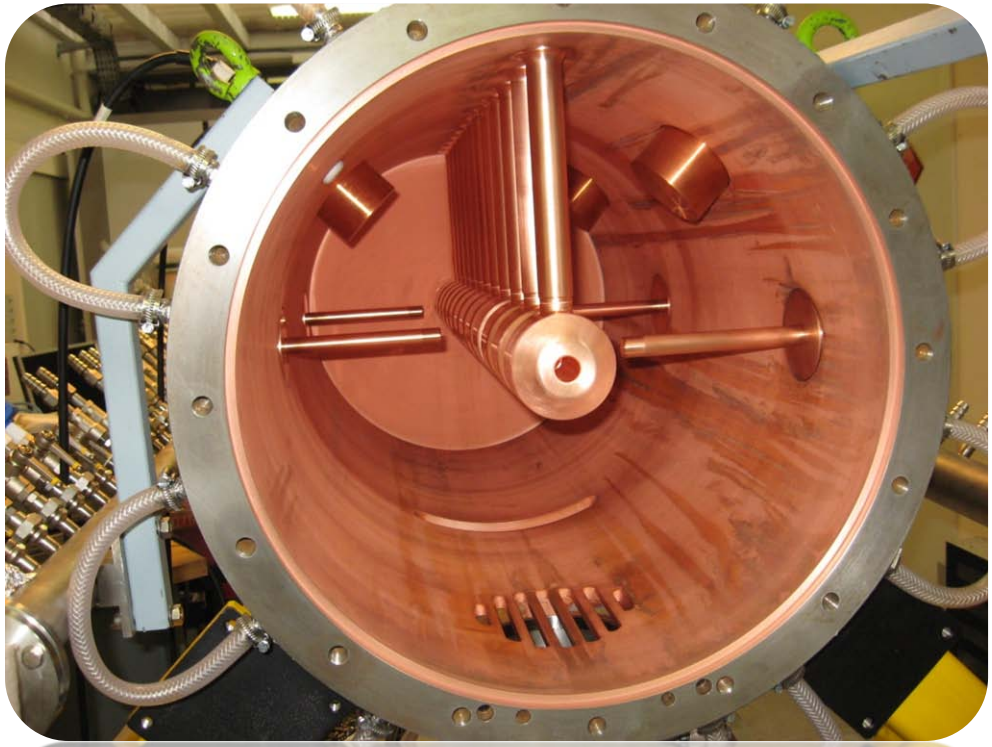


3D RF Design

Mini-workshop on DTL Design
G. De Michele, BE-RF

Outline

- Interconnecting waveguide (IWG) between power coupler and cavity
- Tuners position
- Vacuum grid

