

Multipacting suppression in 56 MHz Quarter Wave Resonator

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March 26, 2008



Simulation studies

- 2D Multipac 2.1 code using Finite element method field solver and Matlab user interface.
- It analyzes for axis symmetric RF structure.

Features of computational method

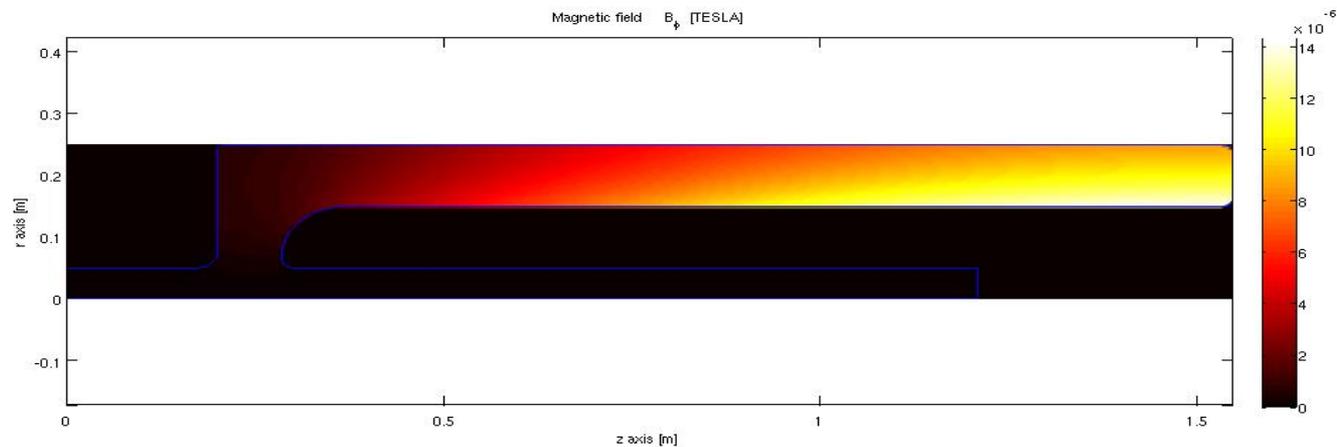
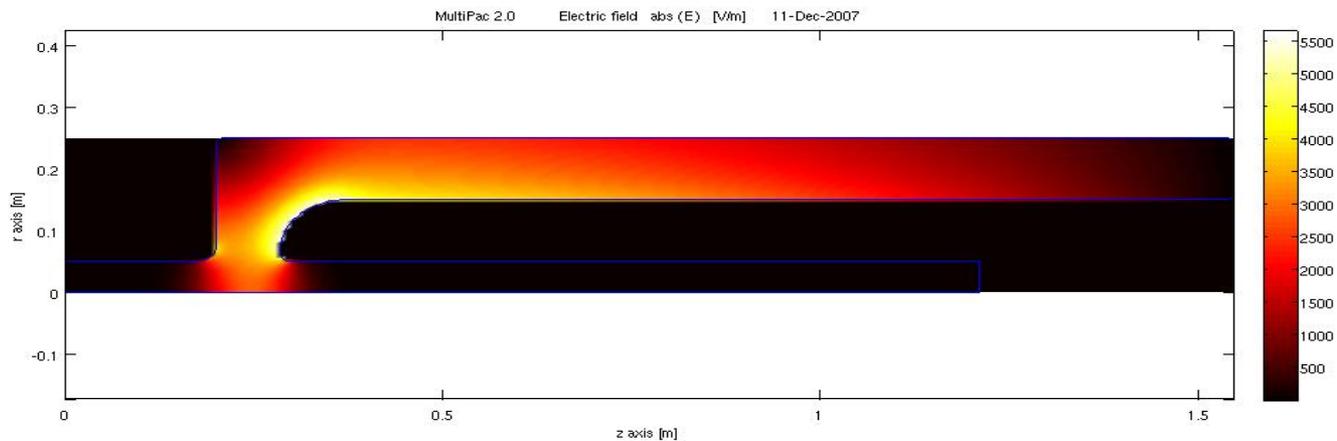
1. Calculates time harmonic electromagnetic field
2. Finds multipacting field levels using secondary yield function
3. Locates and identifies the multipacting electron trajectories

