2nd Progress Report on

Studies and Simulations for the 5.1 PITZ RF Gun

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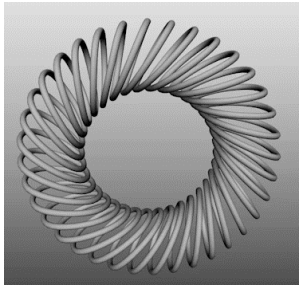
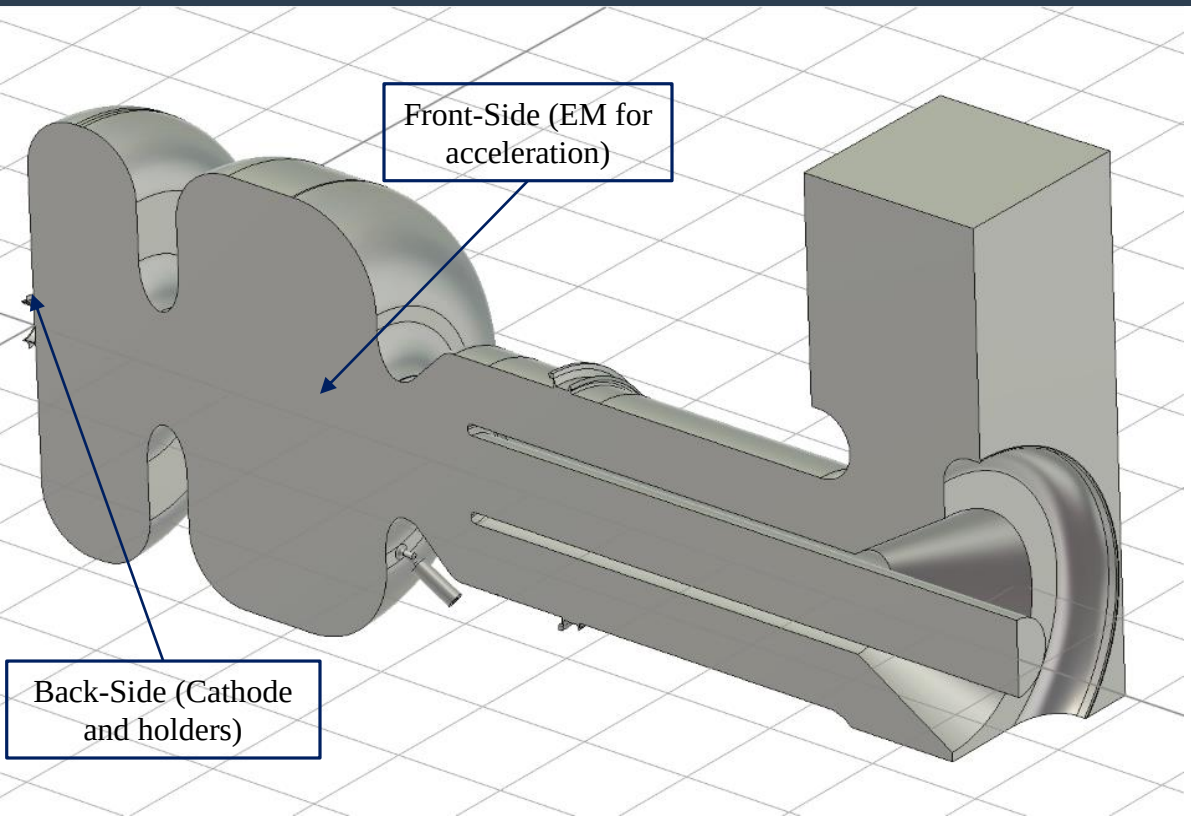
Contents

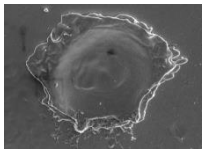


1.1 Gun Main Characteristics

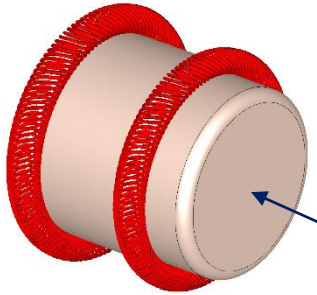


Characteristic	Value
Generation	5.1
Cell Number	1.6
Frequency	1.3 GHz-L Band
Type (Material-Wave)	NC-SW
Operation Mode	π
Max Input Power	8 MW
Wave Guide	Coaxial-WR650

