

## The IGNITOR ICRF system

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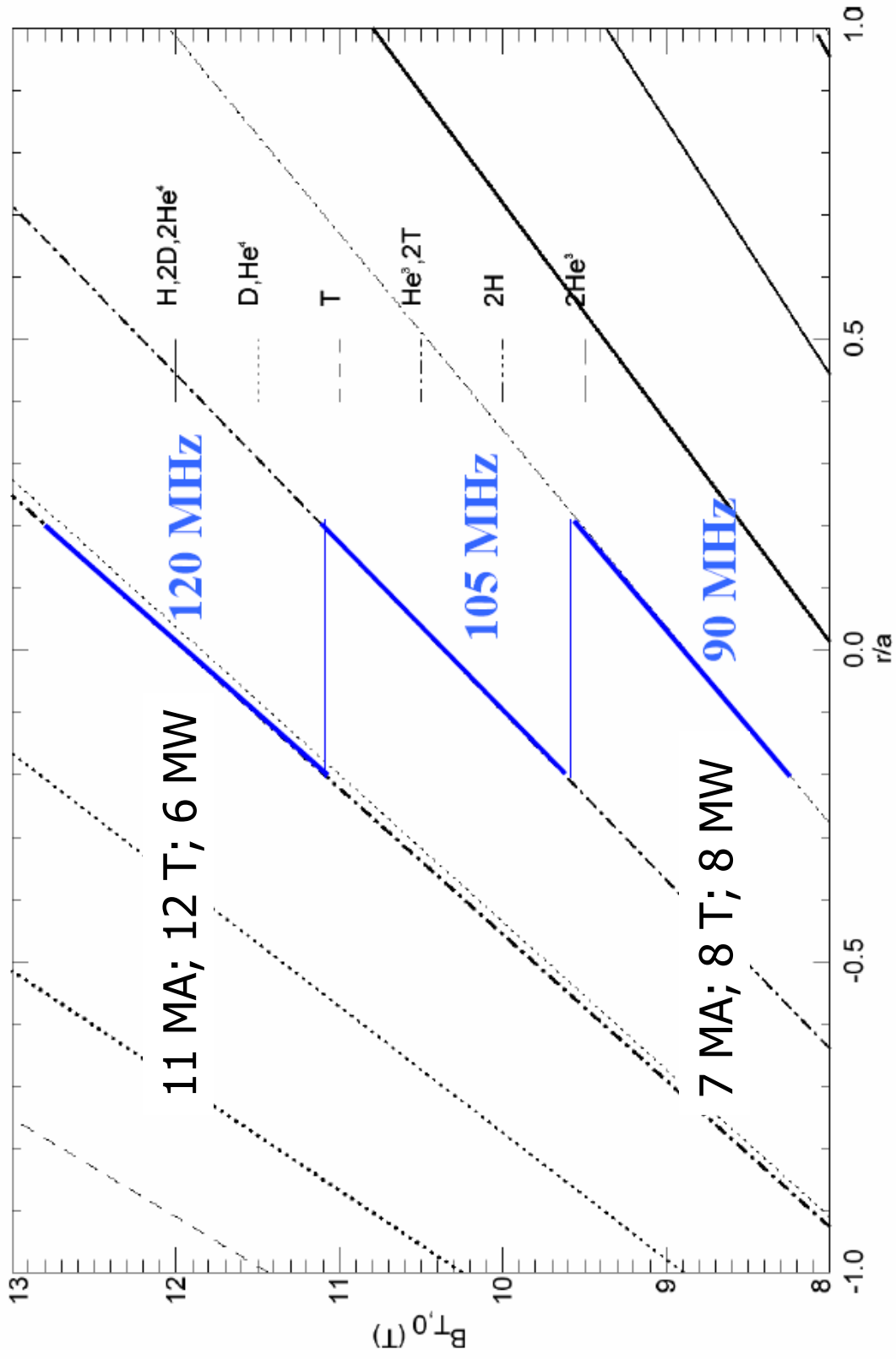


