TERTIARY COLLIMATOR CHAMBER (2)

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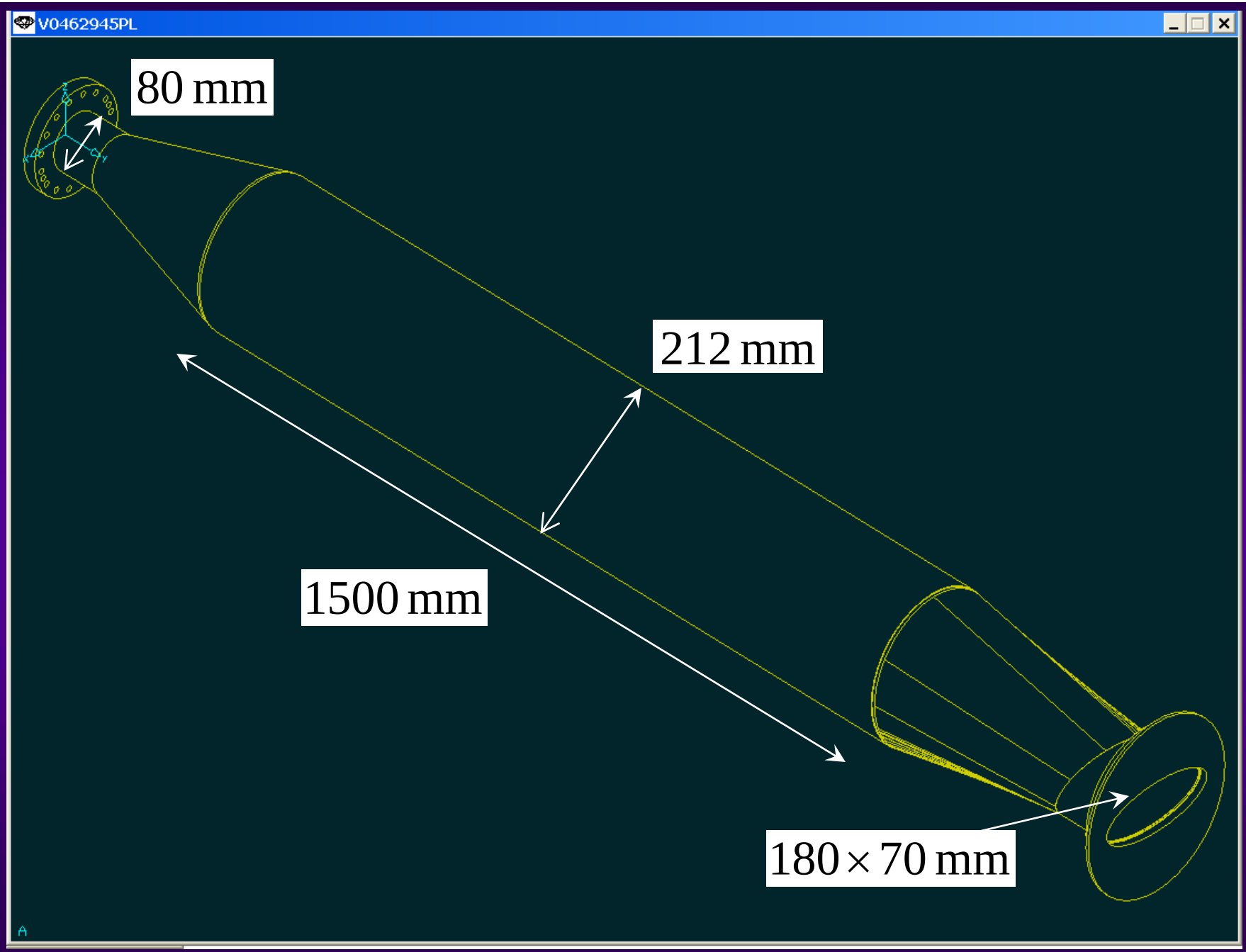
- **Email from Christian Rathjen on 06/10/05:**
  - **"The studies of the tertiary collimators at IR2 and IR8 have finally started. A current proposal requires a transition chamber between D1 and the TCTVB of about 2 m length (on the other side of the IP there is the TCDD). The collimator aperture is elliptical (180x70). Since we are short in time we would like to install a chamber of 212 inner diameter which is terminated on one side with a cone down to 80 mm and on the other side with a cone down to 180x70. The 212 mm part will be 1.5 m long"**
  - **Question: Does this "sausage" creates a resonator? (The alternative would be a hand made elliptical tube of 180x70 mm)"**