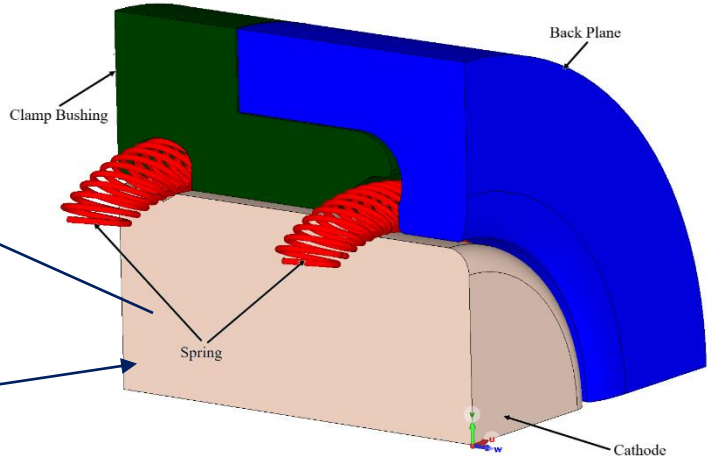
1.2 New Structure-Back Side Geometry

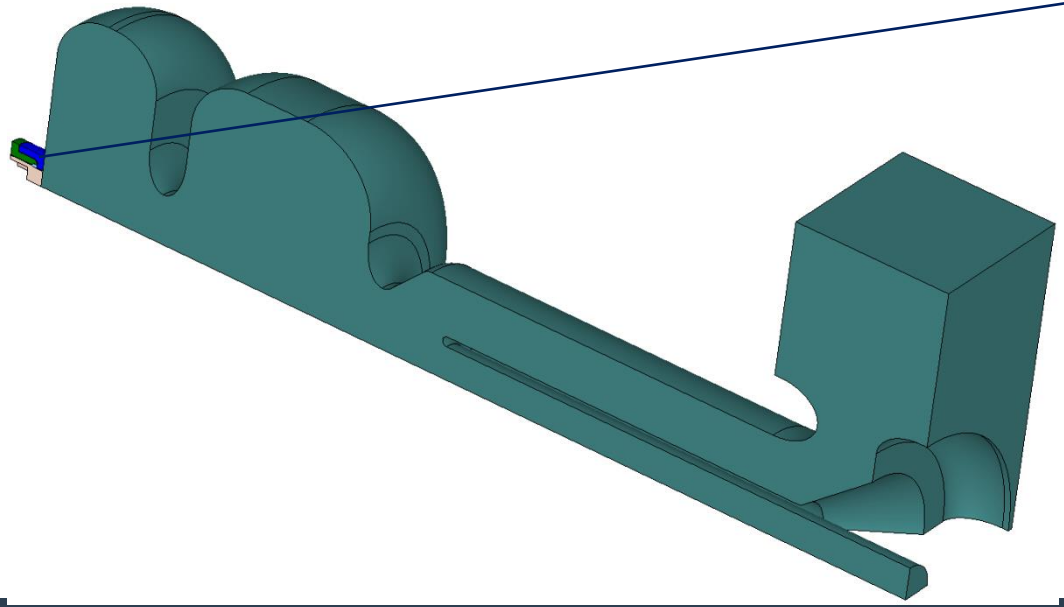


RF Breakdown



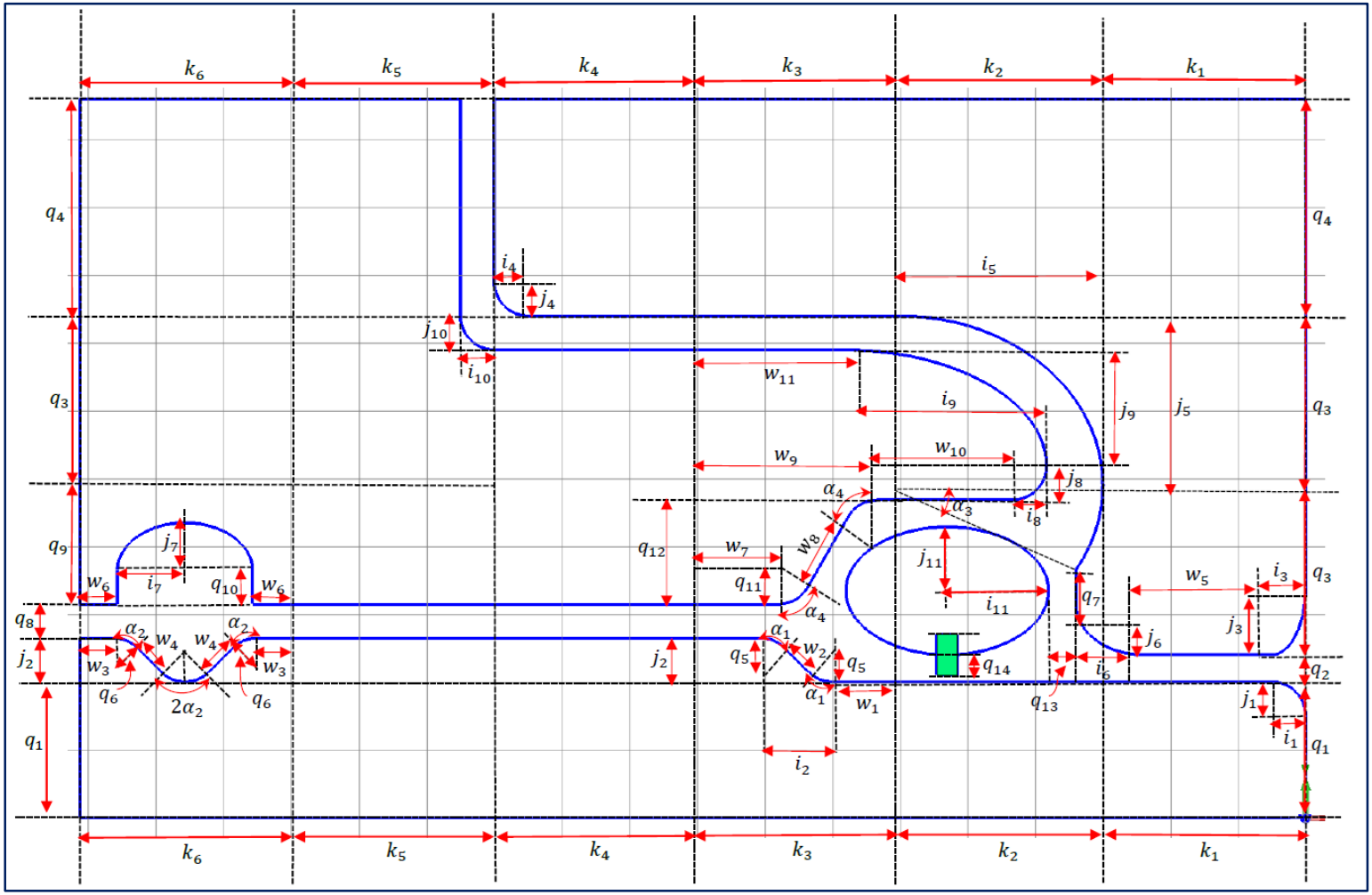
Many circular/elliptic windings of 0.25mm thickness



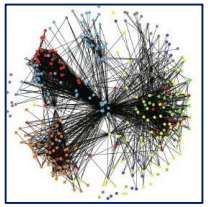


1.2 New Structure-Back Side Geometry

Back Side-Geometry



Parameter Space



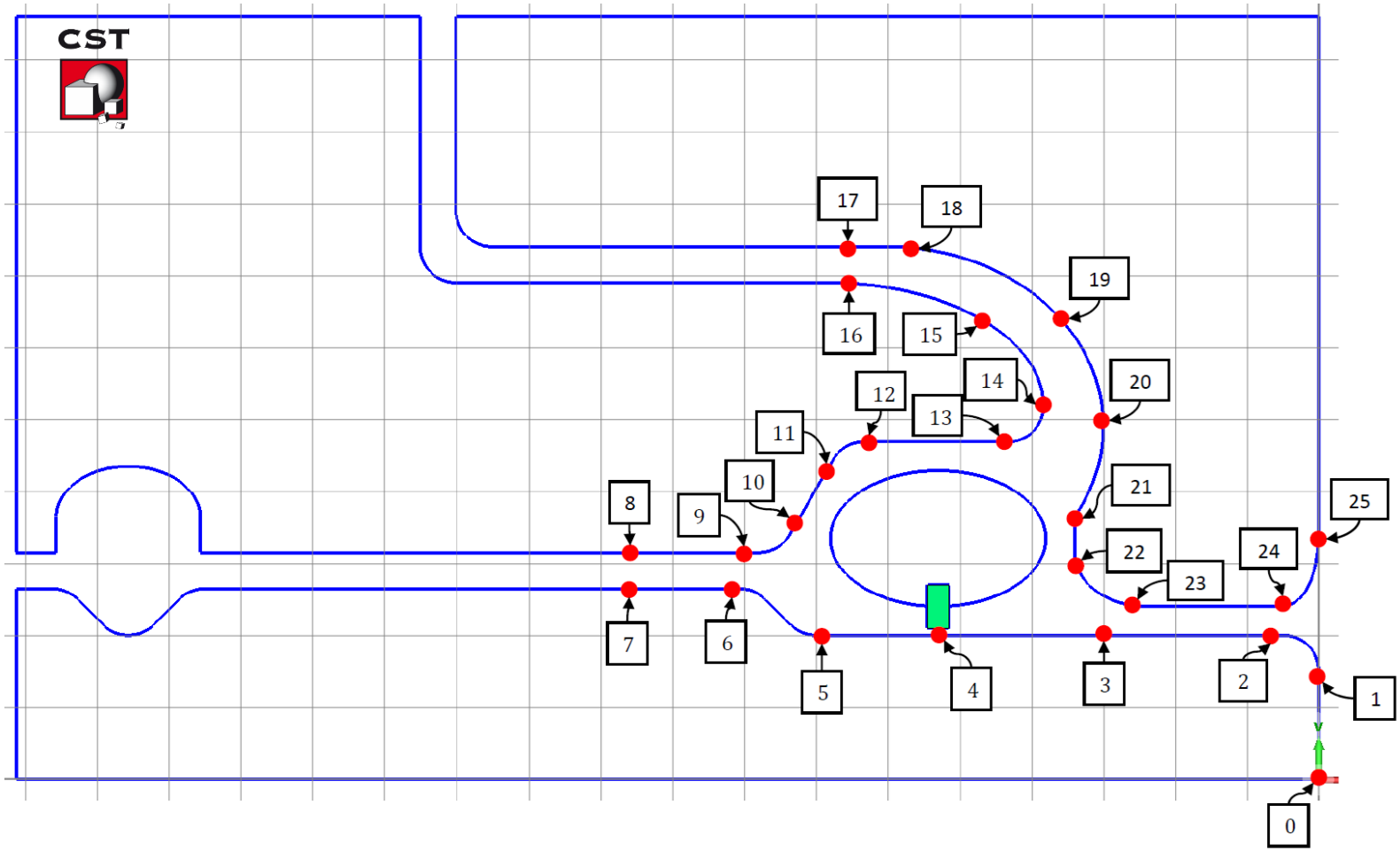
1.2 New Structure-Back Side Geometry

Back Side-Geometrical Parameters

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
i_1	1.0	j_4	0.1	k_7	1.62	w_1	0.2
i_2	1.04	j_5	2.0	q_1	8	w_2	1.0
i_3	0.5	j_6	0.29	q_2	0.3	w_3	1.56
i_4	0.1	j_7	0.95	q_3	2.0	w_4	0.8
i_5	2.0	j_8	0.3	q_4	3.45	w_5	2.70
i_6	0.3	j_9	1.52	q_5	0.2	w_6	0.96
i_7	1.44	j_{10}	0.05	q_6	0.16	w_7	0.2
i_8	0.3	j_{11}	0.975	q_7	0.828	w_8	2.7
i_9	1.8	j_{12}	0.975	q_8	0.25	w_9	3.52
i_{10}	0.1	k_1	3.3	q_9	1.36	α_1	37
i_{11}	1.3	k_2	2.0	q_{10}	1.02	α_2	30
i_{12}	1.3	k_3	2.71	q_{11}	1.0	α_3	26
j_1	1.0	k_4	3.49	q_{12}	1.49	α_4	27.9
j_2	0.68	k_5	1.75	q_{13}	0.125	a_w	1.31
j_3	1.95	k_6	4.54	q_{14}	0.125	b_w	1.30

