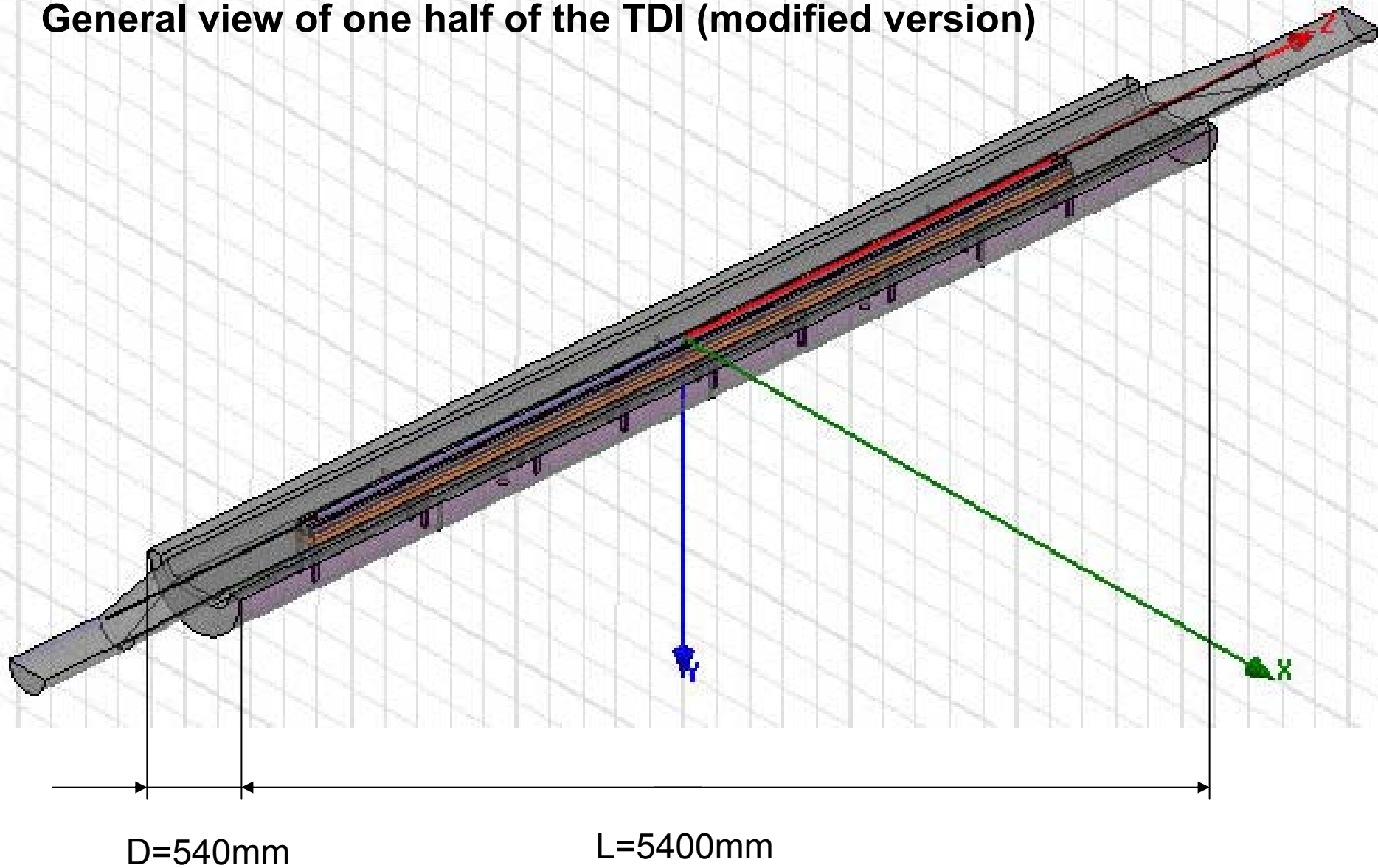


Transverse impedance of TDI

A. Grudiev
RLC meeting
13.01.2006

