The IGNITOR ICRF system

The IGNITOR ICRF Antenna System

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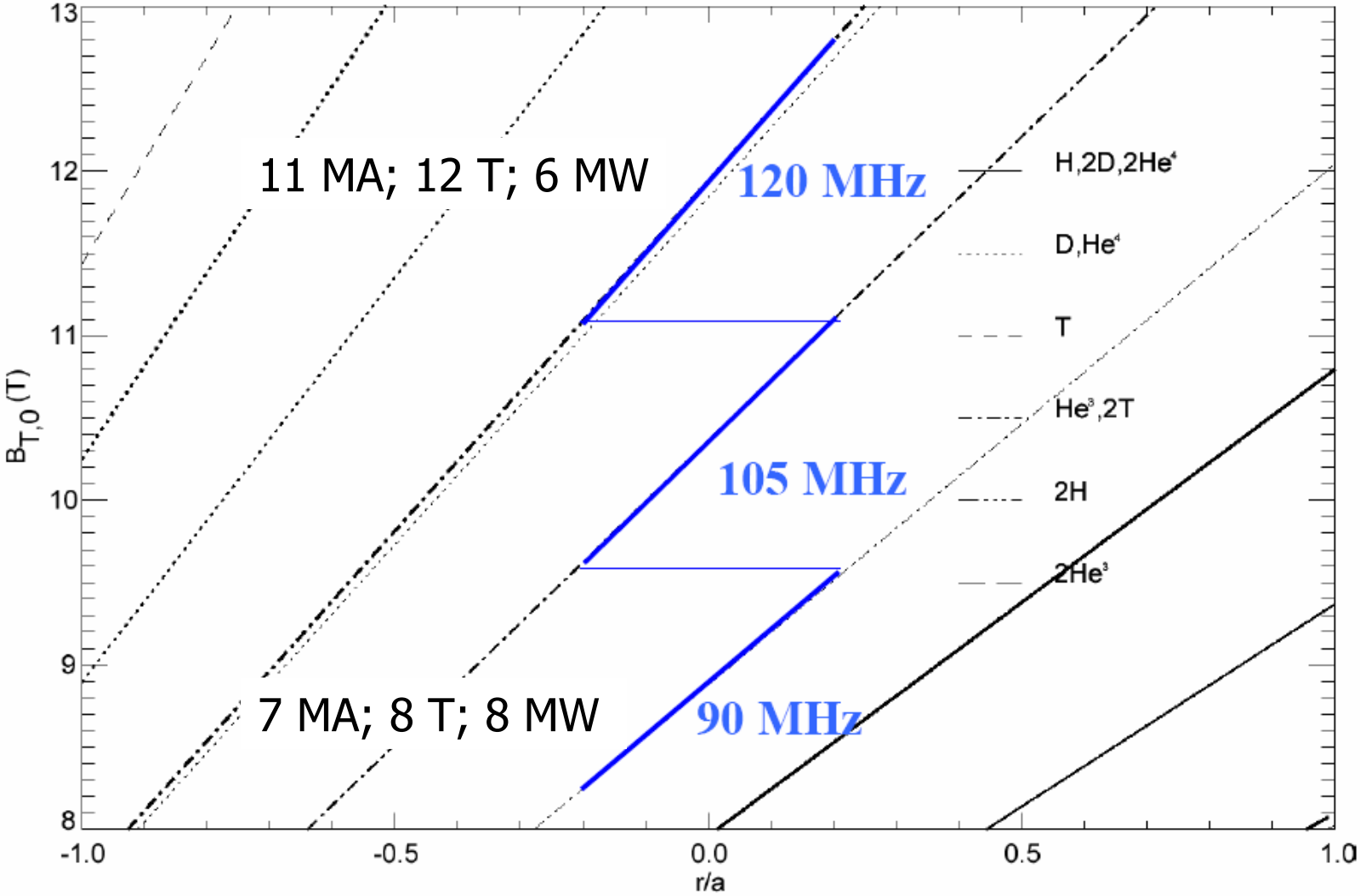
Three-frequencies, ^{3}He minority heating