Criteria of code to determine Multipacting

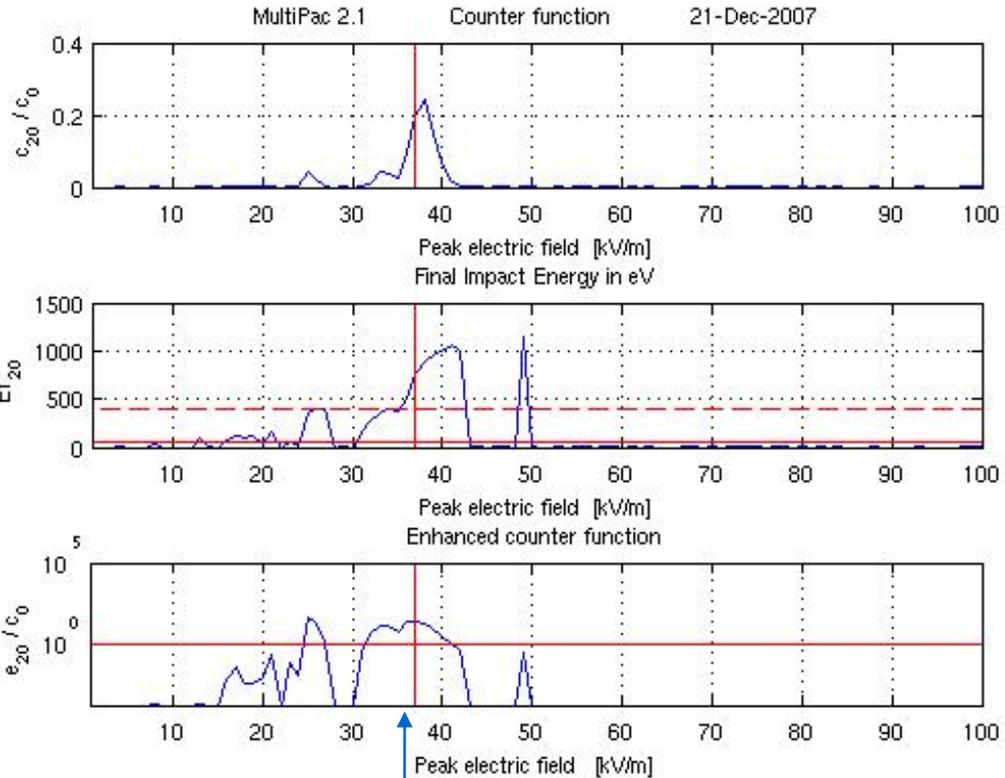
1. Counter function (number of free electrons after 20 impacts/initial electrons) C_{20}/C_0
2. Average impact energy after 20 impacts ($E_{f_{20}}$) : $54 \text{ eV} < E_{f_{20}} < 1554 \text{ eV}$ (Niobium)

Enhanced counter function (number of secondary electrons after 20 impacts/initial electrons)
 $e_{20}/C_0 > 1$

Cavity with electric and magnetic field distribution



Triplot: 1 kV/m-100 kV/m



Counter function

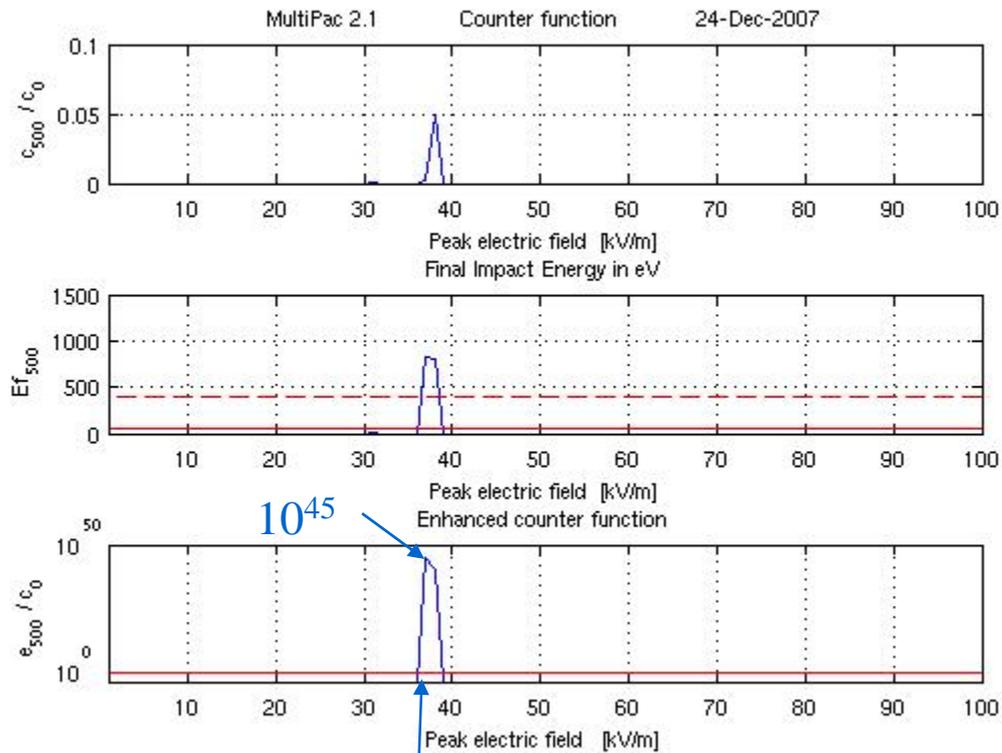
Average impact energy after 20 impacts

Enhanced counter function

Electron impact number: 20

37 kV/m

Triplot: 1-100 kV/m(37-57 cm)