# The IGNITOR ICRF Antenna System

**Volodymyr Kyrytsya, Riccardo Maggiore,  
Vito Lancellotti, Daniele Milanesio,  
Giuseppe Vecchi**



## Three-frequencies, $^3\text{He}$ 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

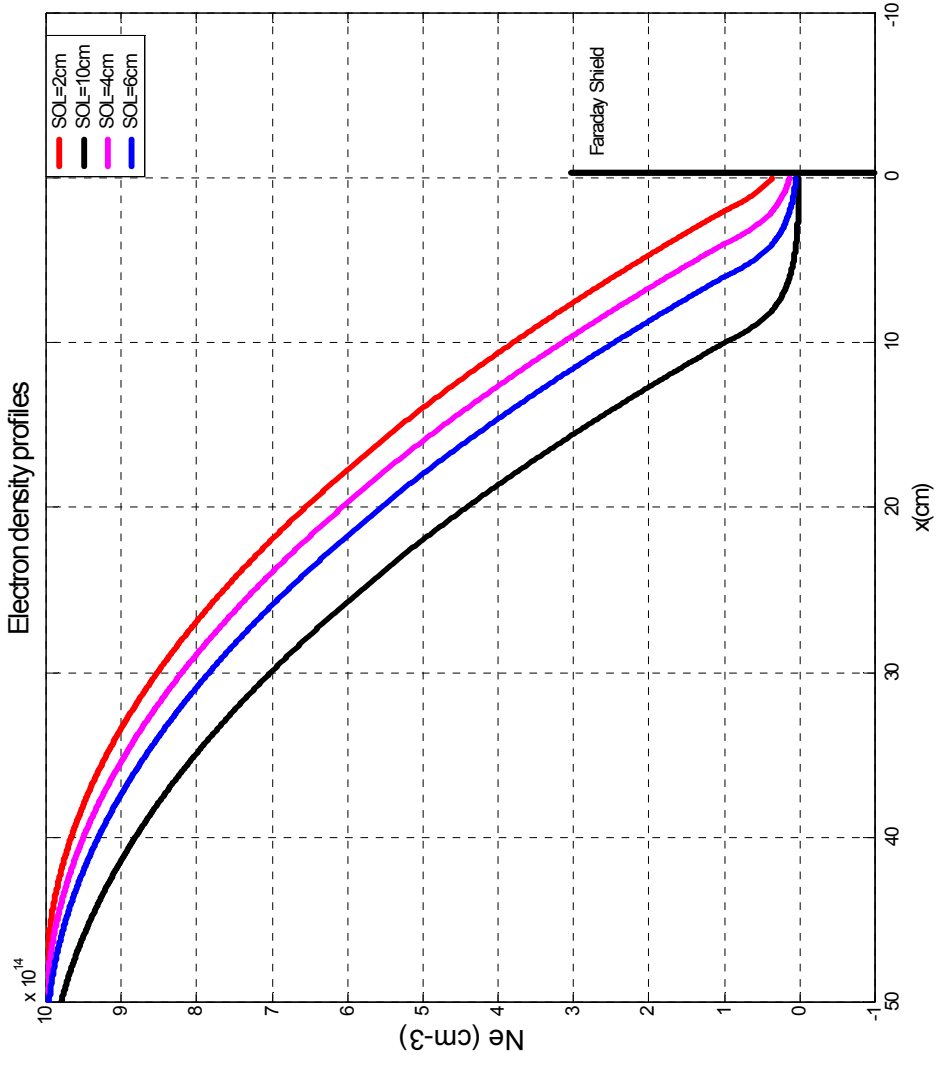


## IGNITOR plasma parameters

- $R = 1.32\text{m}$ ,  $a = 0.47\text{m}$
- $B_0 = 7.9\text{-}8.8\text{-}9.8\text{-}10.8\text{-}11.8\text{ T}$ , pitch angle  $15^\circ$
- Frequency = 80-90-100-110-120 MHz (minority He<sup>3</sup>)
- 45%D, 48%T, 3%He<sup>3</sup>, 1%H
- Central electron temperature 10 keV
- Central electron densities  $1.0\text{E}21\text{ m}^{-3}$
- Separatrix electron densities  $1.0\text{E}20\text{ m}^{-3}$
- Separatrix electron temperature 0.5 keV
- Scrape off layer 2-10 cm, decay length 2 cm

