

The IGNITOR ICRF system

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APS-DPP meeting, Philadelphia, 1 November 2006

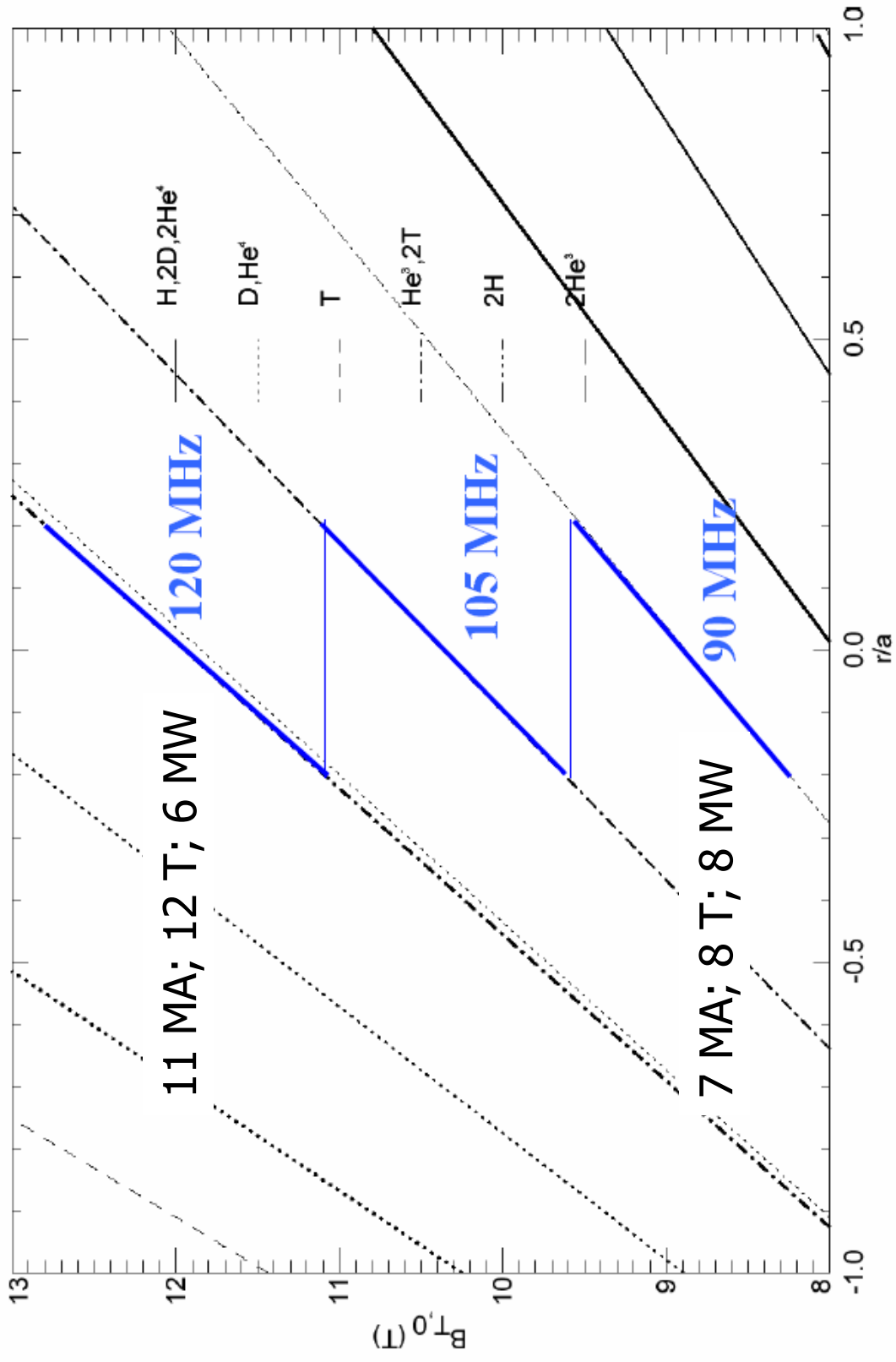


The IGNITOR ICRF Antenna System

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



Three-frequencies, ^3He 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

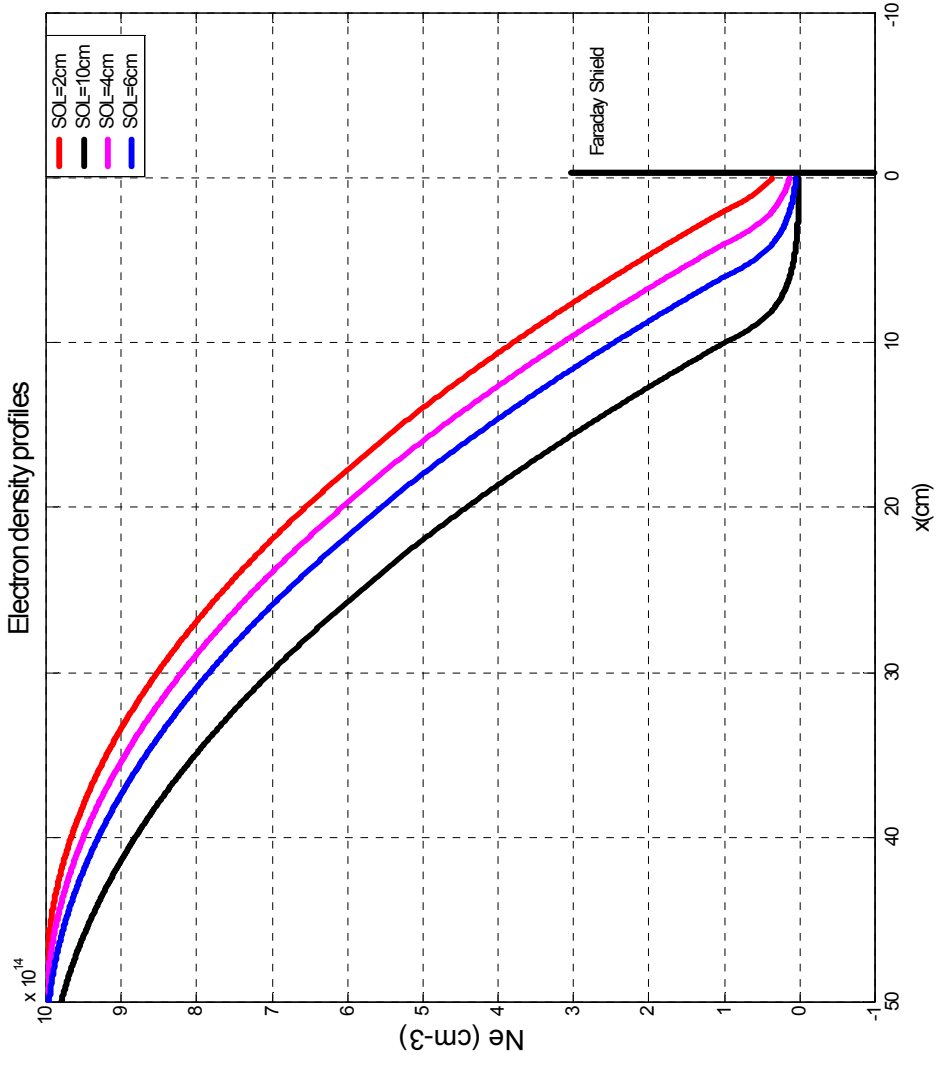


IGNITOR plasma parameters

- $R = 1.32\text{m}$, $a = 0.47\text{m}$
- $B_0 = 7.9\text{-}8.8\text{-}9.8\text{-}10.8\text{-}11.8\text{ T}$, pitch angle 15°
- Frequency = 80-90-100-110-120 MHz (minority He³)
- 45%D, 48%T, 3%He³, 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

