RF design, and cooling and thermal analysis of the BOC pulse compressor

Ping Wang, Alexej Grudiev

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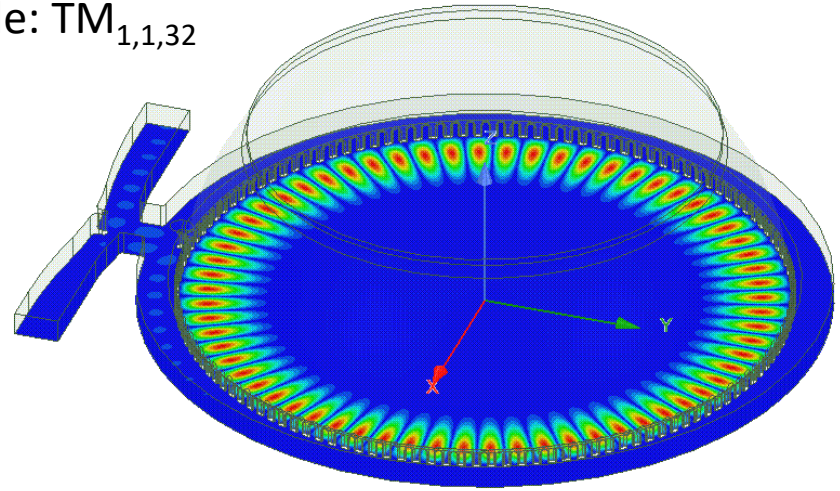
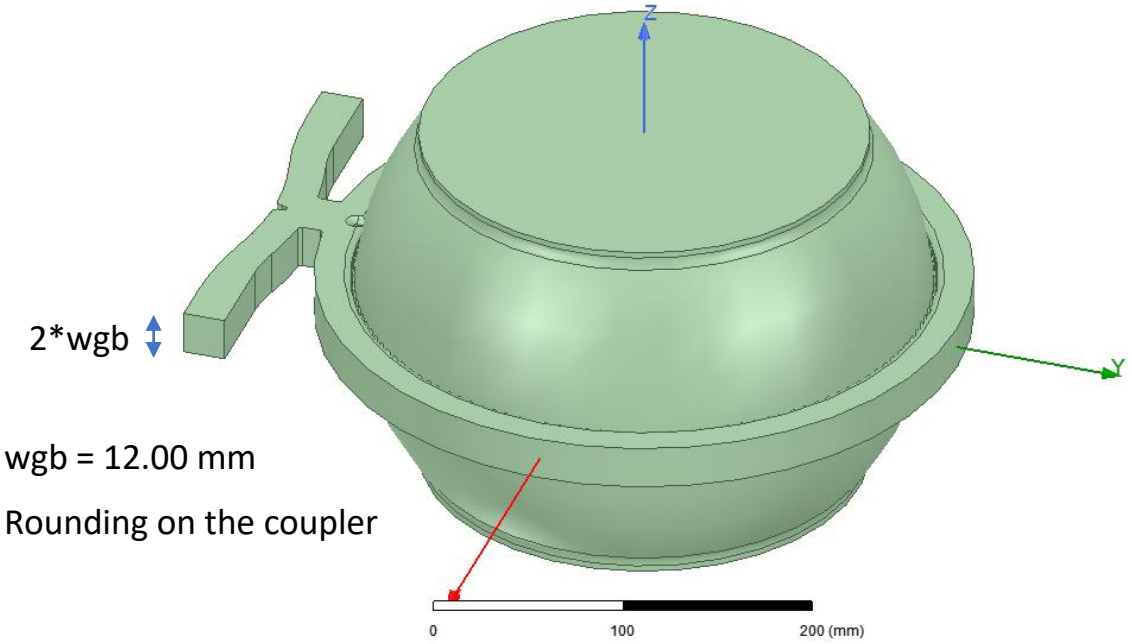
RF design of the BOC

