Simulation of Longitudinal and Transverse Impedance of TCDD (original geometry)

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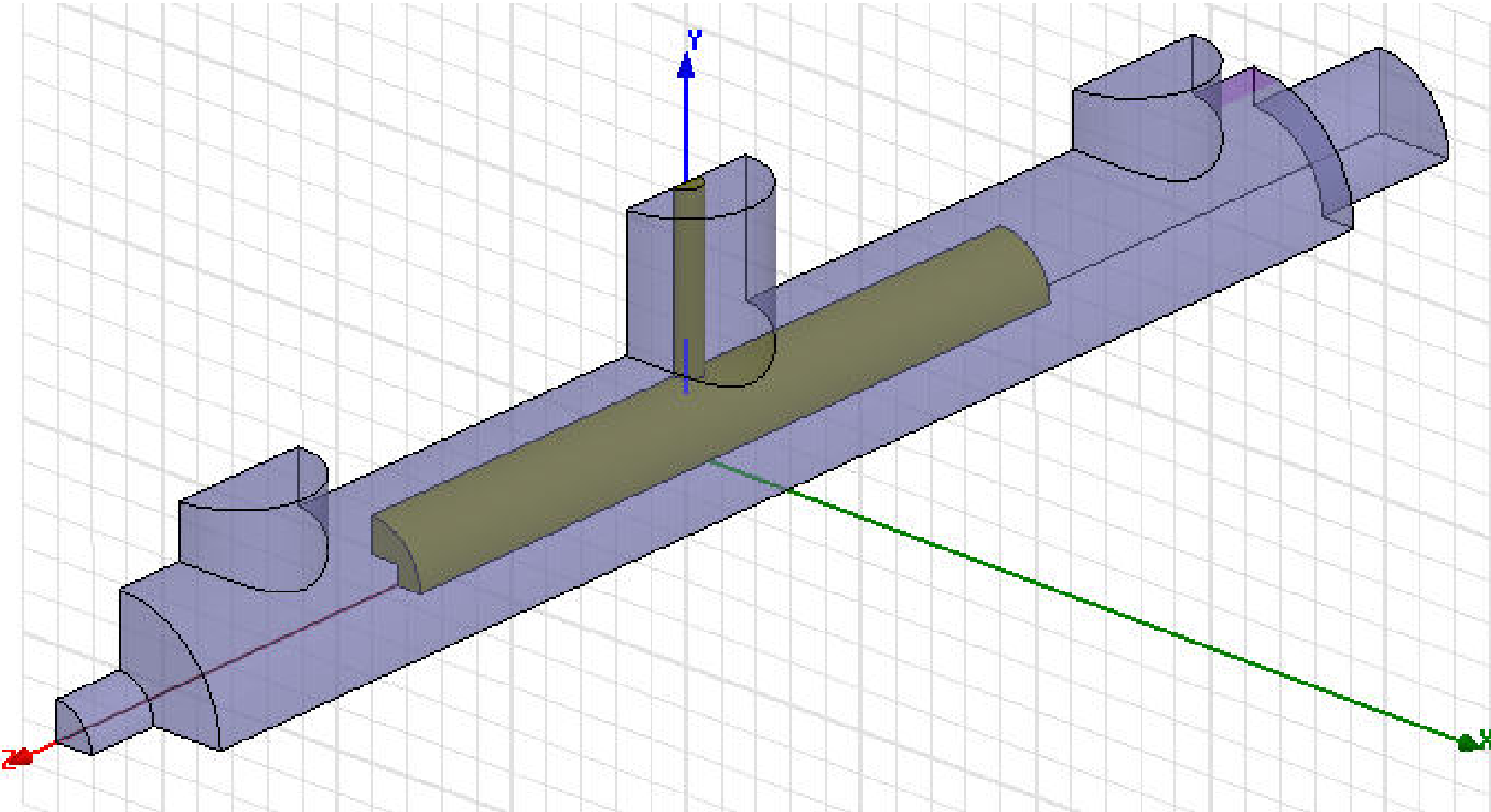
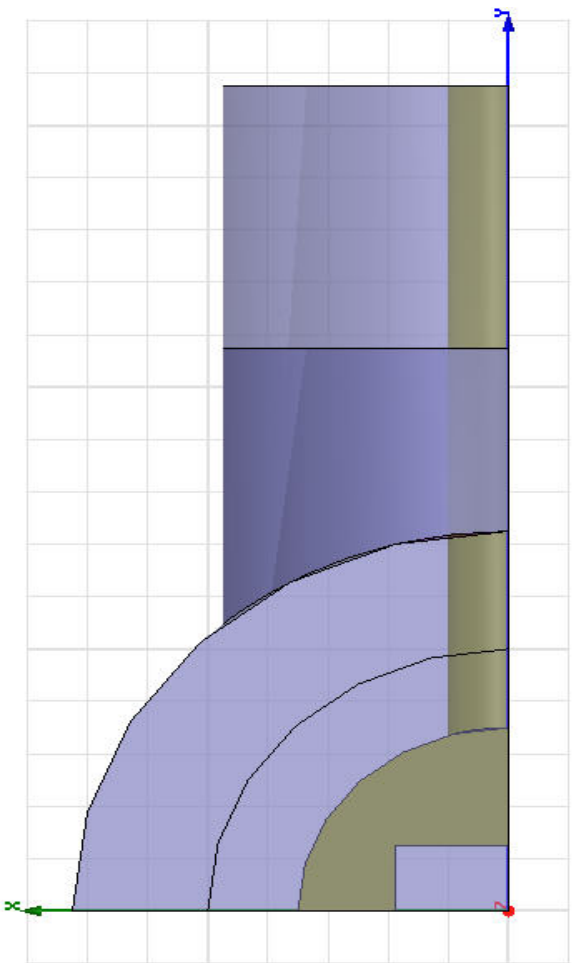
28.10.2005