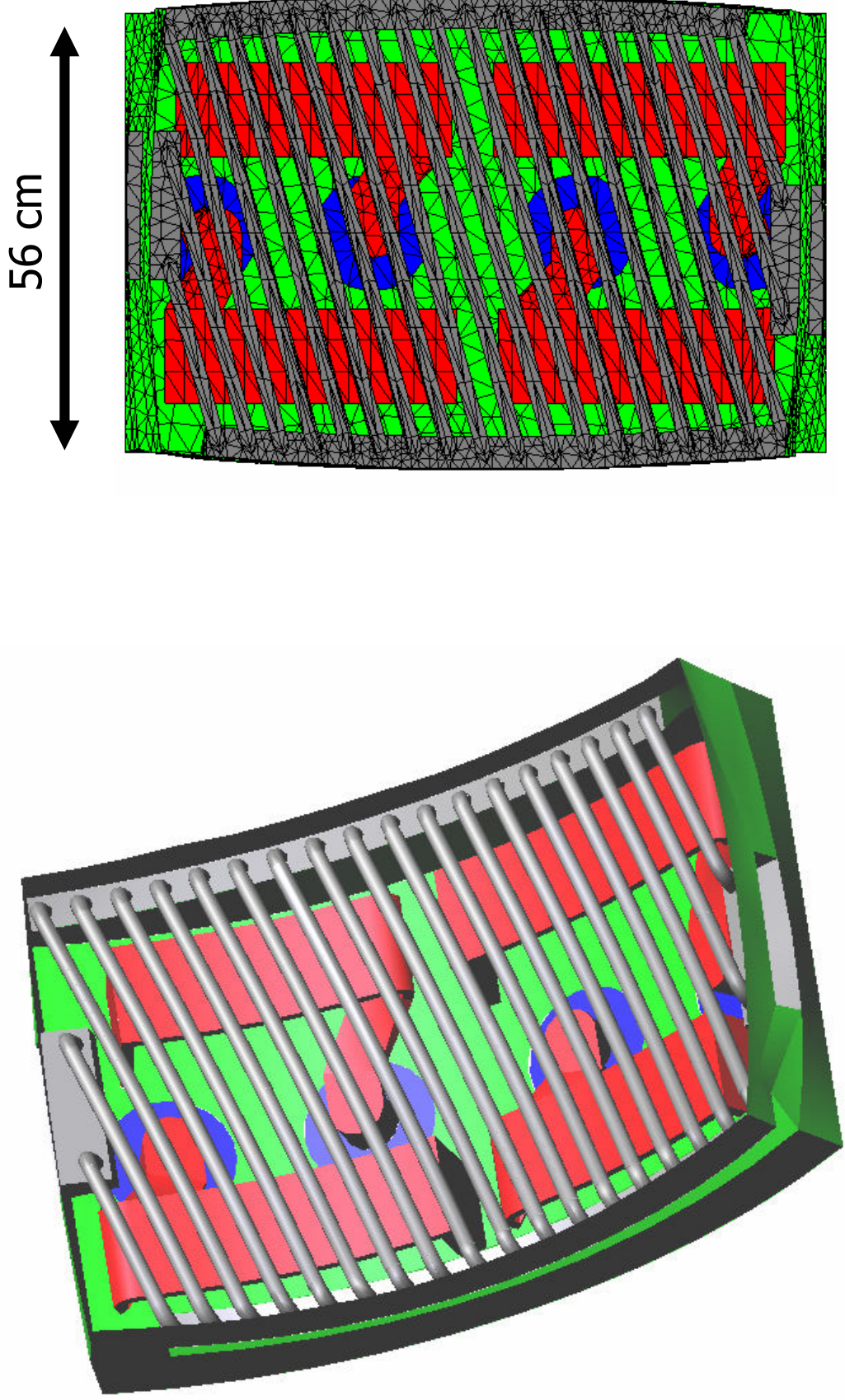


Electron density profile

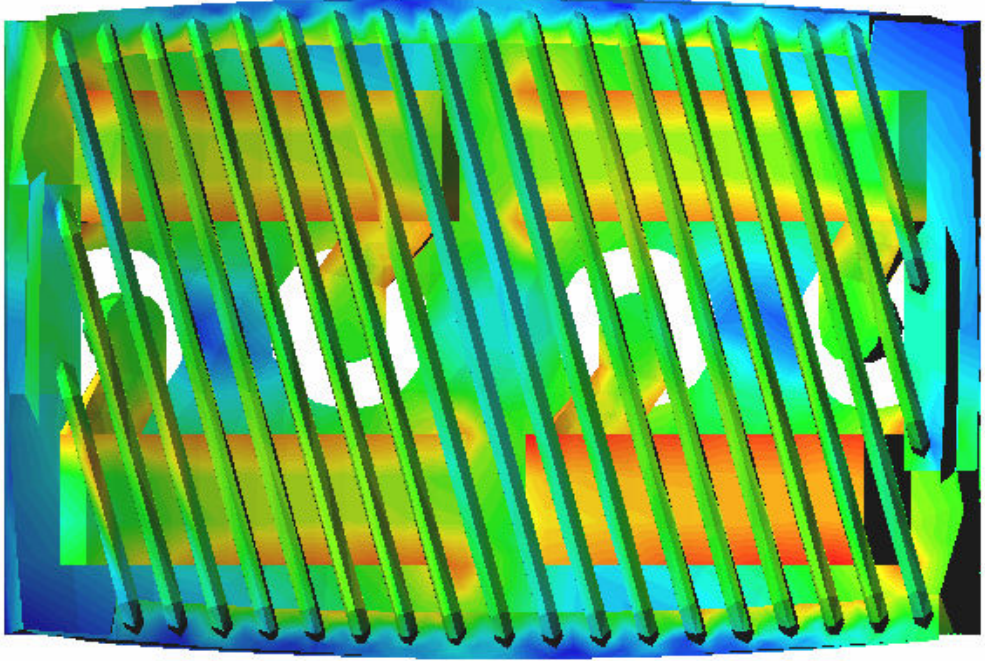




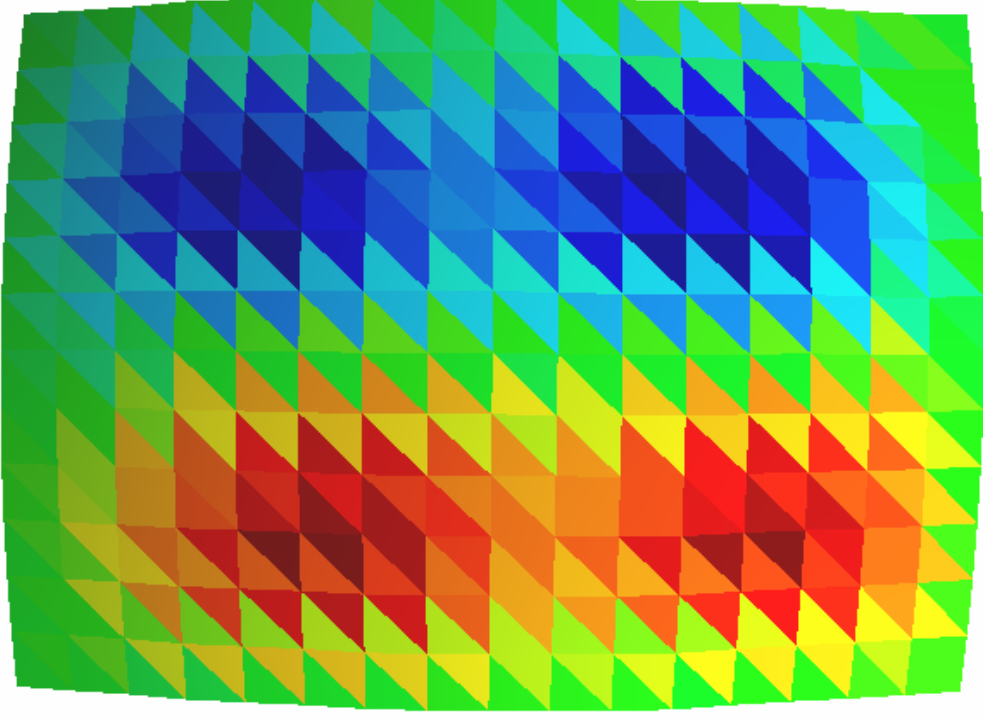
4 straps antenna



