Investigations on the Standing Wave Ka-Band linearizer with a 2 mm iris radius

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On behalf of Compact Light XLS project

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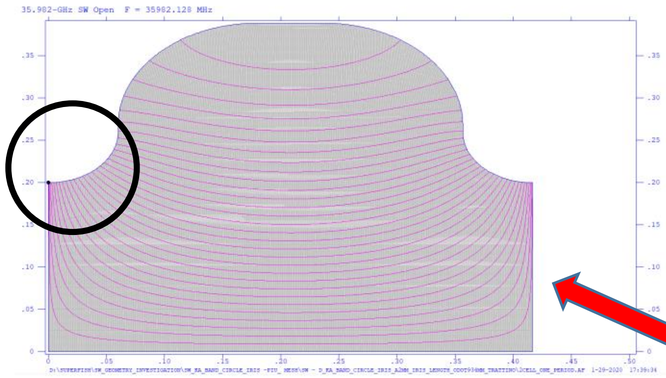
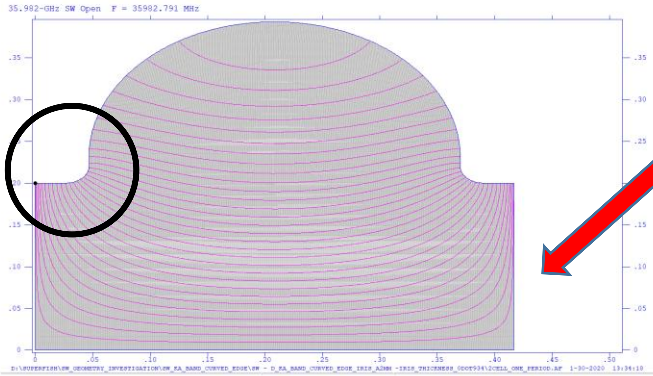
Simulated geometries profile of the Standing Wave Ka-Band structure