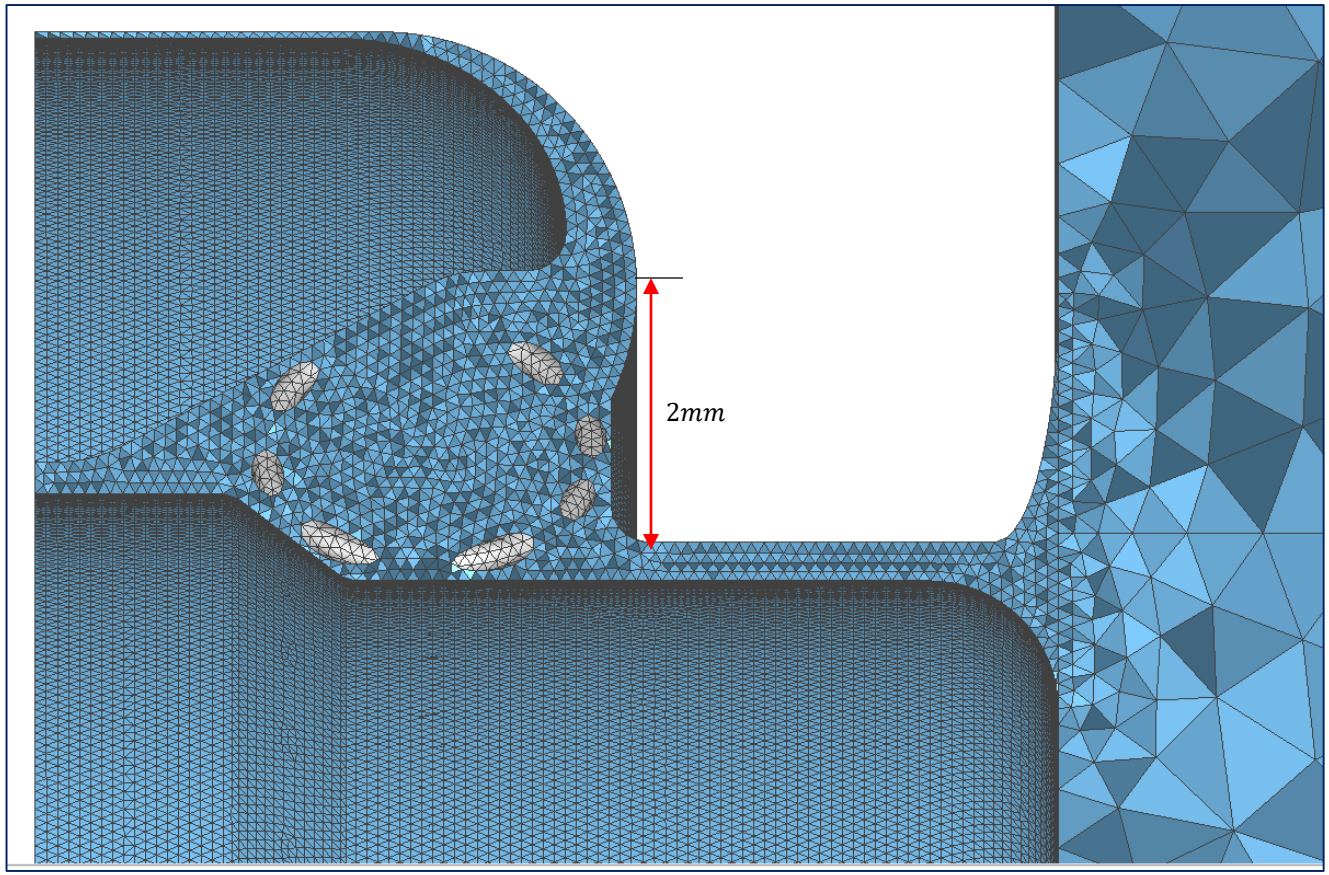
1.2 New Structure-Back Side Geometry

Critical Points from EM View

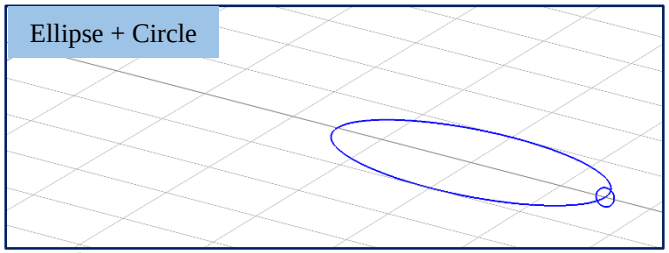


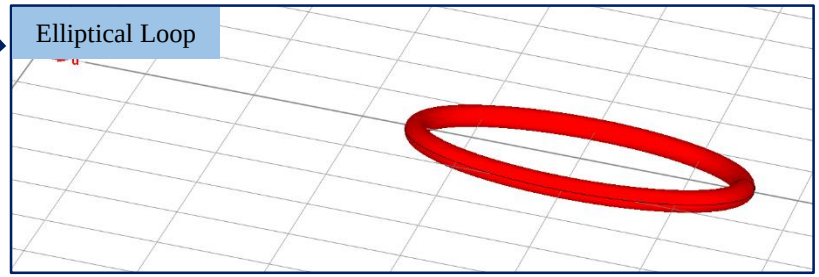
1.2 New Structure-Back Side Geometry

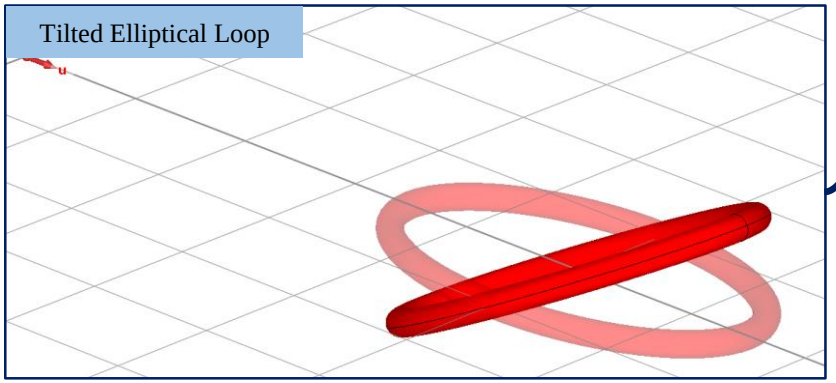
Mesh Structure

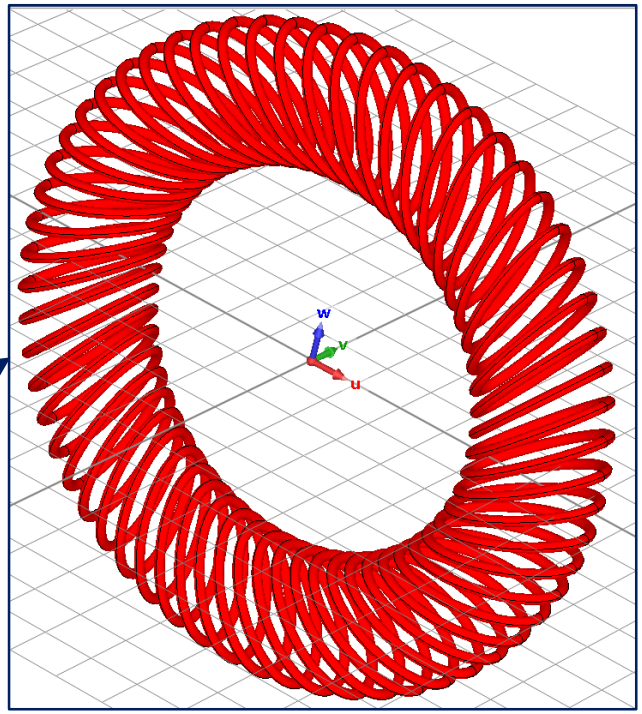


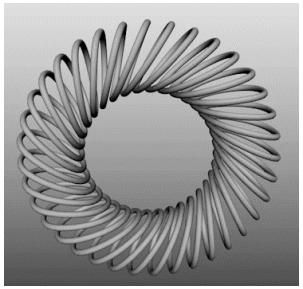
2.1 Spring-Simplified Model



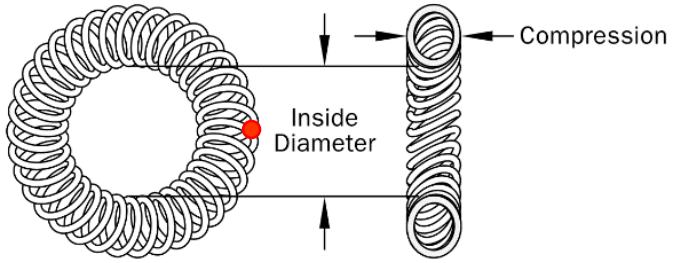


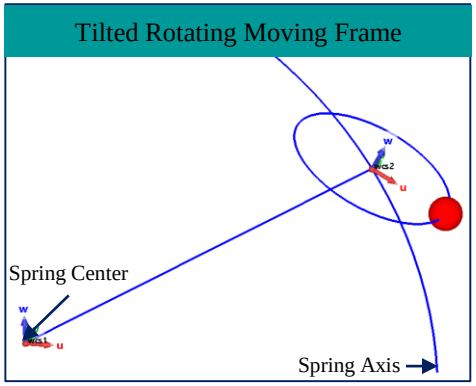


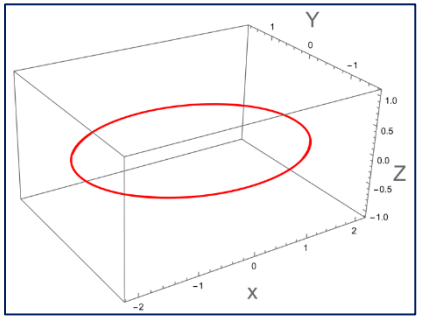




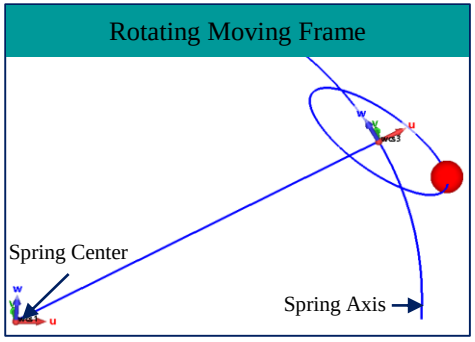
2.2 Spring-Realistic Model

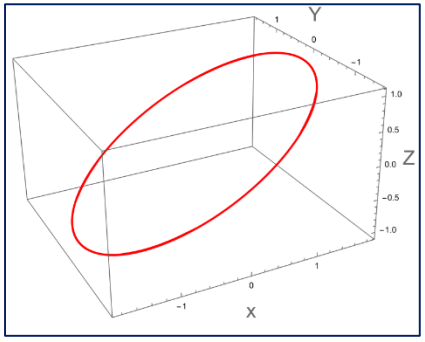






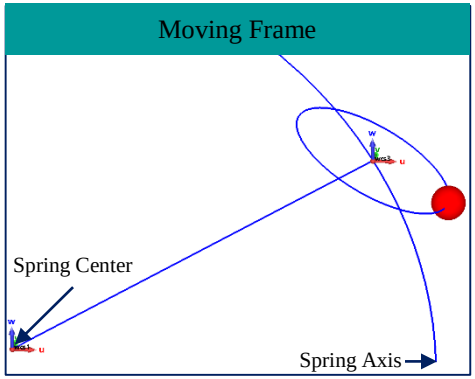
$$X1[tt\_] := a \times \text{Cos}\left[tt \times \frac{\pi}{180}\right];$$
$$Y1[tt\_] := b \times \text{Sin}\left[tt \times \frac{\pi}{180}\right];$$
$$Z1[tt\_] := 0.0;$$

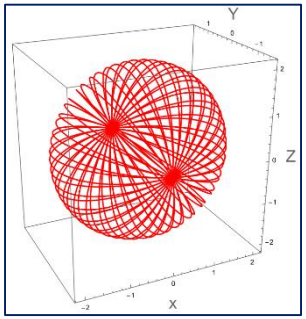




$$X2[tt\_, \beta\beta\_] := X1[tt] \times \text{Cos}\left[\beta\beta \times \frac{\pi}{180}\right] - Z1[tt] \times \text{Sin}\left[\beta\beta \times \frac{\pi}{180}\right];$$