V0462945PL
80 mm
212 mm
1500 mm
180 × 70 mm

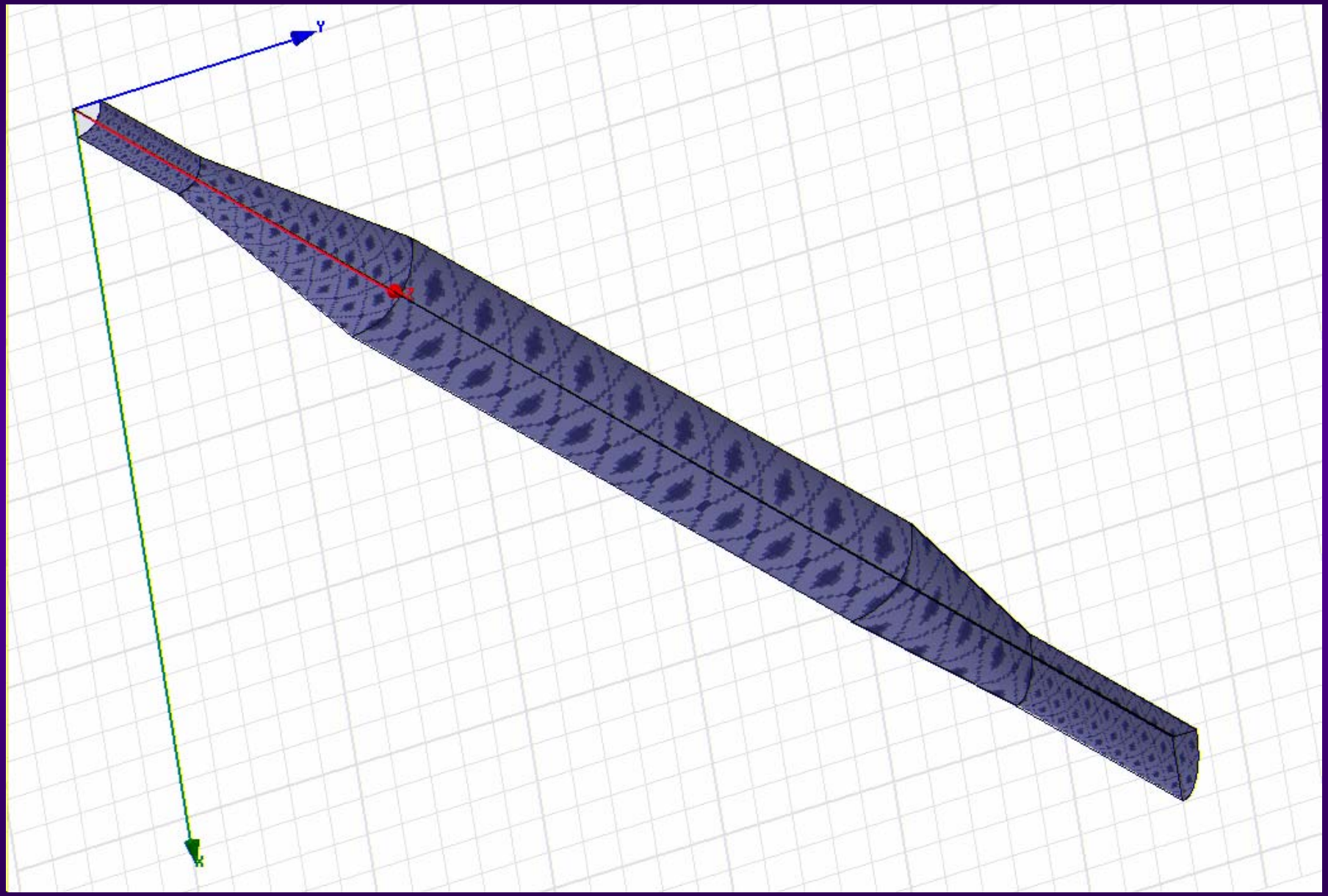
FIRST ROUGH ESTIMATE

- **Yes, this will create a resonator with frequencies above 1 GHz**