10^{45}

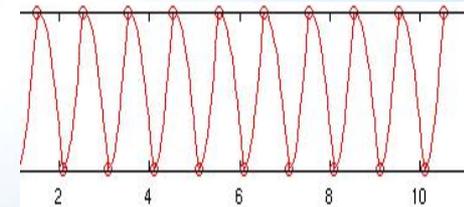
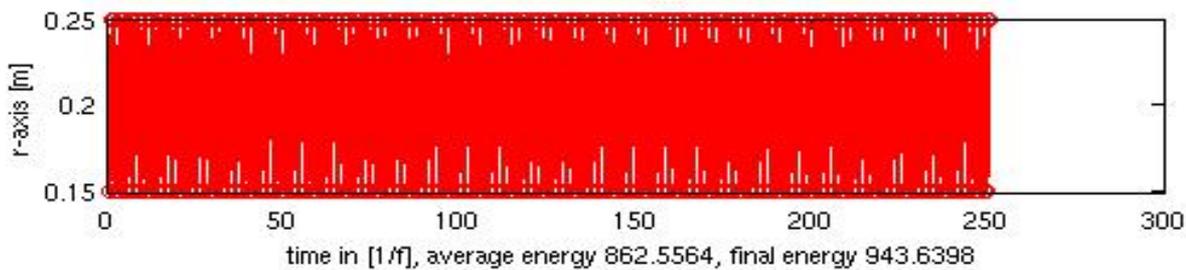
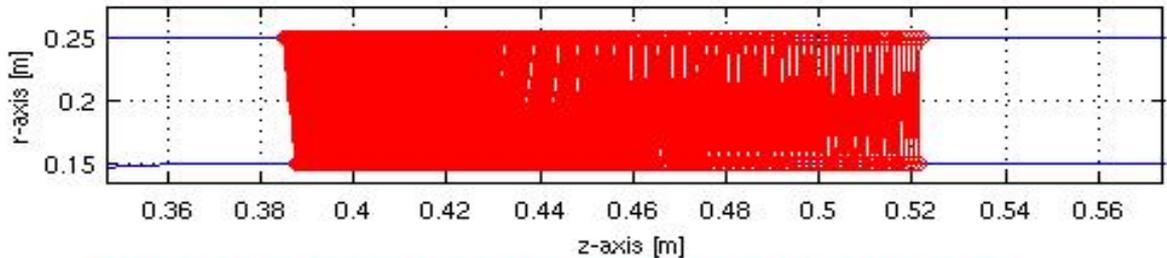
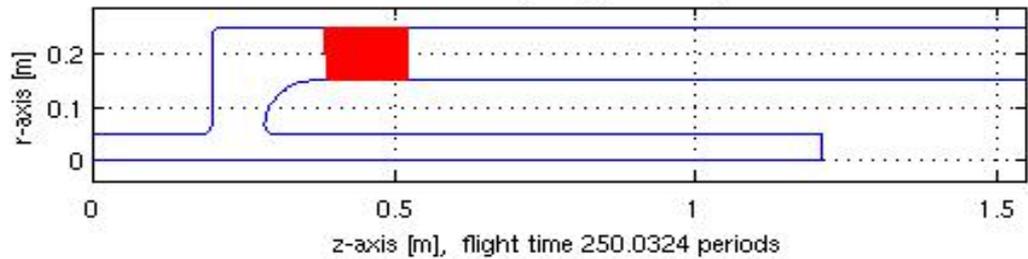
37 kV/m