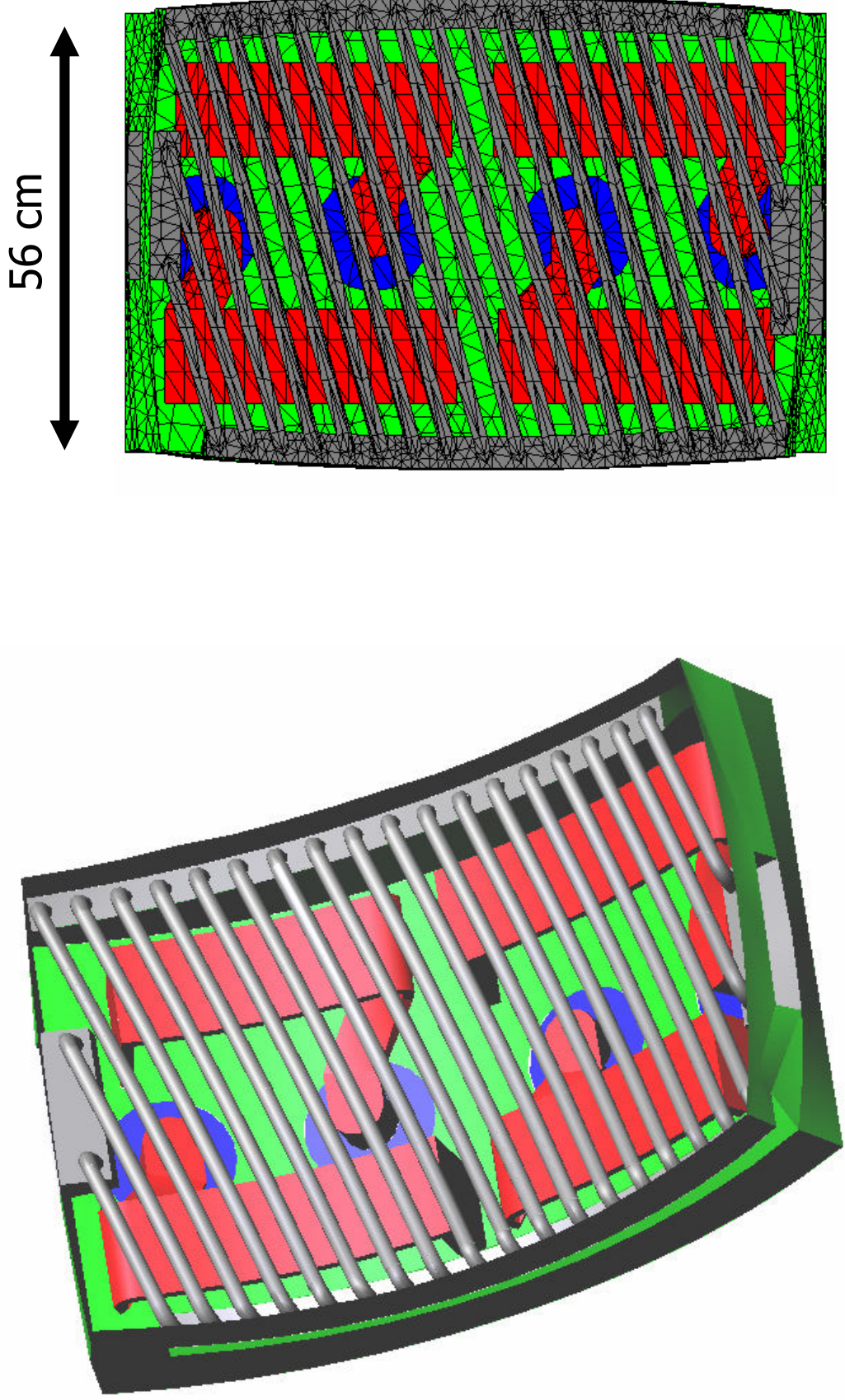


# Electron density profile



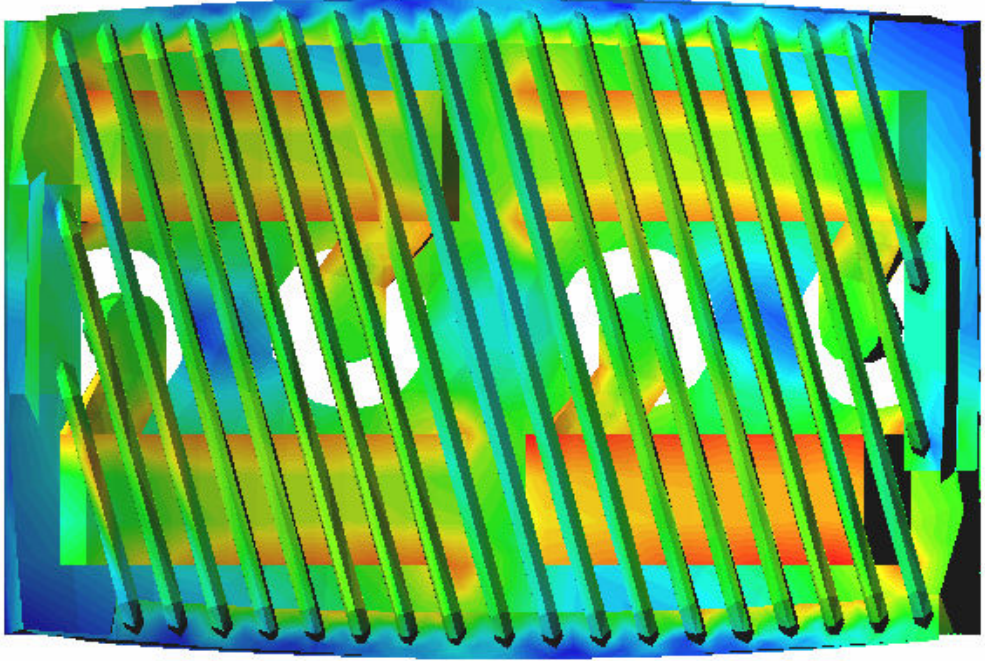


# 4 straps antenna

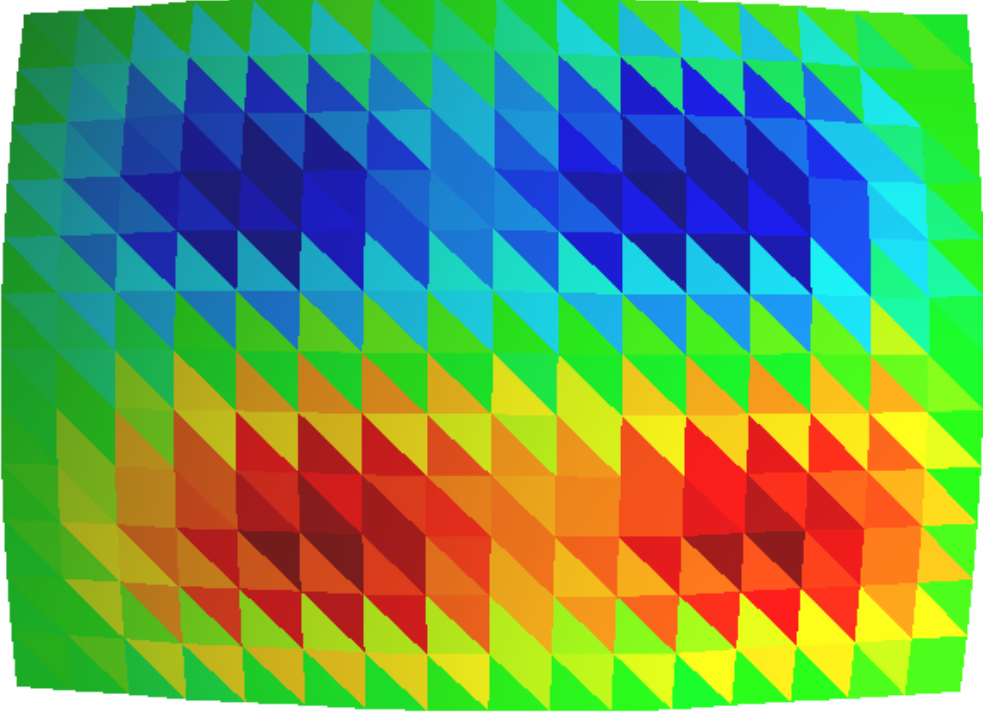




Typical electric  