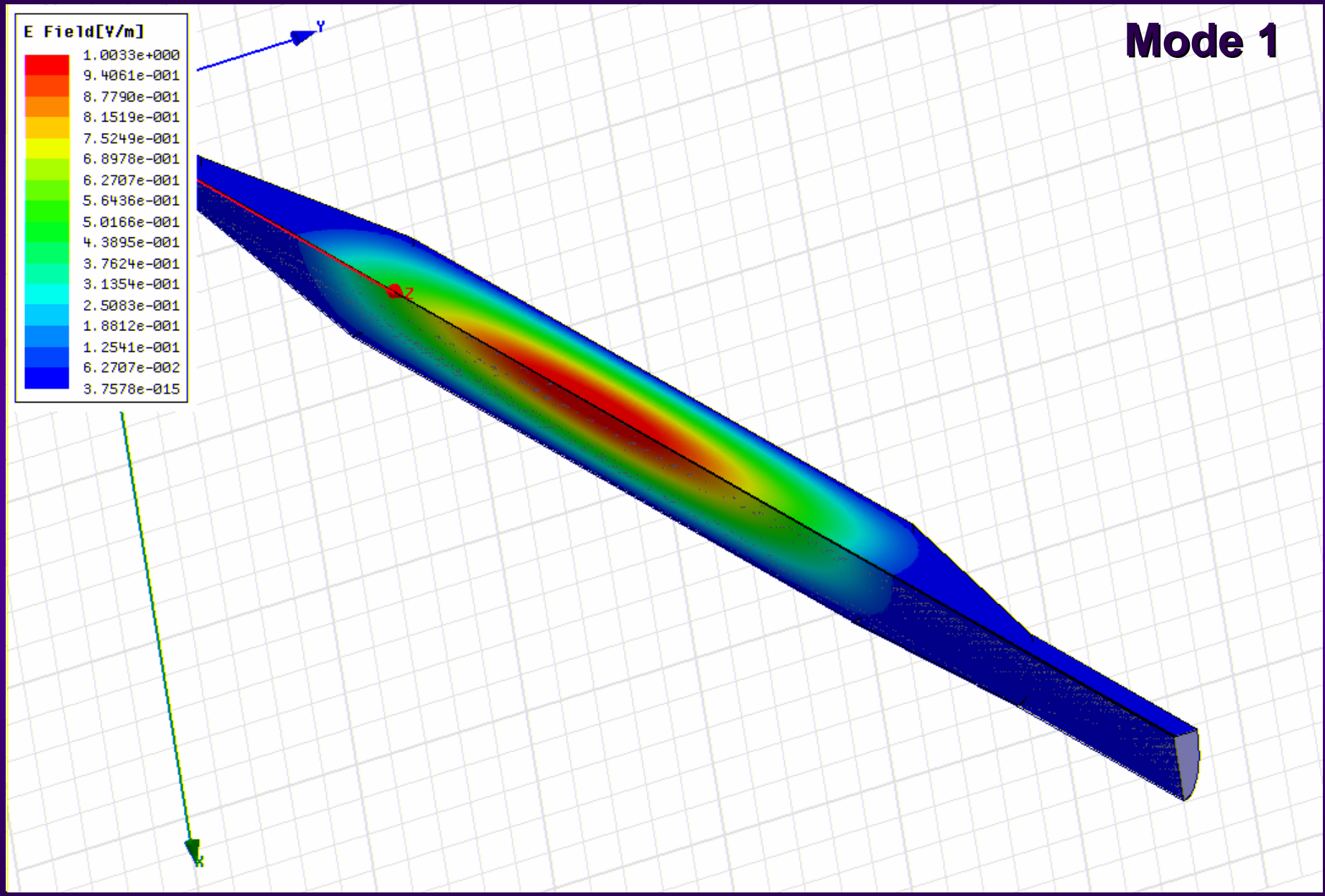
$$f_{cut-off}^{\text{1st long mode}}\left[\text{GHz}\right] \approx \frac{10}{b\left[\text{cm}\right]}$$