Electron impact number: 500



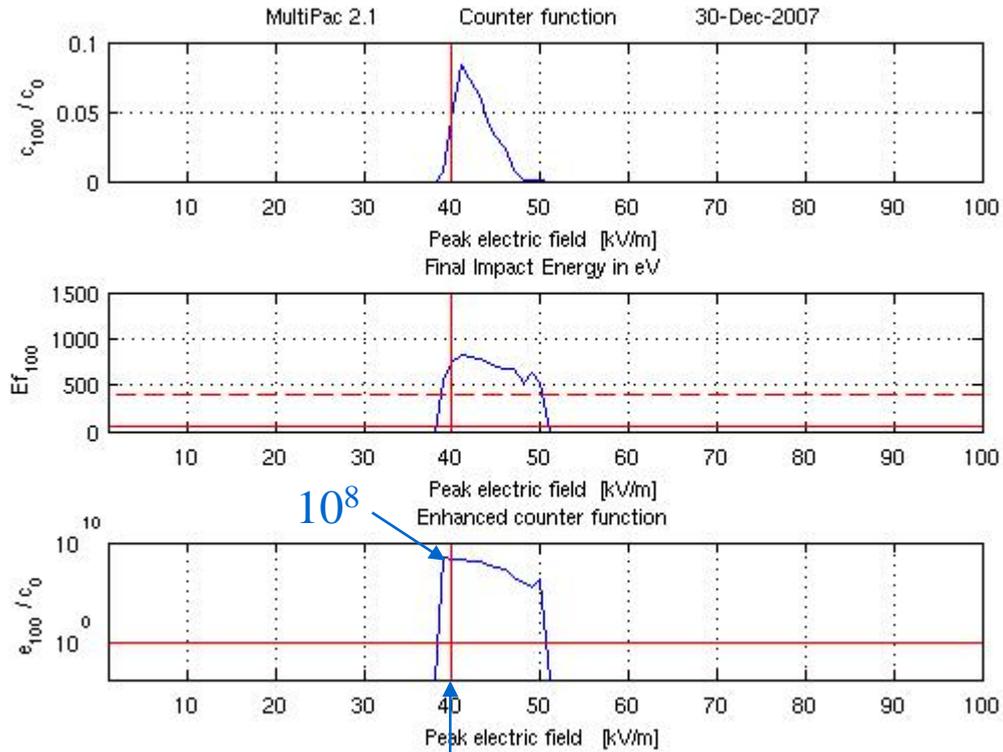
Electron-trajectory: 37 kV/m

MultiPac 2.1 Electron Trajectory, N = 500, 24-Dec-2007



Electron impact number: 500

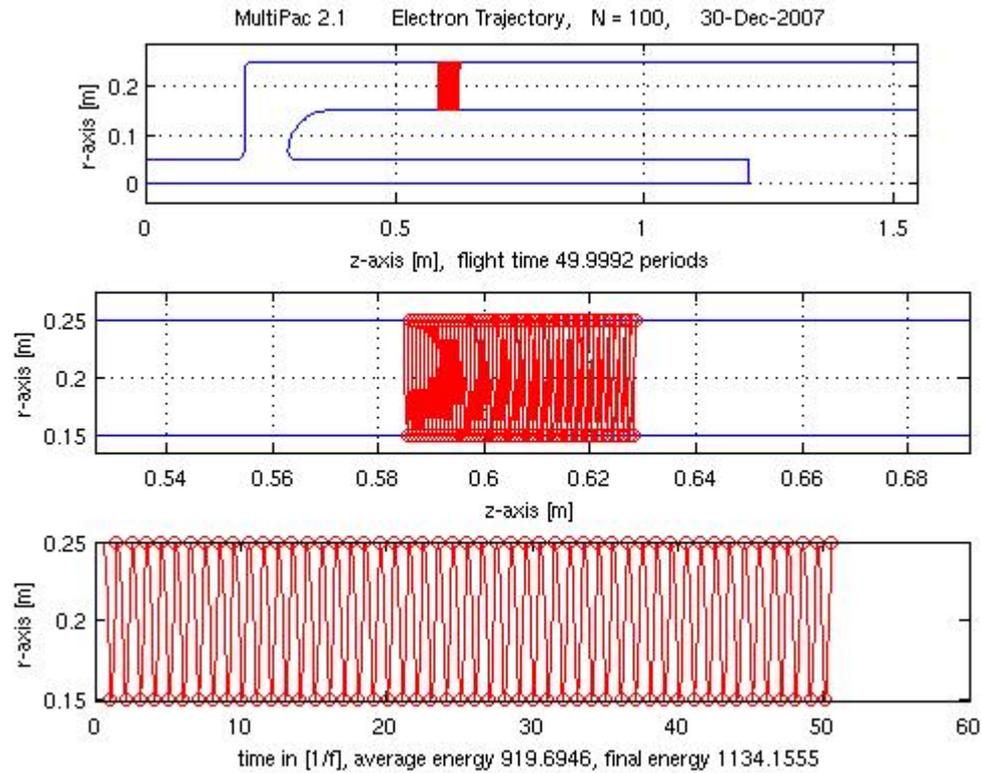
Triplot: 1 -100 kV/m (57-77cm)