TCDD geometry (original proposal)

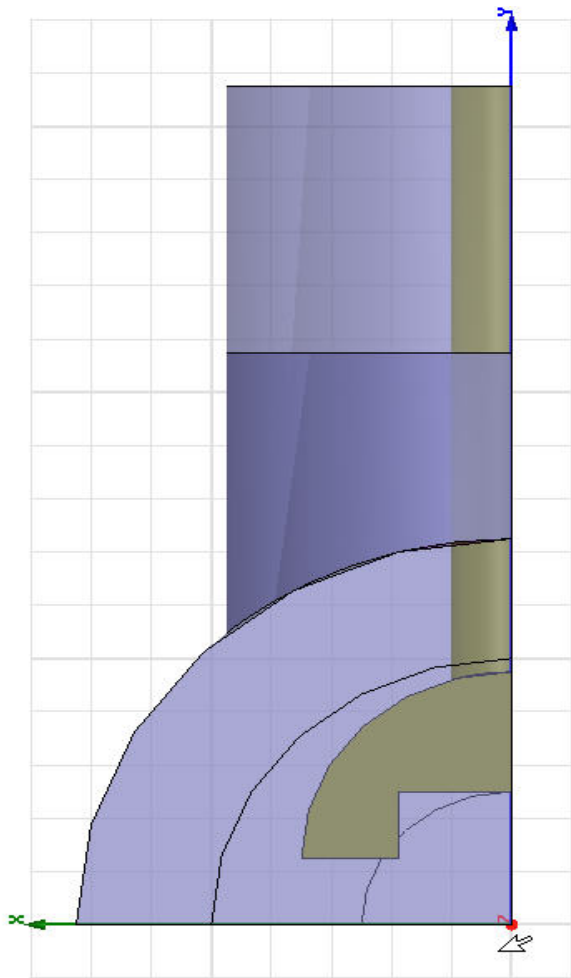


TCDD geometry (original proposal)