1) **Rounded iris**

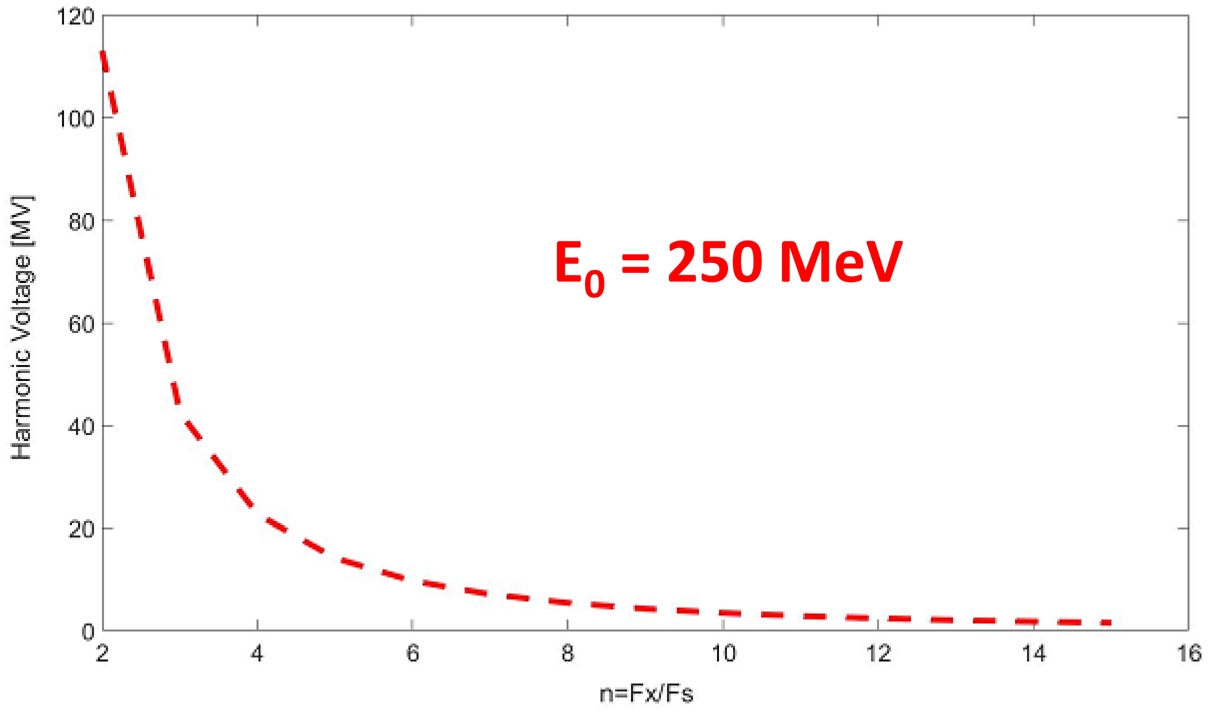


2 mm iris radius

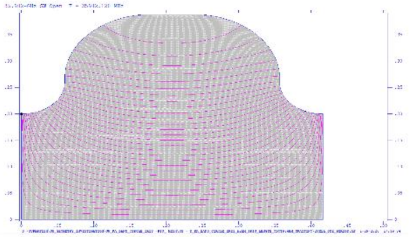
2) **Iris fillet with 0.2 mm radius**



Harmonic Voltage (according to P. Emma paper)



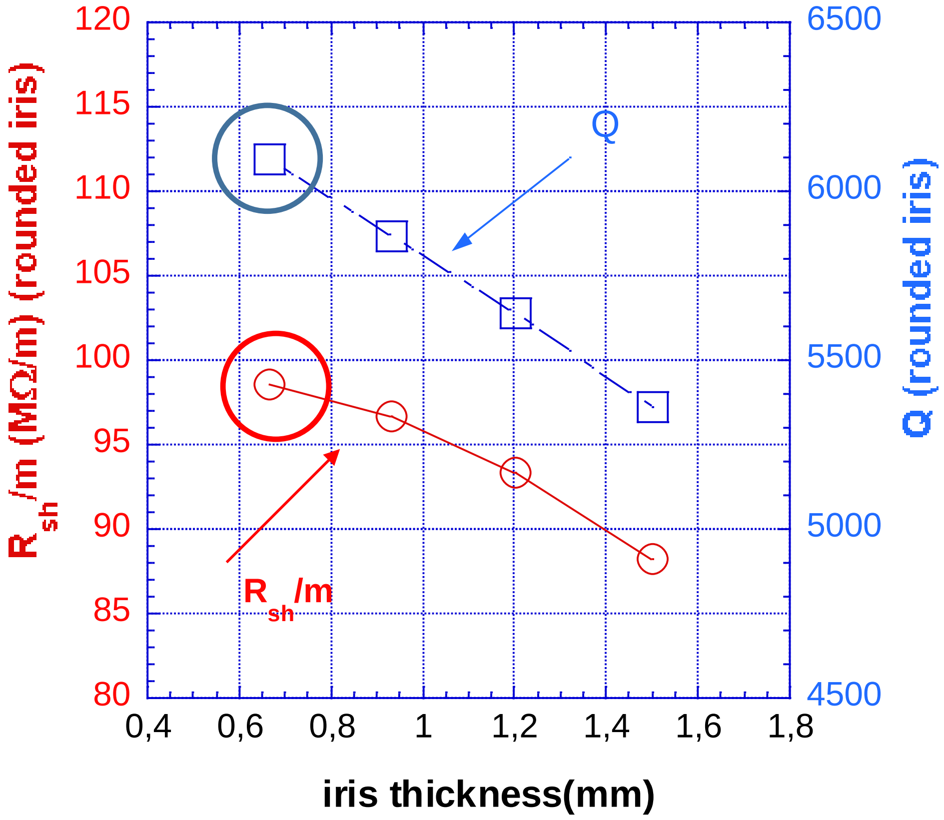
Shunt impedance and quality factor Q as function of the iris thickness



Rounded iris

Rounded iris with a 2 mm iris radius

Shunt impedance Rsh/m and unloaded quality factor Q as function of the iris thickness with an 2 mm iris radius at the operating frequency F = 35.982 GHz in case of rounded circle