Full picture of the BOC pulse compressor

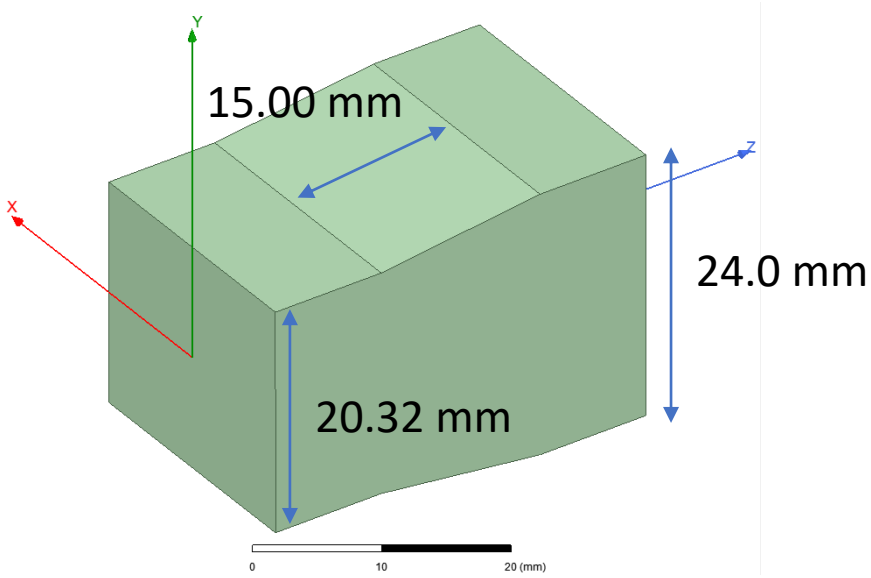
Parameters	Values	Units
Frequency	11.9940	GHz
Q_0	2.35e5	
β	6.1	

Mode: $TM_{1,1,32}$

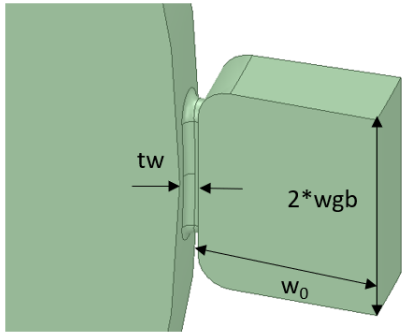


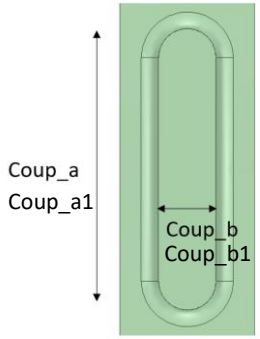


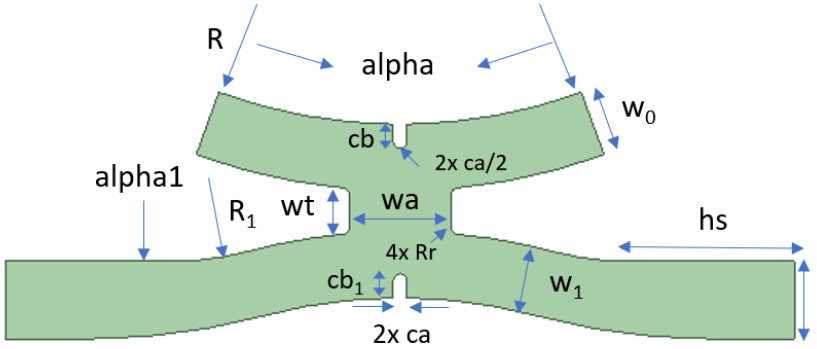
- wgb = 12.00 mm
- Rounding on the coupler