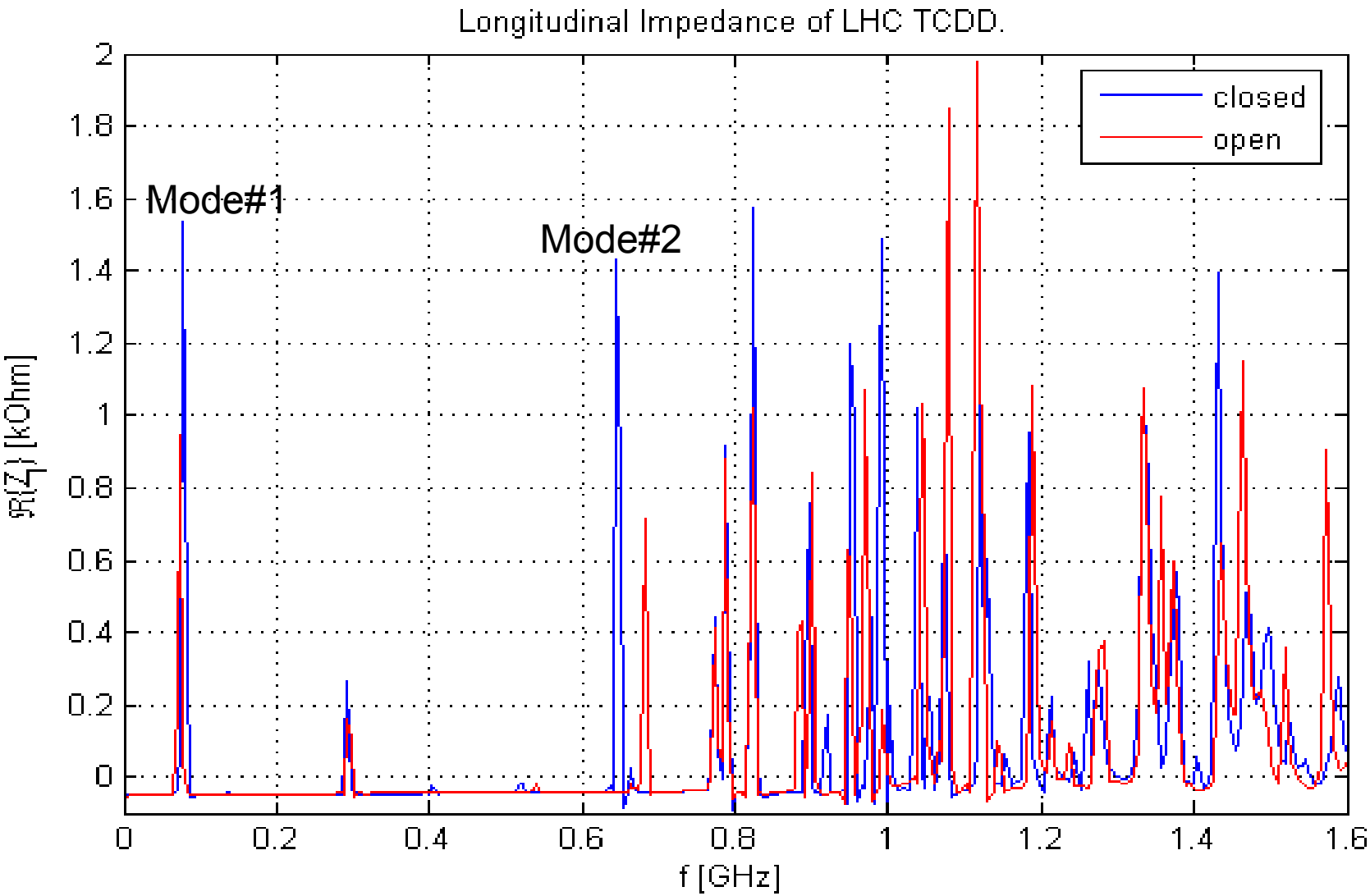
closed



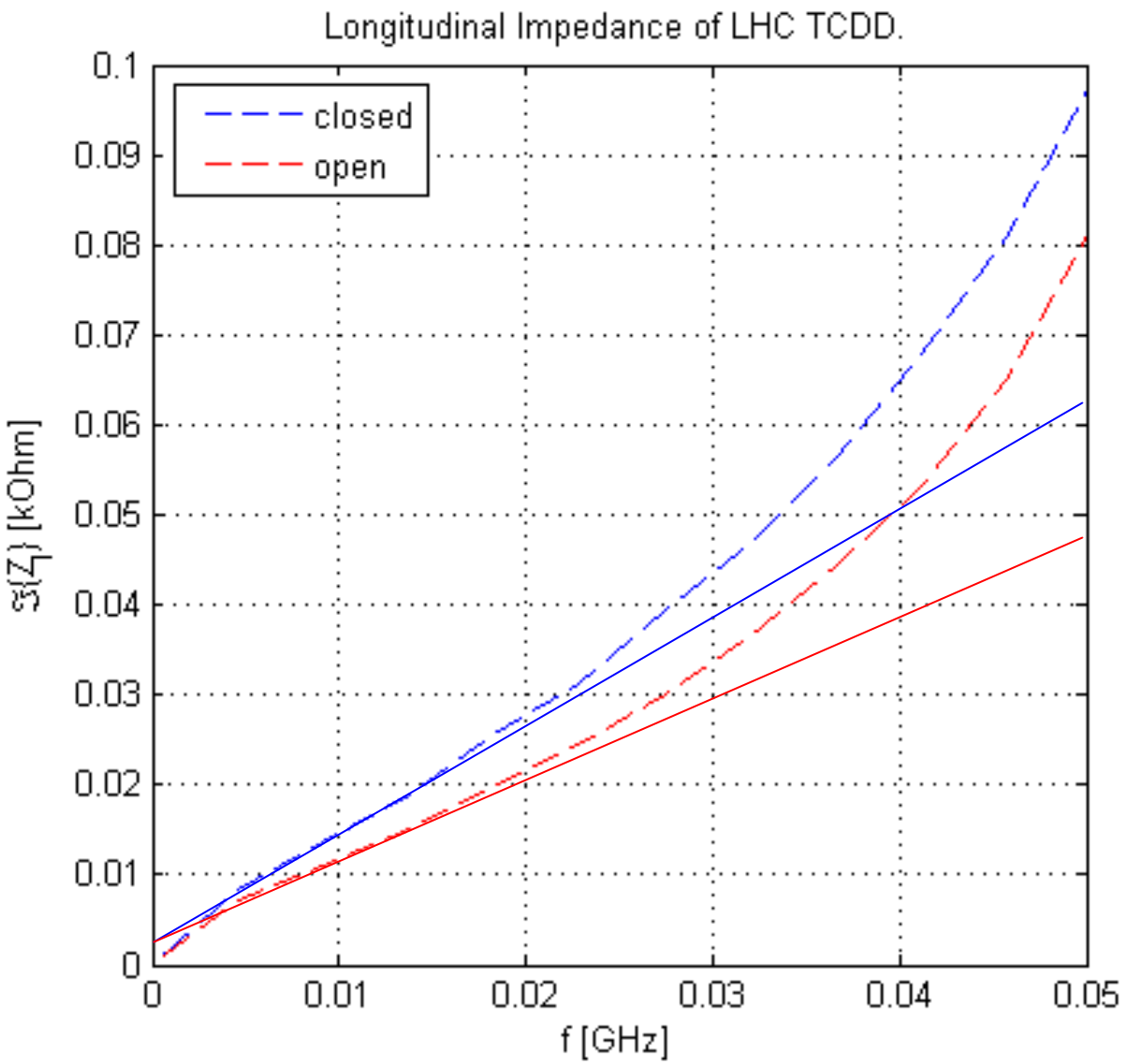
open



Longitudinal Impedance from GdfidL



Longitudinal Impedance from GdfidL