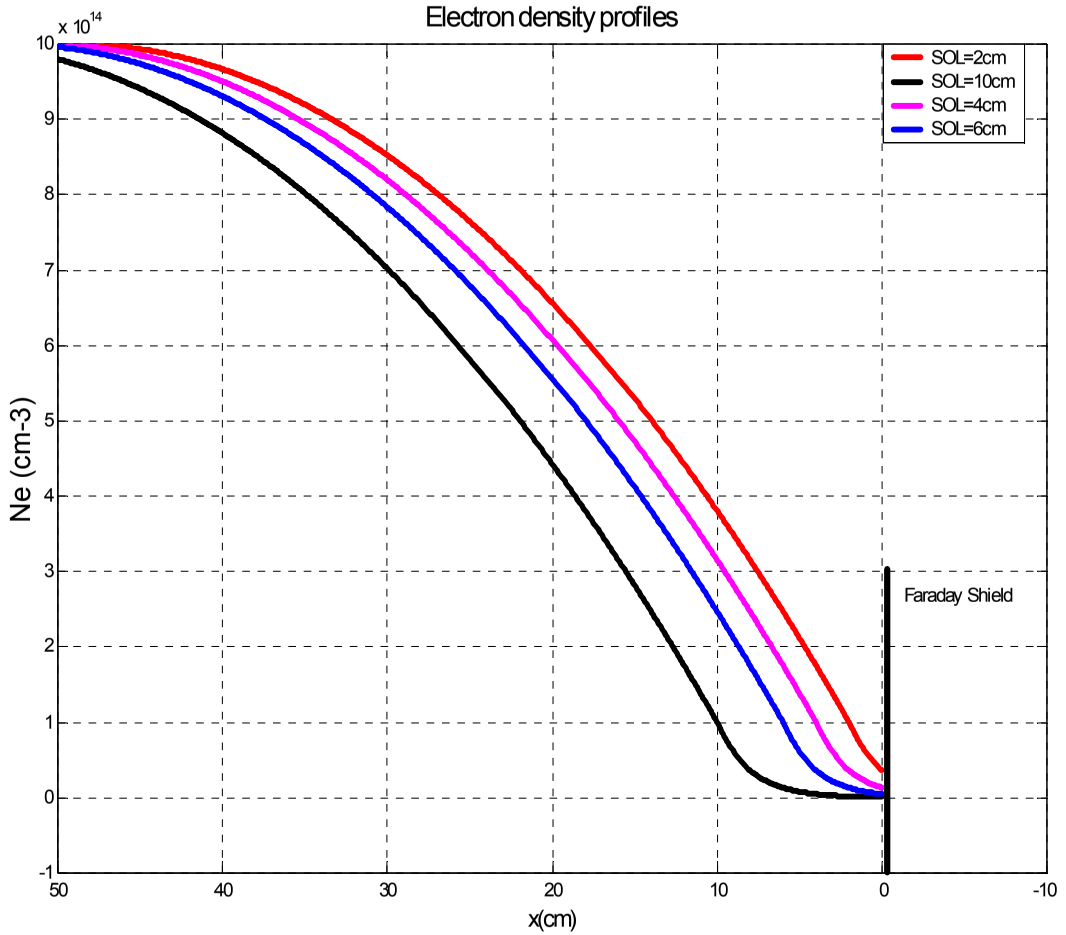
Aim of this work

- Propose CAD designs of the ICRF antenna for IGNITOR
- Analysis of the proposed antenna models and parametric study of input impedance and coupled power as a function of plasma parameters
- Comparison between proposed antenna models and suggestions for definitive choice of the geometry of the antenna straps that will be installed

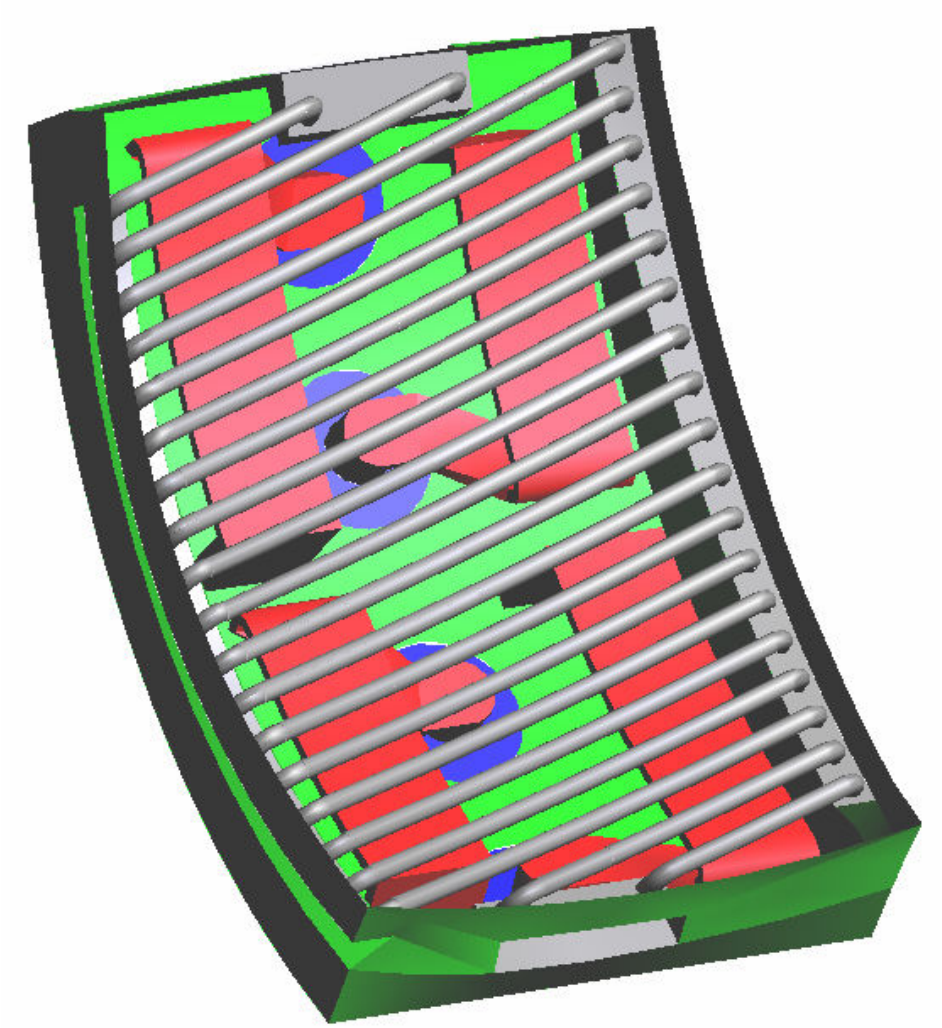
IGNITOR plasma parameters

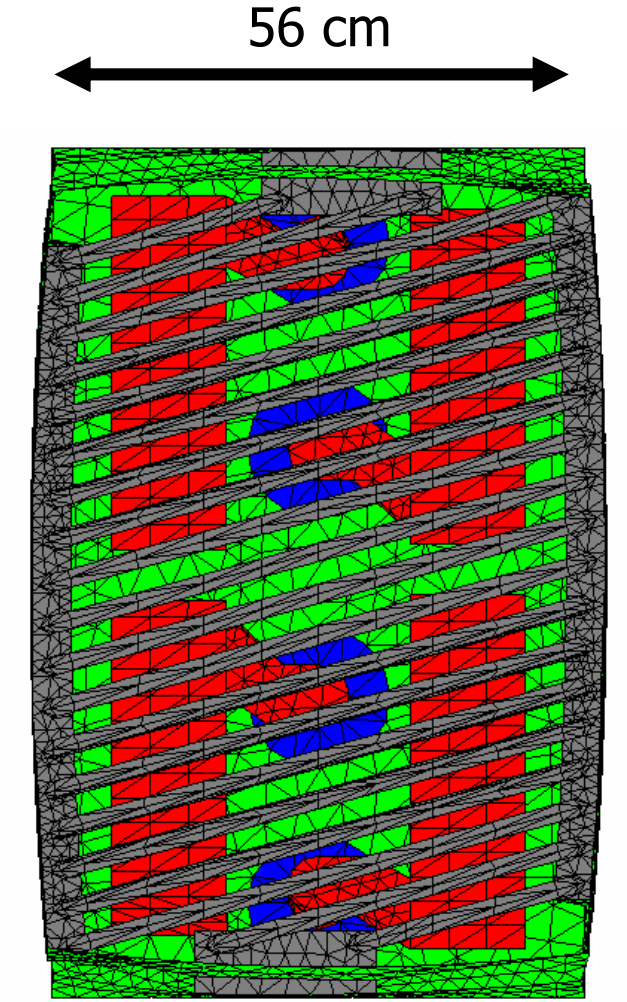
- R = 1.32m, a = 0.47m
- B_o = 7.9-8.8-9.8-10.8-11.8 T, pitch angle 15°
- Frequency = 80-90-100-110-120 MHz (minority He^3)
- 45%D, 48%T, 3%He^3, 1%H
- Central electron temperature 10 keV
- Central electron densities 1.0E21 m^{-3}
- Separatrix electron densities 1.0E20 m^{-3}
- Separatrix electron temperature 0.5 keV
- Scrape off layer 2-10 cm, decay length 2 cm