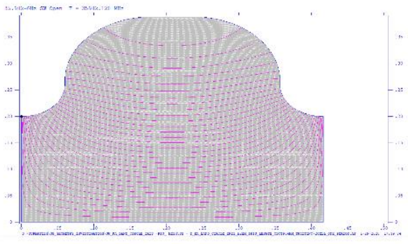


With a h = 0.667 mm iris thickness

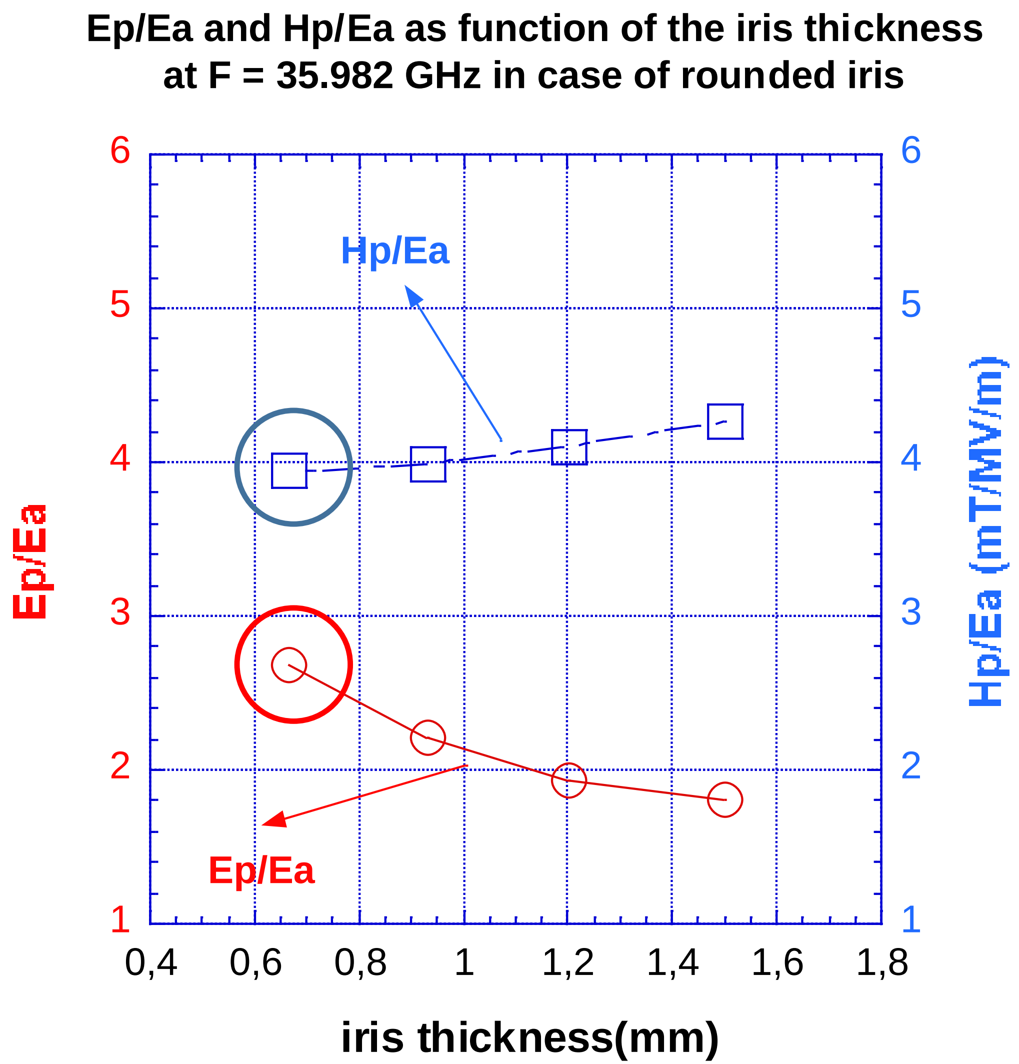
- **Rsh/m ~ 99 MΩ/m**
- **Q ~ 6100**

Ep/Ea and Hp/Ea as function of the iris thickness

Rounded iris with a 2 mm iris radius



Rounded iris



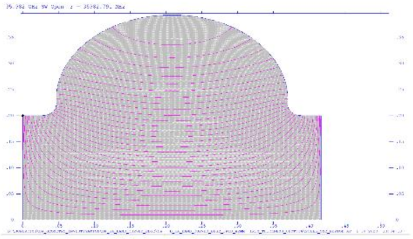
With a h = 0.667 mm iris thickness

Ep/Ea ~ 2.67

Hp/Ea ~ 3.95