current distribution



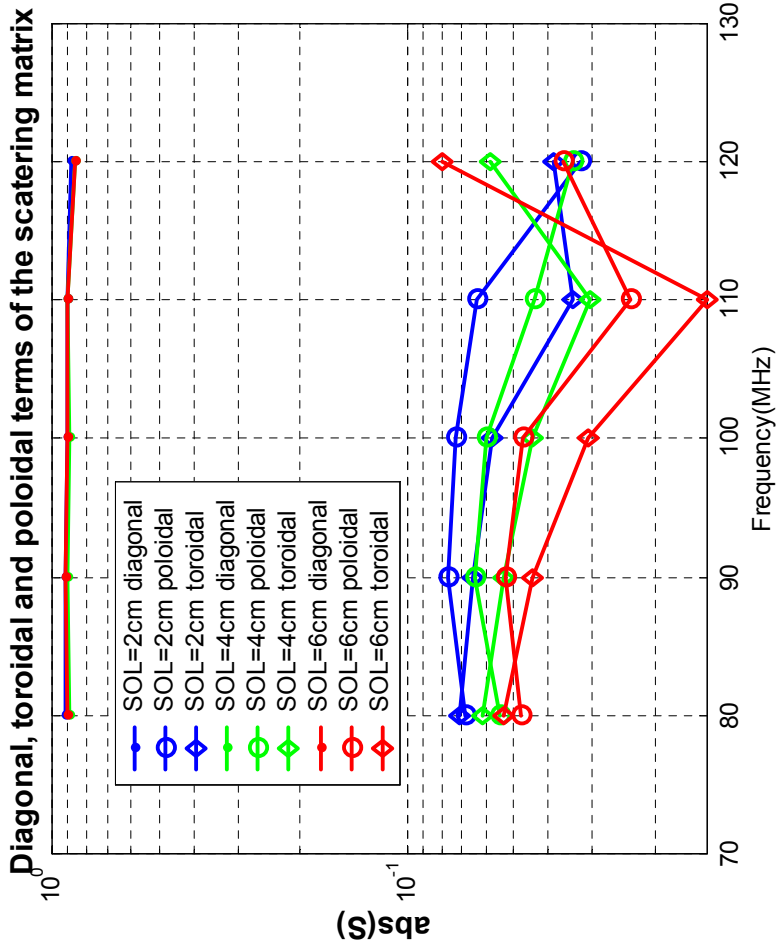
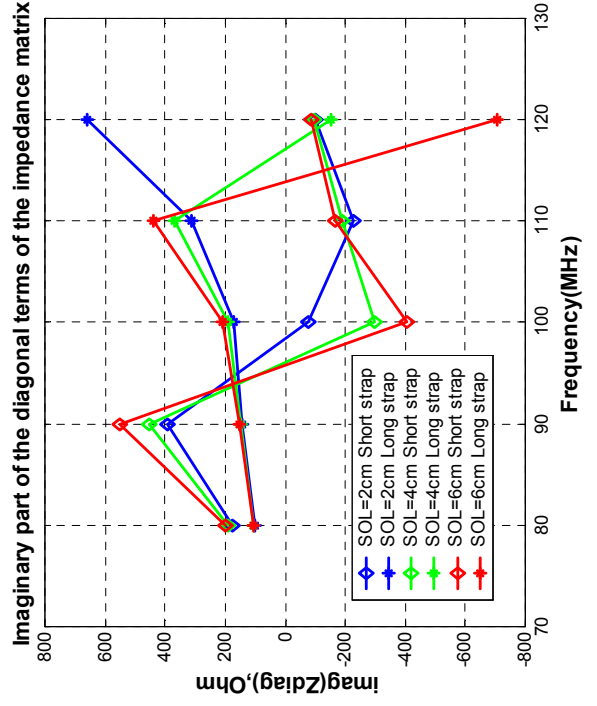
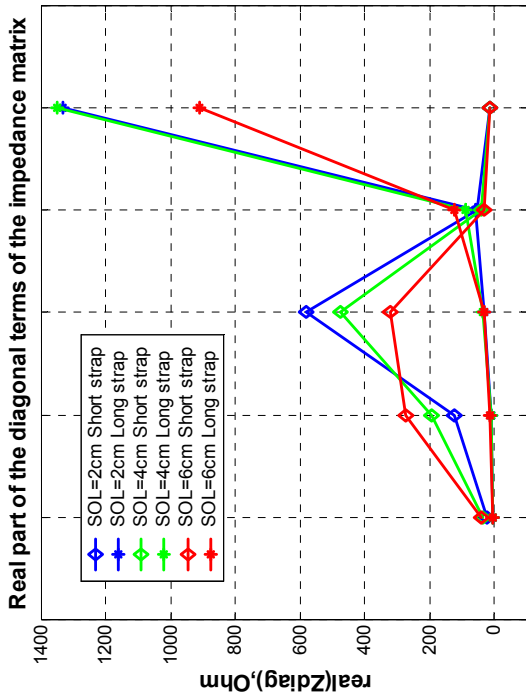
Typical poloidal electric field  
distribution on aperture