40 kV/m

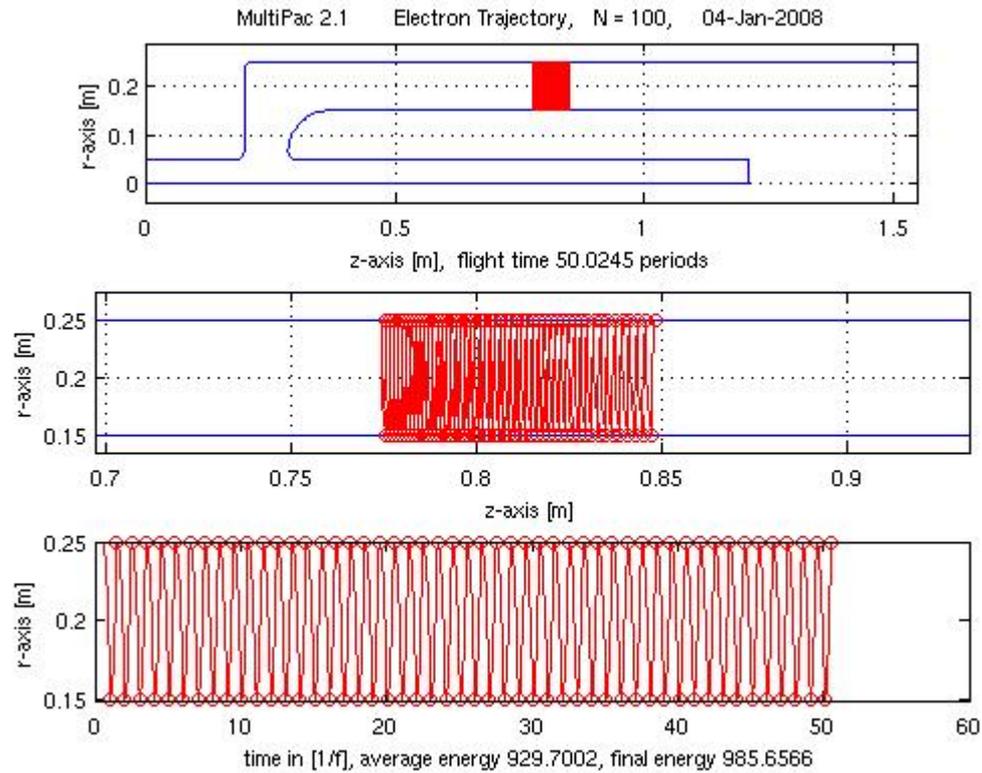
Electron impact number: 100

Electron trajectory: 40 kV/m



Electron impact number: 100

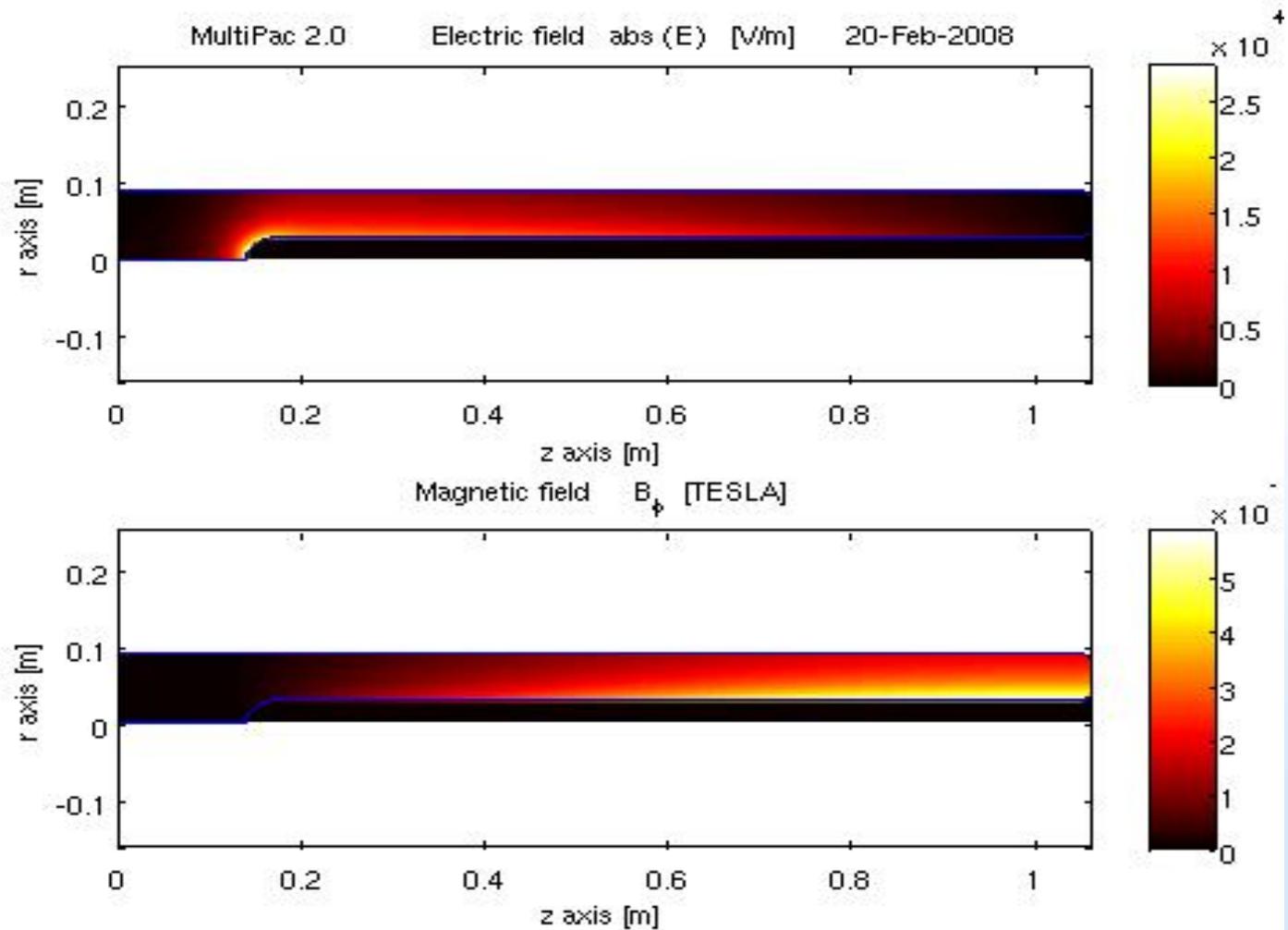
Electron-trajectory: 47 kV/m



