Origin of TCLIA/TCTV transverse BB impedance

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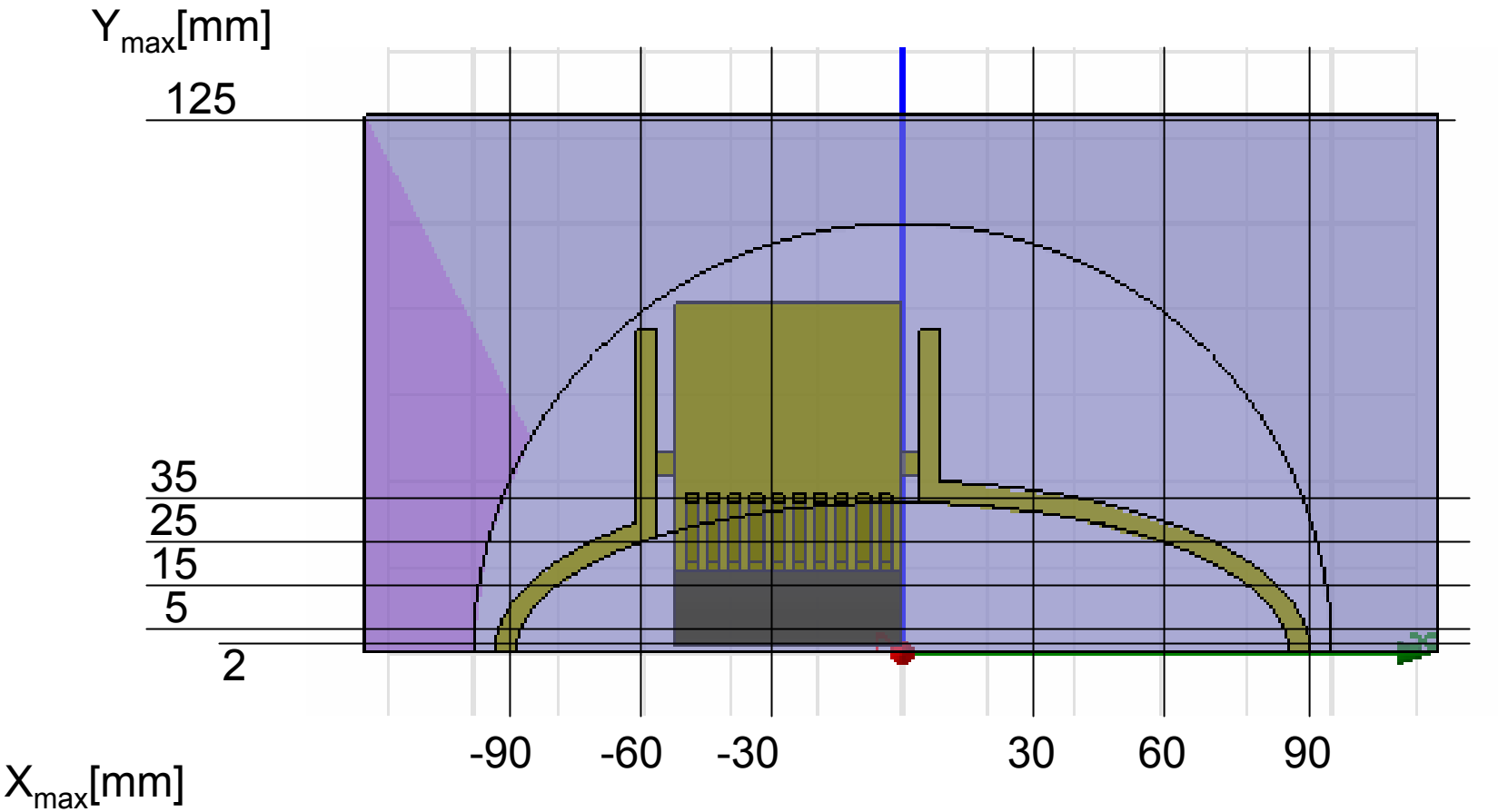
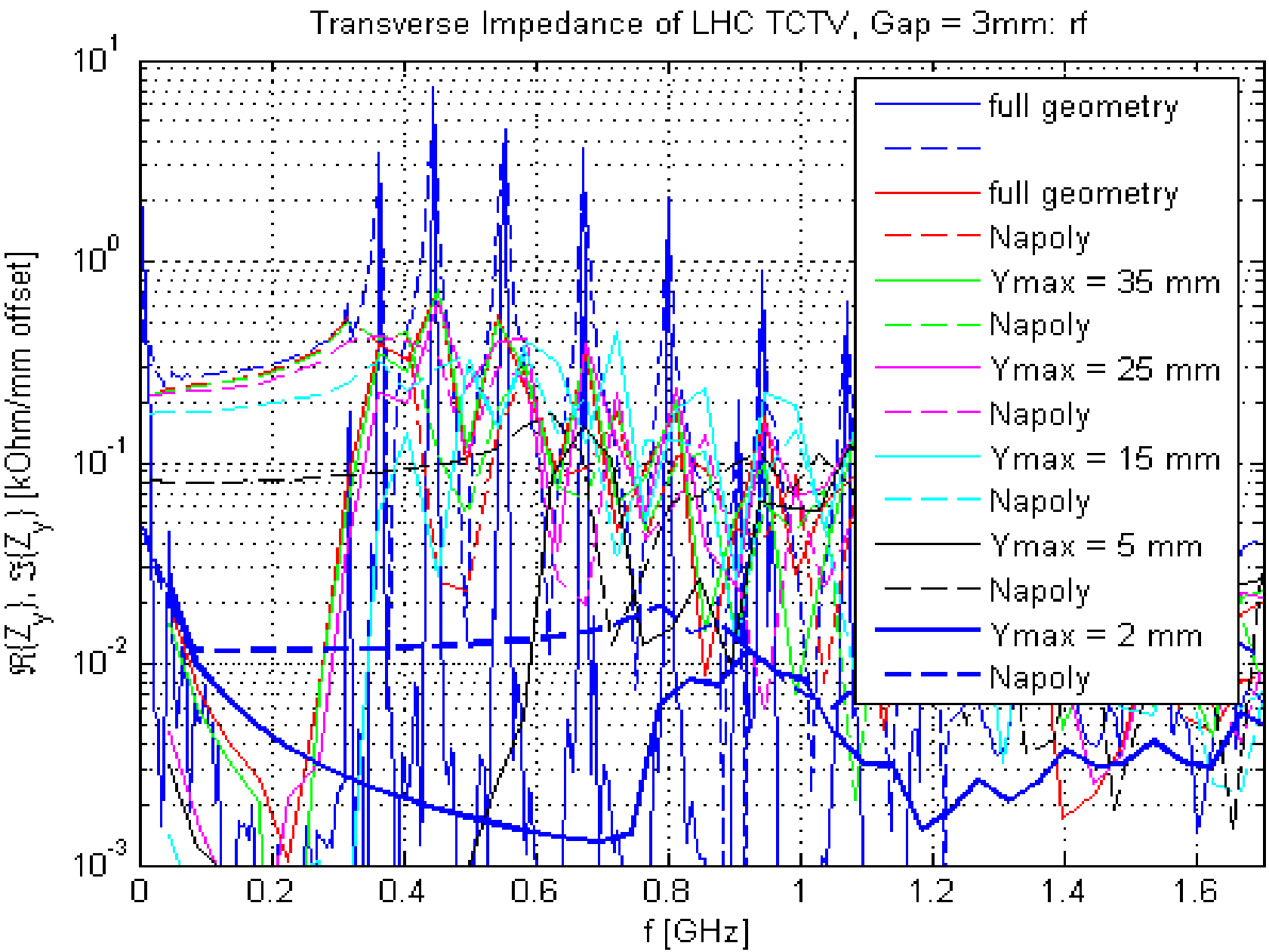
10.03.2006