- **The alternative is better as no cavity is created**
- **However, even if we keep the first scenario, this should not be too harmful as the frequencies are high**
- **To have an exact evaluation of the power loss, HFSS simulations are required**

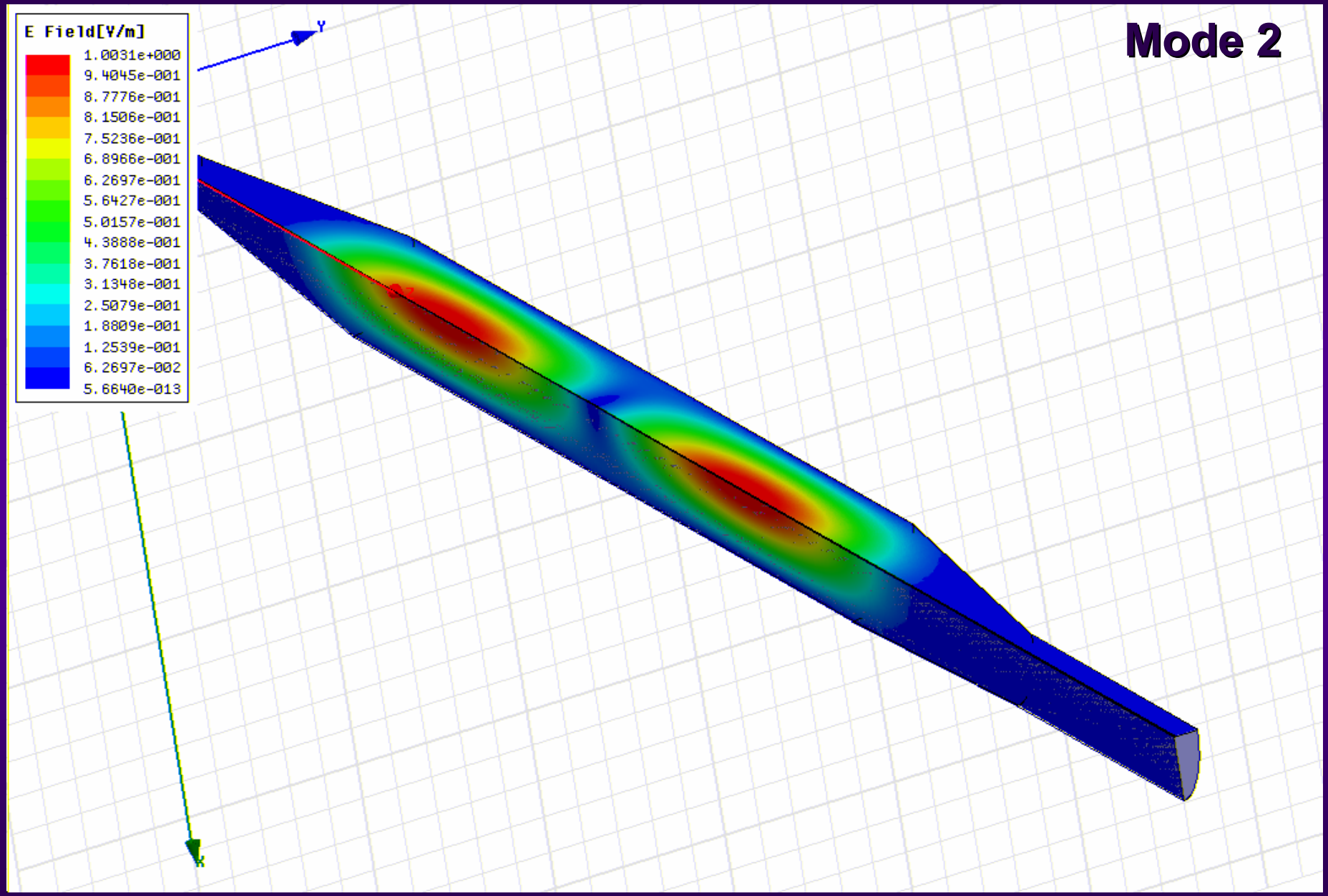
HFSS SIMULATIONS (1/8)