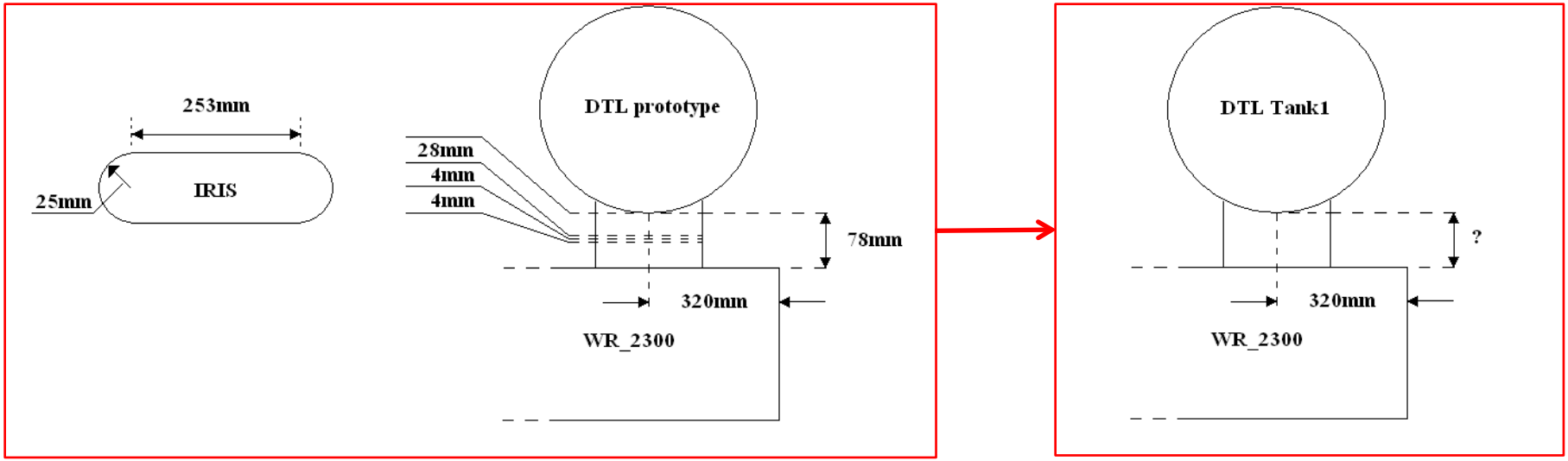


Outline

- Interconnecting waveguide (IWG) between power coupler and cavity
- Tuners position
- Vacuum grid

DTL power coupler (1st version)

- Power transport from klystron to cavity
- Peak power: 1MW/power coupler
- The design follows the Linac4 CCDTL design



CST & HFSS simulations

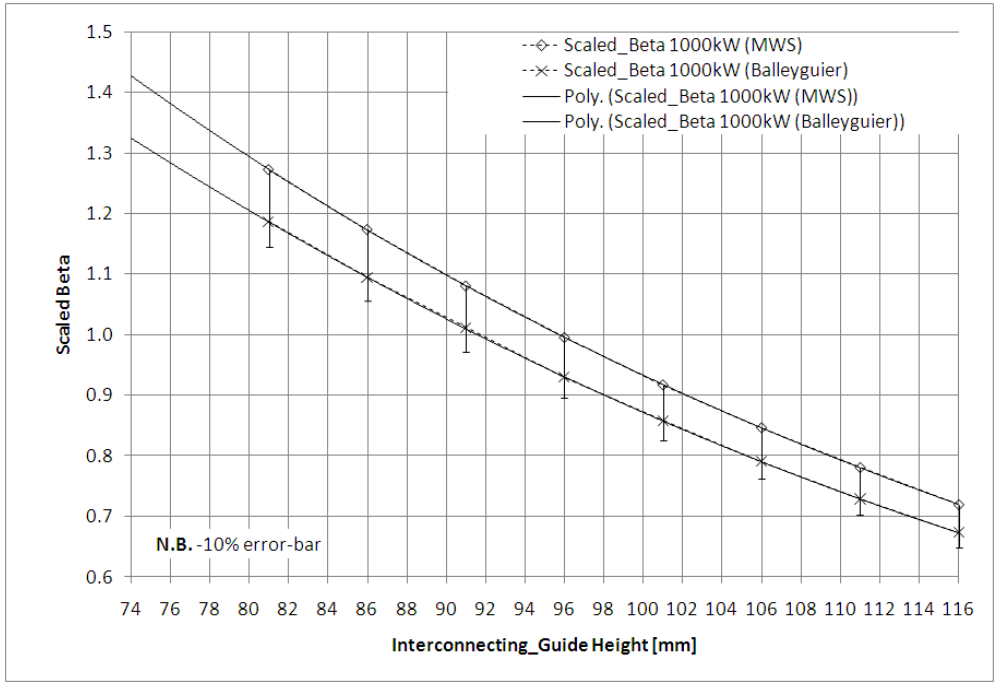
		Freq. [MHz]	Q0	P_{diss} [kW]	U [Joule]
Cell 7-8	Superfish	351.940	24300	48.7	0.54
	CST MWS	349.328	24408	48.4	1
Prototype	Superfish	351.811	42605	179.0	3.47