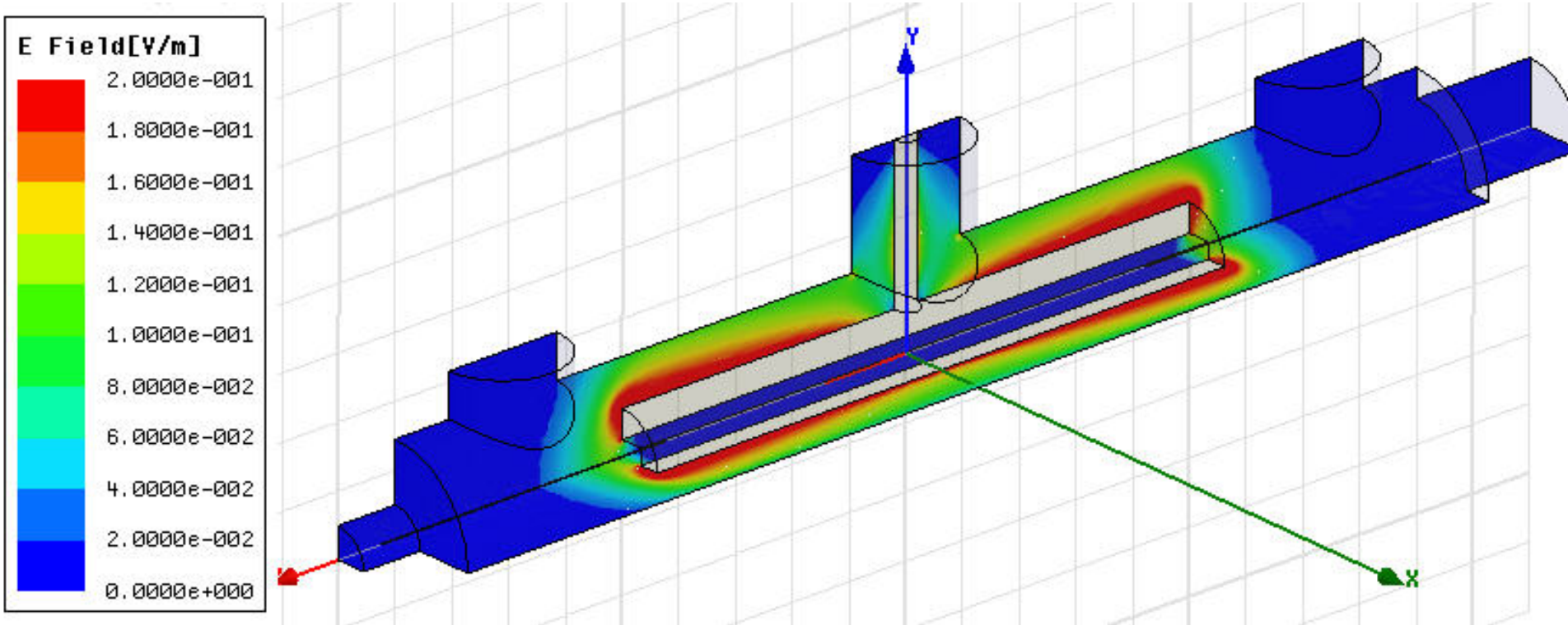
Z/n = 13.5 mΩ

Z/n = 10.1 mΩ

LHC total broad band longitudinal impedance ~ 70 mΩ

Longitudinal impedance from HFSS

Mode#1