Nominal values of all the geometrical parameters

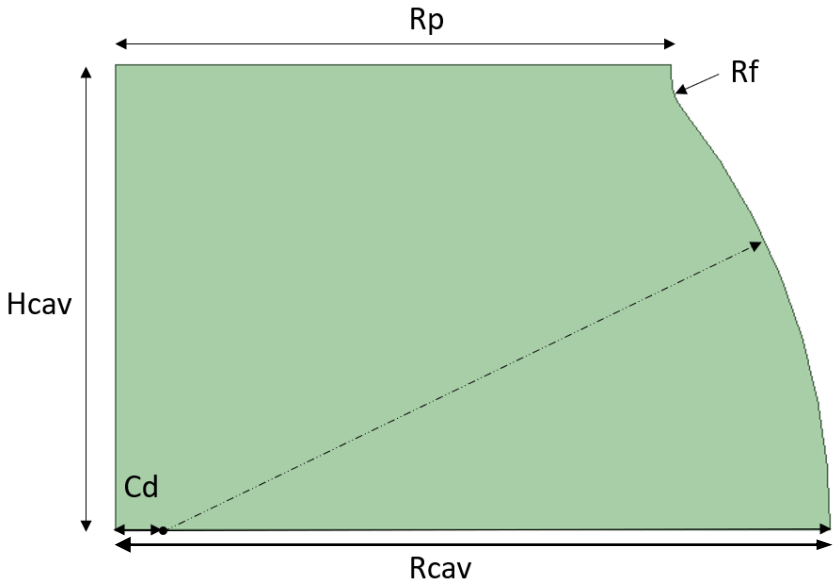






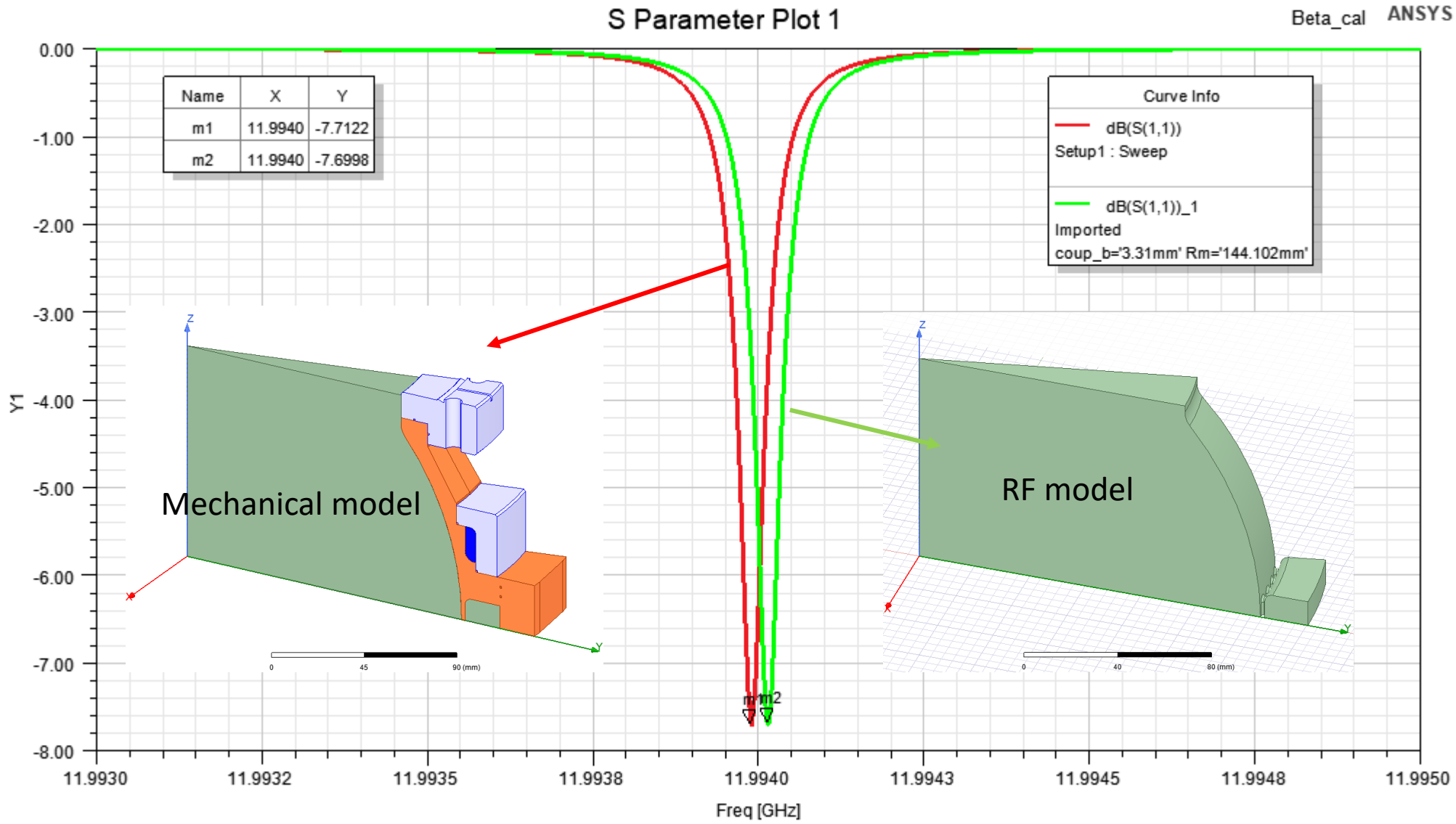
Coupler without roundings

No.	Parameters	Values	Unit
1	Rp	120.0	mm
2	Rf	10.0	mm
3	Rcav	154.102	mm
4	Cd	10.00	mm
5	Hcav	100.0	mm
6	Coup_a/Coup_a1	16.00/16.00	mm
7	Coup_b/Coup_b1	3.31/4.90	mm
8	tw	2.00	mm
9	w_0	19.501	mm
10	wgb	12.00	mm



No.	Parameters	Values	Unit
1	R	156.102	mm
2	R_1	80.00	mm
3	w_0	19.501	mm
4	w_1	19.501	mm
5	alpha	20	mm
6	alpha1	10	mm
7	ca	4.0	mm
8	cb	7.00	mm
9	cb_1	7.12	mm
10	wa	30.00	mm
11	wt	13.20	mm
12	wga	22.86	mm
13	wgb	12.00	mm
14	hs	50.0	mm
15	Rr	2.0	mm
16	rb	3.5	mm