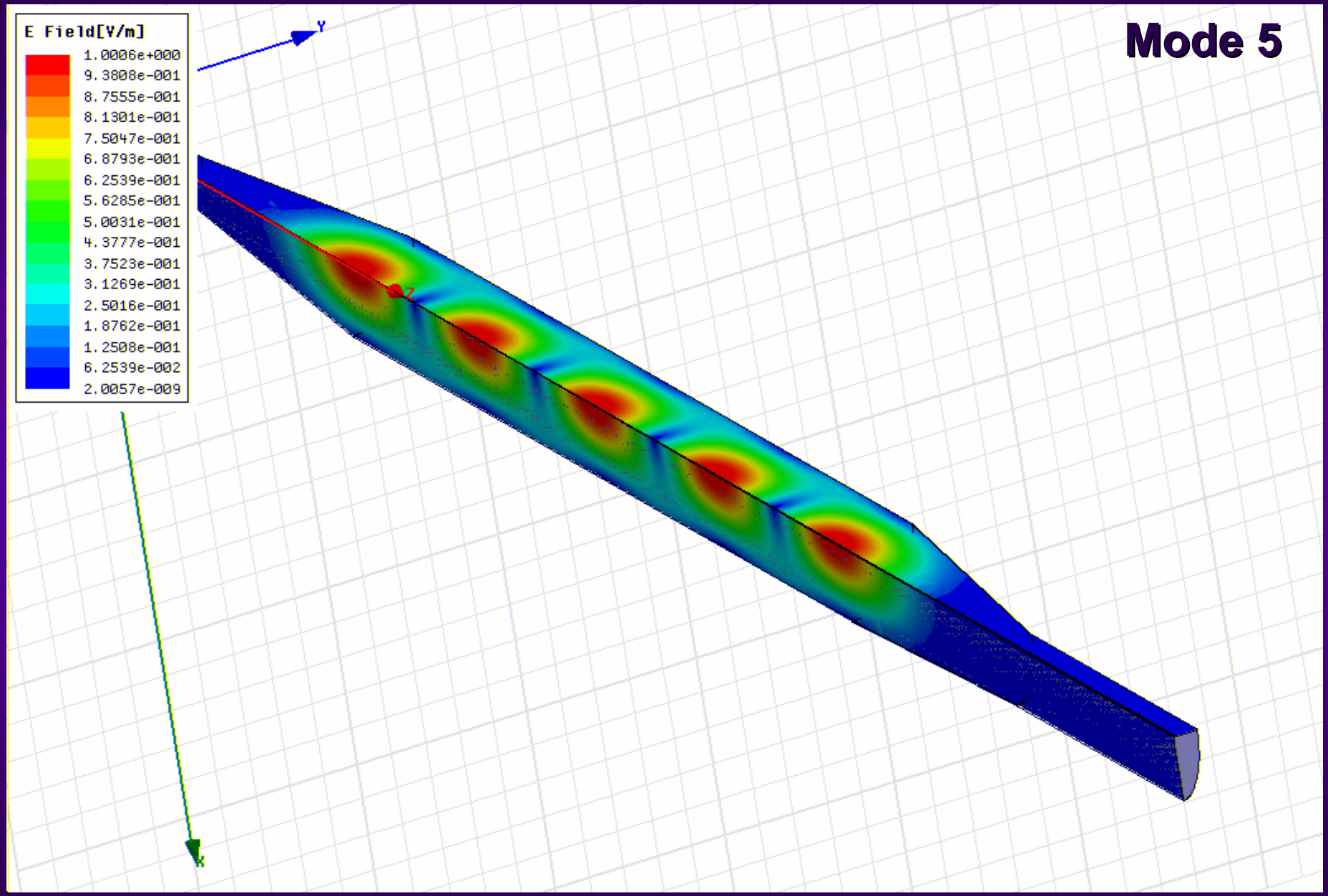
HFSS SIMULATIONS (2/8)



HFSS SIMULATIONS (3/8)