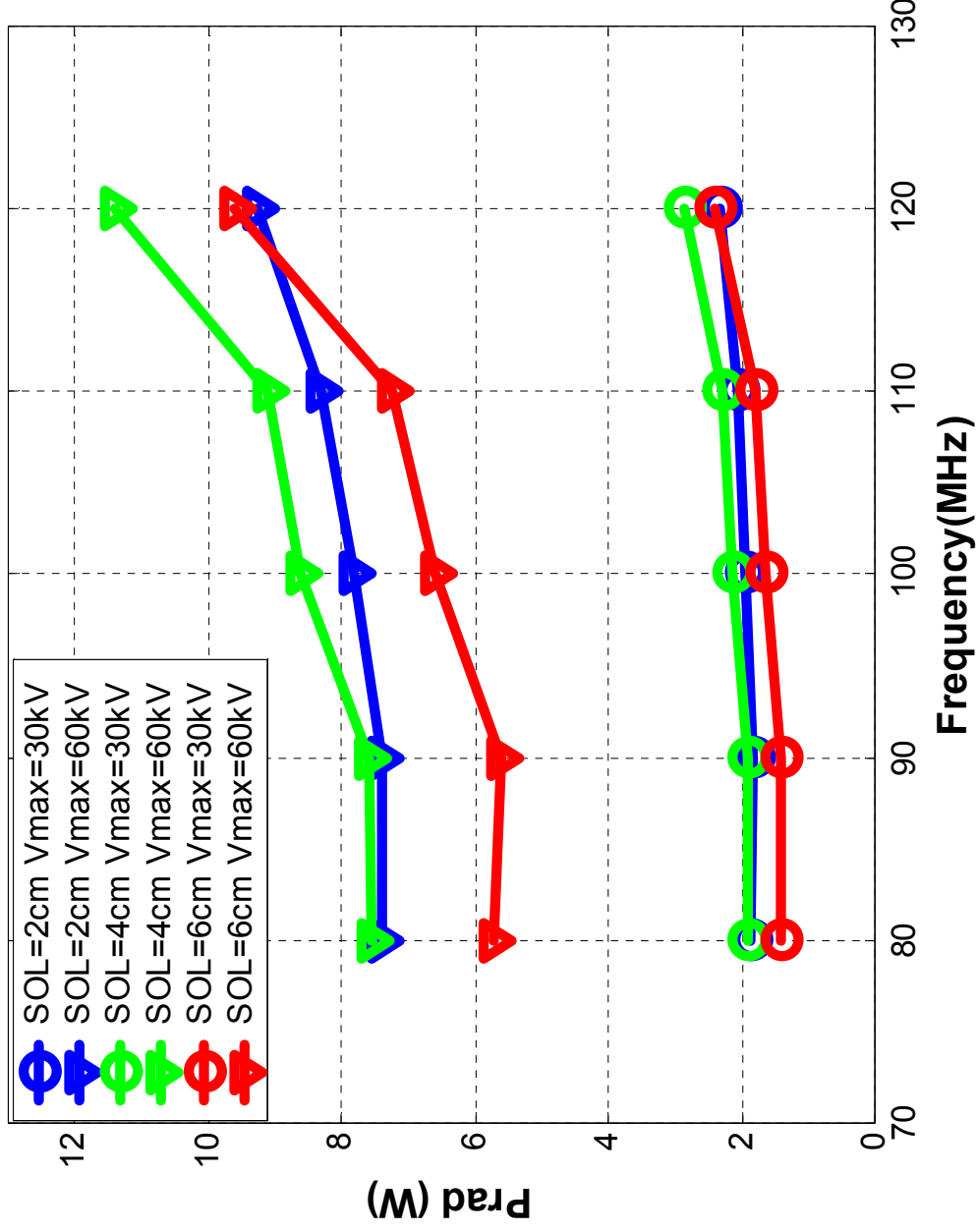


# Input parameters



# Radiated power

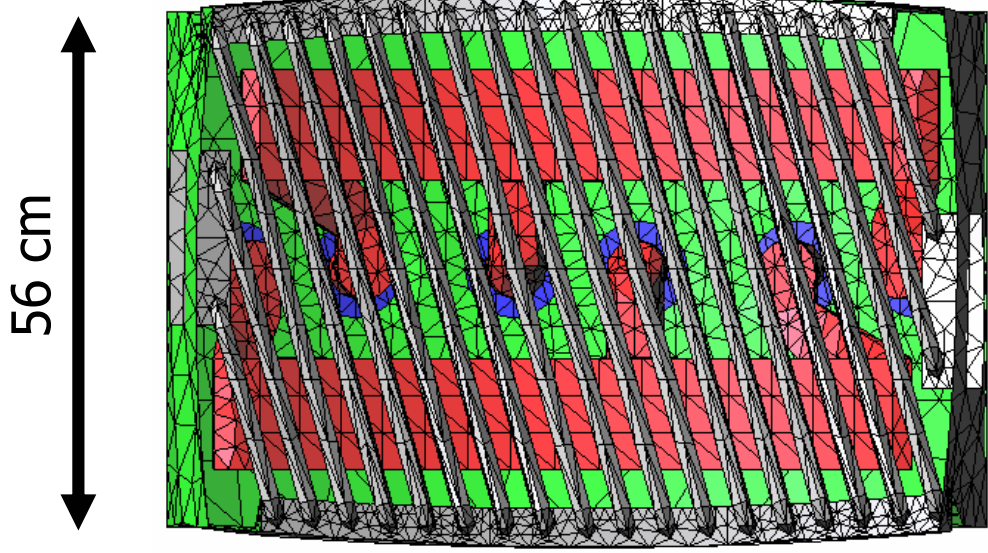
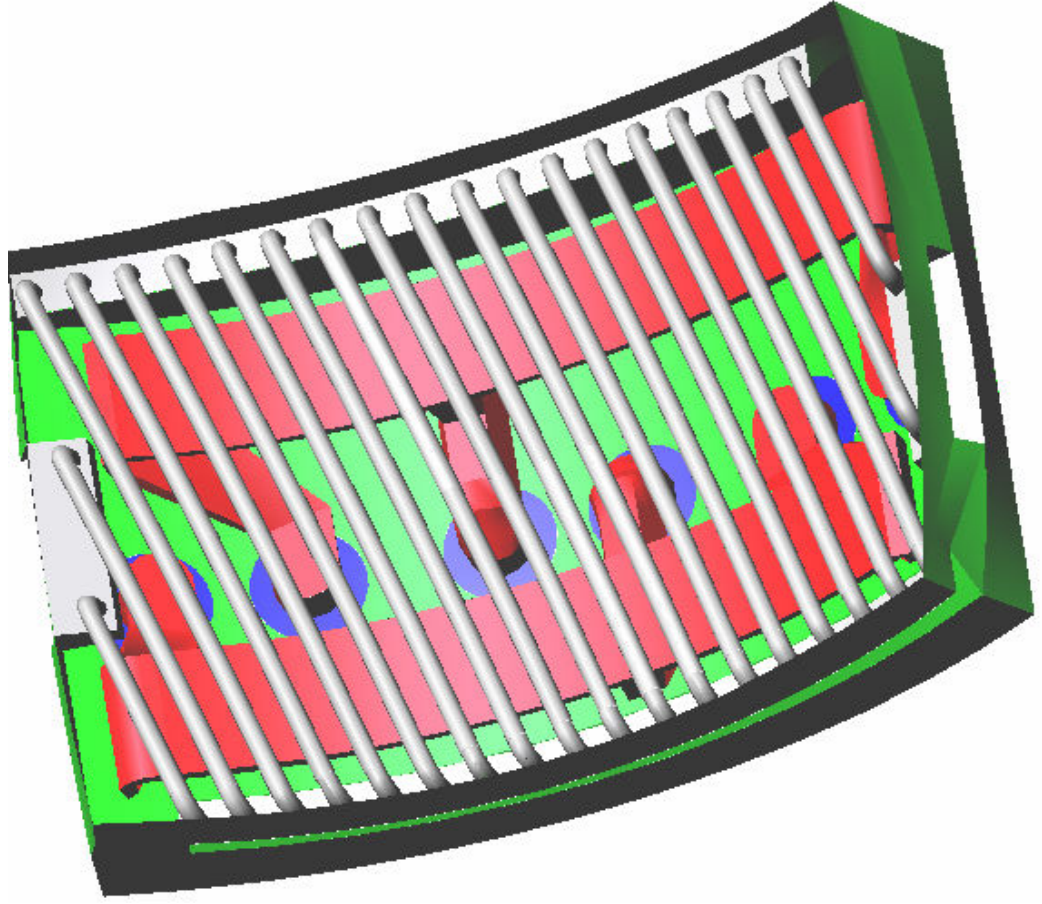
$\times 10^6$  Prad of antenna with different  $V_{max}$  in coax