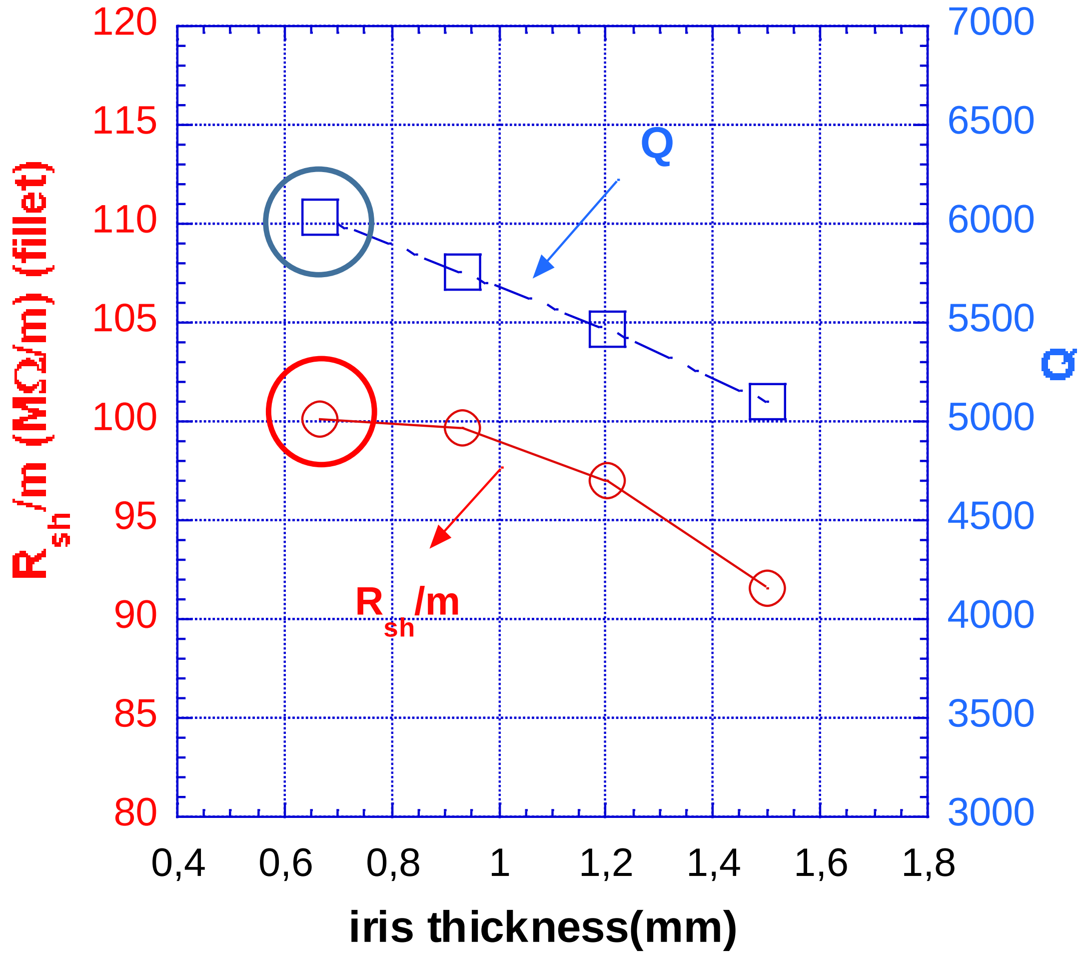
Shunt impedance and quality factor Q as function of the iris thickness

2 mm iris radius and a 0.2 mm Fillet radius



Fillet iris

Shunt impedance Rsh/m and uloaded quality factor Q as function of the iris thickness with a 2 mm iris radius at the operating frequency F = 35.982 GHz in case of fillet shape with 0.2 mm radius