Electron density profile

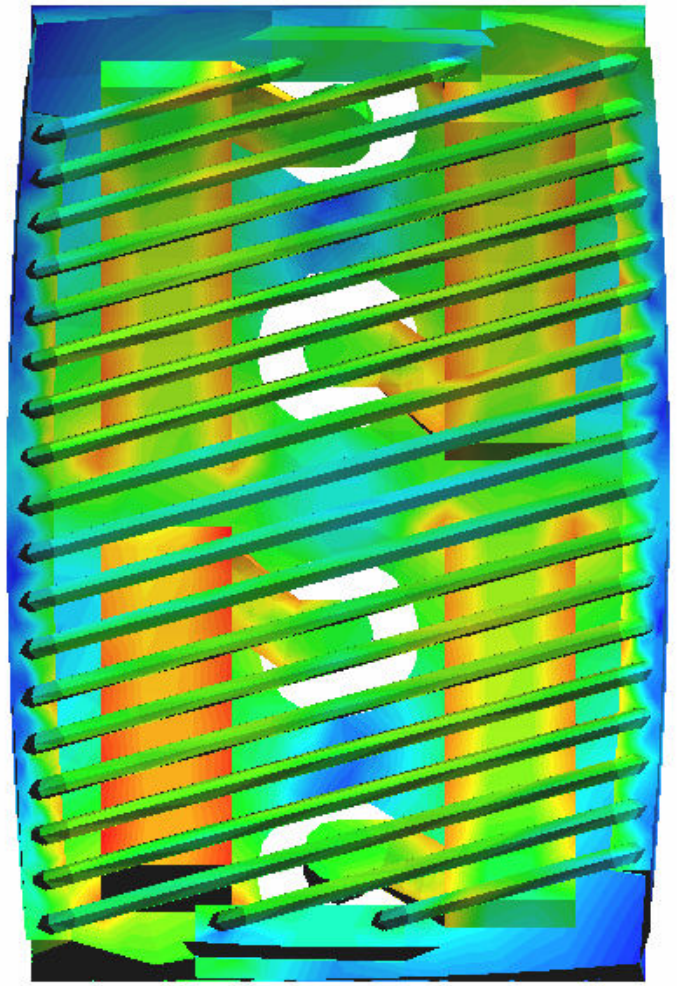


4 straps antenna

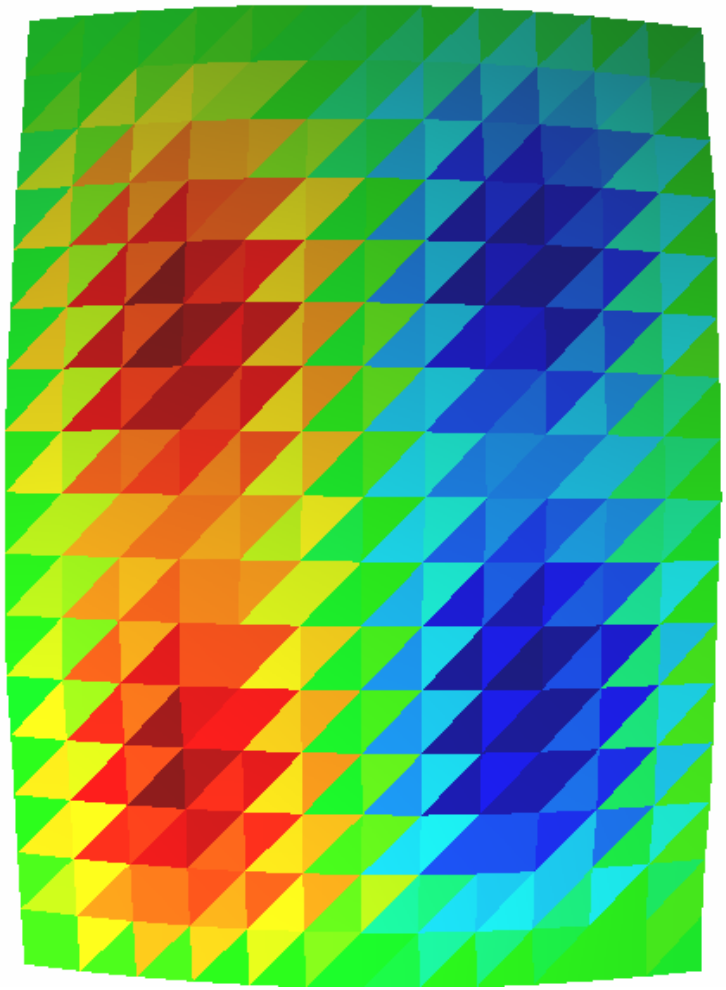




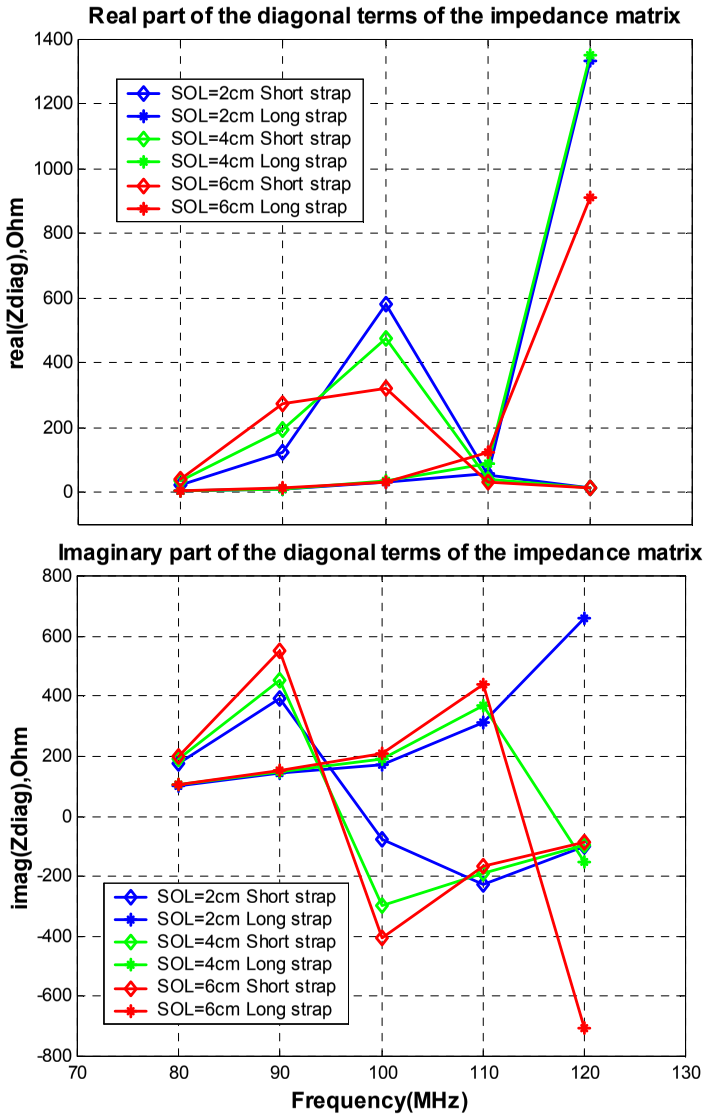