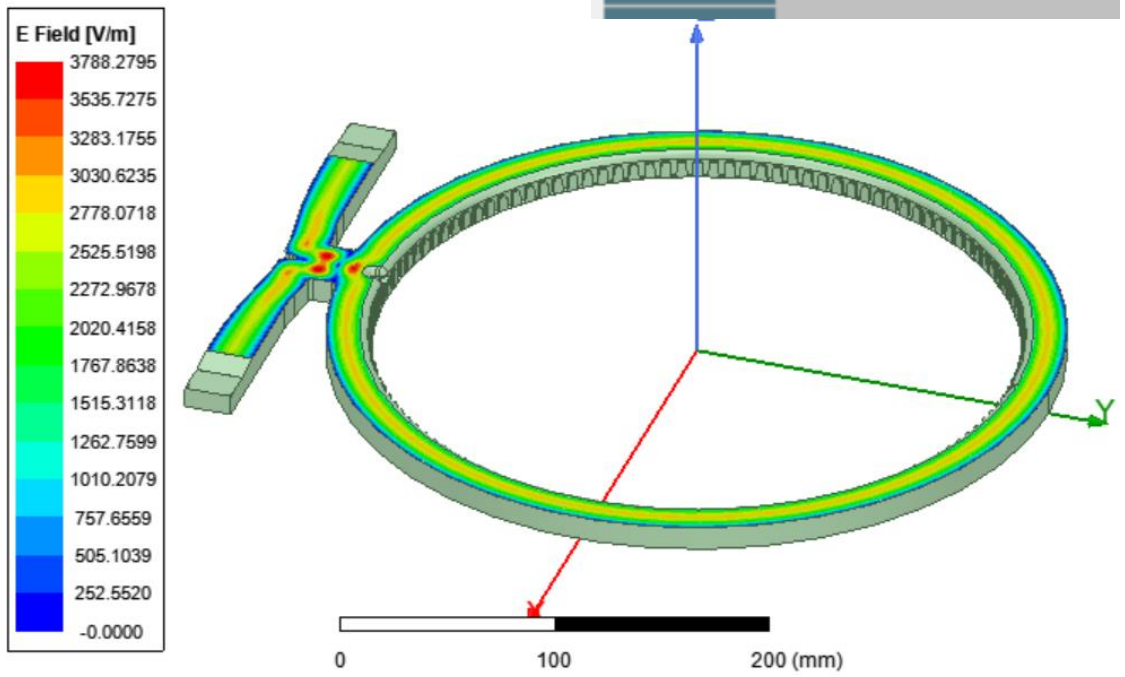
RF check of the BOC



RF check of the BOC

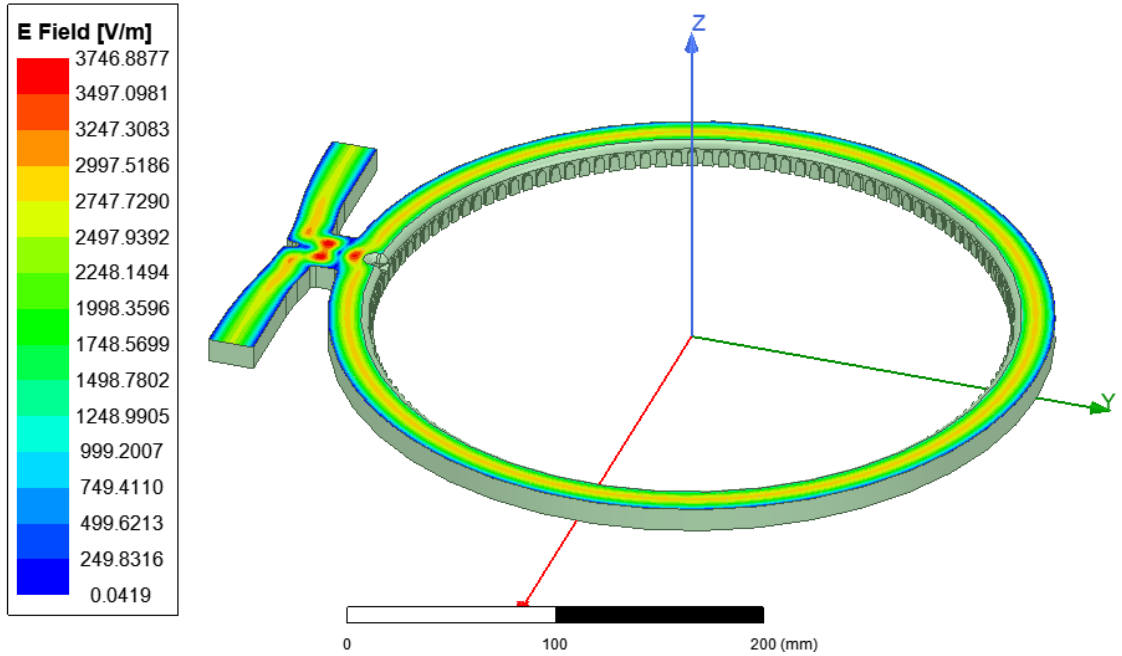
Mechanical model

Freq		S:1	S:2
11.994GHz	1	-56.4	-9.84e-06
	2	-9.84e-06	-56.4



RF model

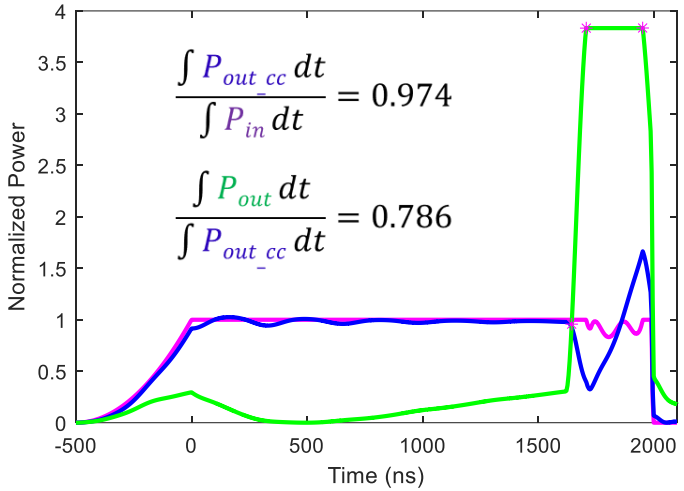
Freq		S:1	S:2
11.994GHz	1	-55.3	-0.0846
	2	-0.0846	-55.3

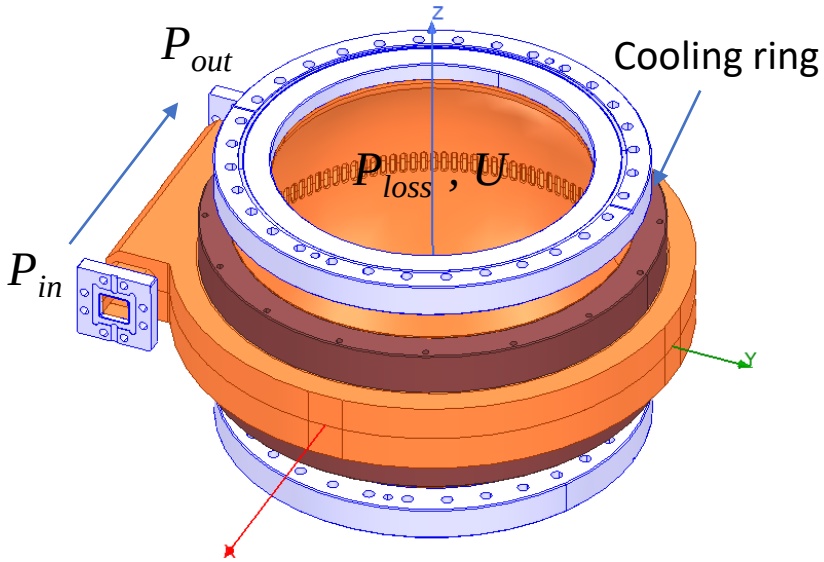


Cooling and Thermal analysis

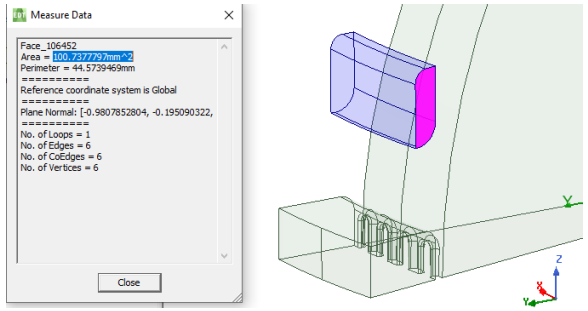
Cooling analysis of the BOC

Parameters of the klystron	
Peak power [MW]	50
Pulse length [μs]	2.5
Repetition rate [Hz]	50
Average power [kW]	6.25





$$P_{loss\_boc} = P_{in}\frac{\int P_{out\_cc}\,dt}{\int P_{in}\,dt}\left(1-\frac{\int P_{out}\,dt}{\int P_{out\_cc}\,dt}\right) \approx 0.21P_{in} = 1.3\ \text{kW}$$