$$Y2[tt\_, \beta\beta\_] := Y1[tt];$$
$$Z2[tt\_, \beta\beta\_] := X1[tt] \times \text{Sin}\left[\beta\beta \times \frac{\pi}{180}\right] + Z1[tt] \times \text{Cos}\left[\beta\beta \times \frac{\pi}{180}\right];$$

2.2 Spring-Realistic Model





$$\theta[tt\_] := \frac{tt}{\Delta t} \times \alpha;$$

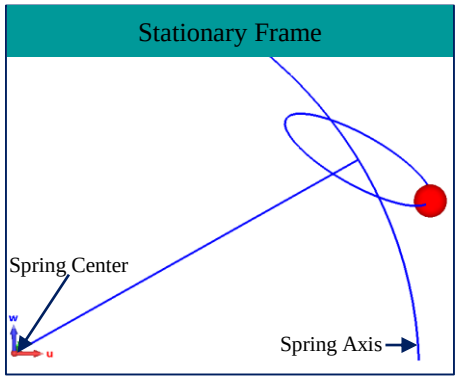
$$X3[tt\_, \beta\beta\_] := X2[tt, \beta\beta] \times \text{Cos}\left[\theta[tt] \times \frac{\pi}{180}\right] - Z2[tt, \beta\beta] \times \text{Sin}\left[\theta[tt] \times \frac{\pi}{180}\right];$$

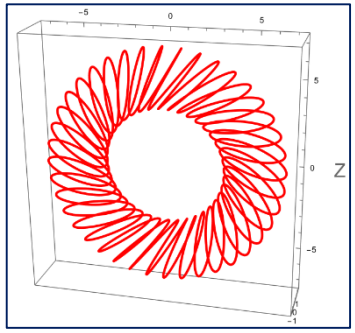
$$Y3[tt\_, \beta\beta\_] := Y2[tt, \beta\beta];$$

$$Z3[tt\_, \beta\beta\_] := X2[tt, \beta\beta] \times \text{Sin}\left[\theta[tt] \times \frac{\pi}{180}\right] + Z2[tt, \beta\beta] \times \text{Cos}\left[\theta[tt] \times \frac{\pi}{180}\right];$$

$\alpha = 360$

$\Delta t = n \times 360$

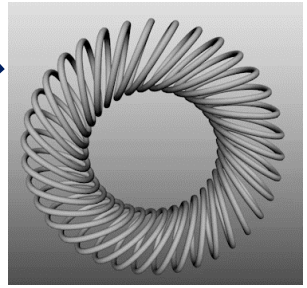




$$X4[tt\_, \beta\beta\_] := X3[tt, \beta\beta] + r \times \text{Cos}\left[\theta[tt] \times \frac{\pi}{180}\right];$$