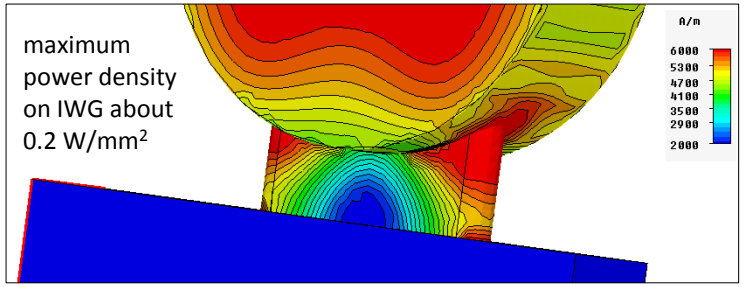
***β* (prototype)**	**CST MWS**	**HFSS**	**Measurements**	
Code solver	0.93	0.95	0.88	
Balleyguier's Method	0.87	0.93		

		Freq. [MHz]	Q0	P_{diss} [kW]	U [Joule]
Cell 22-23	Superfish	353.750	28171	43.2	0.55
	CST MWS	350.977	29818	40.7	1
Tank1	Superfish	353.768	50965	528.9	12.18

$$\beta_{cav} = \beta_{7-8MWS} \cdot \frac{P_{7-8SF}}{P_{cavSF}}$$

Coupling strength vs IWG height





In order to reach the optimum value for power transfer at beta equal 1, the height of the IWG is chosen to reach a beta around 1.2, including a 20% margin that can be tuned by increasing the length of the short circuit.

Cell 22-23	MWS	Superfish	HFSS
freq. [MHz] w/o WG	350.977	353.750	353.600
freq. [MHz] with WG	347.780	-	350.600
β	29.43 (27.51 Balleyguier)	-	30.27 (VSWR= β overcoupl.)
scaled *β*	1.27 (1.19 Balleyguier)	-	1.31
Δf [MHz]	3.197	-	3.000
Δf*m [MHz*m]	0.644	-	0.604

…towards TACO tasting

- Different IWG for DTL, CCDTL, PIMS and use of the movable short circuit for the final tuning of the coupling strength beta
- Different IWG for DTL, CCDTL, PIMS and use of a piston tuner into the WG to adjust the coupling strength beta

See P. Ugena Tirado talk for details on TACO

Outline

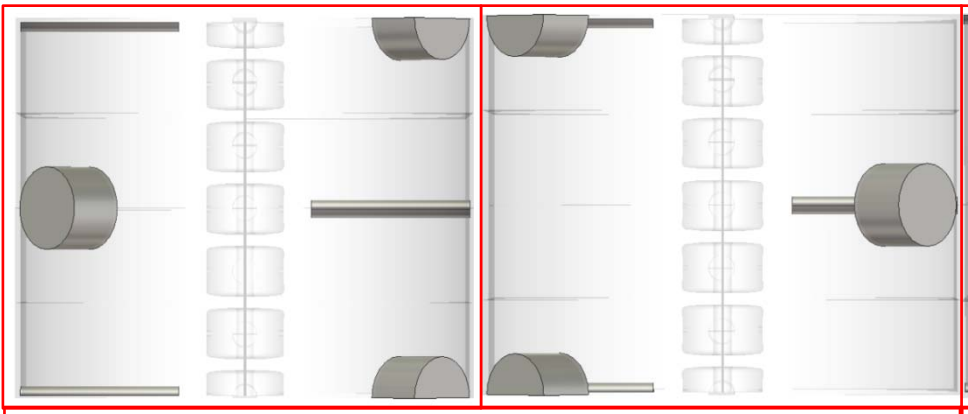
- Interconnecting waveguide (IWG) between power coupler and cavity
- Tuners position
- Vacuum grid