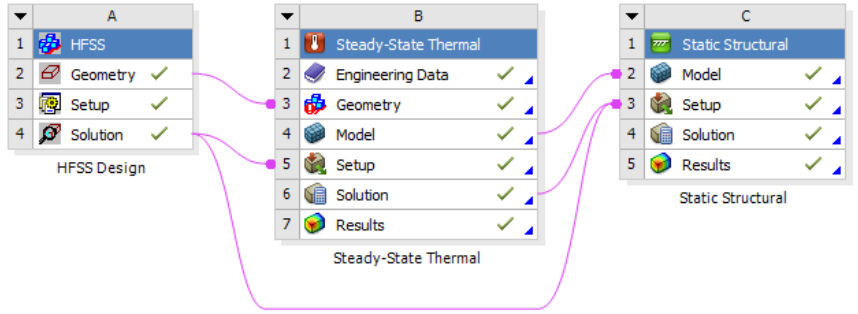


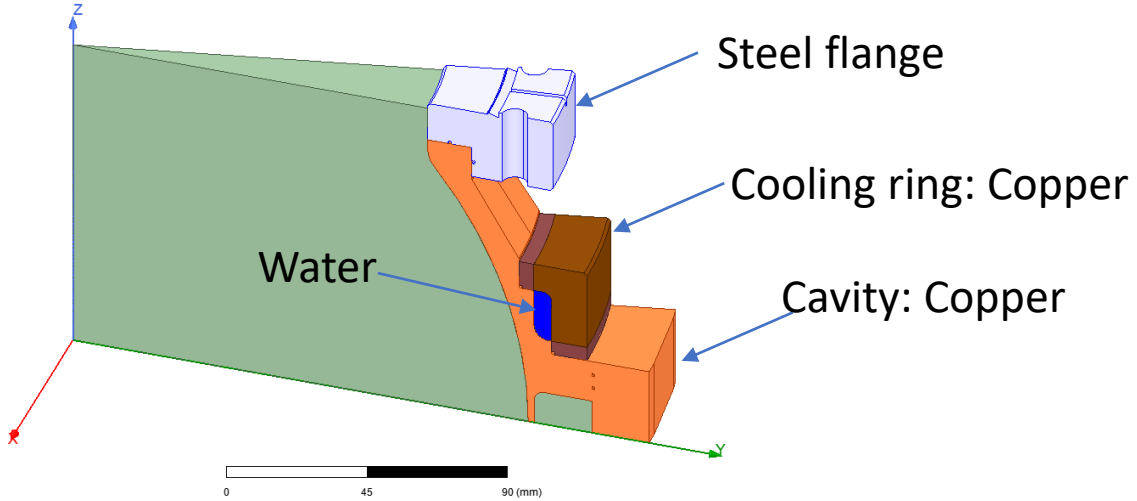
$\Delta T = Q\,\Delta t/(A*v*\Delta t*\rho*Cp) = Q/(A*v*\rho*Cp) =$ **3.1 °C**

- Heat Q: 1300 W
- Water speed v: 1 m/s
- Cross Section A: 100.7 mm2
- heat capacity of water Cp: 4182 J/(kg°C)
- Water density ρ: 997 kg/m3

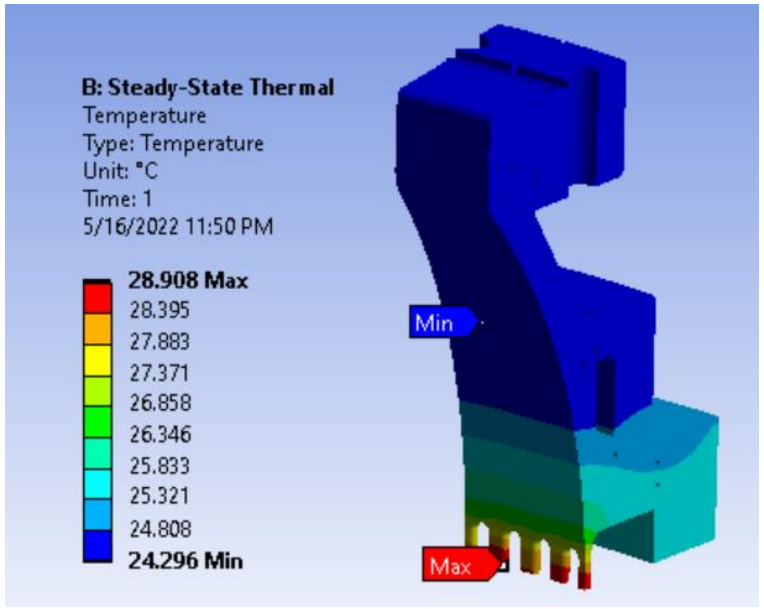
- Water speed: 1 m/s
- Cross Section: 100.7 mm2
- Water flow: 6.04 L/min
  < 10 L/min@20C°(HRS018-W)
- Water temperature: 22C°