RLC meeting

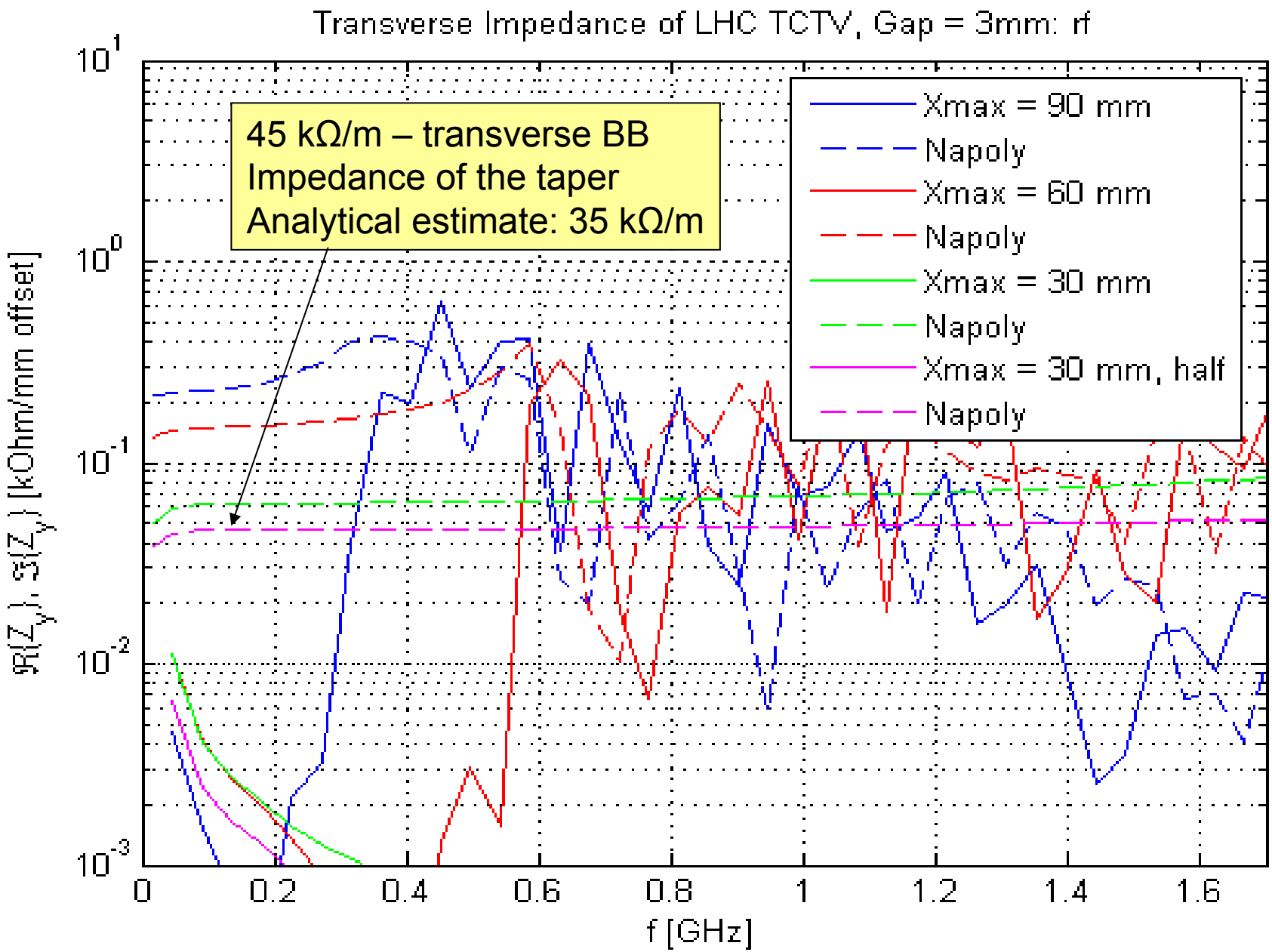
Cross-section of TCLI/TCTV collimator



TCTV transverse impedance for different Y_{max}



TCTV transverse impedance for different X_{max}



Dipole trapped mode impedance

Transverse Impedance of a single mode

$$Z_m^{\perp} = \frac{c}{\omega}\frac{R_s}{1+iQ(\omega_R/\omega-\omega/\omega_R)} = \Big|_{\omega\to 0} \frac{cR_s}{\omega_R Q} = \frac{R_t}{Q}$$

Parameters of first 4 dipole trapped modes from HFSS simulations

n	f [MHz]	Q	R_t [MΩ/m]	R_t/Q [kΩ/m]
1	317	3080	16.6	5.4
2	362	1700	152.8	89.9
3	443	1080	173.8	160.9
4	551	920	81.4	88.5

344.7 kΩ/m – transverse BB impedance of these 4 trapped modes

Conclusions and recommendations

- Transverse Broad Band impedance originates both from the jaw tapers (~40 kΩ/m) and from the dipole trapped modes (4 modes -> ~350 kΩ/m). The sum is in agreement (though not perfect) with the total transverse BB impedance of ~300 kΩ/m calculated using GdfidL.
- Previous recommendation to open the slots for damping trapped modes using ferrite in the vacuum tank will reduce the peak impedance of the trapped modes but will probably increase BB impedance of the collimator because of appearance of new lower frequency modes. (to be checked). For the moment it is not clear whether it was a good recommendation. Further study is needed.
- Following measures will certainly help:
  - To increase the gap
  - To reduce the transverse dimensions of the elliptical beam screen