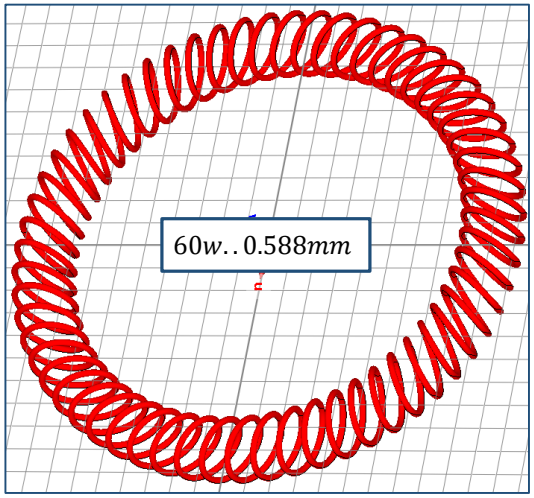
$$Y4[tt\_, \beta\beta\_] := Y3[tt, \beta\beta] + 0;$$

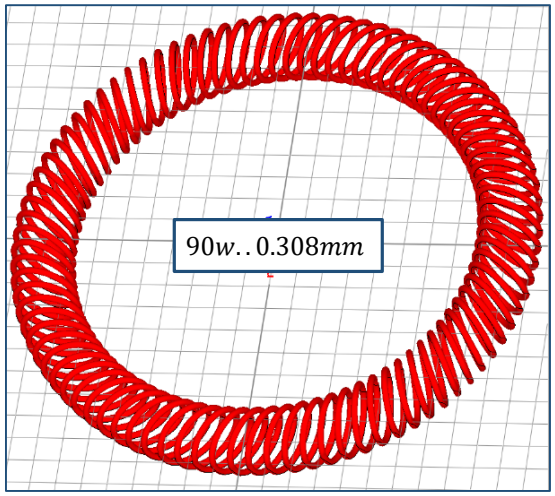
$$Z4[tt\_, \beta\beta\_] := Z3[tt, \beta\beta] + r \times \text{Sin}\left[\theta[tt] \times \frac{\pi}{180}\right];$$