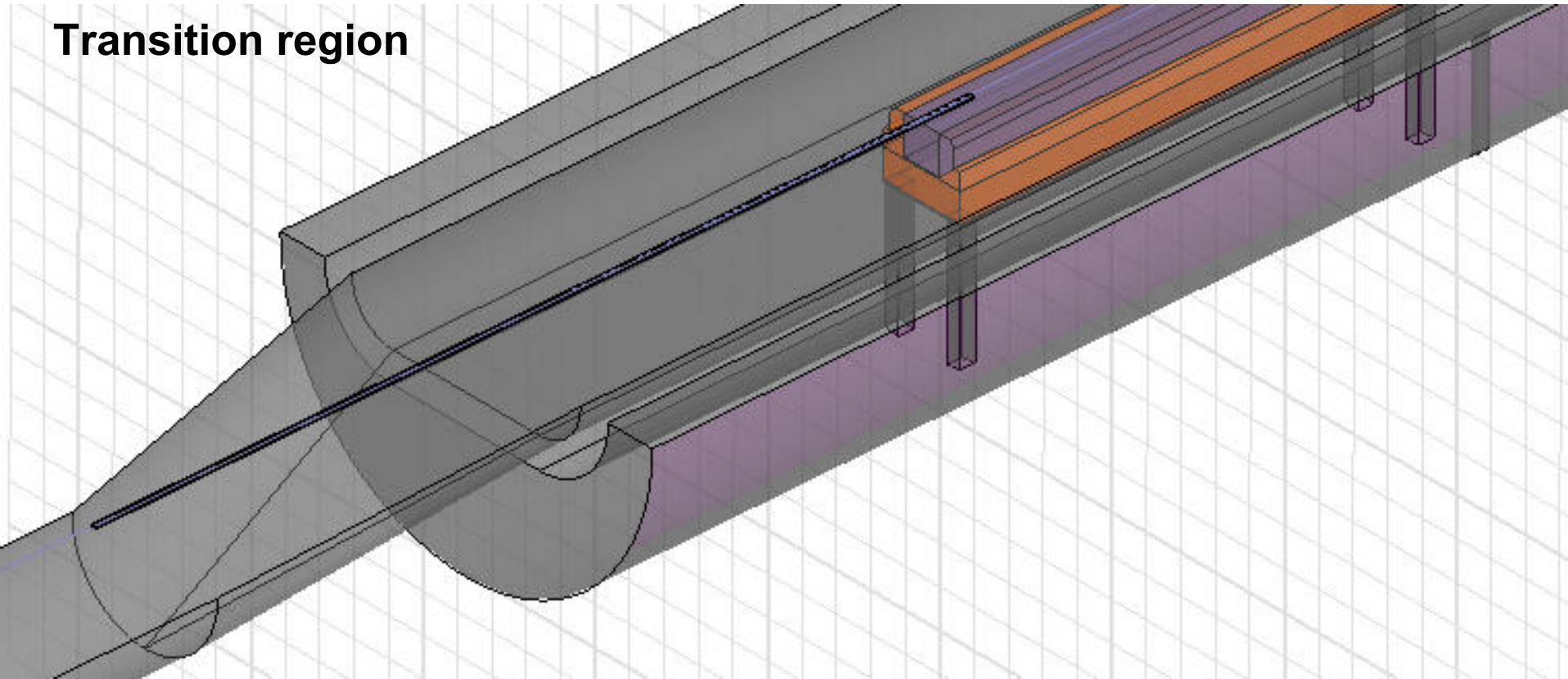
TDI geometry

General view of one half of the TDI (modified version)