Tuners to compensate…

- Manufacturing errors of tank and drift tubes (static tuners)
- Thermal expansion (movable tuners)
- Frequency variation of the neighboring cells due to the power couplers
- Systematic simulation error

See other presentations for more details

Tuner effect on TM010 and 0-PC mode

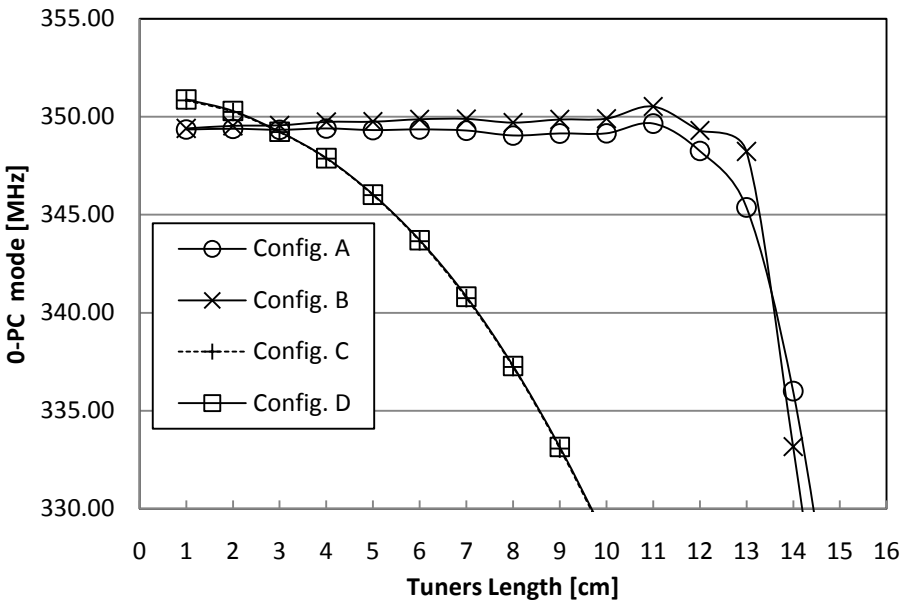


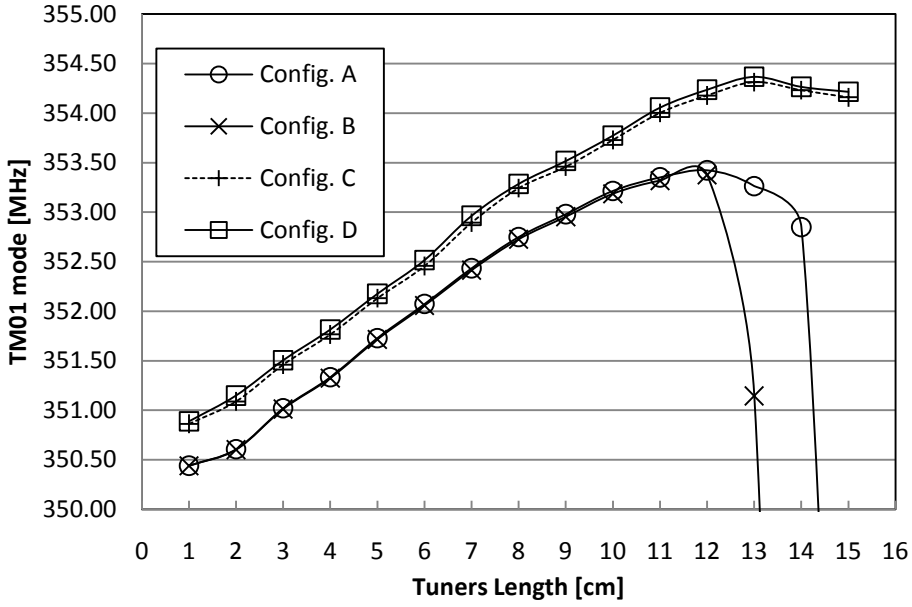
Config. A *Config. B*

Tuners from the top of the structure and with a 45 degree angle.