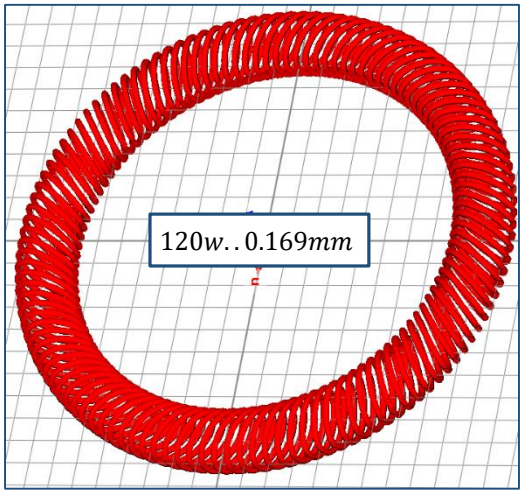


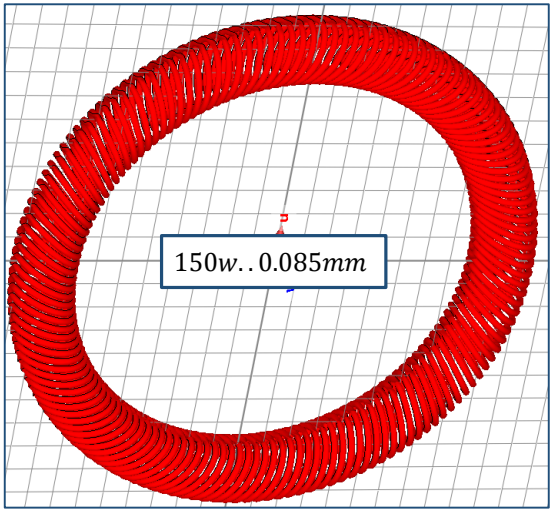
2.3 Cases under Studies

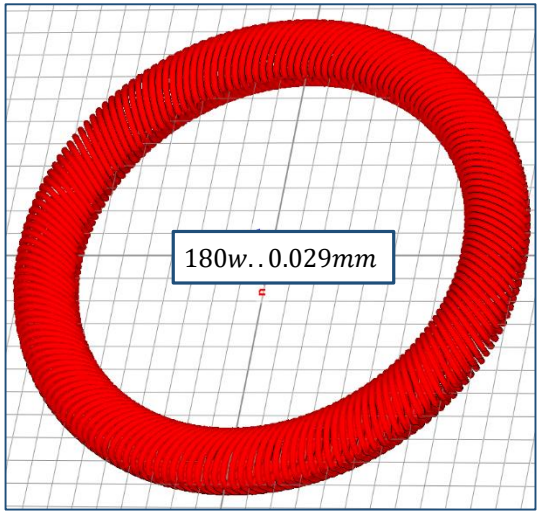
Winding Thickness → 0.25*mm*





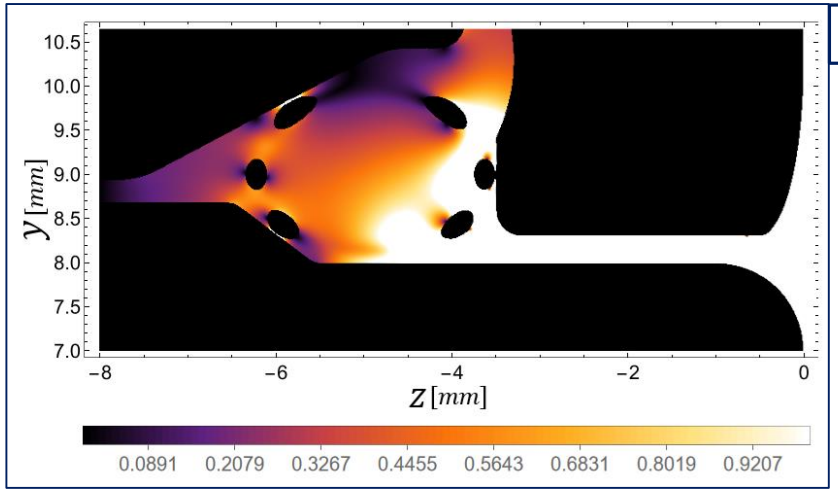




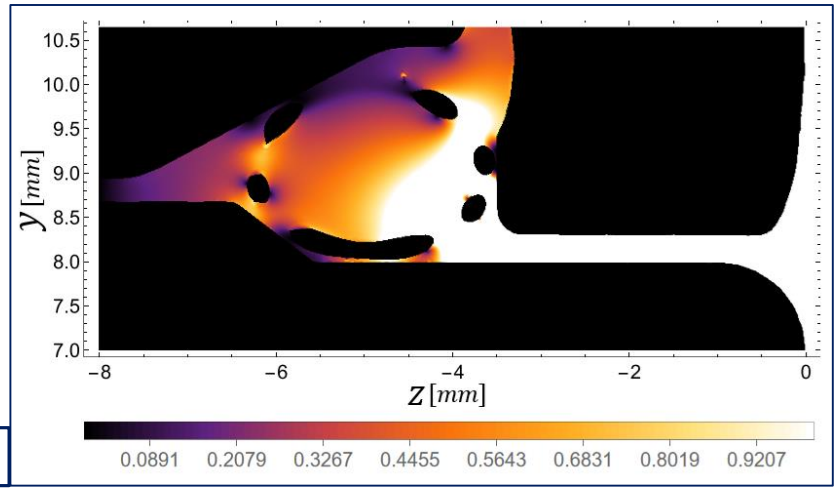


3.1 RF Simulations-90 Windings

E Filed Distribution-1MV/m on the Cavity Axis



Simplified

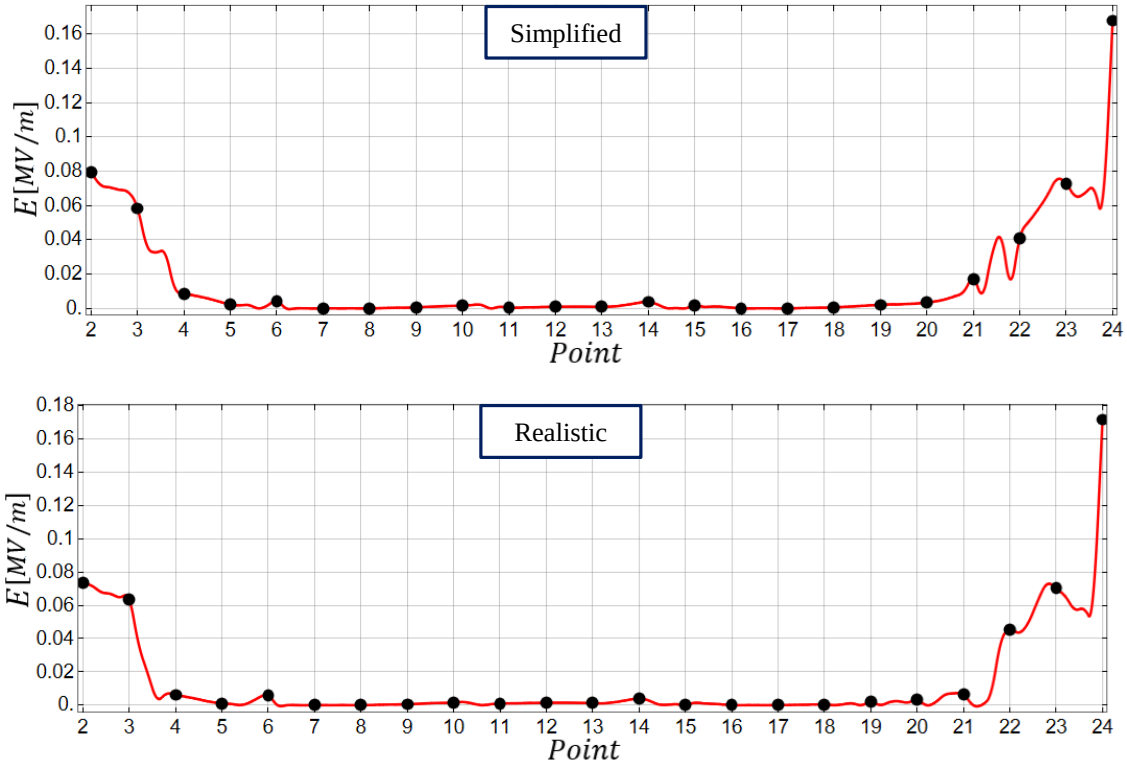


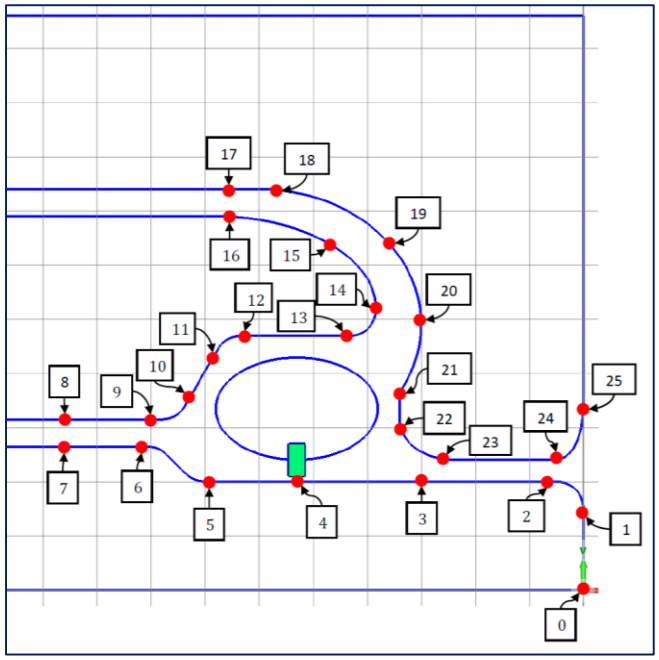
Realistic

Very Different

3.1 RF Simulations-90 Windings

E-Field Profile on the Wall