Typical electric
current distribution

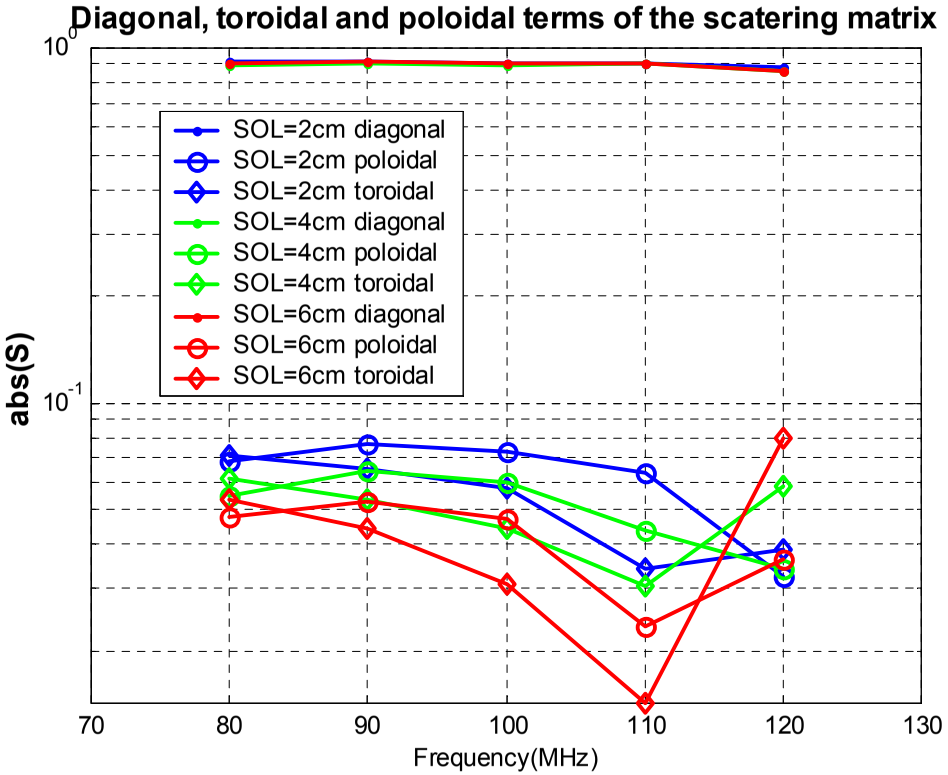


Typical poloidal electric field
distribution on aperture