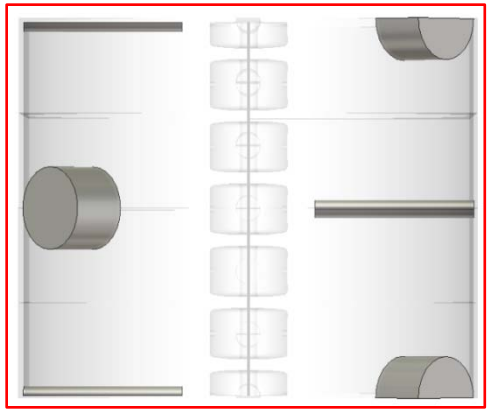
Config. C *Config. D*

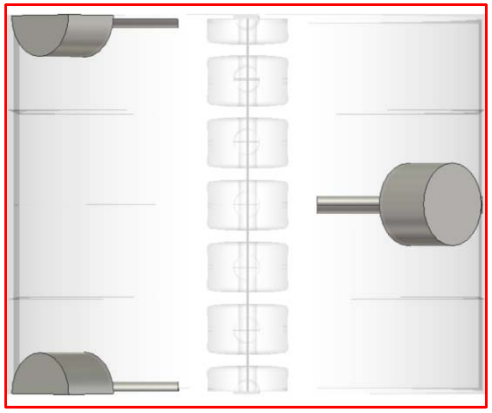
Tuners from the bottom of the structure.



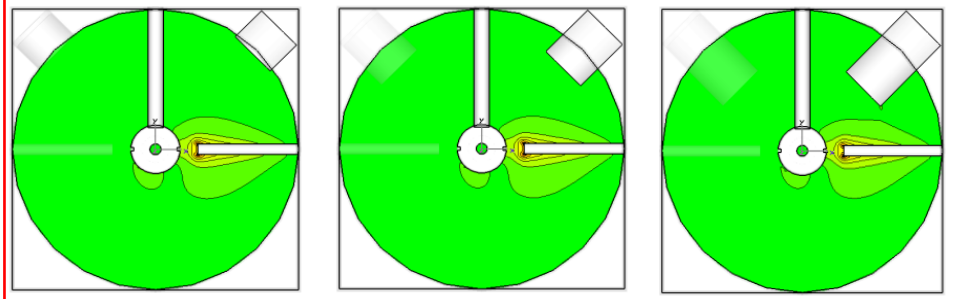


Linac4 DTL tuners choice

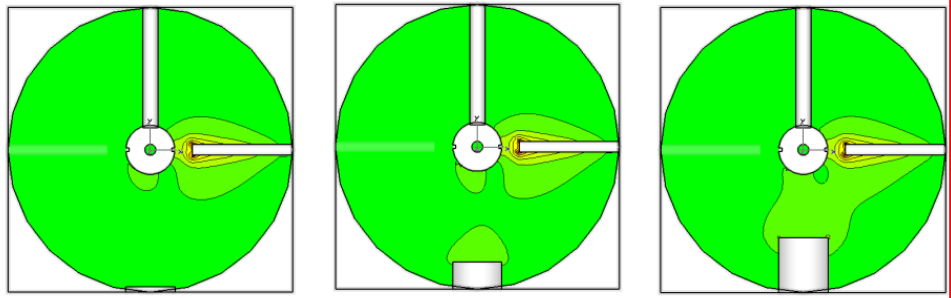




For the configurations A and B, the frequency of the 0-mode PC does not change much. This behavior is confirmed by the electric field in the region where there is basically no “coupling” between tuners and PCs. On the contrary, there is field in the tuner region of the C and D configurations, in fact the frequency of the 0-mode PC drops with the tuner length .This effect can be associated to an equivalent shunt capacitance that adds up to the equivalent capacitance of the post coupler chain.