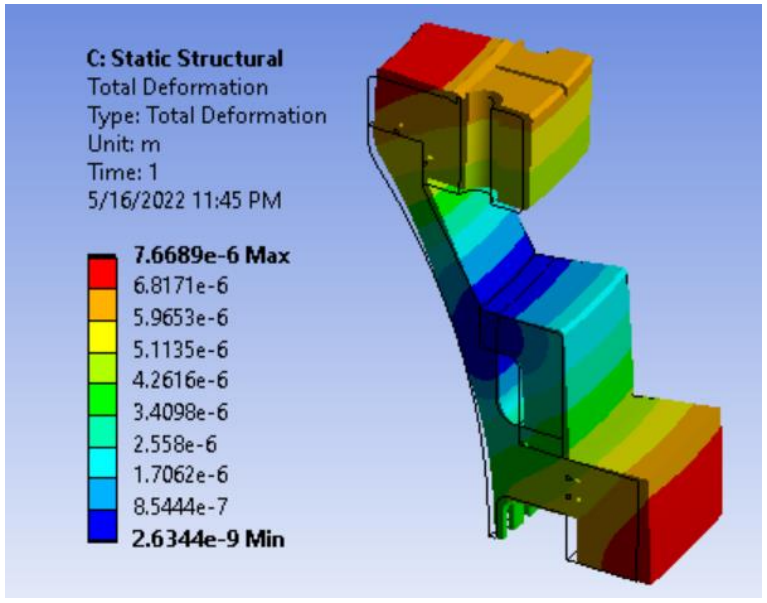
Thermal analysis of the BOC

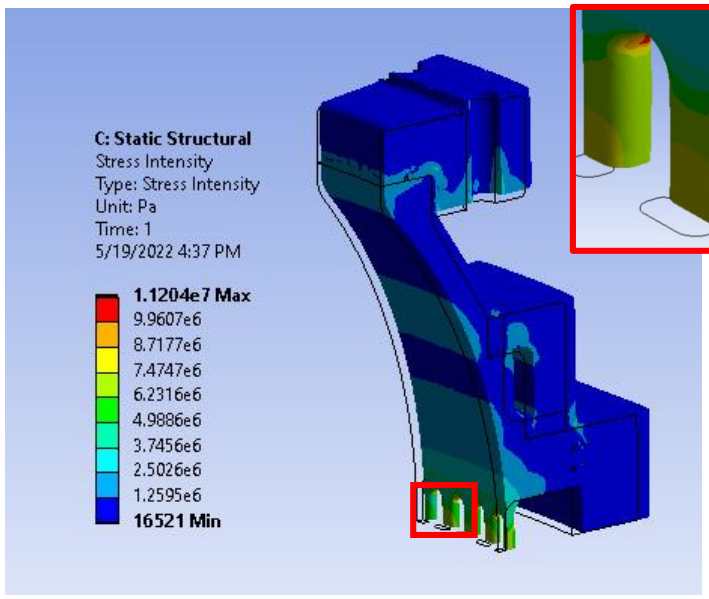




- Water speed: 1 m/s
- Convection Cu&Water: 5000 W/m2K
- Convection Air = 10 W/m2K







Gian Luigi D'Alessandro - CLIC–Note–1061(CERN-THESIS-2015-315)