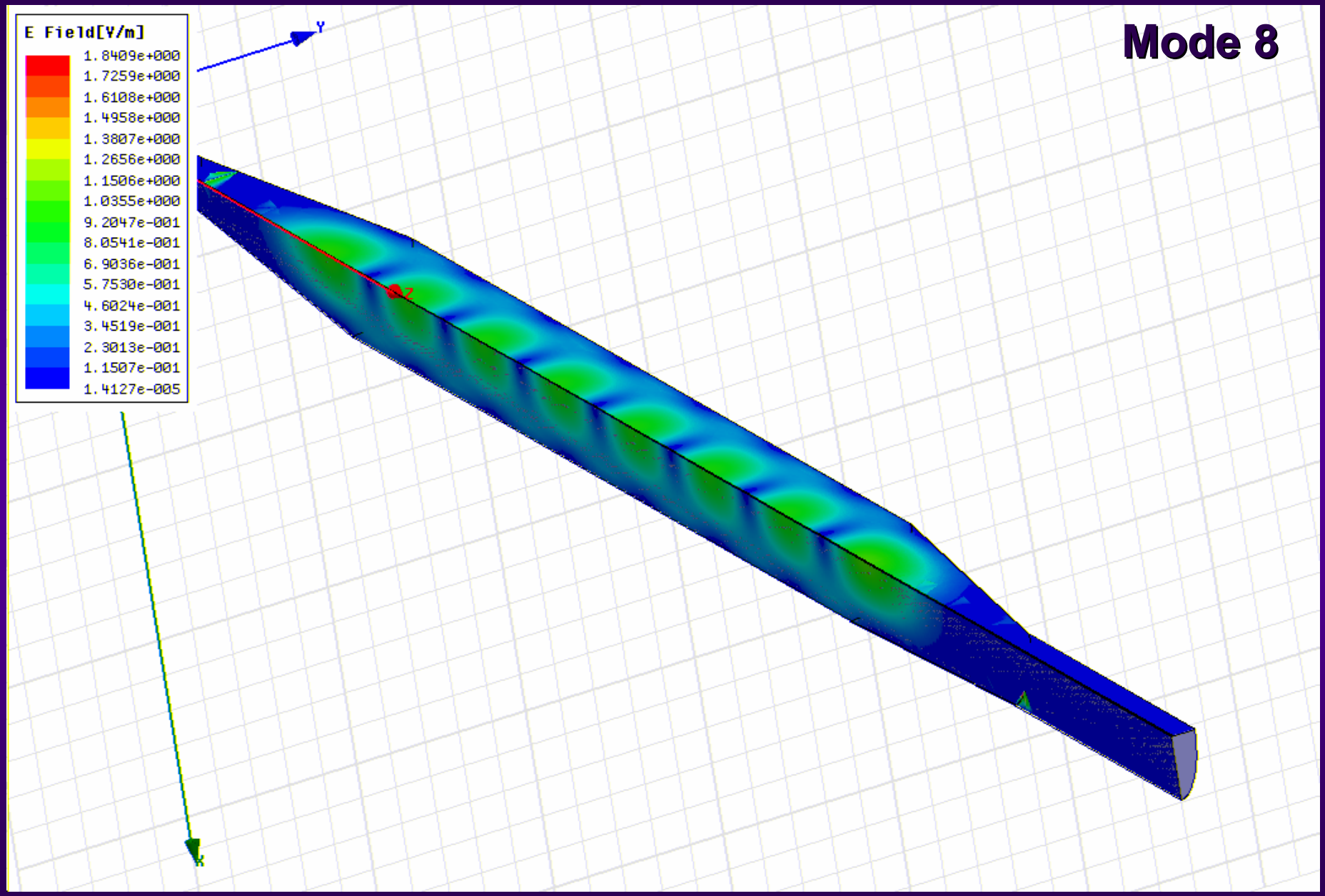


HFSS SIMULATIONS (4/8)