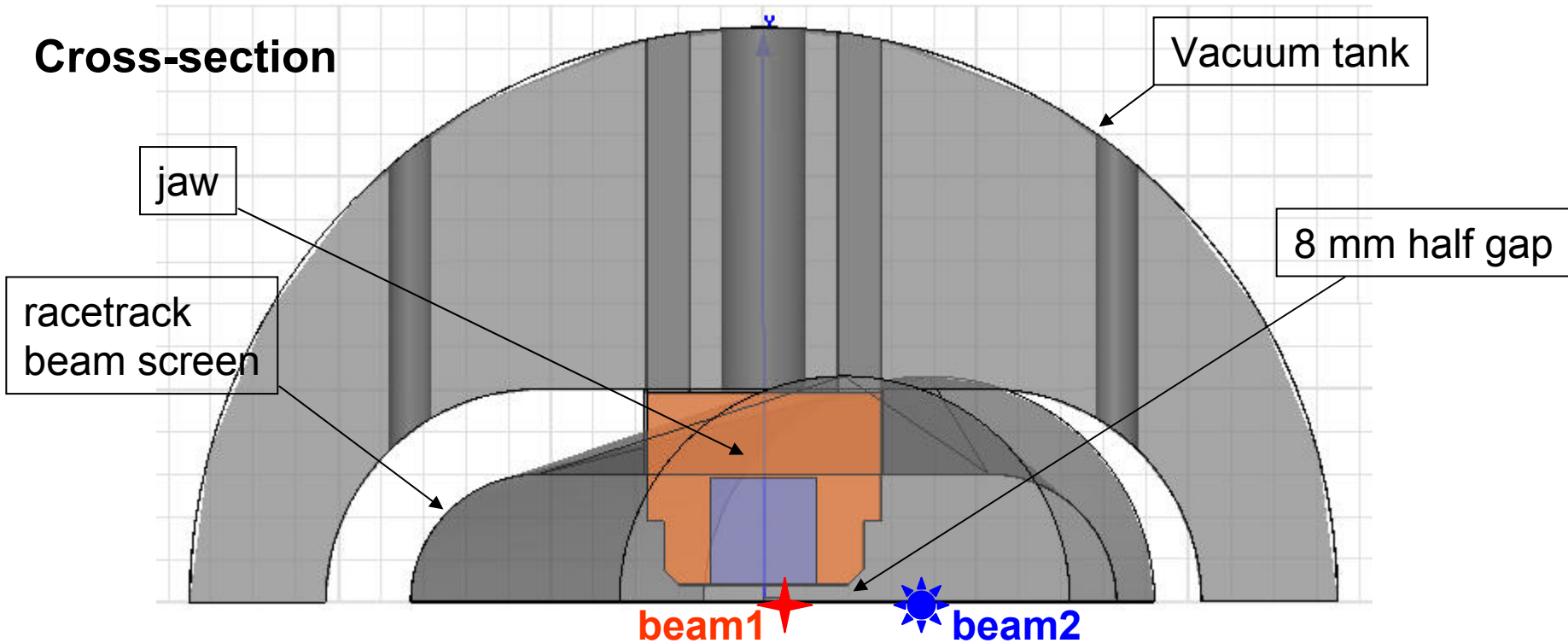
TDI geometry

Transition region

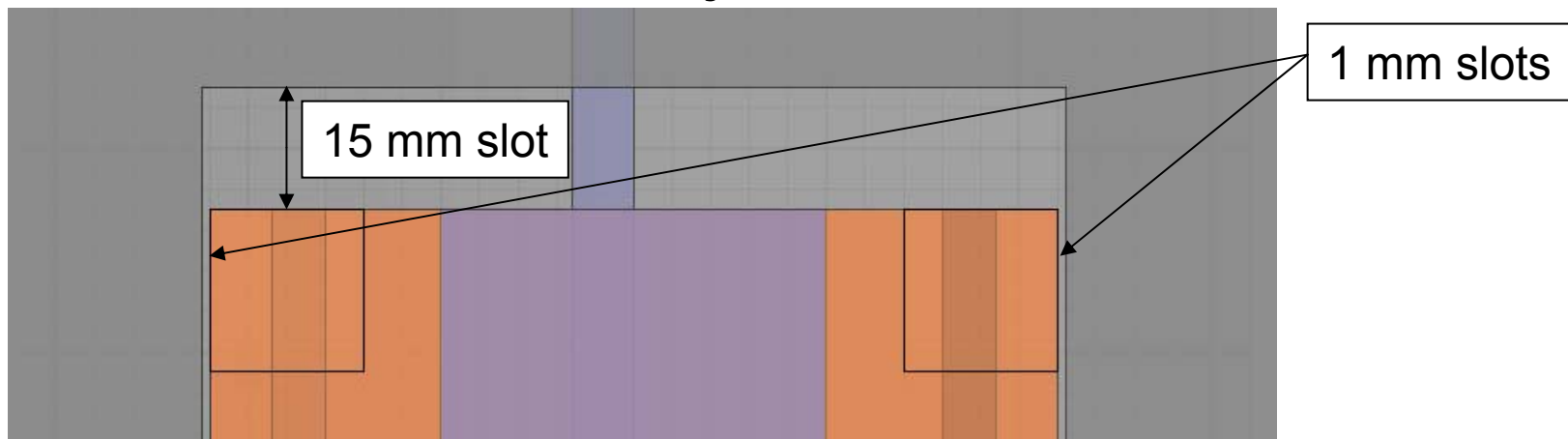


TDI geometry

Cross-section