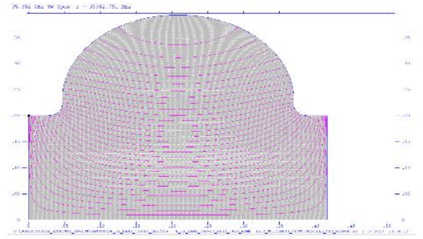


With a h = 0.667 mm iris thickness

- **Rsh/m ~ 100 MΩ/m**
- **Q ~ 6030**

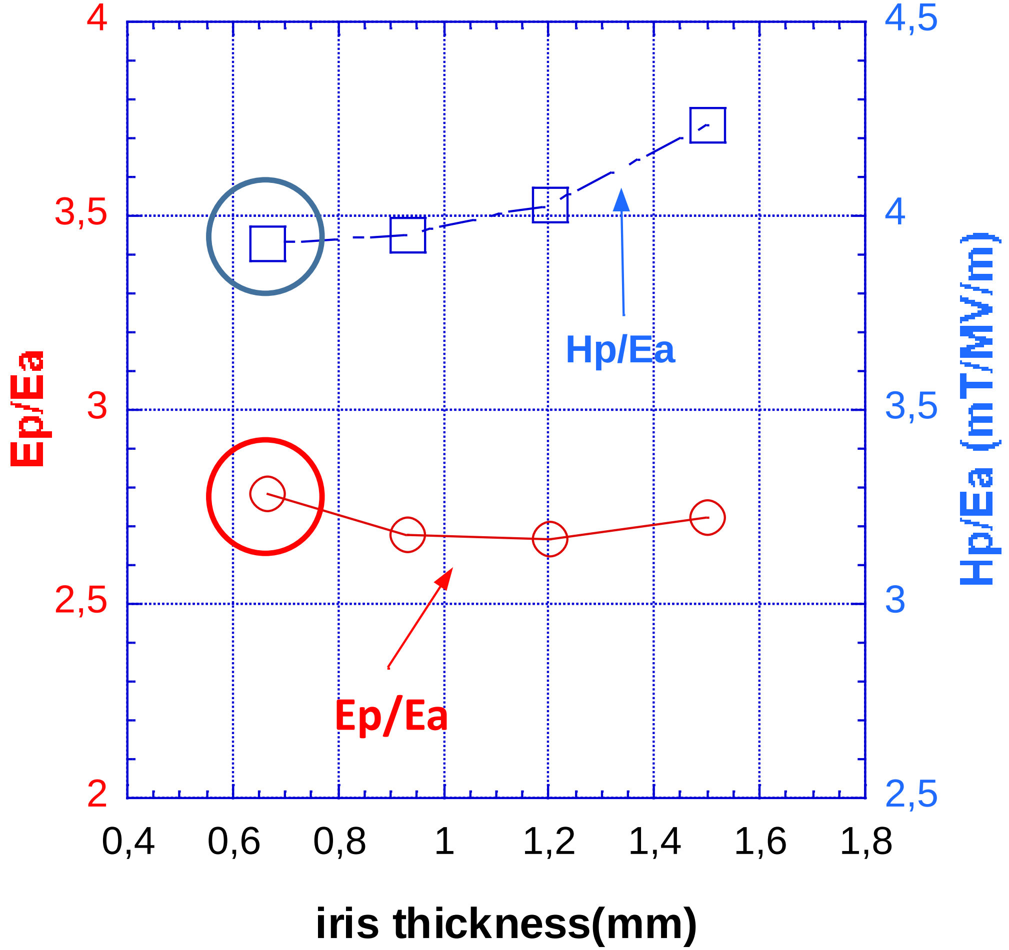
Ep/Ea and Hp/Ea as function of the iris thickness

2 mm iris radius and a 0.2mm Fillet radius



Fillet iris

Ep/Ea and Hp/Ea as function of the iris thickness with a 2 mm iris radius at F = 35.982 GHz in case of fillet shape with 0.2 mm radius