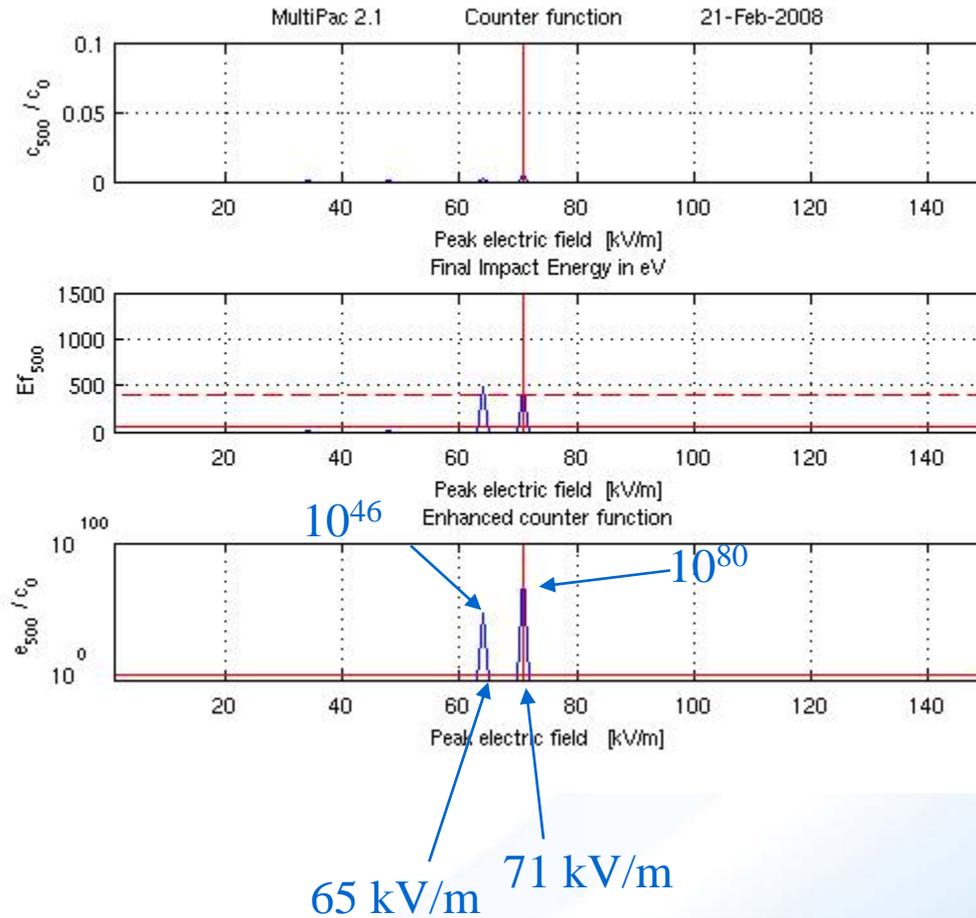
Electron-impact number: 100

Comparison with 80 MHz Legnaro QWR

Electric and Magnetic field distribution

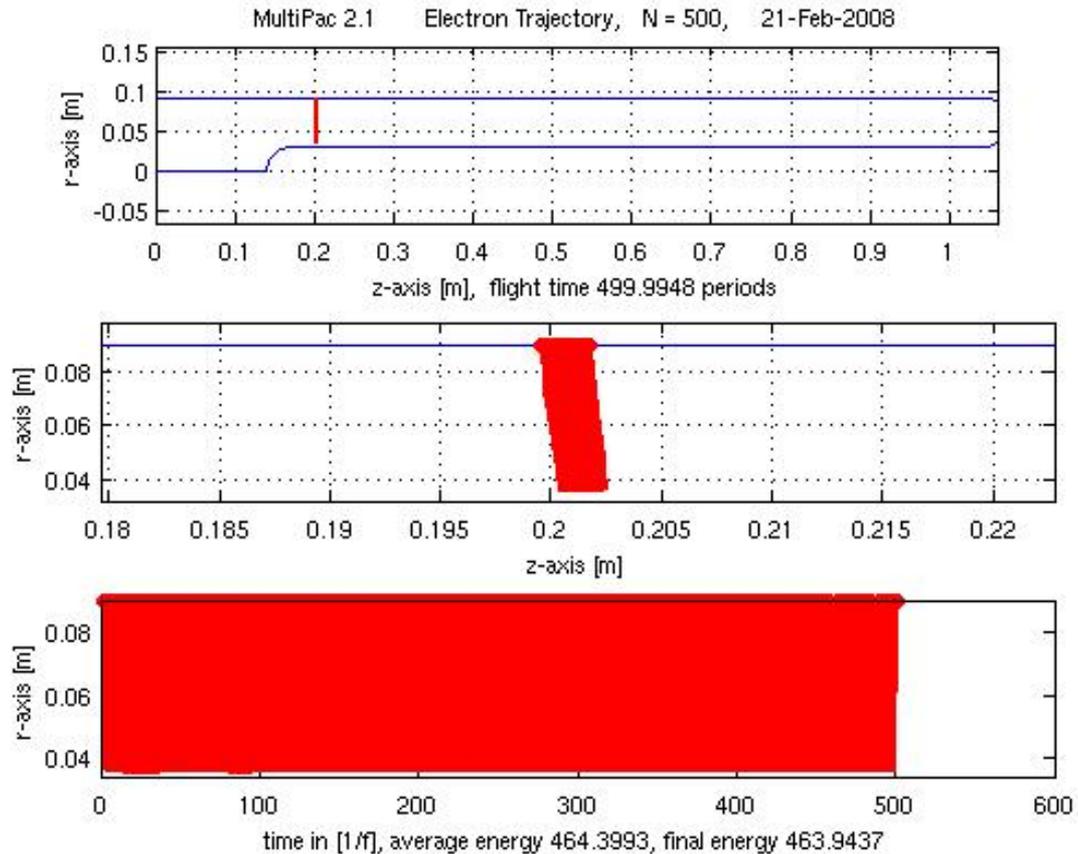


Triplot: 1 -150 kV/m (20 - 60cm)