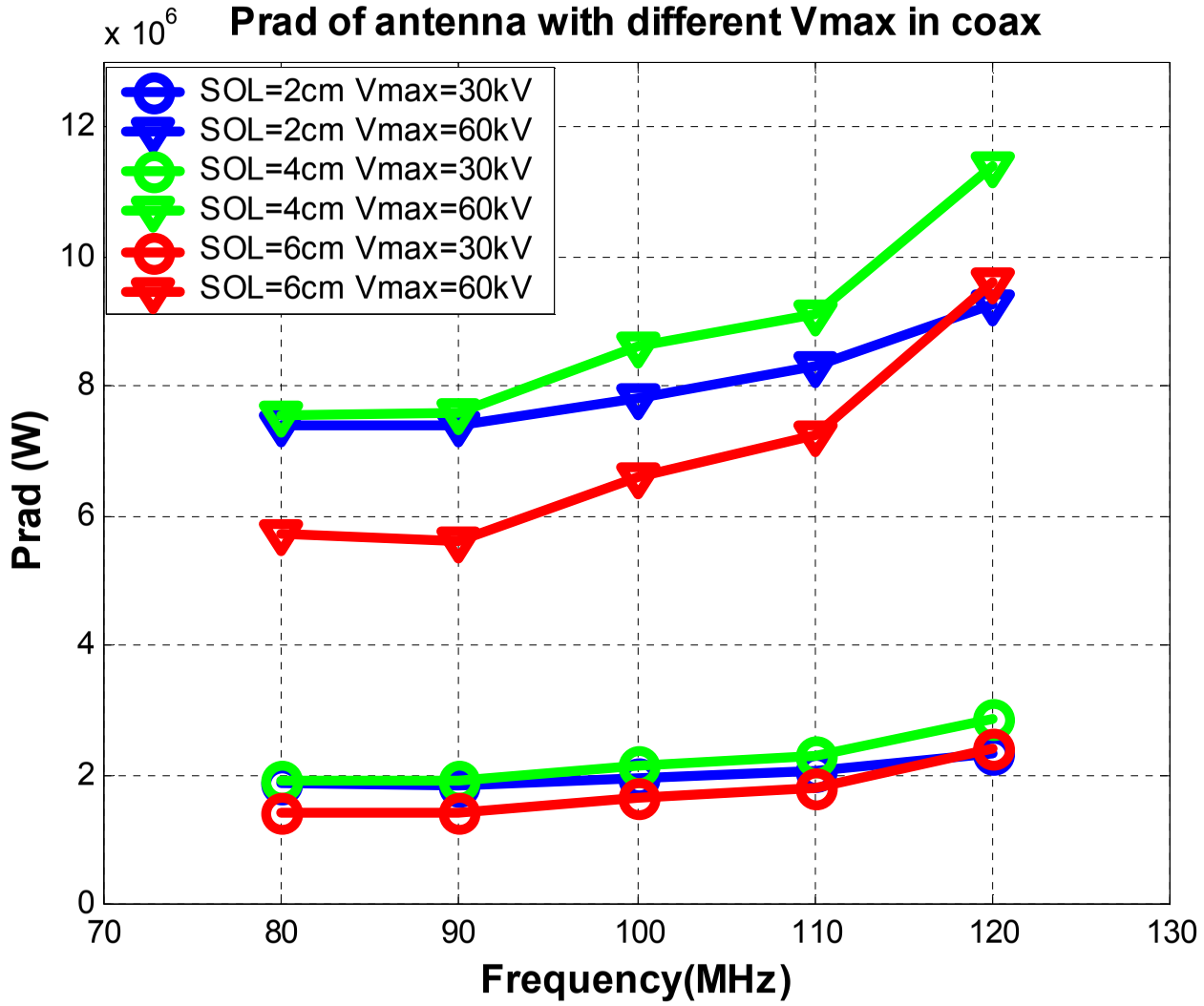


Input parameters





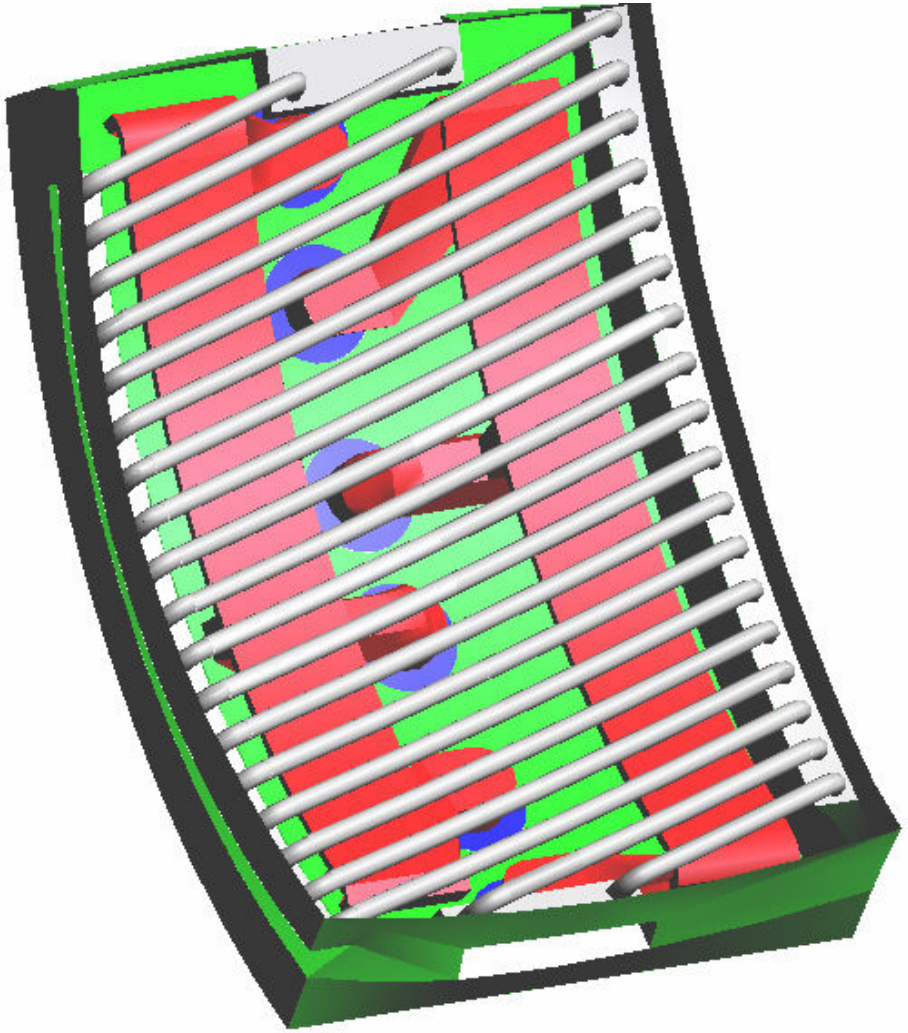
Radiated power

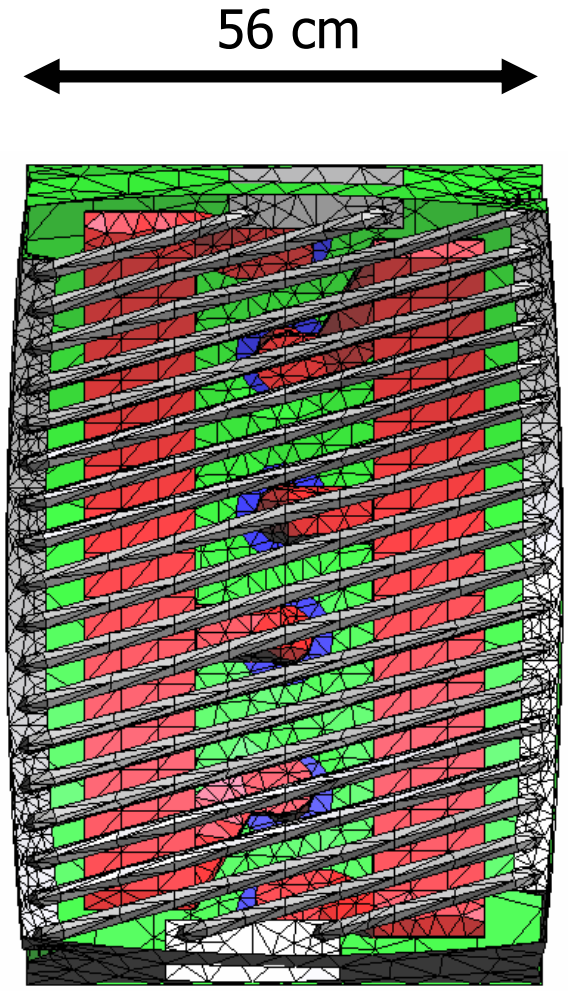