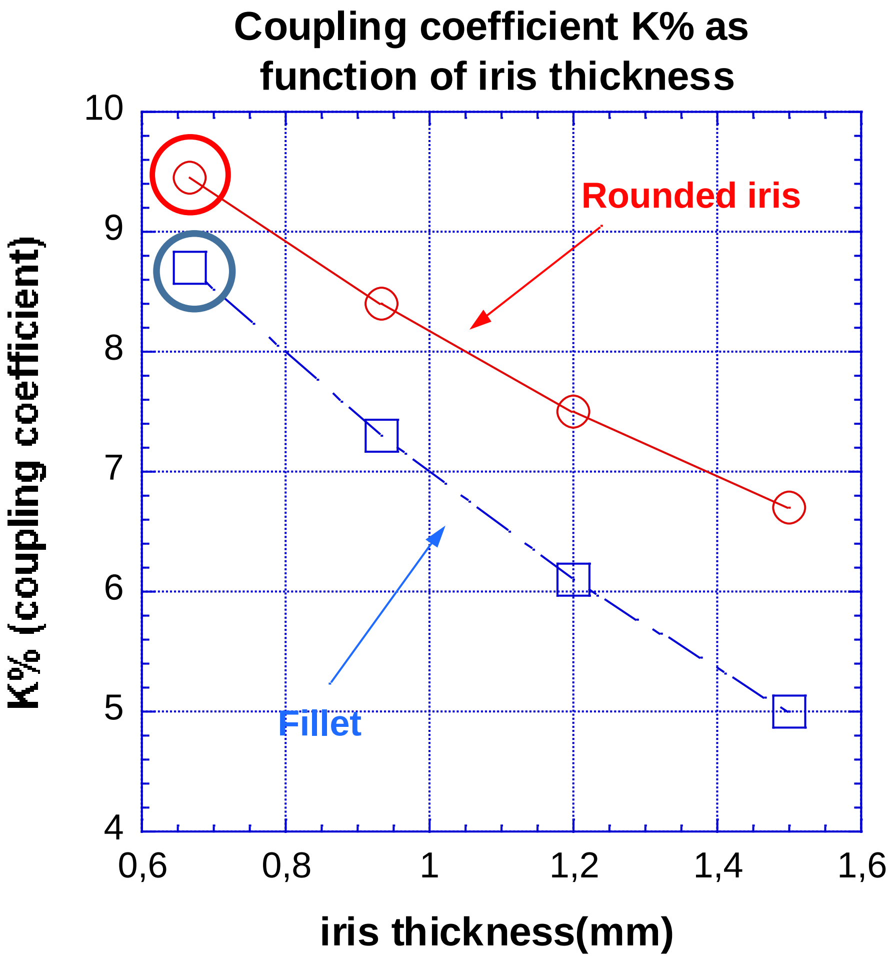


With a h = 0.667 mm iris thickness

Ep/Ea ~ 2.78

Hp/Ea ~ 3.93

Cell to cell coupling coefficient as function of the iris thickness



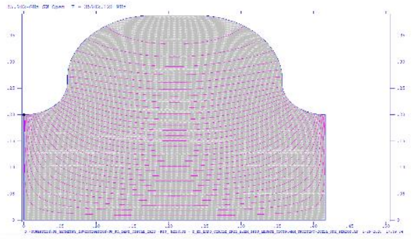
With a h = 0.667 mm iris thickness

Rounded iris K = 9.5 %
(cell to cell coupling coefficient)

