On rf-finger heating and trapped mode damping in LHC collimator

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CWG meeting

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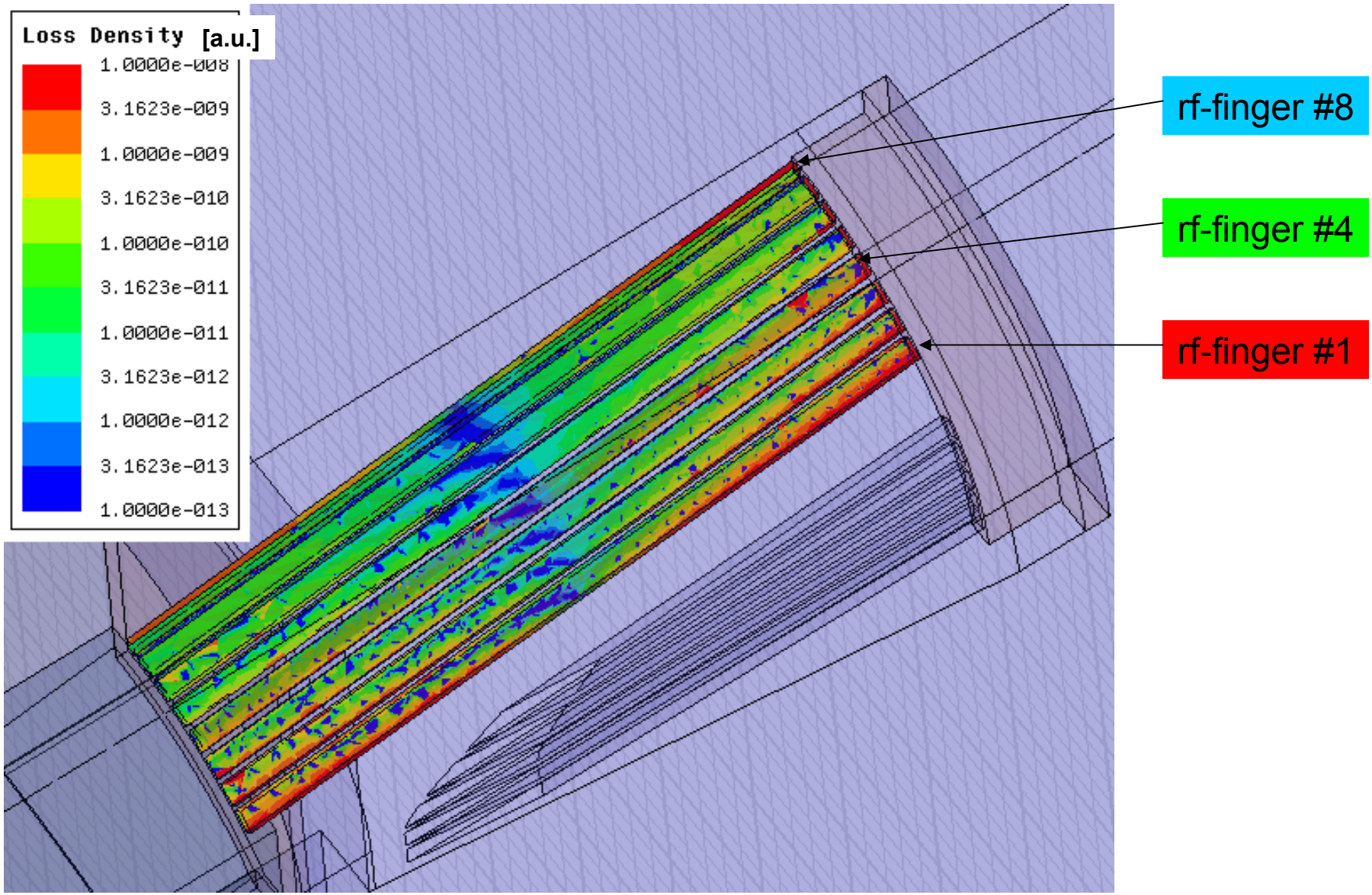
Distribution of rf-losses on the rf-fingers due to longitudinal mode at 1.247 GHz