Gradient 1MV/m on the Cavity Axis

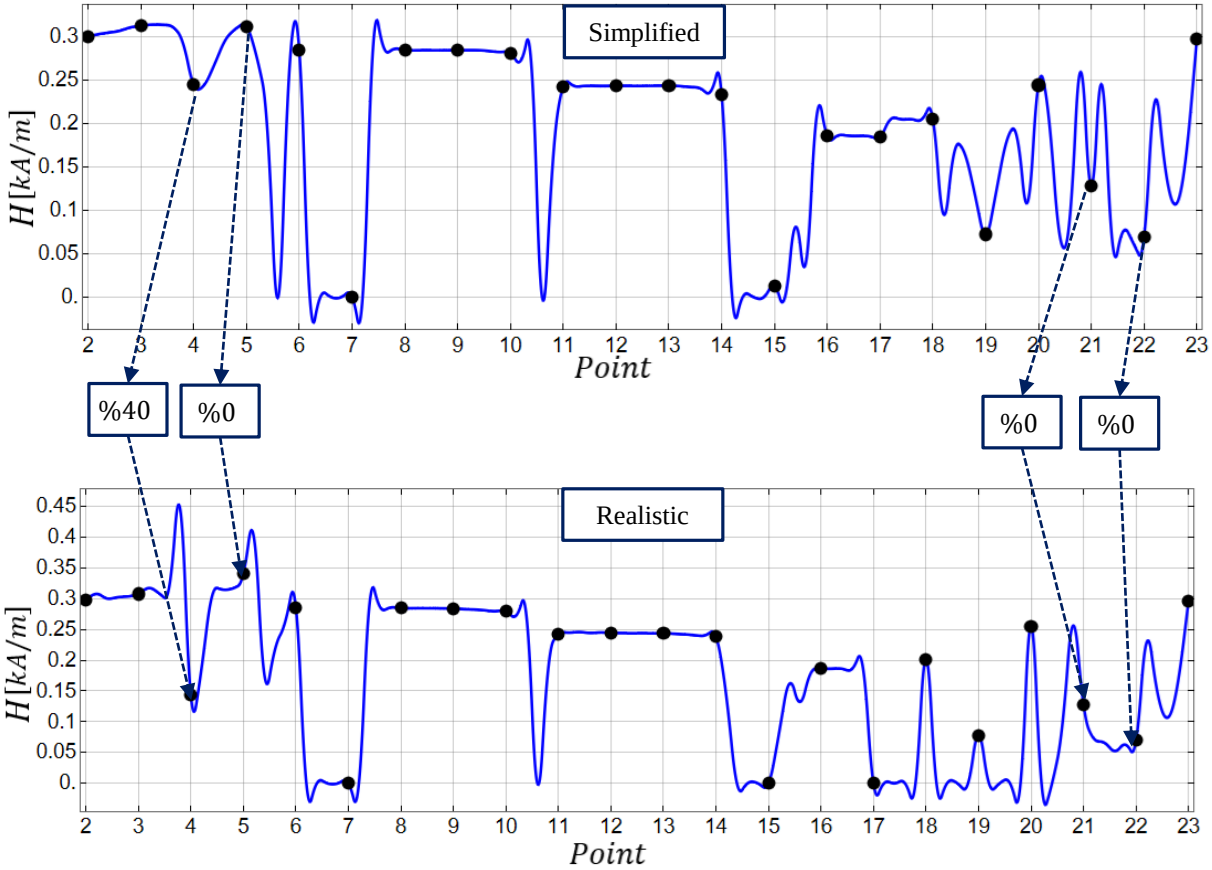


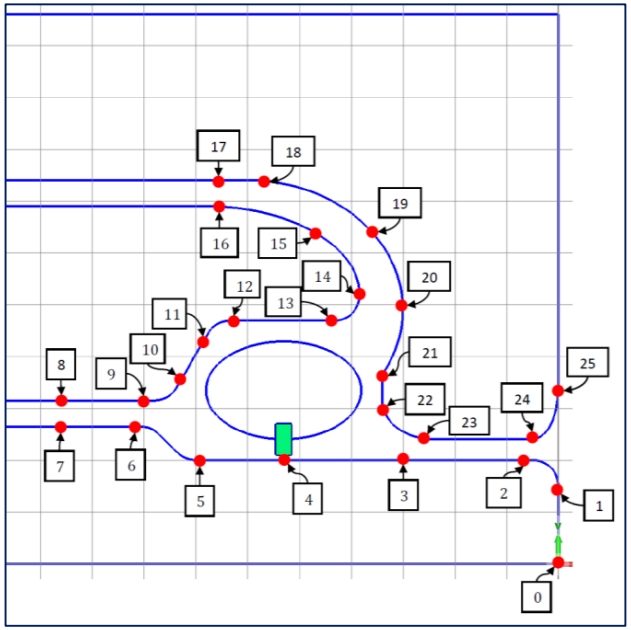


More or Less Similar

3.1 RF Simulations-90 Windings

H-Field Profile on the Wall
1MV/m Gradient on the Cavity Axis

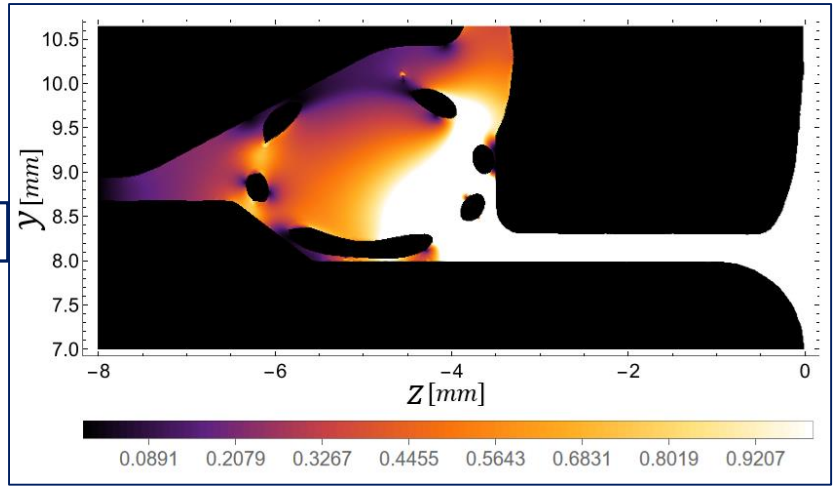




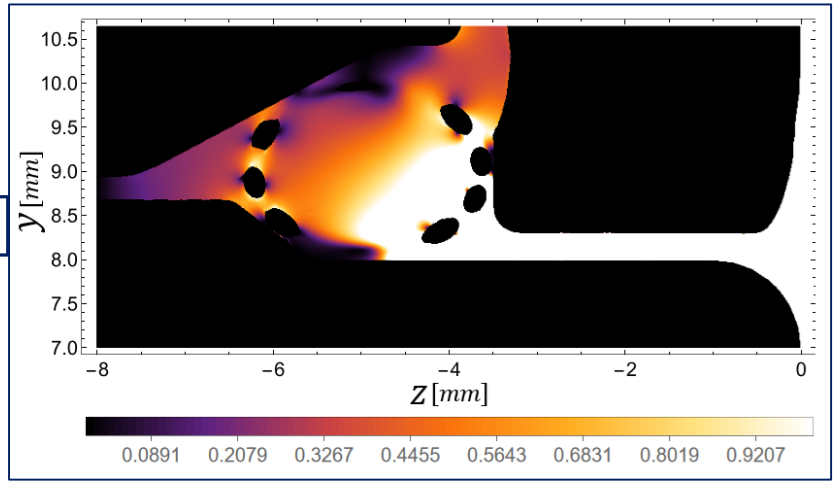
3.2 RF Simulations-120 Windings

E Filed Distribution-1MV/m on the Cavity Axis

90 Windings



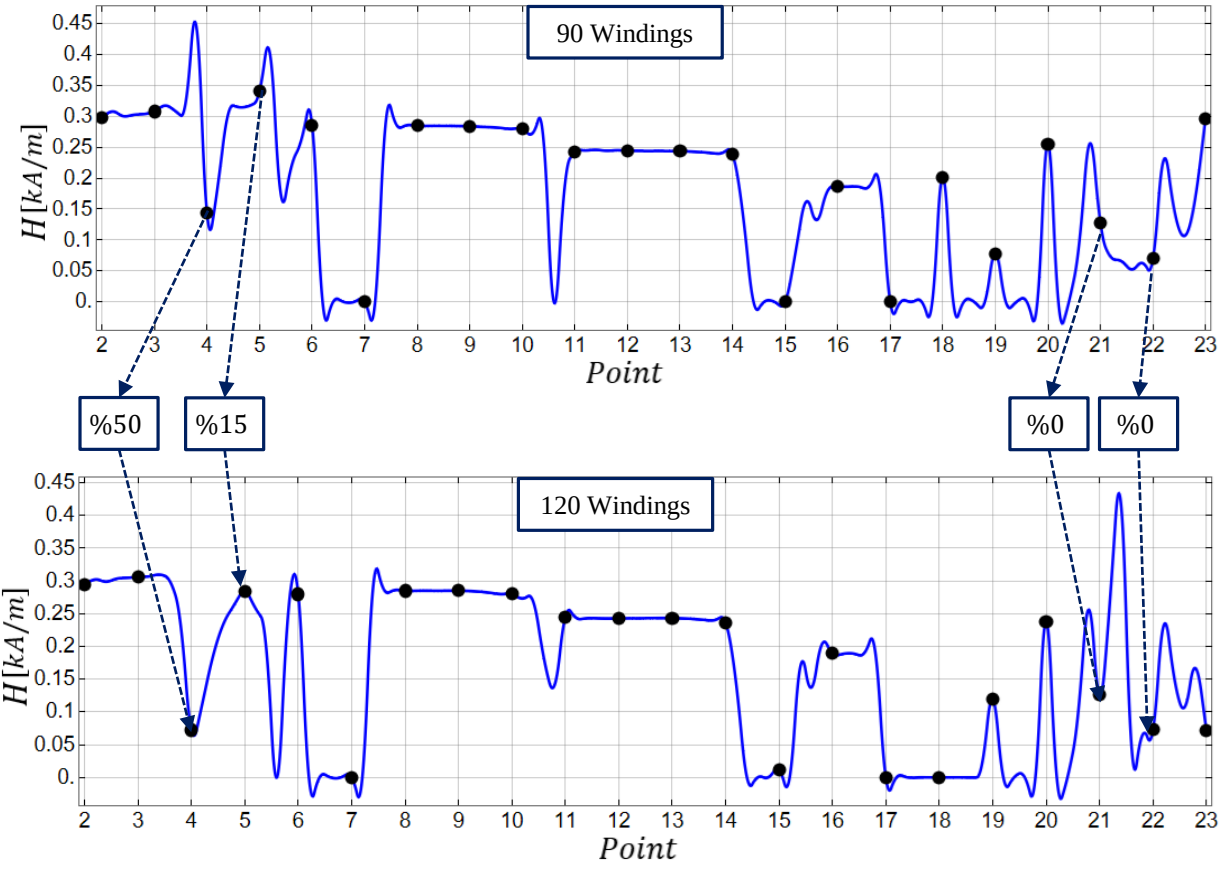
120 Windings

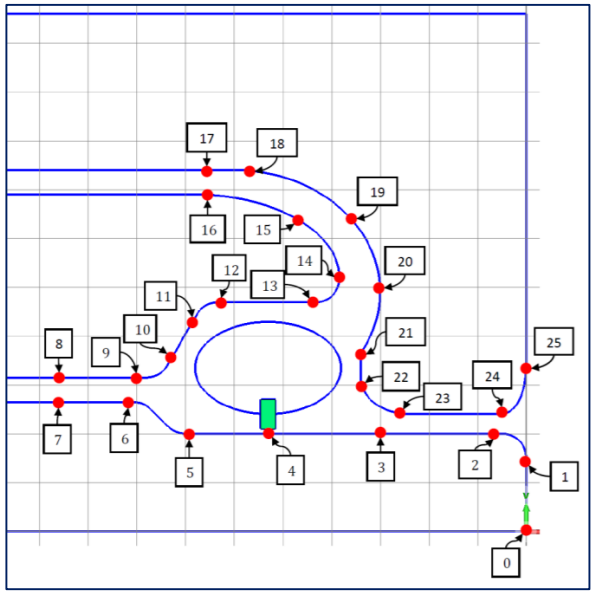


Better Screening at Contact Points