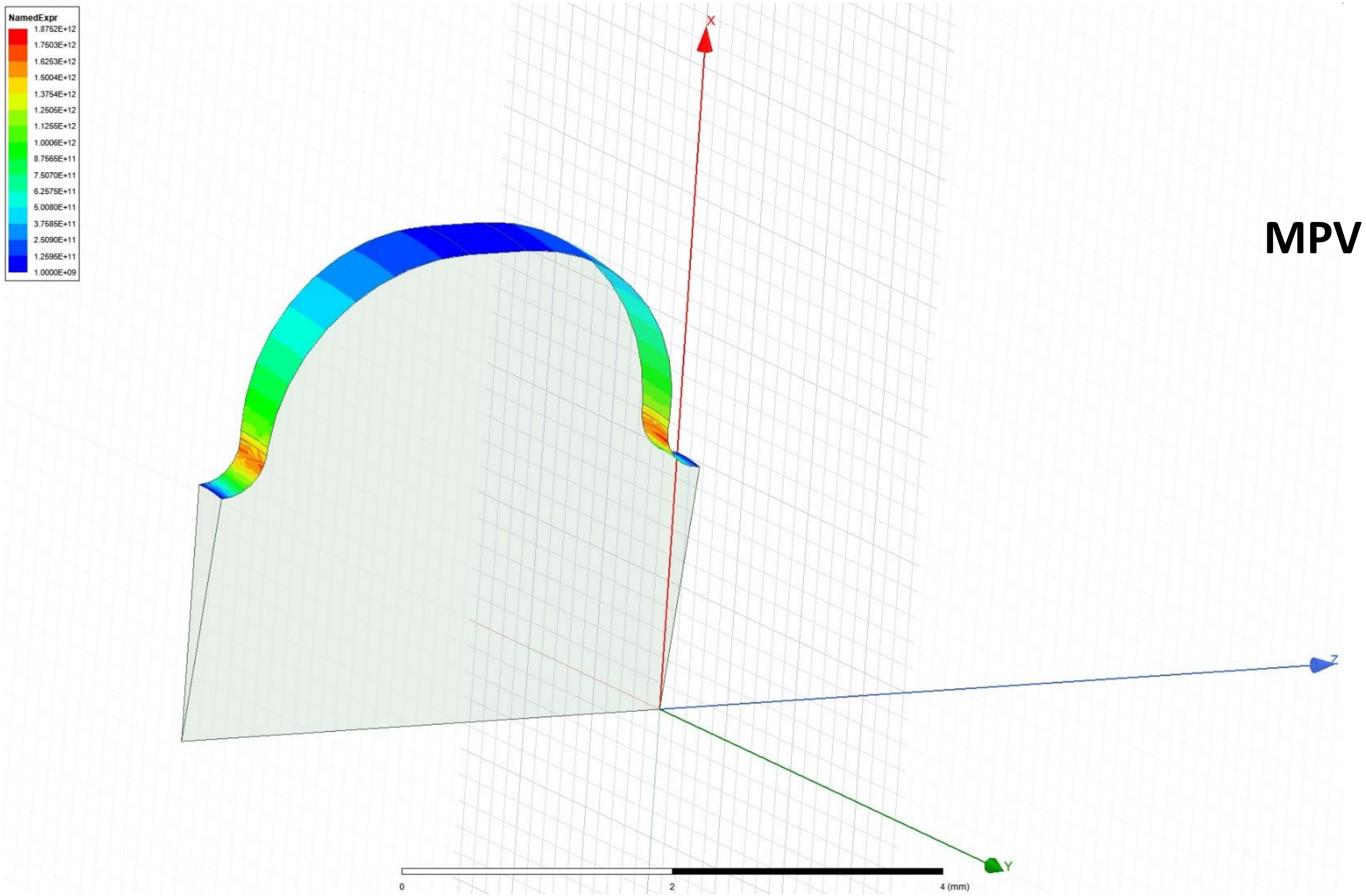
Fillet iris K = 8.7 %
(cell to cell coupling coefficient)