Typical coax:
D/d = 16 cm / 7 cm
Z_0 = 50 Ohm
$V_{breakdown}$ = 60 kV

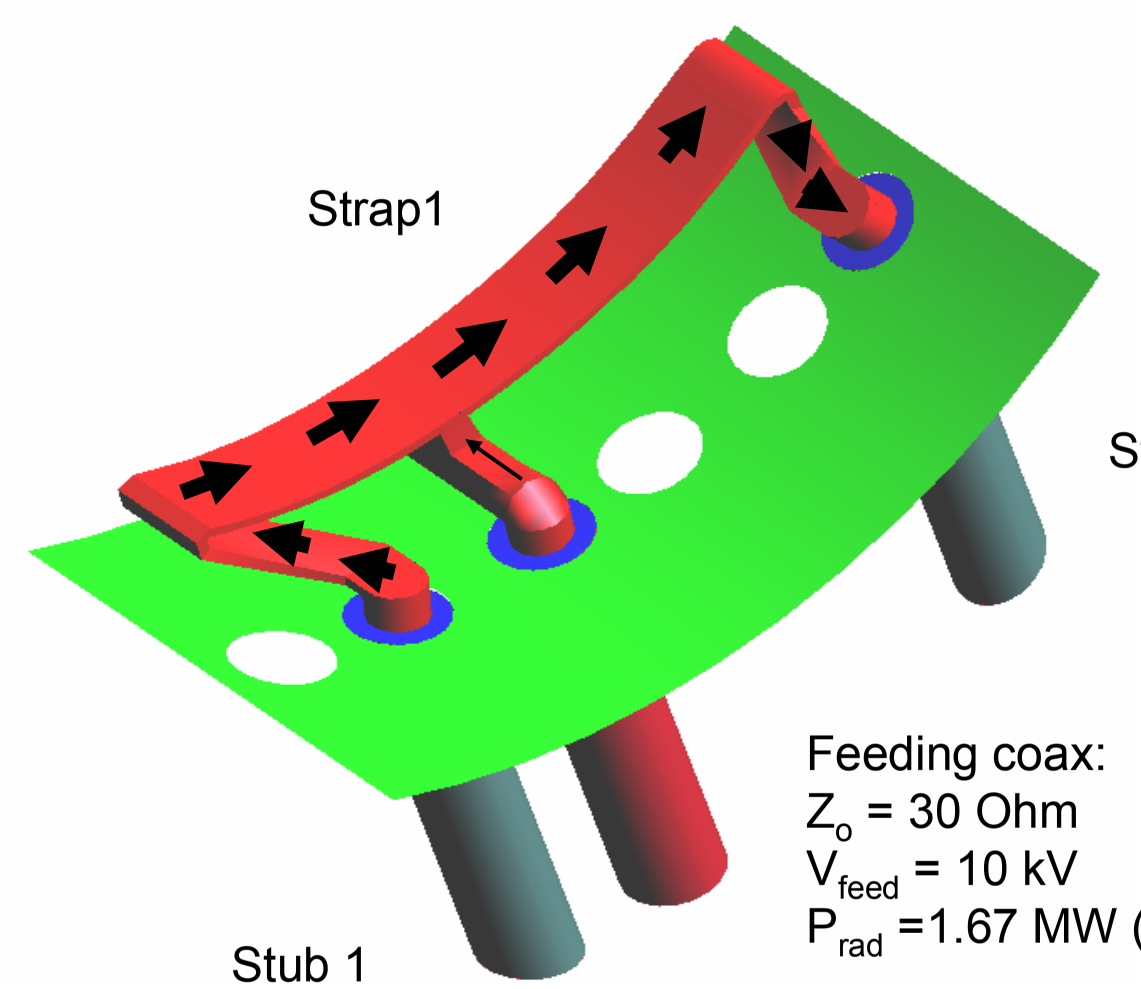
1.5 MW can be coupled, always!