Coupling of 45 degree angle tuners with PCs



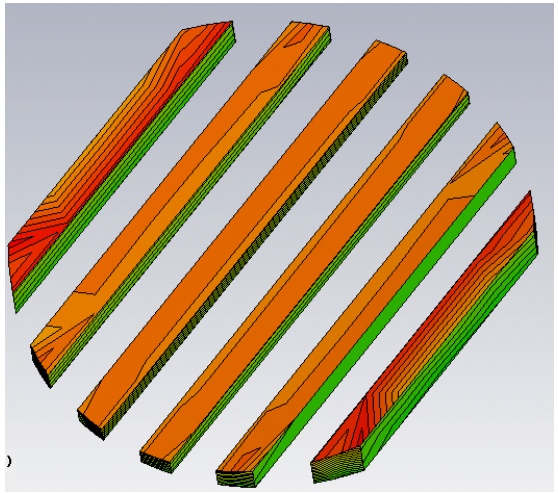
Coupling of the tuners from the bottom with PCs

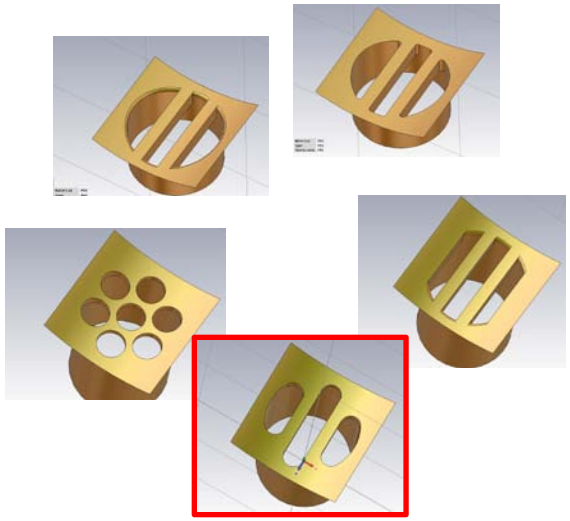
Outline

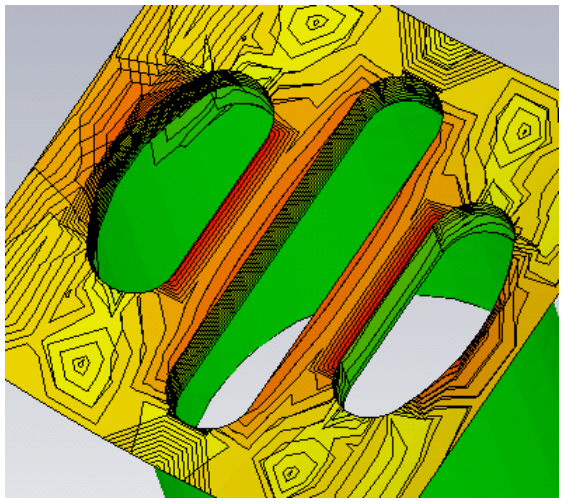
- Interconnecting waveguide (IWG) between power coupler and cavity
- Tuners position
- Vacuum grid

DTL vacuum grid

- The design of the vacuum grid for the Linac4 DTL considers an optimal pumping area while limiting the power leak in the manifold sleeve and providing acceptable power dissipation on its surfaces
- The prototype vacuum grid consists of six 10 mm wide and 10 mm thick bars within a DN150 flange. The pumping surface is 11147 mm^2
- The redesigned pumping grid for the tanks has just two 20 mm wide and 25 mm thick bars. The pumping surface is about 11376 mm^2







Characteristics

- Temperature rise easily exceeds 100 K at 10% duty cycle without active cooling
- Integrated cooling channels reduce the temperature rise to 10 K
- Larger openings increase RF leakage while thicker bars reduce it.
- A peak power loss of 1.1 W was simulated on a reference surface where the vacuum pump is connected to a 200 mm long manifold sleeve.