Typical electric
current distribution

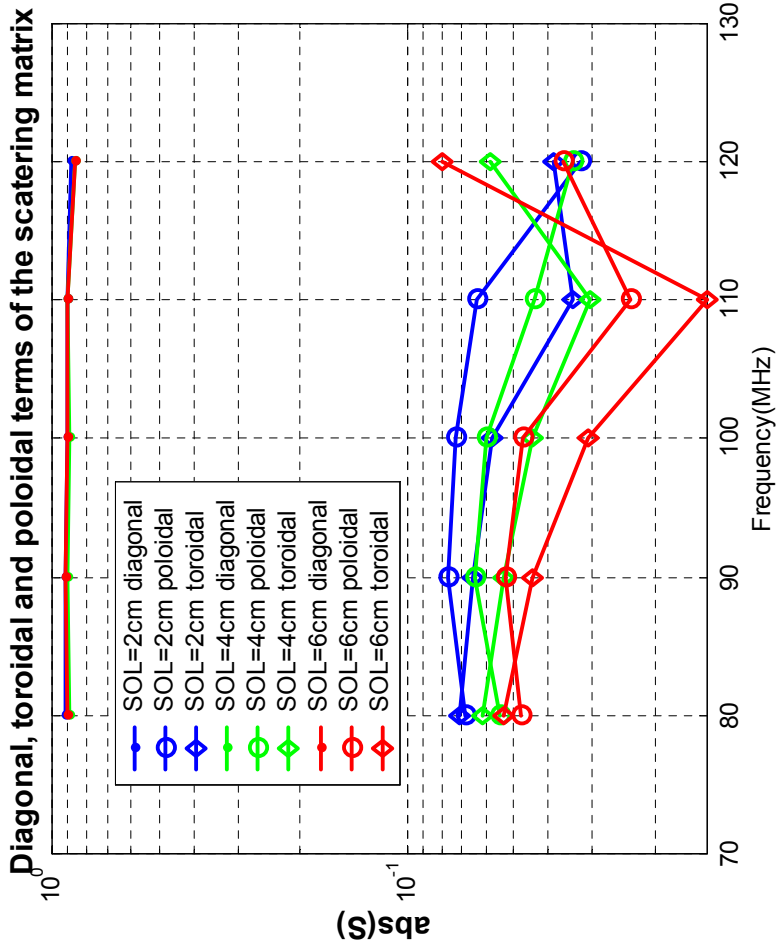
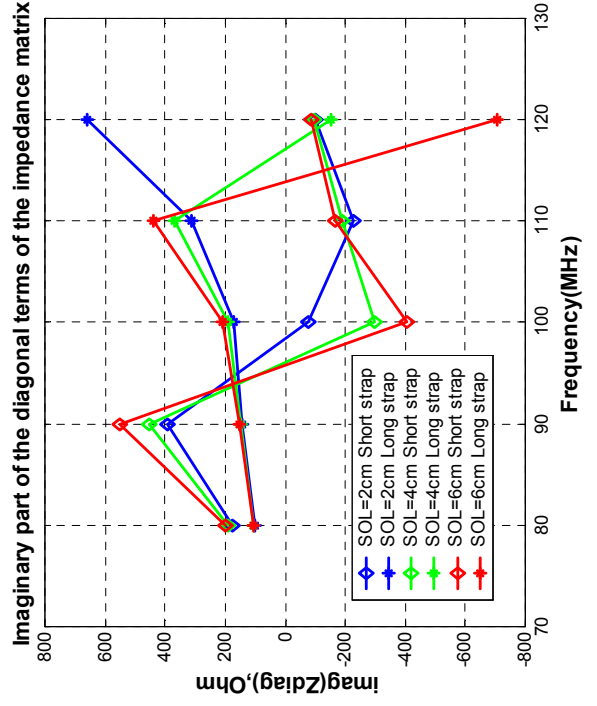
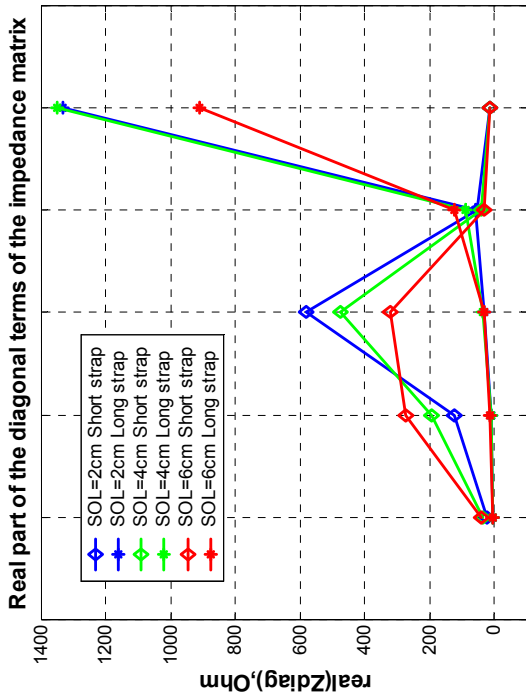