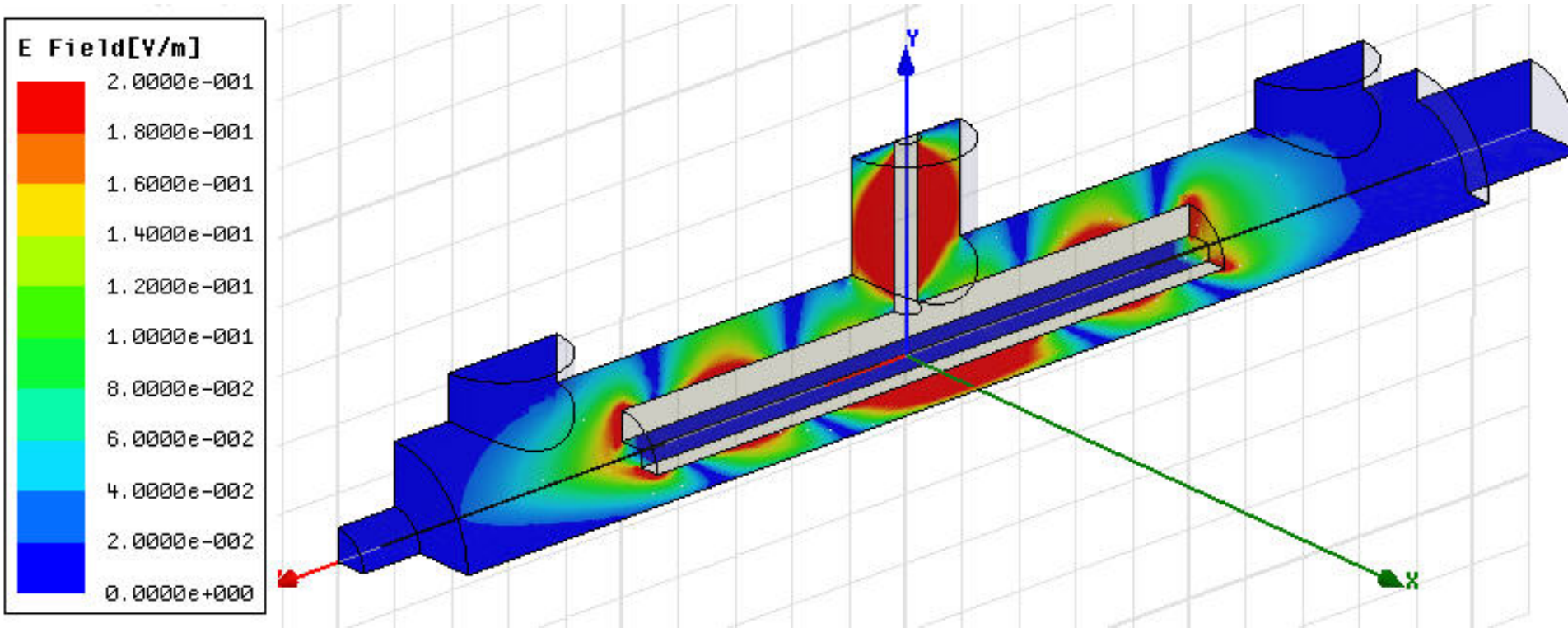


f = 78.5 MHz, Q=6320, r_l/Q = 157.5 LinacΩ, k_l = 19.4 V/nC

For LHC beam: 80mm x 16nC x 40 MHz and assuming f = 80 MHz: P_{loss} ~ 400 kW