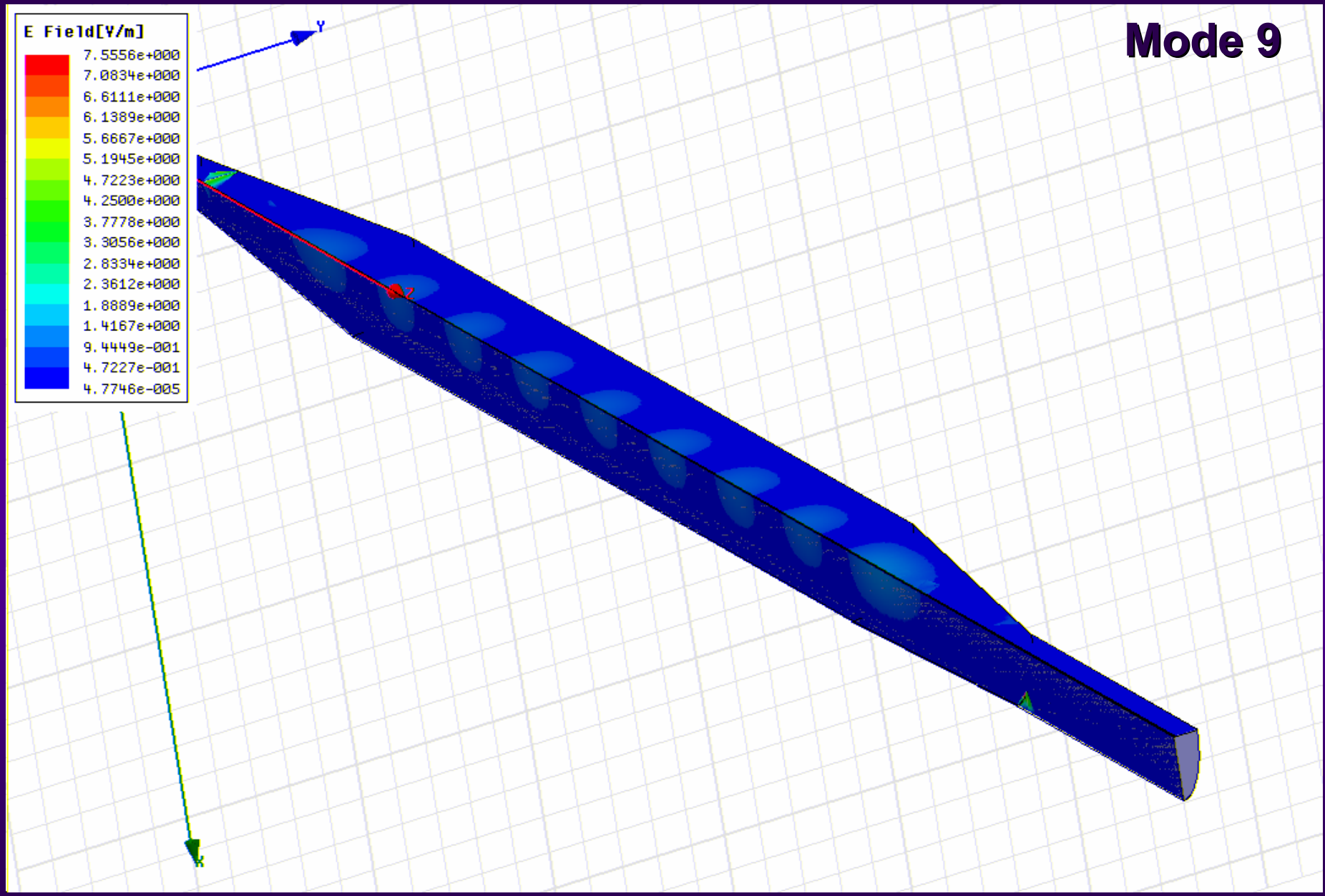
Mode 5

HFSS SIMULATIONS (5/8)



Mode 8

HFSS SIMULATIONS (6/8)



Mode 9

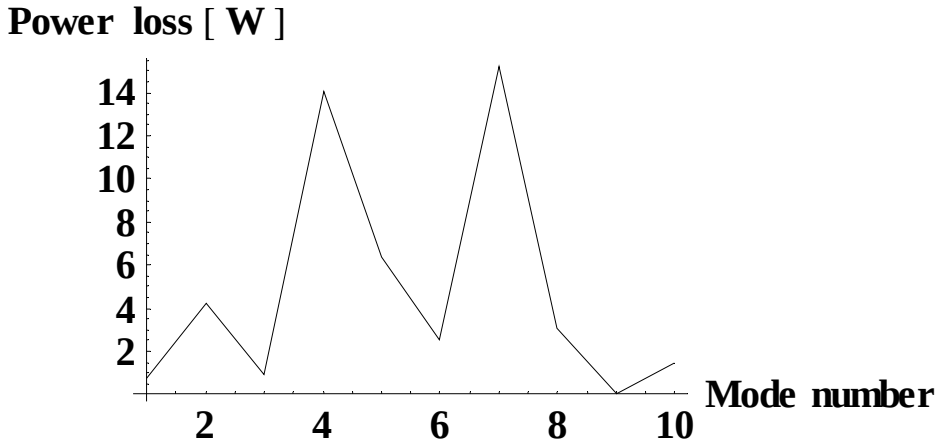
HFSS SIMULATIONS (7/8)