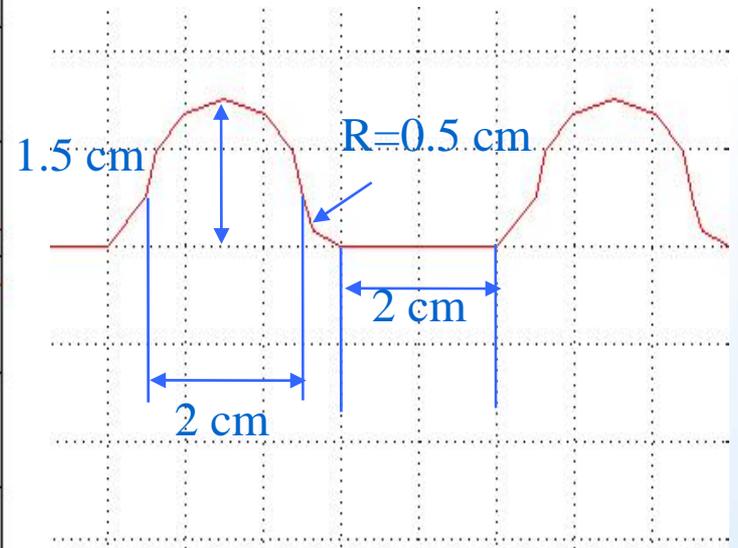
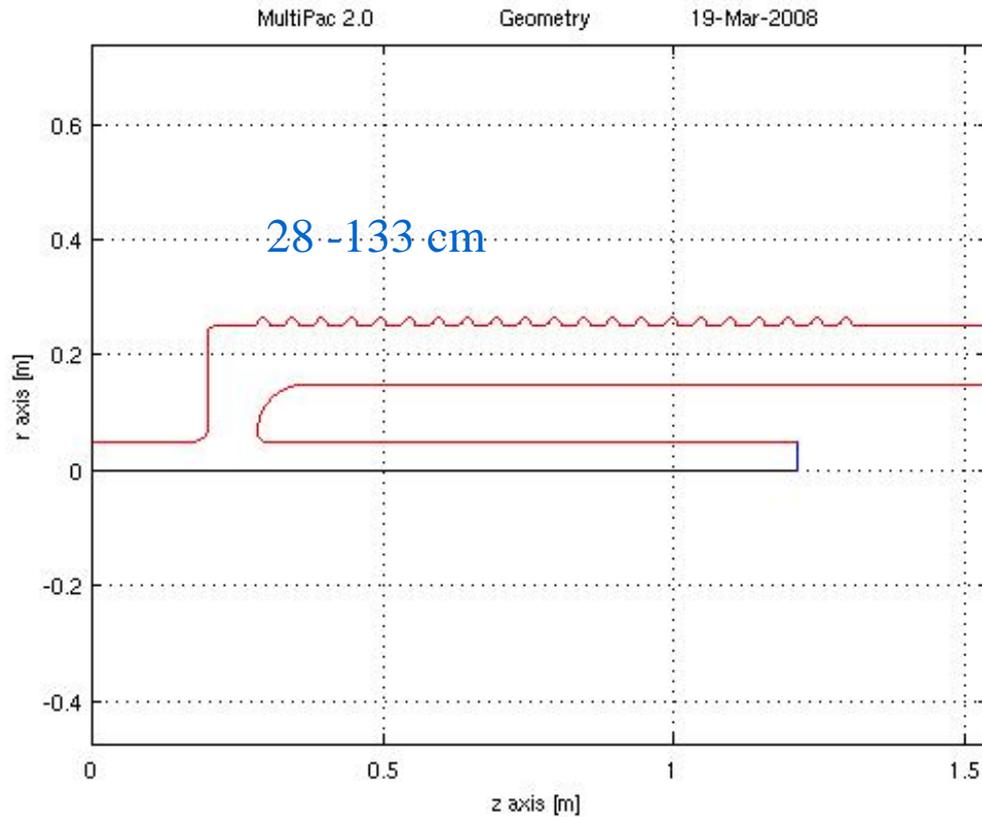
Electron-impact number: 500

Electron trajectory: 71 kV/m (20-60cm)