Longitudinal impedance from HFSS

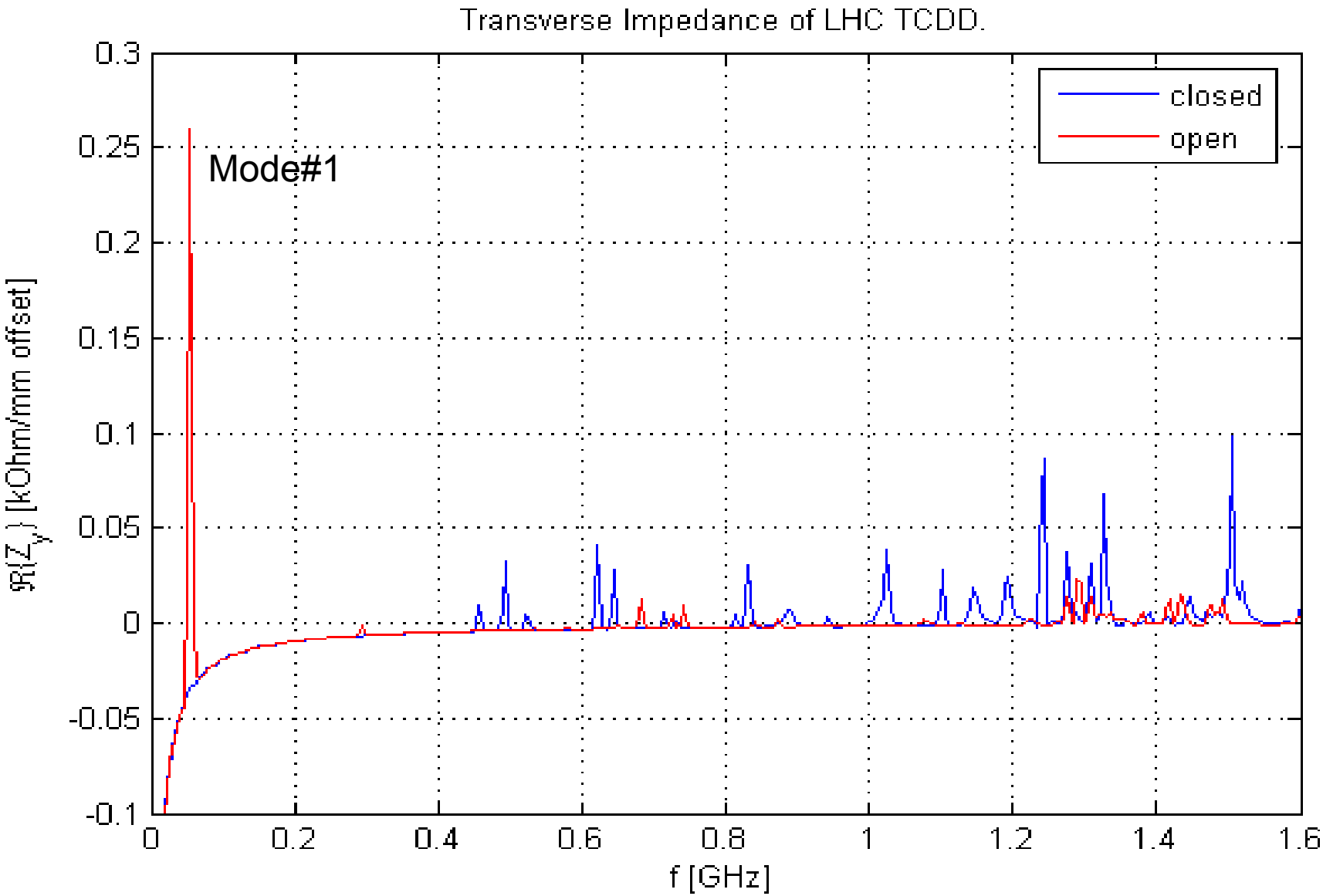
Mode#2



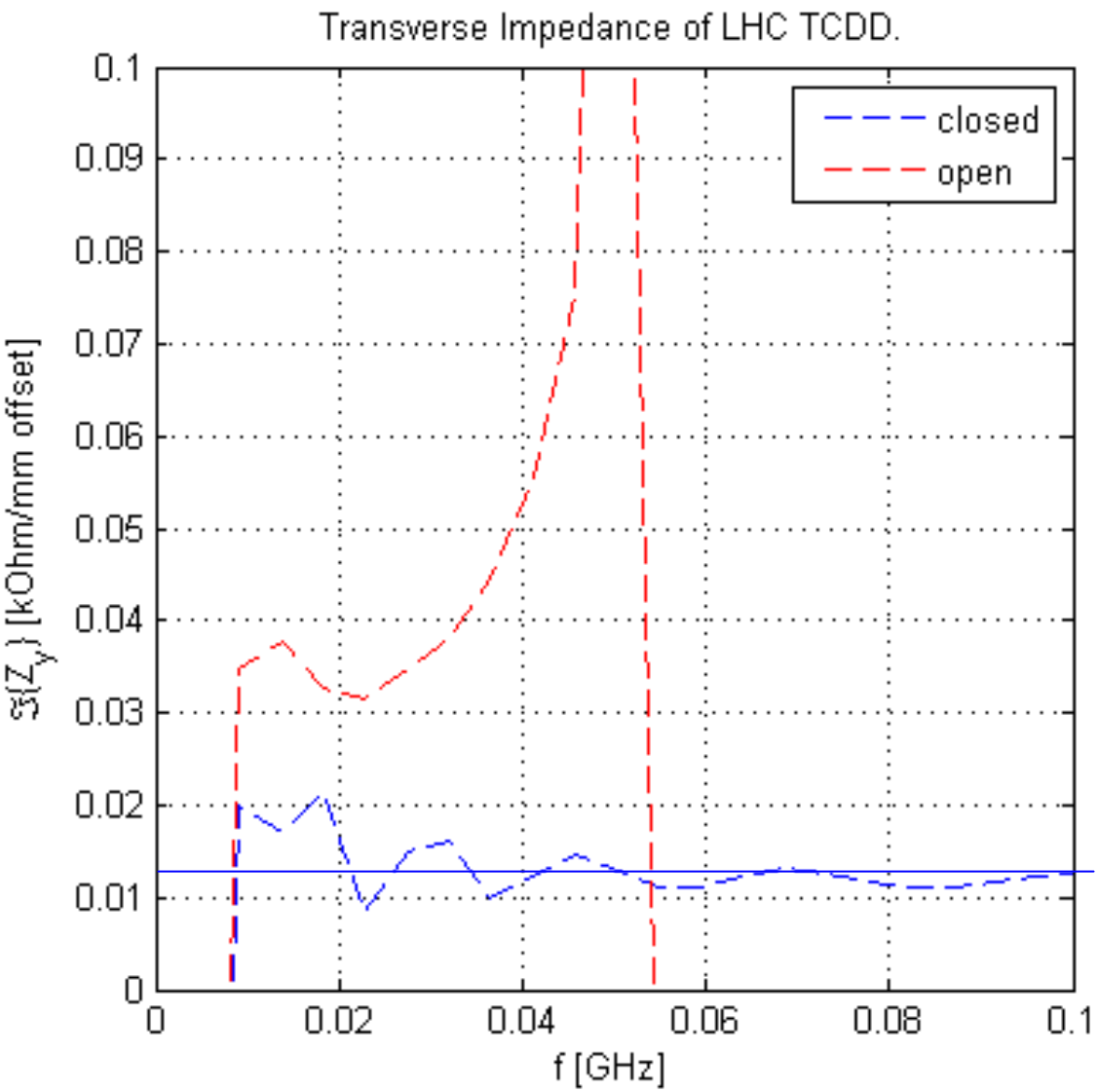
f = 648 MHz, Q=18400, r_l/Q = 21 LinacΩ, k_l = 21.6 V/nC