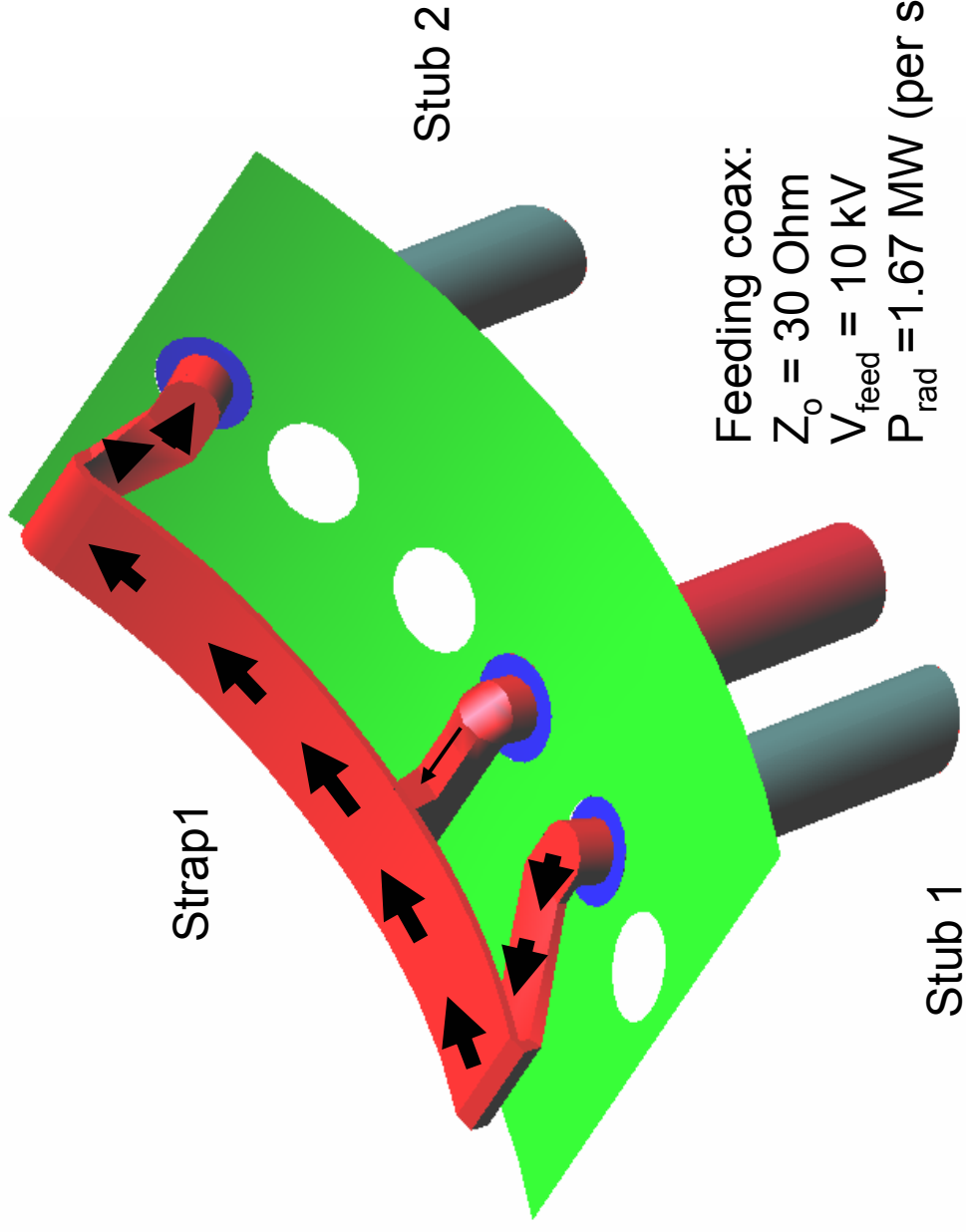
Typical coax:  
 $D/d = 16 \text{ cm} / 7 \text{ cm}$   
 $Z_0 = 50 \text{ Ohm}$   
 $V_{breakdown} = 60 \text{ kV}$

1.5 MW can  
 be coupled,  
 always!

## 2 straps antenna + stubs



# Feeding scheme



Feeding coax:

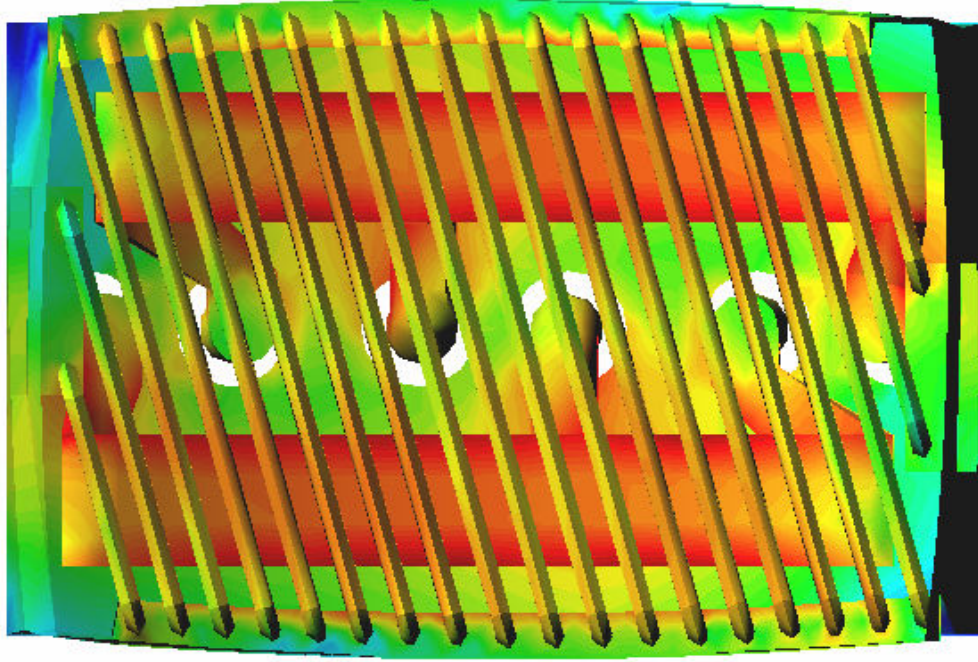
$$Z_0 = 30 \text{ Ohm}$$

$$V_{\text{feed}} = 10 \text{ kV}$$

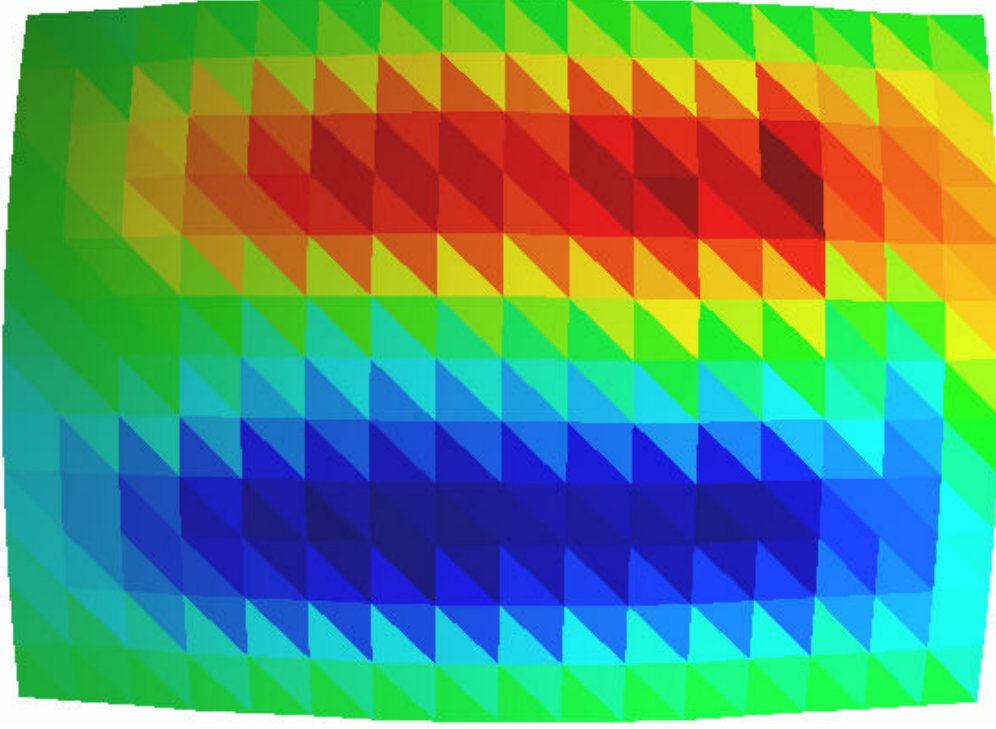
$$P_{\text{rad}} = 1.67 \text{ MW (per strap)}$$