3.2 RF Simulations-120 Windings

H-Field Profile on the Wall
1MV/m Gradient on the Cavity Axis

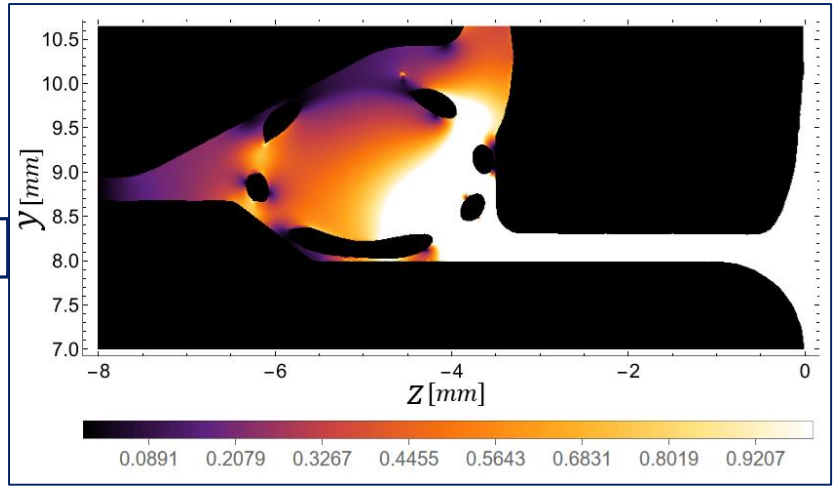




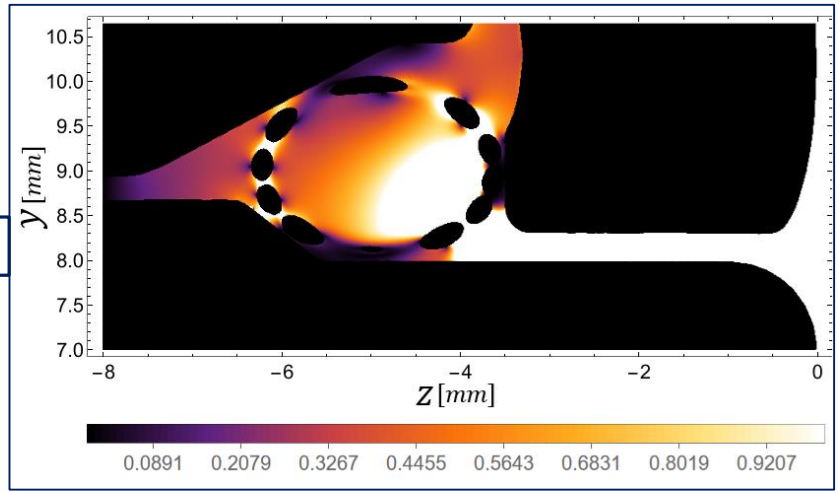
3.3 RF Simulations-150 Windings

E Filed Distribution-1MV/m on the Cavity Axis

90 Windings



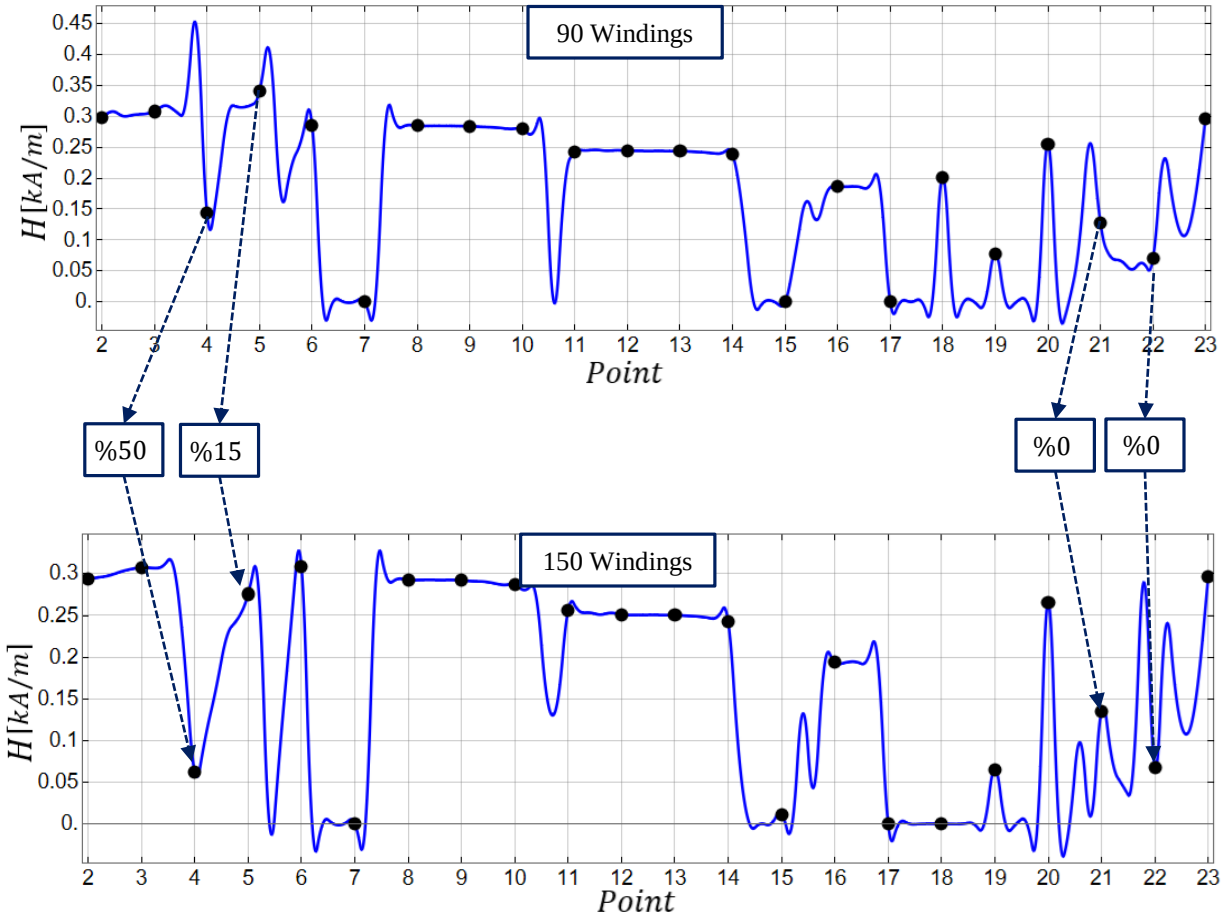
150 Windings

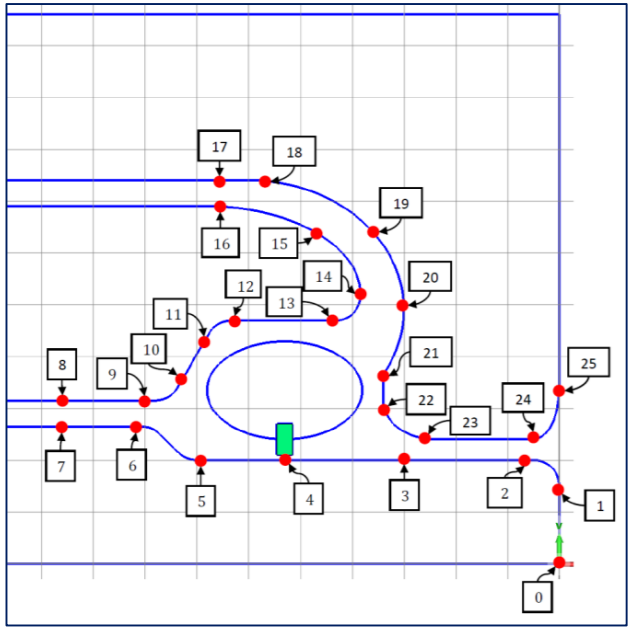


Much More Screening at Contact Points

3.3 RF Simulations-150 Windings

H-Field Profile on the Wall
1MV/m Gradient on the Cavity Axis





Thanks for Attention