For LHC beam: 80mm x 16nC x 40 MHz and assuming f = 680 MHz: P_{loss} ~ 44 kW

Transverse Impedance from GdfidL



Transverse Impedance from GdfidL

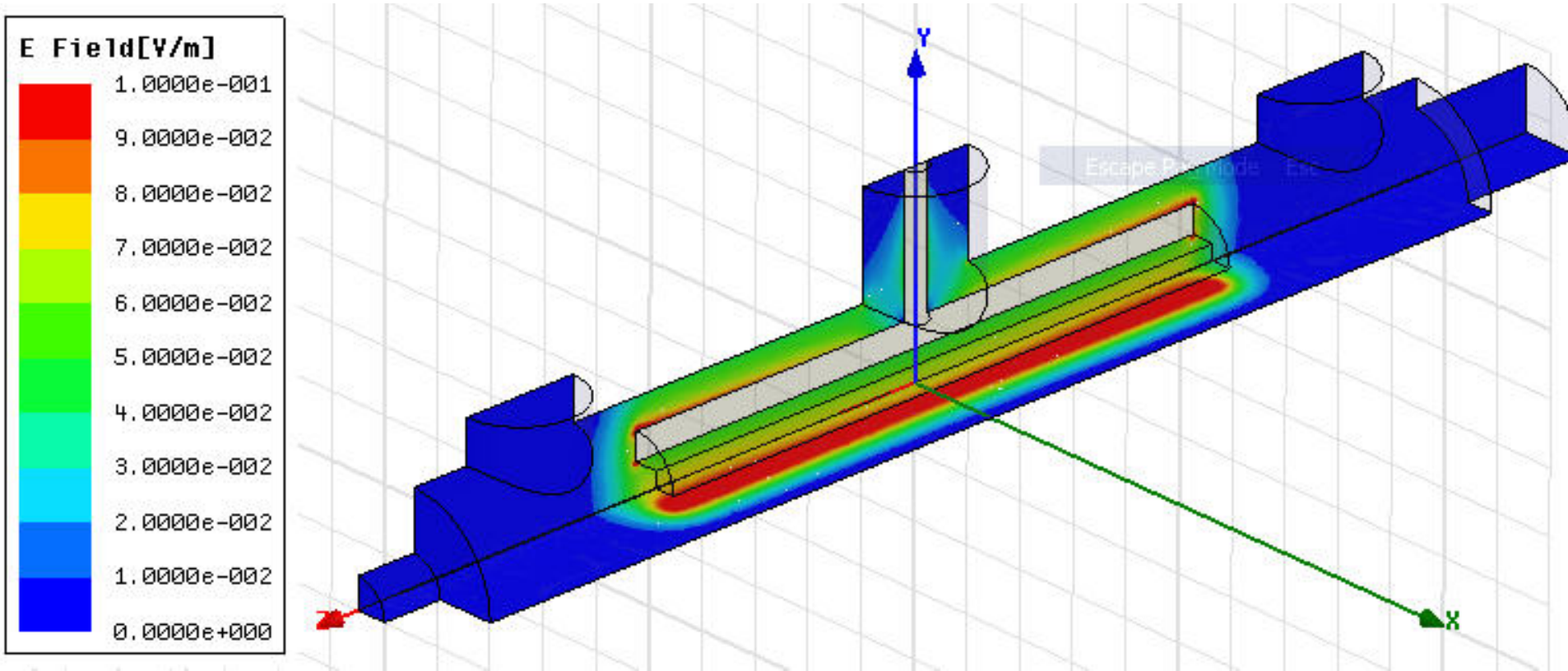


LHC total broad band transverse impedance ~ 2000 kΩ/m

Z_y = 12 kΩ/m

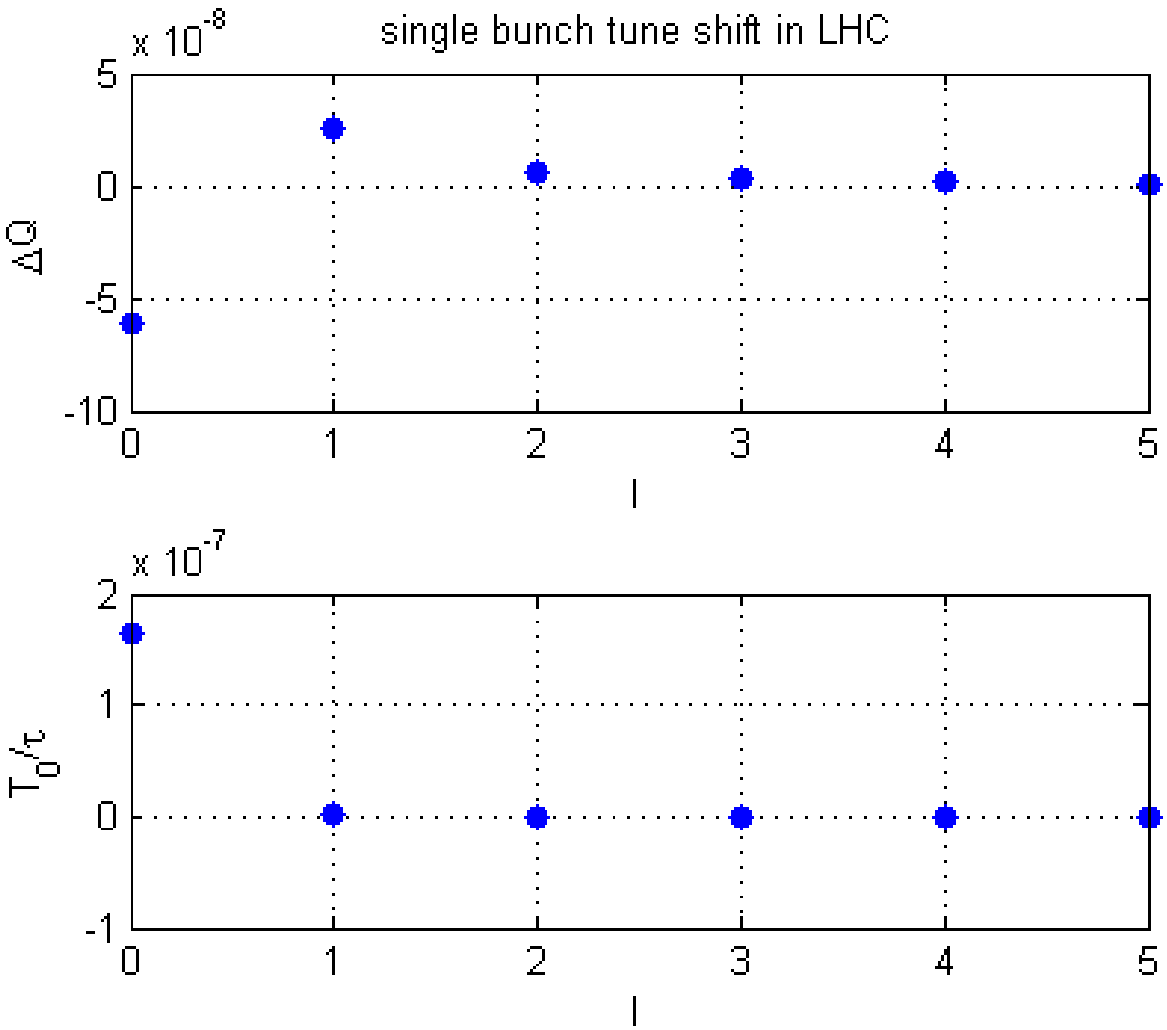
Transverse impedance from HFSS

Mode#1



f = 54.8 MHz, Q=4870, r_t/Q = 20200 LinacΩ/m, k_t = 1800 V/nC/m, R_t = 49.2 MΩ/m

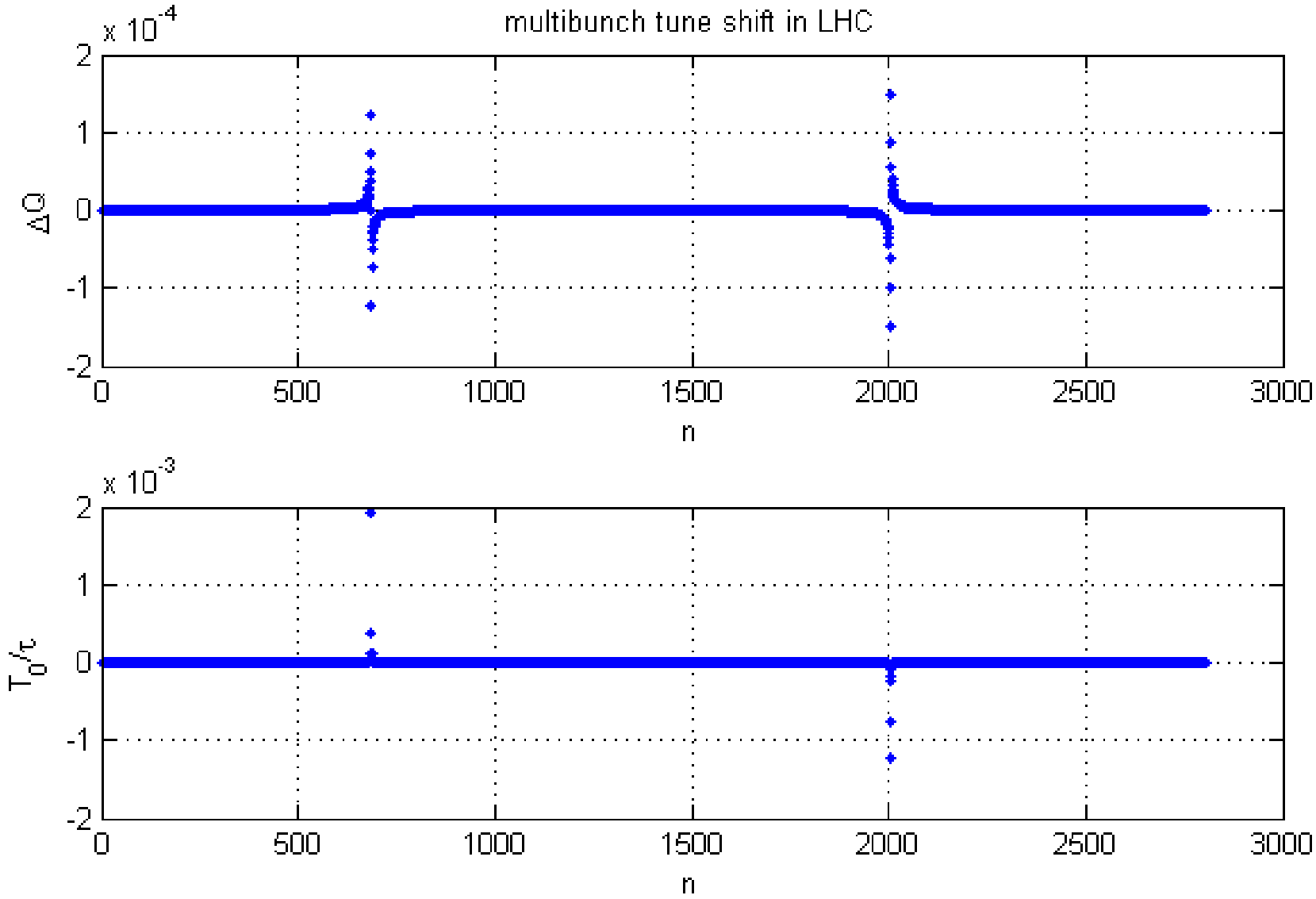
Vertical tune shift



LHC injection pars:

E=450 GeV
σ_z = 115 mm
N = 10^{11}
f_0 = 11.2455 kHz
Q_y = 59.31
ξ = 0

Vertical tune shift



Recommendations

- To avoid transverse mode#1 rf contact between upper and lower parts of the absorber is necessary
- To avoid longitudinal mode#1 rf contact between beam pipe aperture and absorber aperture is necessary on each side
- To reduce broad band impedance smooth (~15^{o}) transition from beam pipe aperture (round) to absorber aperture (rectangular) is necessary on each side