Typical poloidal electric field
distribution on aperture



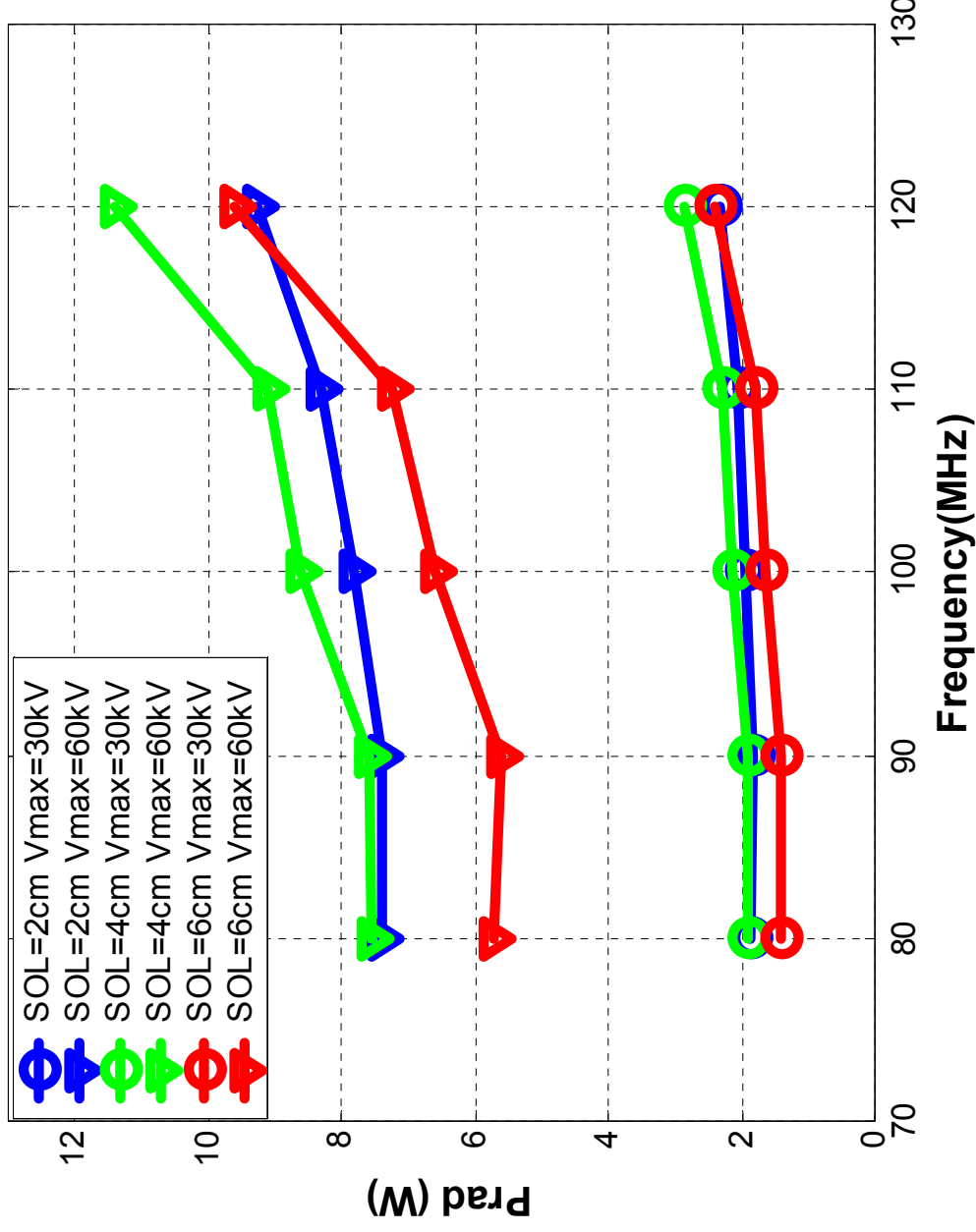


Input parameters



Radiated power