GHz		Ω
$f_{r1} = 1.0857$	$Q_1 = 7113.9$	$R_1 = 12.1$
$f_{r2} = 1.0948$	$Q_2 = 7120.3$	$R_2 = 75.2$
$f_{r3} = 1.1098$	$Q_3 = 7135.9$	$R_3 = 18.1$
$f_{r4} = 1.1305$	$Q_4 = 7158.7$	$R_4 = 302.6$
$f_{r5} = 1.1565$	$Q_5 = 7194.1$	$R_5 = 158.3$
$f_{r6} = 1.1872$	$Q_6 = 7374.7$	$R_6 = 74.8$
$f_{r7} = 1.2218$	$Q_7 = 8914.4$	$R_7 = 555.6$
$f_{r8} = 1.2596$	$Q_8 = 4488.6$	$R_8 = 143.1$
$f_{r9} = 1.3000$	$Q_9 = 1743.3$	$R_9 = 3.8$
$f_{r10} = 1.3474$	$Q_{10} = 2220.0$	$R_{10} = 116.0$

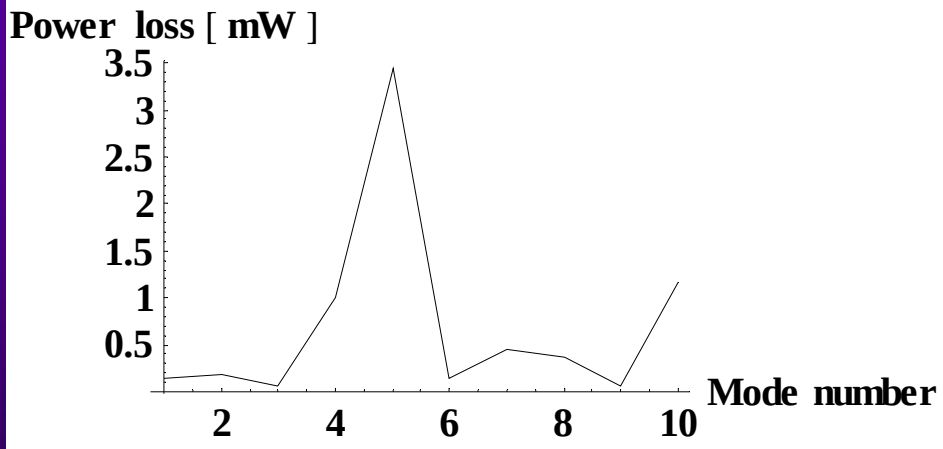
HFSS SIMULATIONS (8/8)

From "Energy loss of bunched beams in SSC RF cavities" by Furman, Lee and Zotter

Maximum power loss, assuming that the resonance frequency is a multiple of the bunch frequency



Power loss, assuming that the resonance frequency given by HFSS is "exact" (which is not a multiple of the bunch frequency)



APPENDIX: Power loss for mode i

$$P_{loss}^{\mathrm{Max}} = 2\left(M\ I_b\right)^2\ R_i\ e^{-\left(\omega_{ri}\,\sigma_\tau\right)^2}$$

and

$$P_{loss}^{\mathrm{"Real"}} = P_{loss}^{\mathrm{Max}} \times \frac{\Delta^2}{\Delta^2 + \sin^2\left(\dfrac{\pi\ f_{ri}}{f_b}\right)}$$

if $\Delta = \dfrac{\pi\ f_{ri}}{2\,Q_i\ f_b} << 1$ $\quad Q_i >> 1$

$M = 3564$

$I_b = N_b\ e\ f_0$

$N_b = 1.15 \times 10^{11}$ p/b

$f_0 = 11245.5$ Hz

$\sigma_\tau = 0.25$ ns

$f_b = M\ f_0 = 40$ MHz