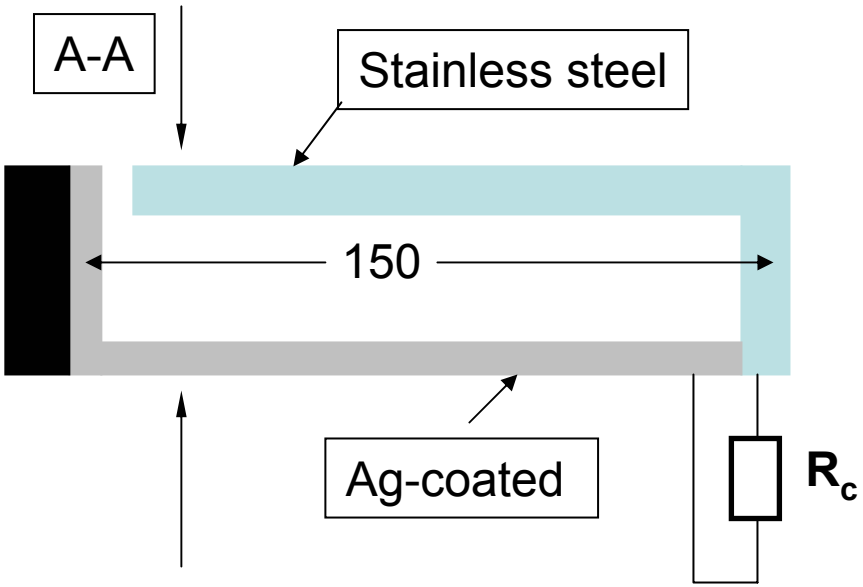


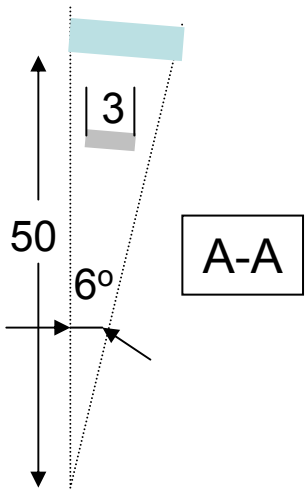
Losses in CuBe and Ag-coated rf-fingers

	CuBe2	Ag
σ [1/Ωm]	1.2×10^7	6.1×10^7
Q	785	892
P_{total} [W]	28	32
$P_{rf\text{-}fing}$ [W]	3.5 (12.4%)	2 (6.2%)
$P_{rf\text{-}fing\#1}$ [W]	0.3 (1%)	0.16 (0.5%)
$P_{rf\text{-}fing\#4}$ [W]	0.08 (0.3%)	0.05 (0.15%)
$P_{rf\text{-}fing\#8}$ [W]	0.05 (0.2%)	0.03 (0.1%)

Ag-coating is 5μm thick what is "much" bigger than skin-depth in Ag at 1.247 GHz which is 2μm

Effect of rf-finger sliding contact resistance





Surface impedance of a good conductor:

$$Z_s = (1+i)/\sigma\delta$$

Resistance of a stripe of size L x d:

$$R = \mathrm{Re}\{Z_s\}\, L/d$$

at 1.25 GHz

$R_{ss} = 1/(10^6 \cdot 15 \cdot 10^{-6}) \cdot 150/(50 \cdot \sin 6^o)$
$= 2\ \Omega$

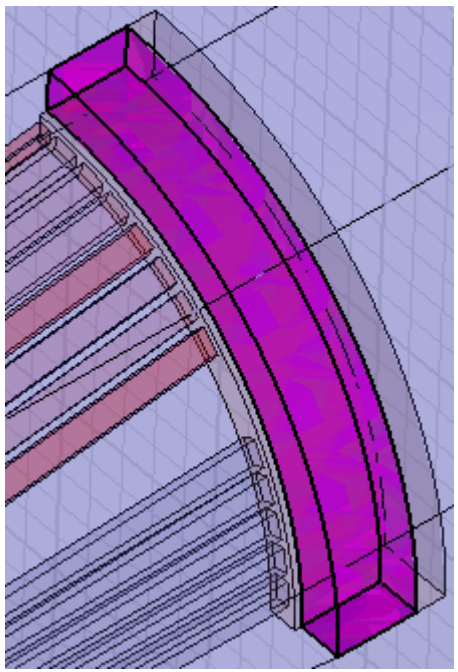
$R_{Ag} = 1/(6 \cdot 10^7 \cdot 2 \cdot 10^{-6}) \cdot 150/3$
$= 8\ m\Omega$

$R_c < 7.5\ m\Omega$

Contact resistance R_c is mach smaller than the equivalent surface resistance $(R_{ss}+R_{Ag})/2$

Damping of transition modes

SiC ring 11x6 mm
at 2 GHz
ε = 15; tanδ = 0.5
μ = 1



Parameters of the dangerous mode

	f [GHz]	Q
No damping	1.247	892
SiC 11x6	1.218	17
4S60 11x6	-	~1
4S60 6x6	-	~1
4S60 3x3	1.246	8

4S60 ring 3x3 mm
at 1.2 GHz
ε = 12 + i7
μ = 1.6 + i9