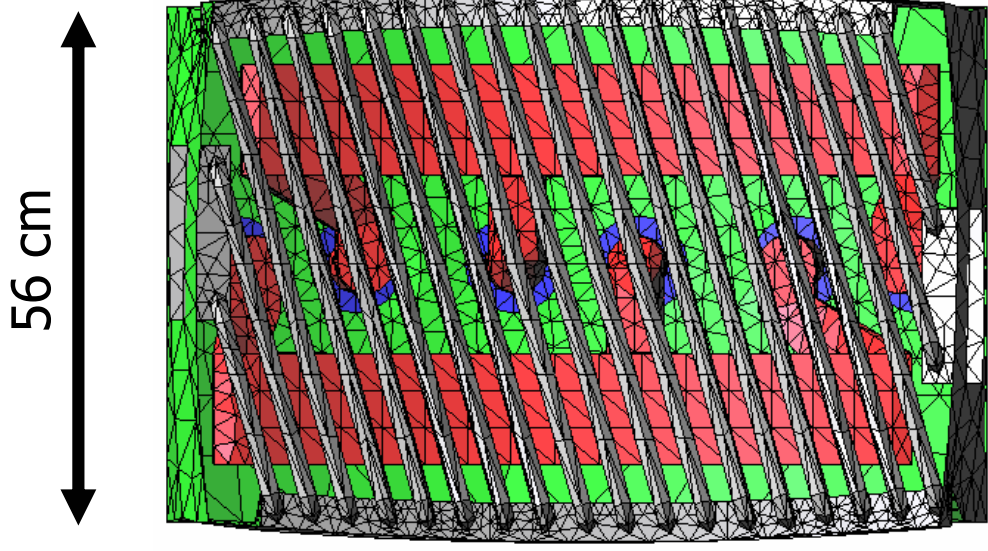
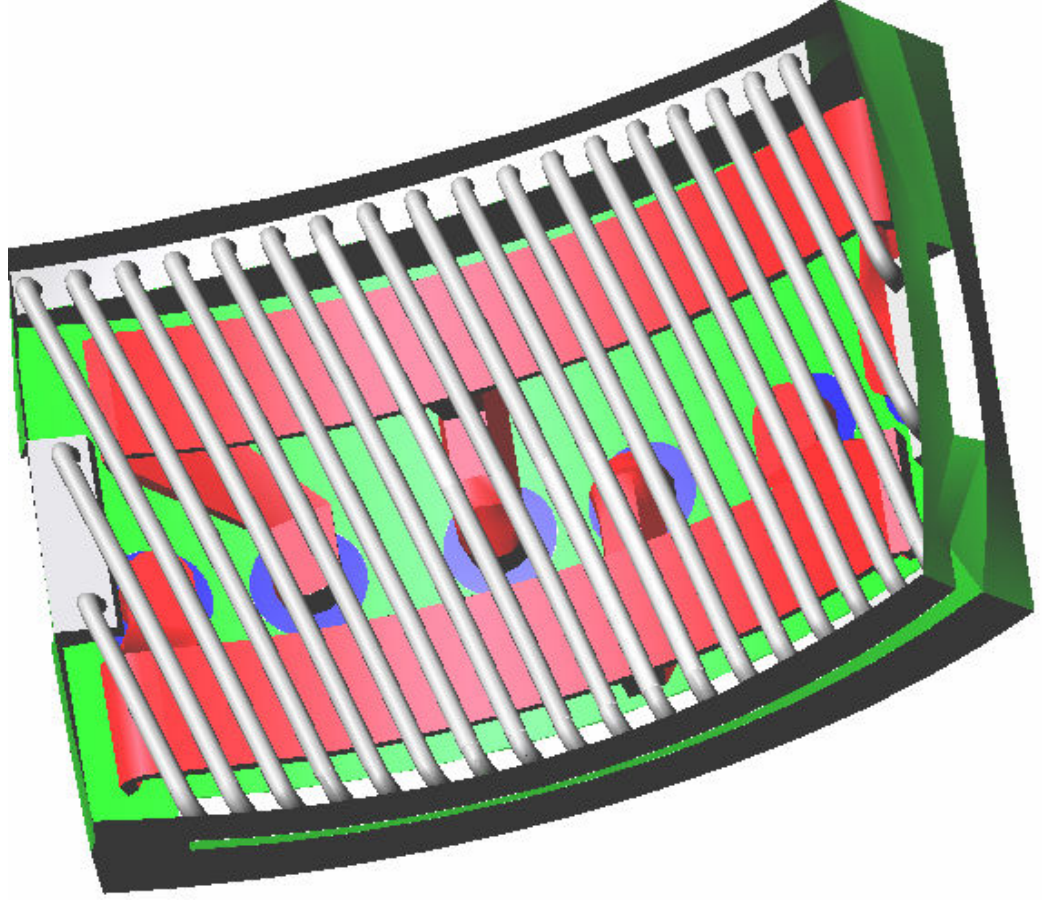
$\times 10^6$ Prad of antenna with different V_{max} in coax