Typical electric  
current distribution

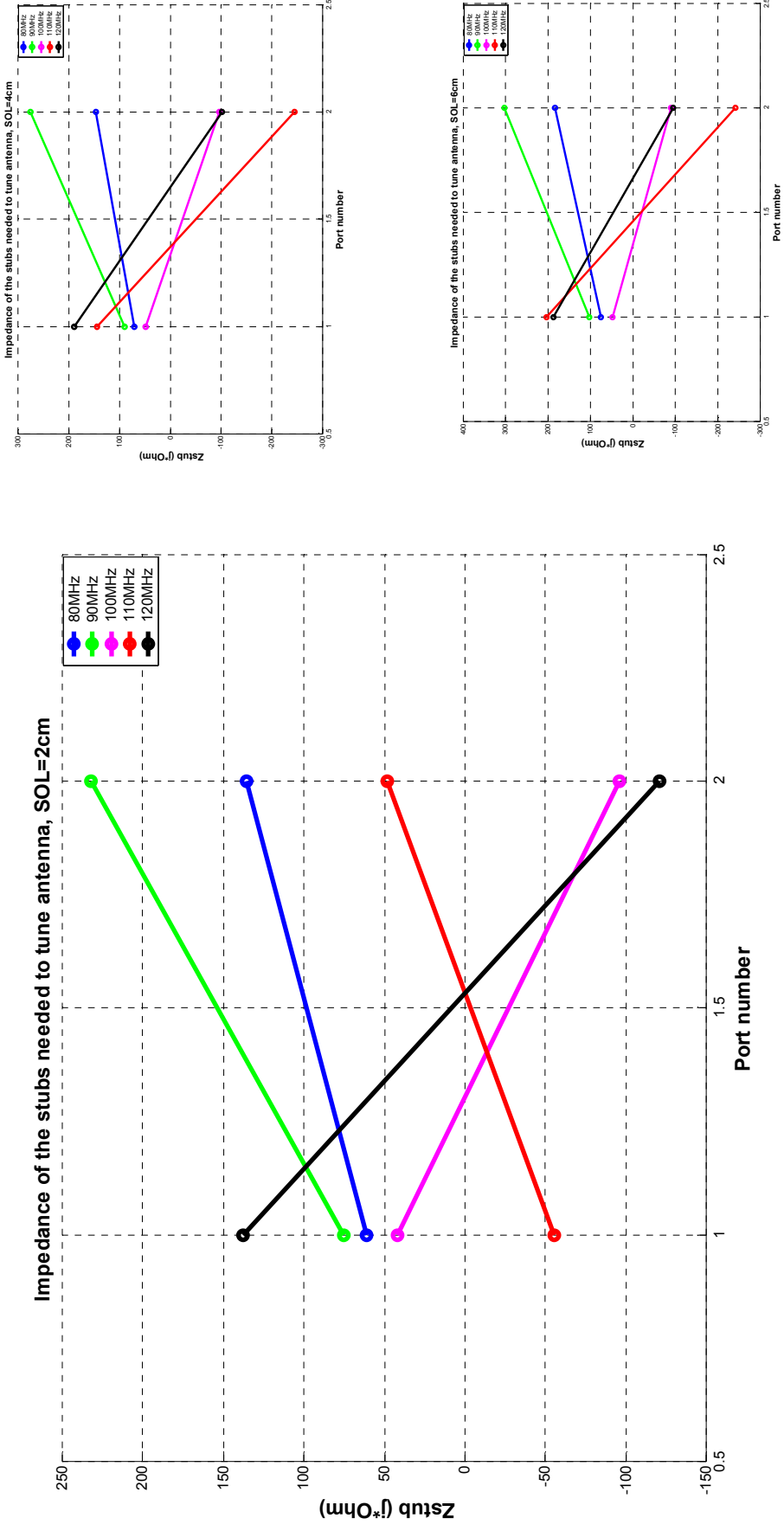


Typical poloidal electric field  
distribution on aperture





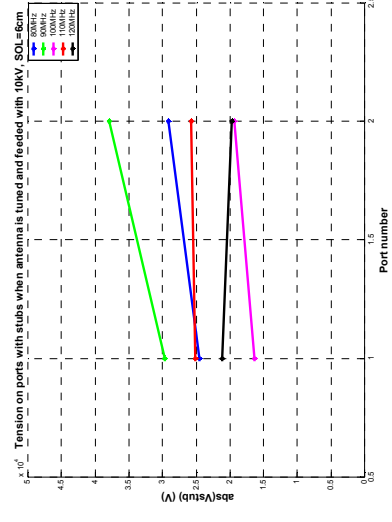
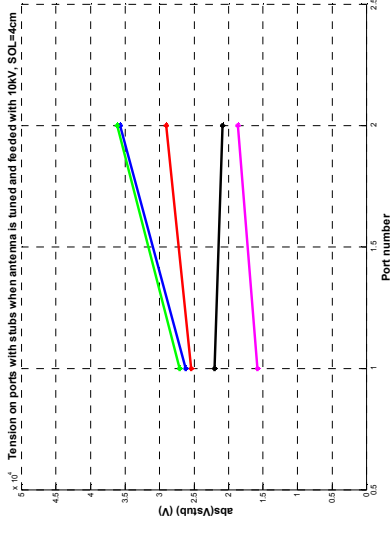
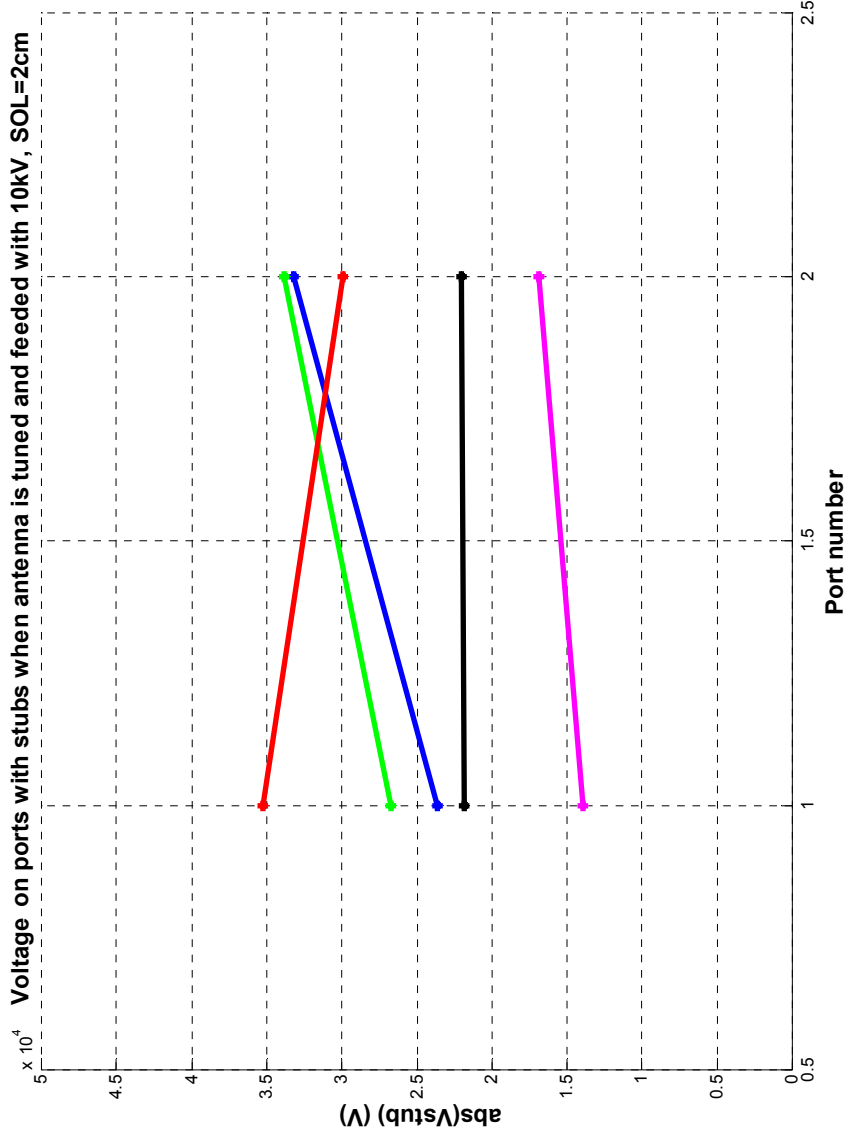
# Stub impedances needed







# 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