2 straps antenna + stubs



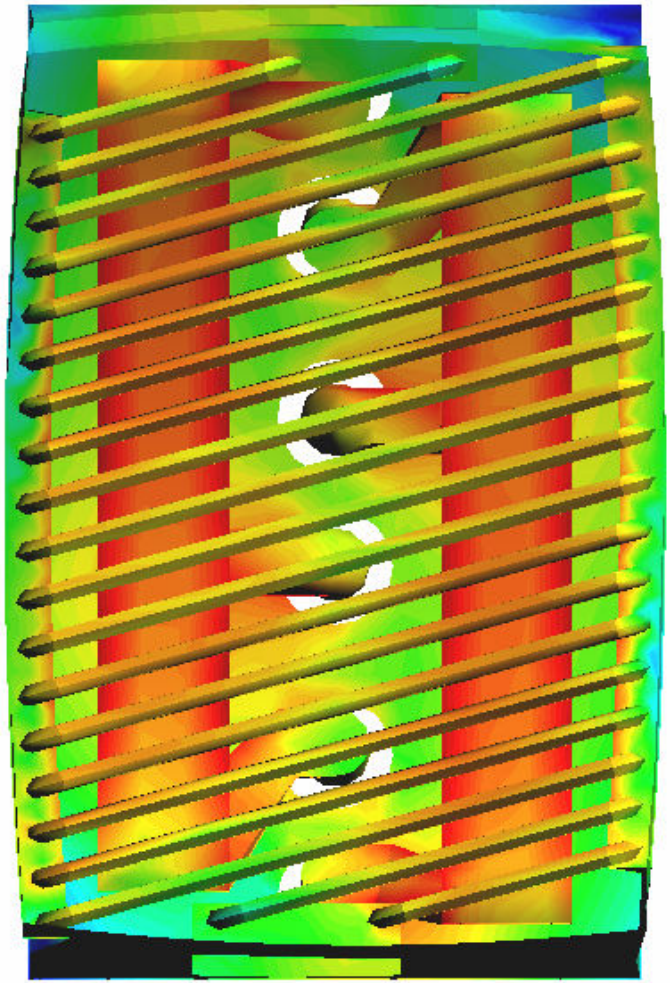


Feeding scheme

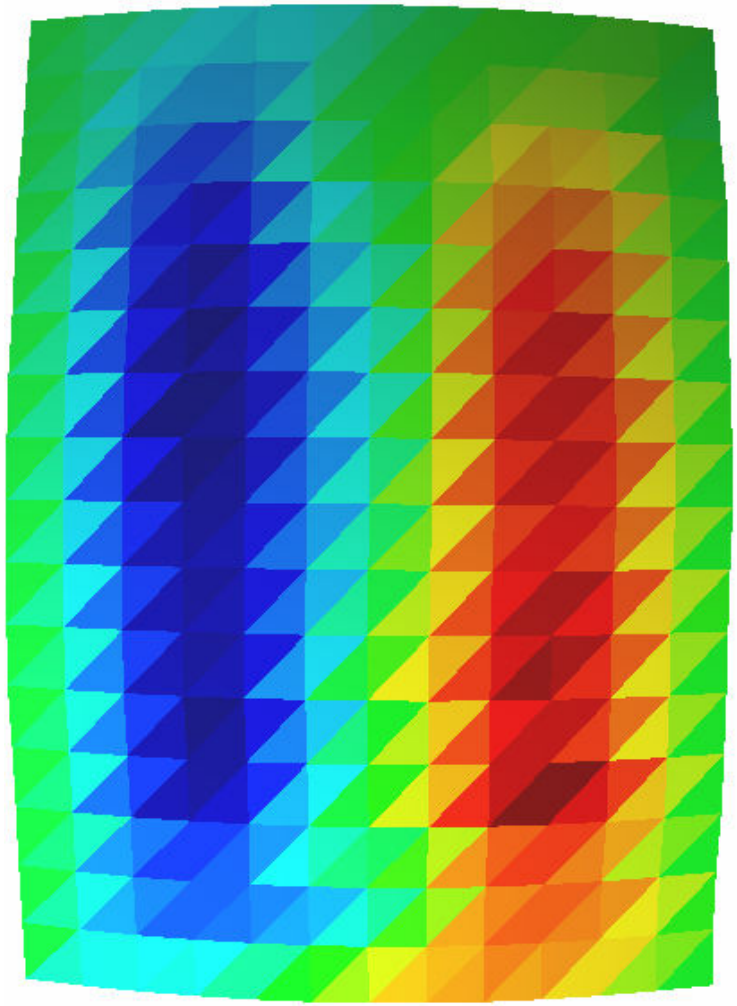


Feeding coax:
Z_o = 30 Ohm
V_{feed} = 10 kV
P_{rad} =1.67 MW (per strap)