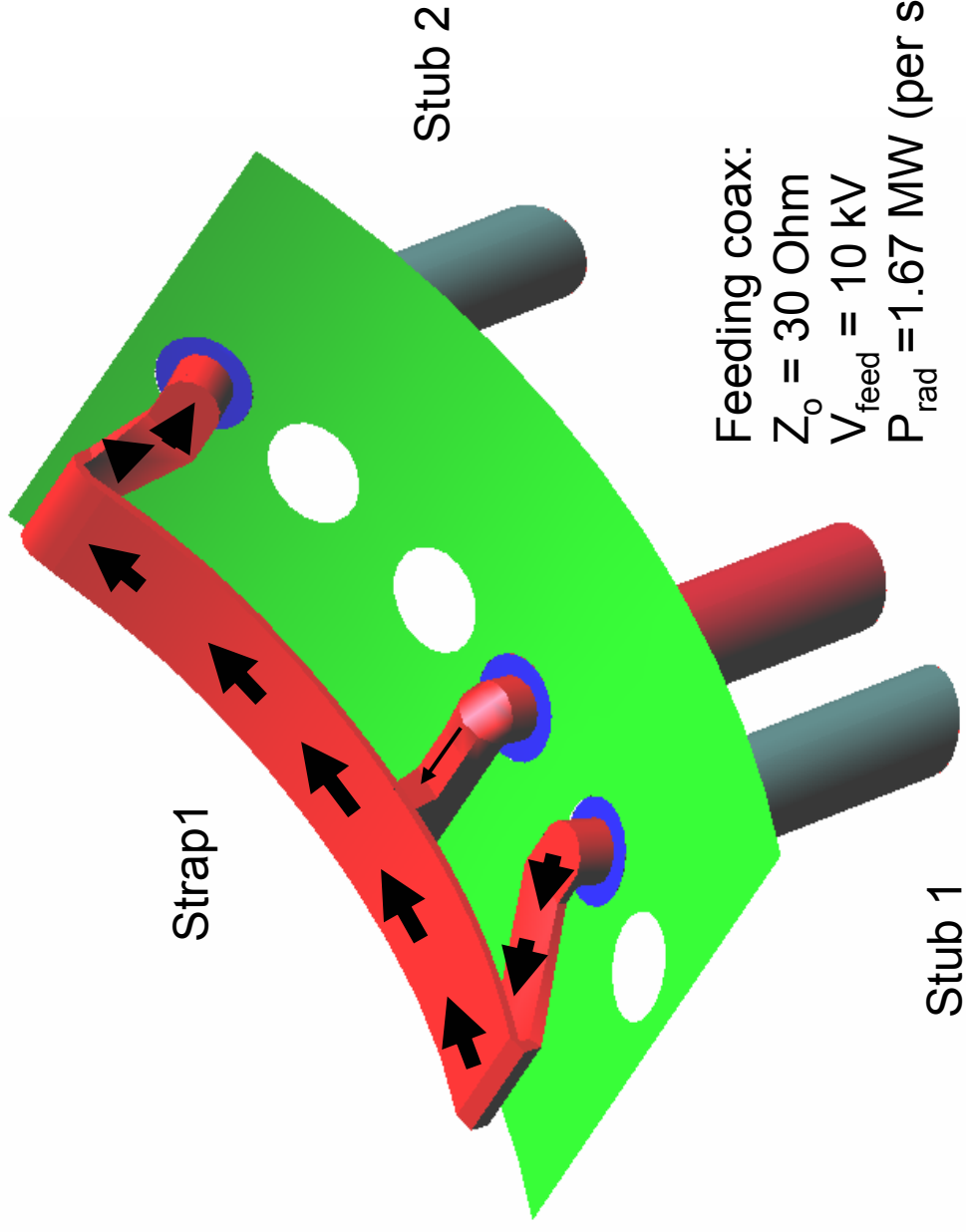
Typical coax:
 $D/d = 16 \text{ cm} / 7 \text{ cm}$
 $Z_0 = 50 \text{ Ohm}$
 $V_{breakdown} = 60 \text{ kV}$

1.5 MW can
 be coupled,
 always!

2 straps antenna + stubs



Feeding scheme



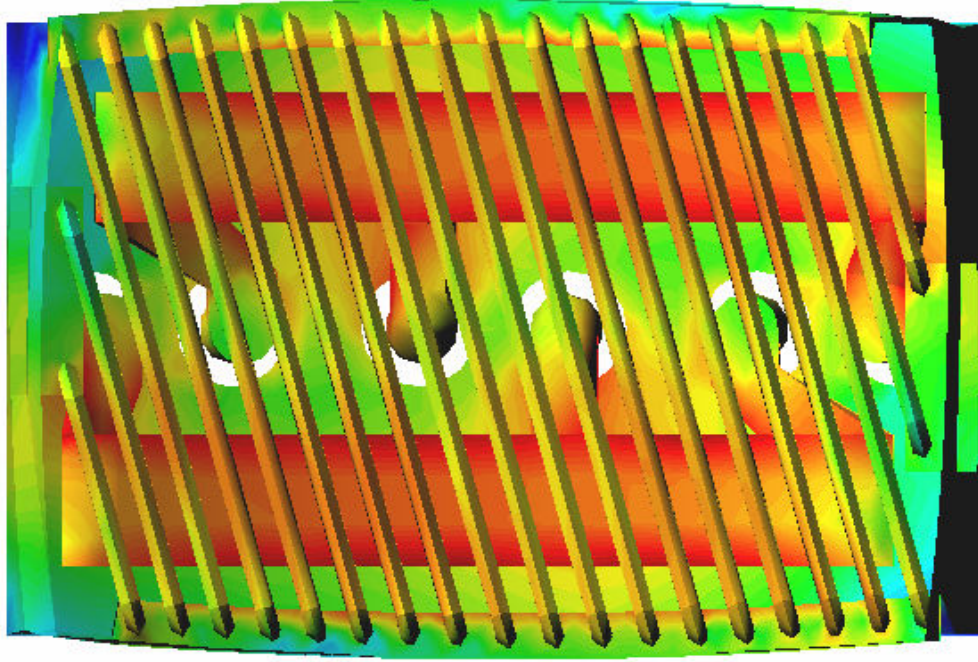
Feeding coax:

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

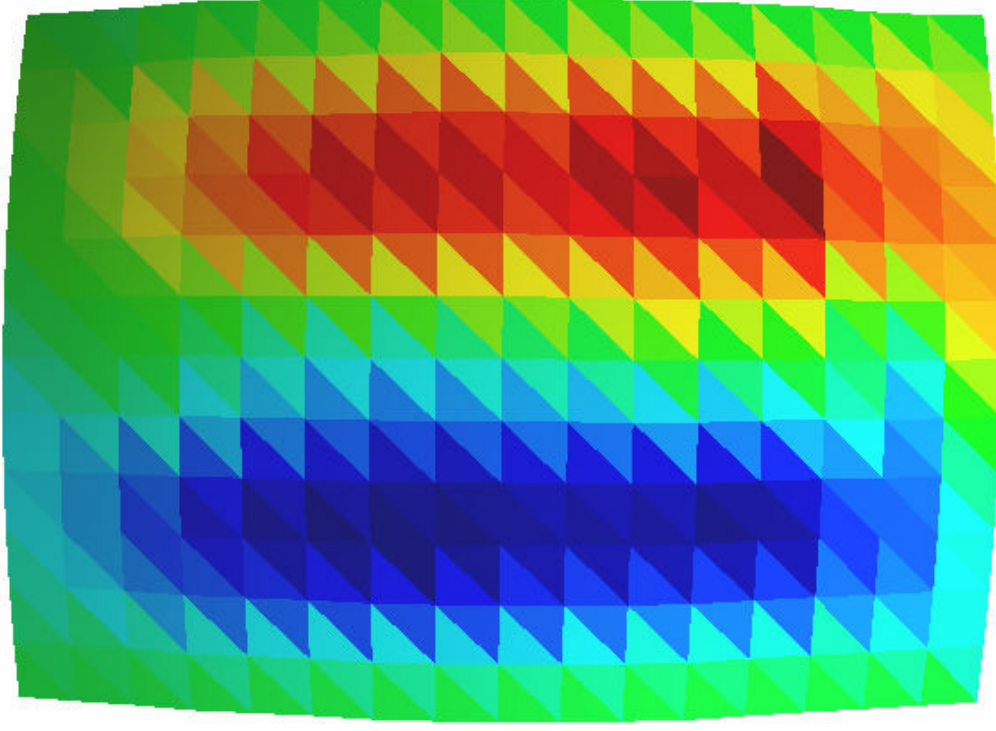
$$V_{\text{feed}} = 10 \text{ kV}$$

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

Typical electric
current distribution

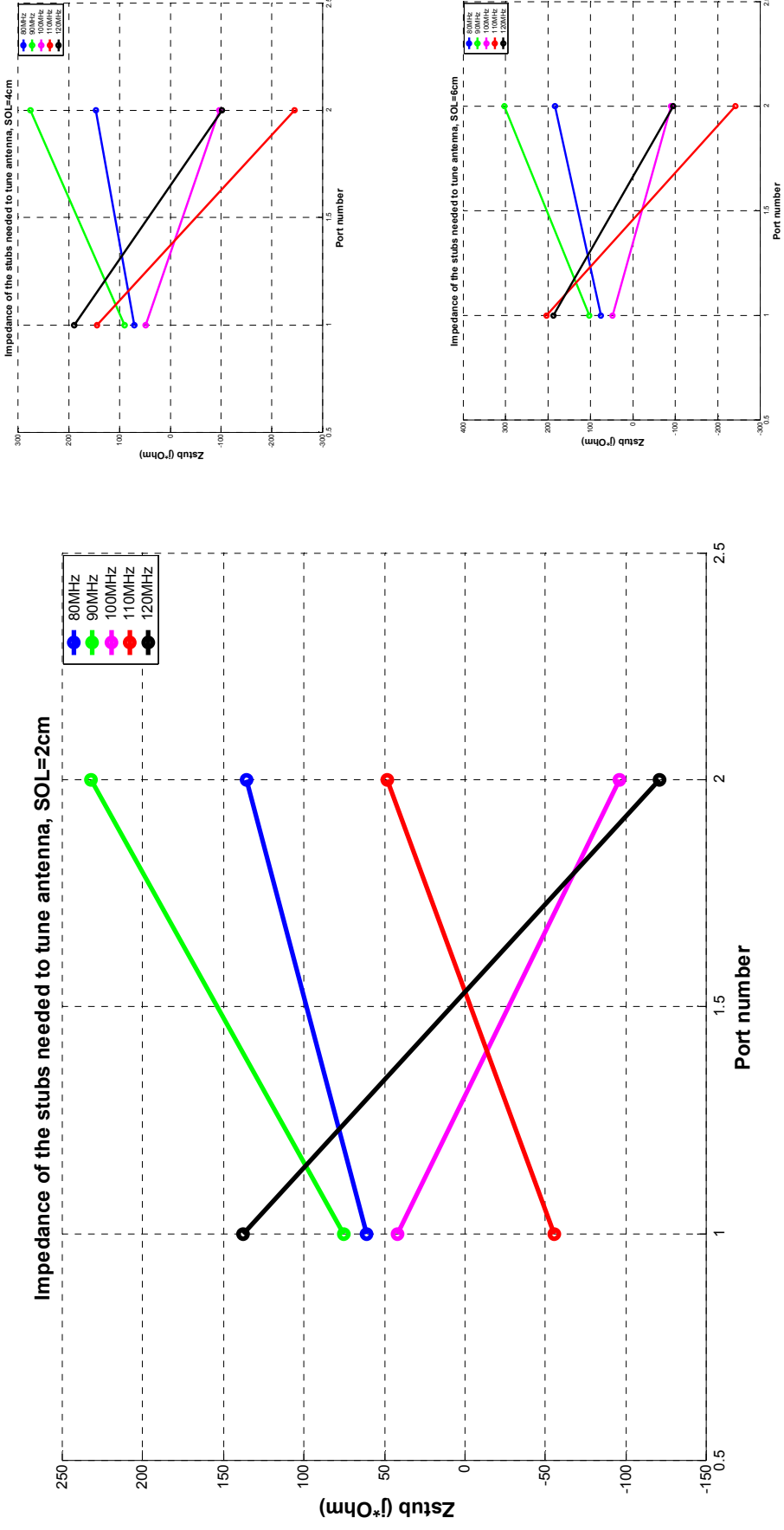