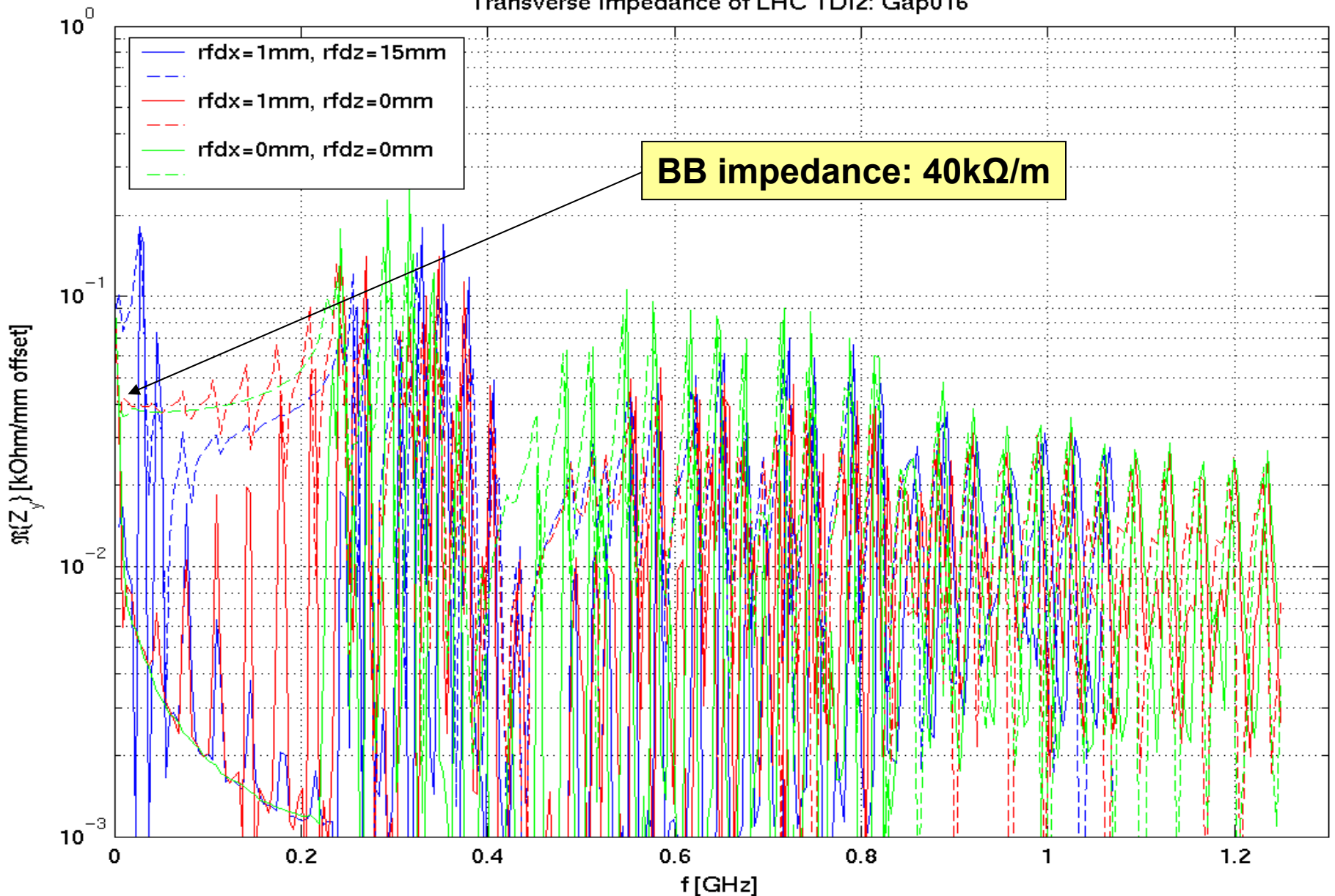


Top view of the slots between the jaw ends and the beam screen



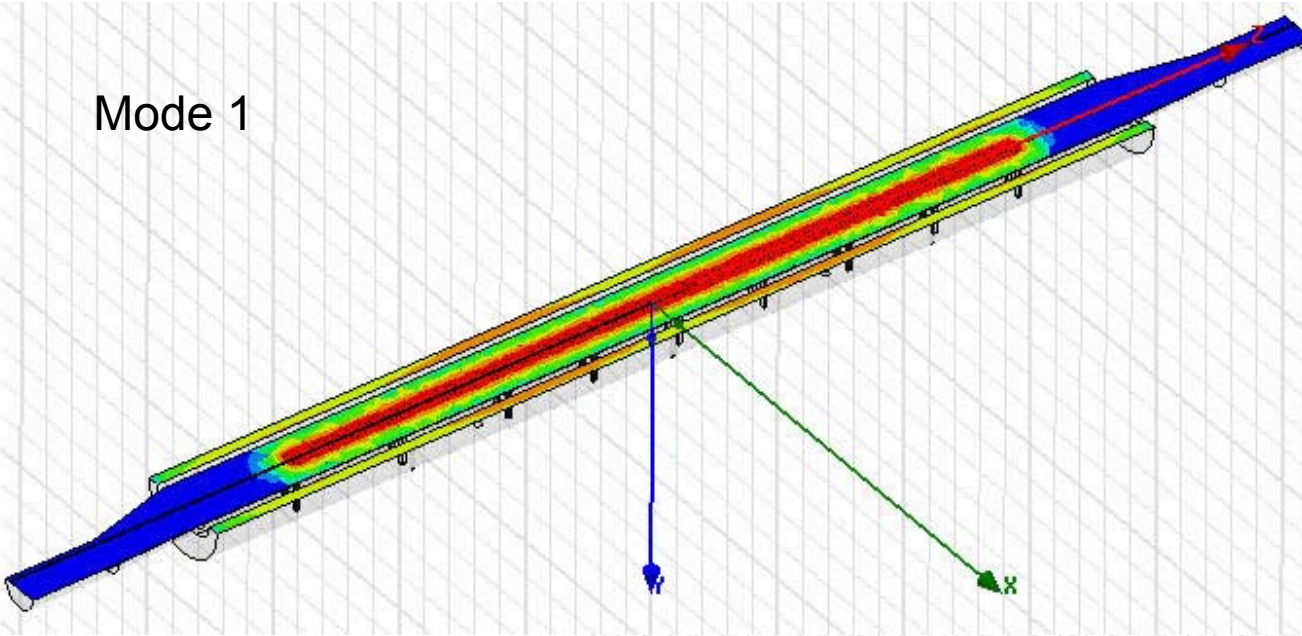