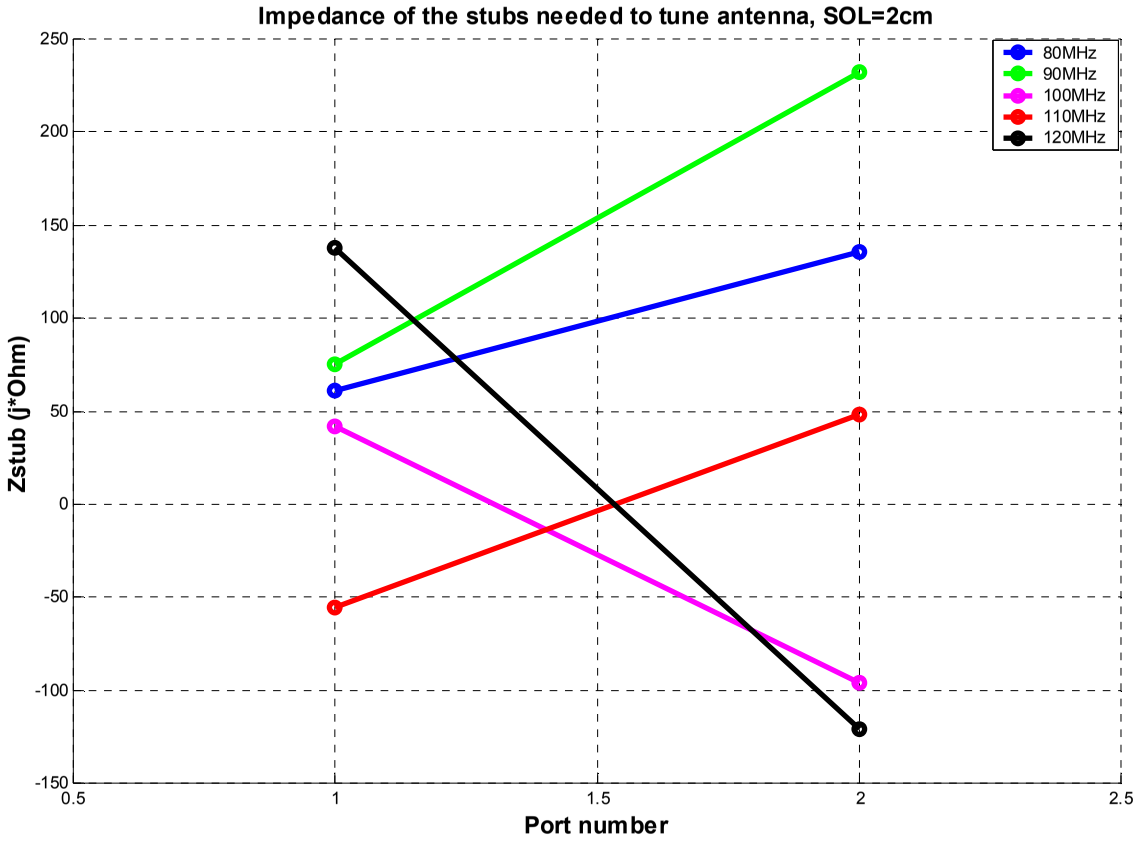
Typical electric
current distribution

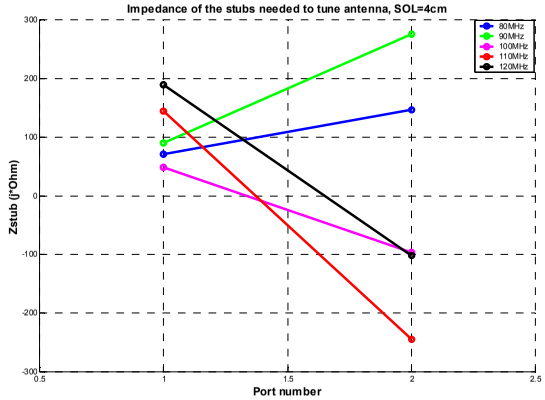


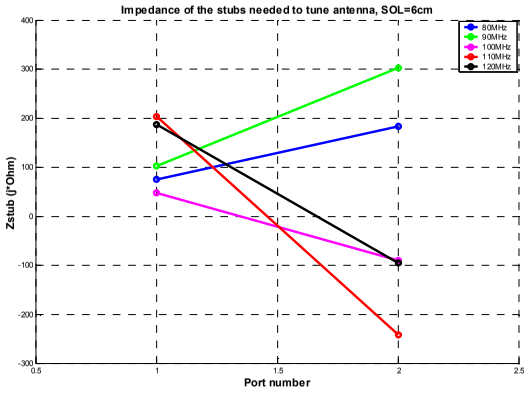
Typical poloidal electric field
distribution on aperture



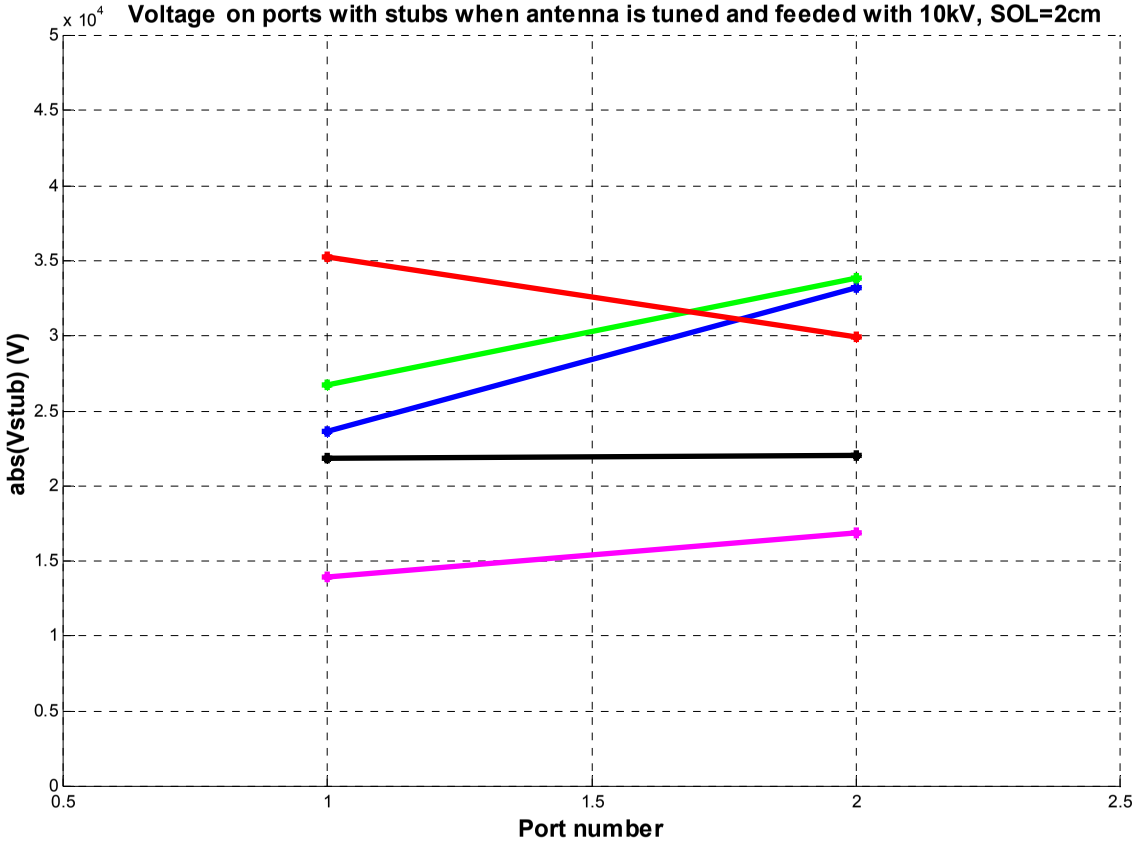
Stub impedances needed

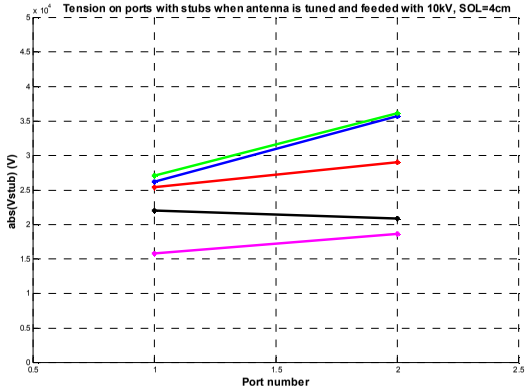


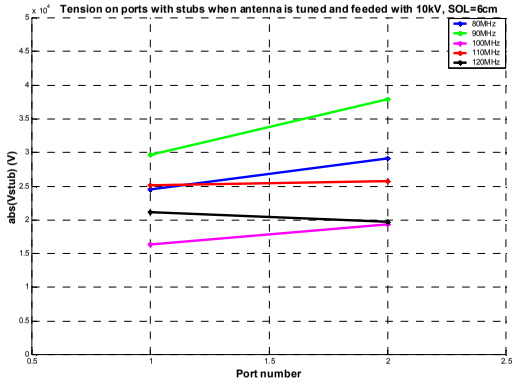




Stub input voltages







Conclusions

4 straps antenna:

- Low inter-strap coupling
- Simple geometry
- Limited power to plasma

2 straps antenna + stubs:

- Very high power to plasma
- High voltage in stubs
- Complex geometry