Modified Poynting vector at Eacc = 70 MV/m

Rounded circle with a 2 mm iris radius and 0.667 mm thickness radius



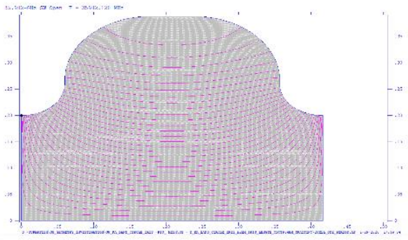
Rounded iris



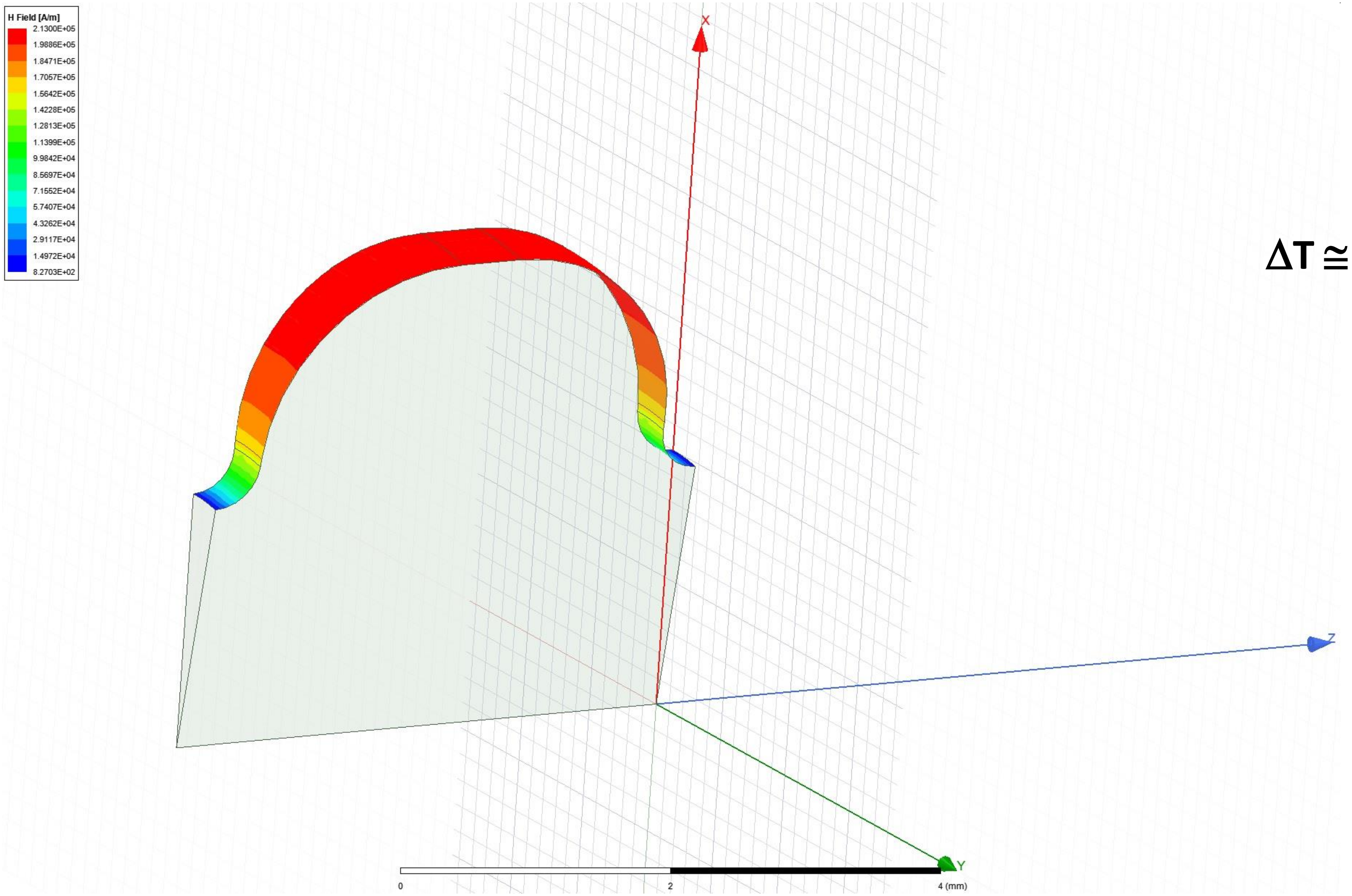
MPV ≅ 1.88 MW/mm^2

Pulse Heating at 70 MV/m@50 ns

Rounded circle with a 2 mm iris radius and 0.667 mm thickness radius



Rounded iris



$\Delta T \cong 7.50\ {}^{0}C$

Modified Poynting Vector and pulse heating with a 2 mm iris radius and rounded iris (iris thickness 0.667 mm)

Eacc (MV/m)	EF (MV/m)	HF (MA/m)	Modified Poynting Vector (MW/mm^2)	Pulse Heating (Celsius ^0C)
35	93.65	0.11	0.47	1.87
70	187.53	0.21	1.88	7.50

K = 9.5 % (cell to cell coupling coefficient)

Modified Poynting Vector and pulse heating with a 2 mm iris radius and fillet iris (iris thickness 0.667 mm)

Eacc (MV/m)	EF (MV/m)	HF (MA/m)	Modified Poynting Vector (MW/mm^2)	Pulse Heating (Celsius ^0C)
35	93.65	0.10	0.43	1.57
70	187.53	0.20	1.72	6.29

K = 8.7 % (cell to cell coupling coefficient)

Conclusions

Assuming a 8 cm structure length, 5 MW matched input power, Rsh ~ 100 MΩ/m we obtain an average accelerating Electric Field Eacc ~ 80 MV/m

Gyroklystron gives P = 3 MW (Cern – England) and by using the SLED we are able to get P = 12 MW

In all cases the modified Poynting vector and the pulse heating are well below the safety thresholds

The circulator has to be designed !

Cryostructure

At 77 Kelvin degree with a 2.2 enhancement factor (From J. Rosenzweig) the shunt impedance is estimated to be Rsh = 220 MΩ/m.
With P = 3 MW we are able to get an average electric field Eacc ~ 91 MV/m by assuming a 8 cm structure length

Thank you very much for your attention !