Transverse Impedance from GdfidL

Transverse Impedance of LHC TDI2: Gap016



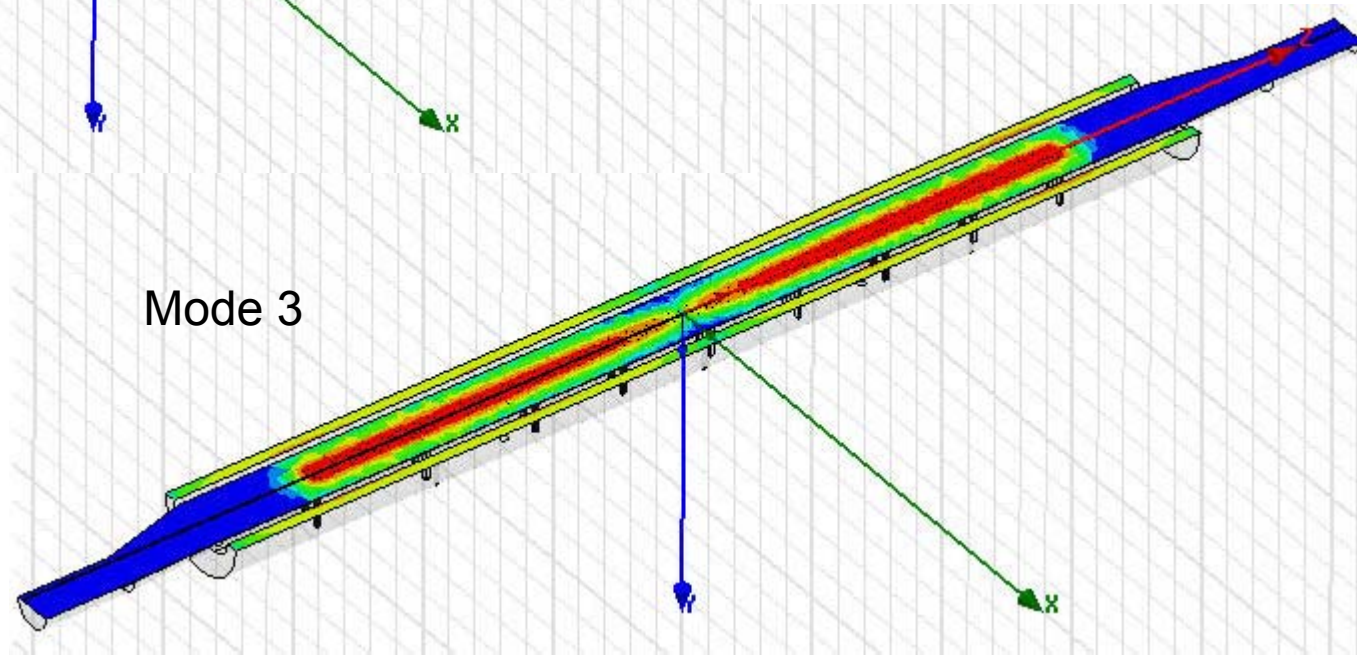
Dipole modes with open jaw ends (15 mm slot)