Typical poloidal electric field
distribution on aperture



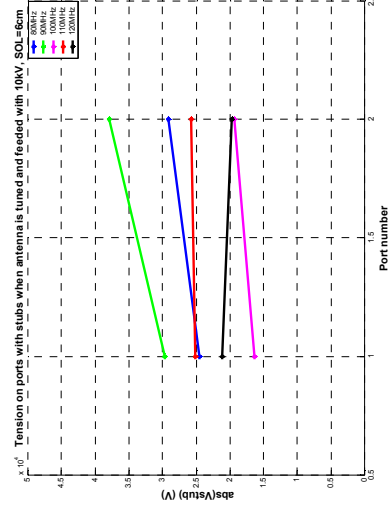
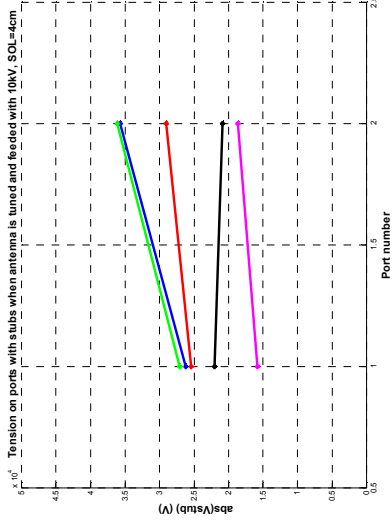
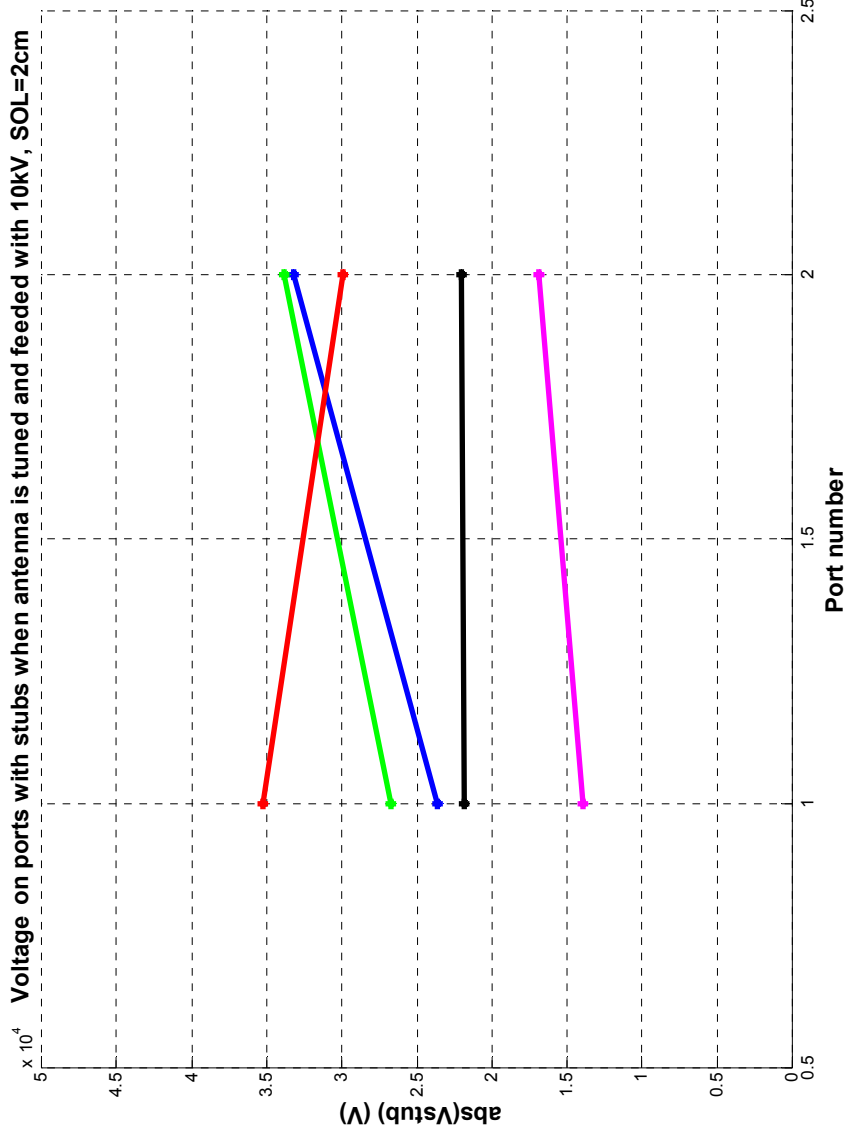


Stub impedances needed





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