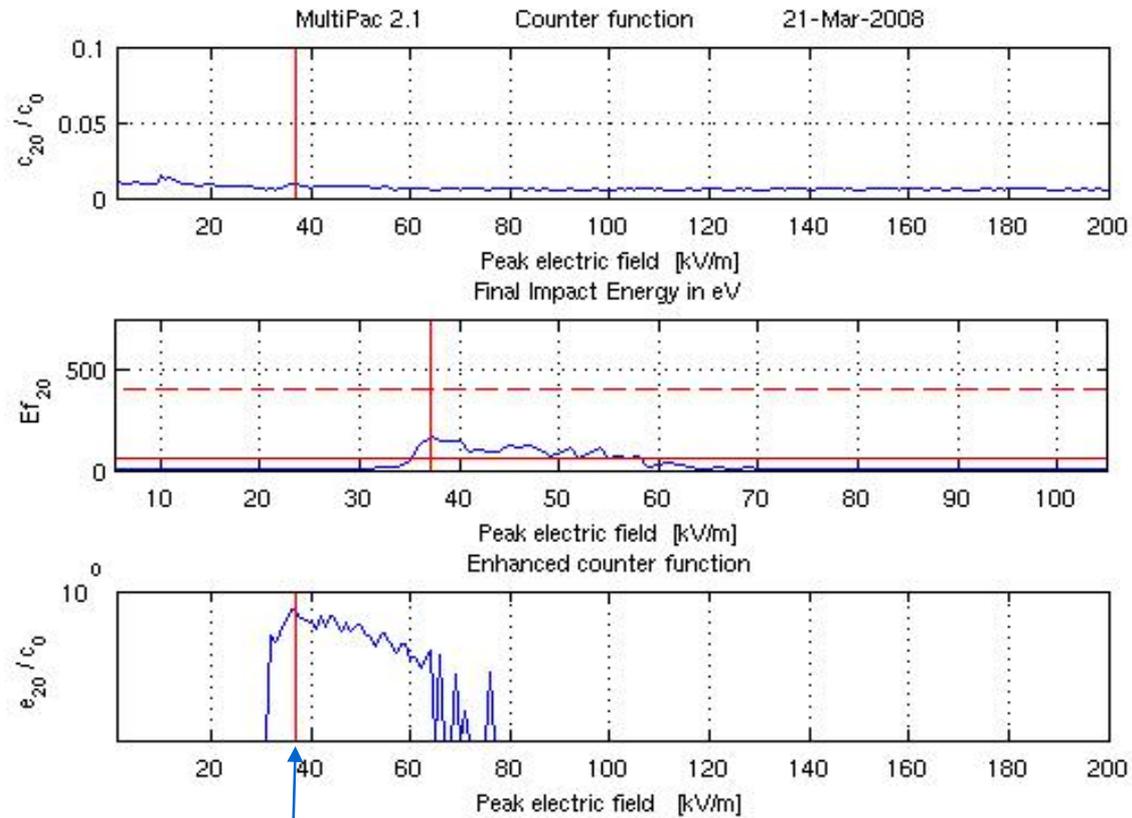


Electron-impact number :500

Suppression of multipacting by structure modification



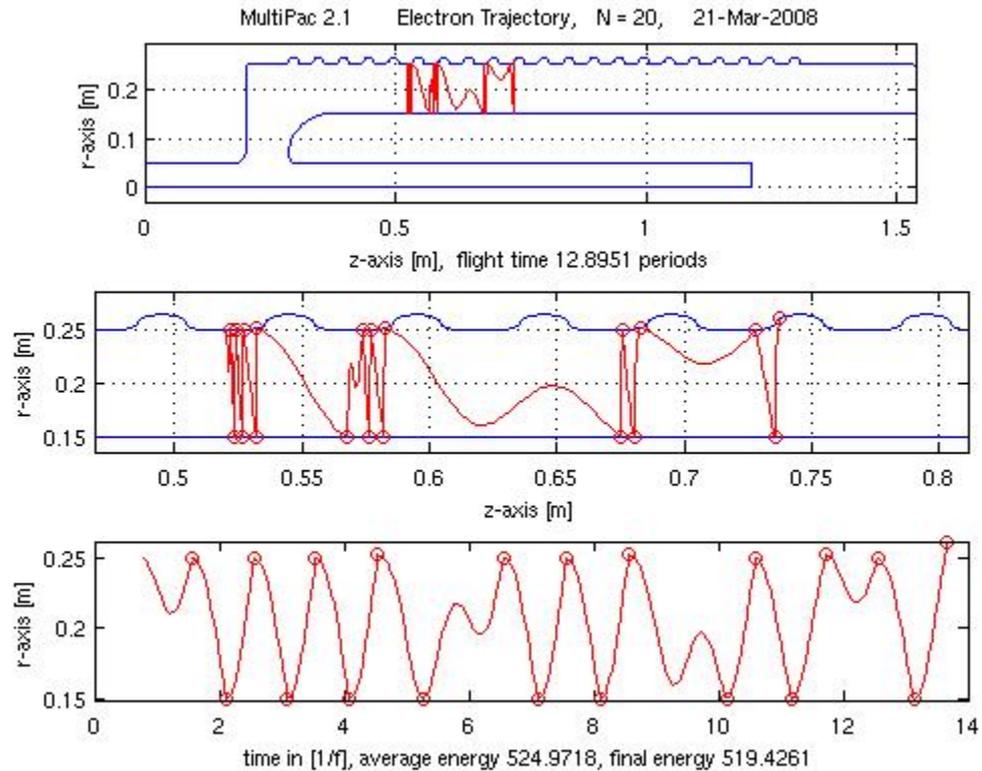
Triplot: 1-200 kV/m(28-100 cm)



37 kV/m

Electron-impact number: 20

Electron trajectory: 37 kV/m



Electron-impact number :20

Conclusion

- 56 MHz QWR is prone to multipacting, taken care of by ripple structure to inner surface of the cavity wall.
- Of course, still some optimization is being carried out to make the ripple more shallow and widely separated from each other.

Future Plan

Cavity with coupler and damper will be studied with 3D multipacting code very soon.

Electric and Magnetic field distribution