Mode 1



An example of electric field distribution in the ZX-plane for two modes

Mode 3



Dipole modes with open jaw ends (15 mm slot)

n	f [MHz]	Q	R_t [k Ω /m]
1	19.8	310	25100
2	29.5	510	30600
3	41.1	46	200
4	46.5	59	680
5	73.4	49	10
6	76.4	52	55
7	105.6	56	1.4

LHC injection pars:

$E = 450$ GeV

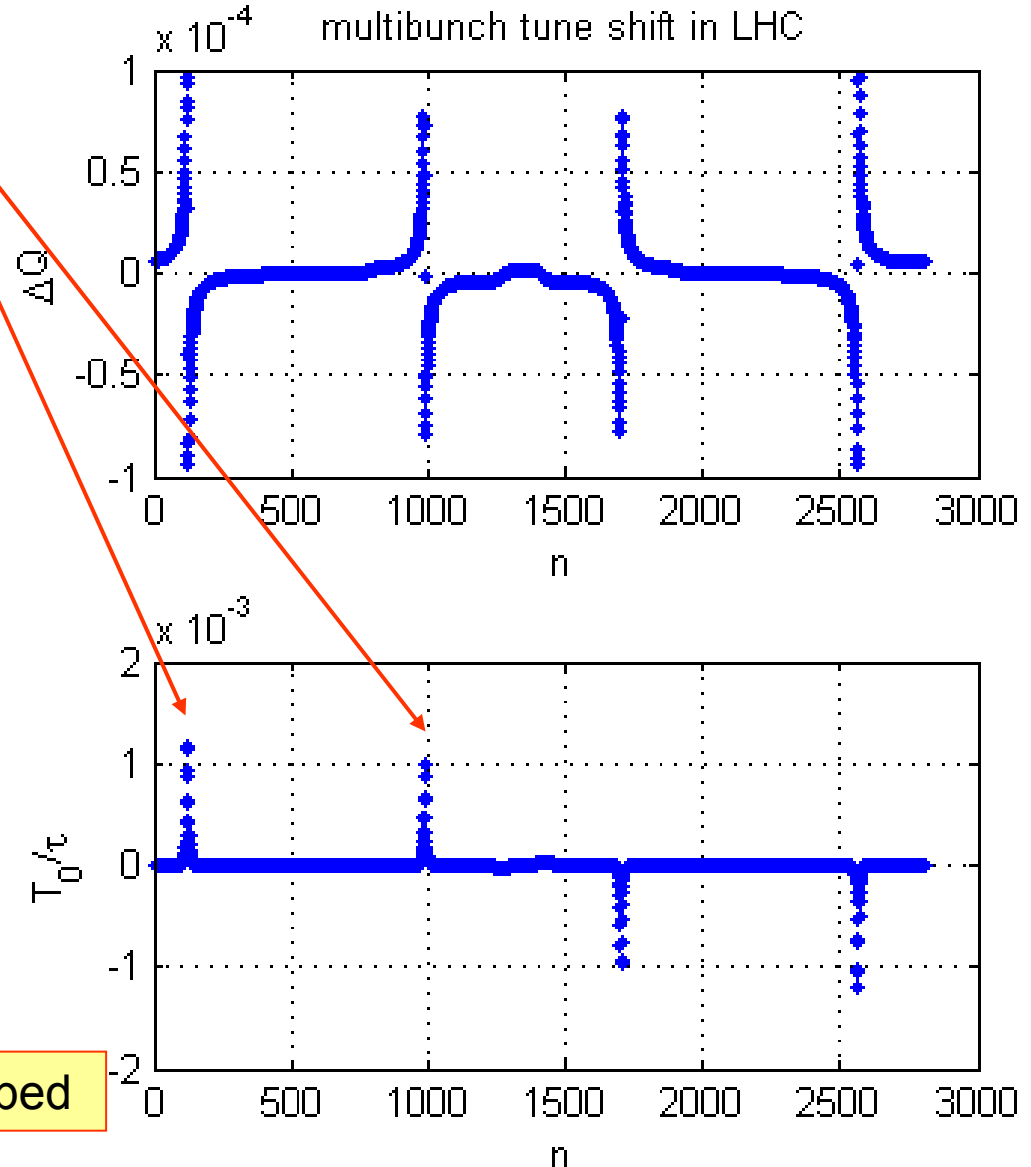
$\sigma_z = 115$ mm

$N = 10^{11}$

$f_0 = 11.2455$ kHz

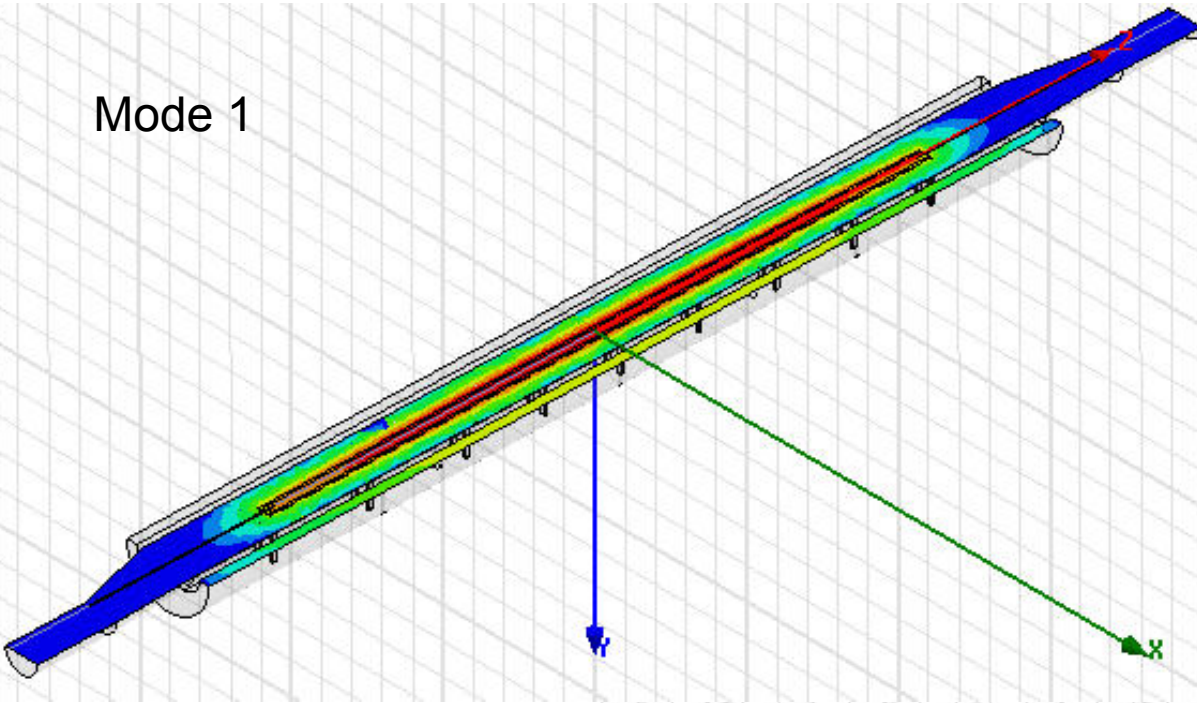
$Q_y = 59.31$

Modes 1 and 2 are not Landau-damped



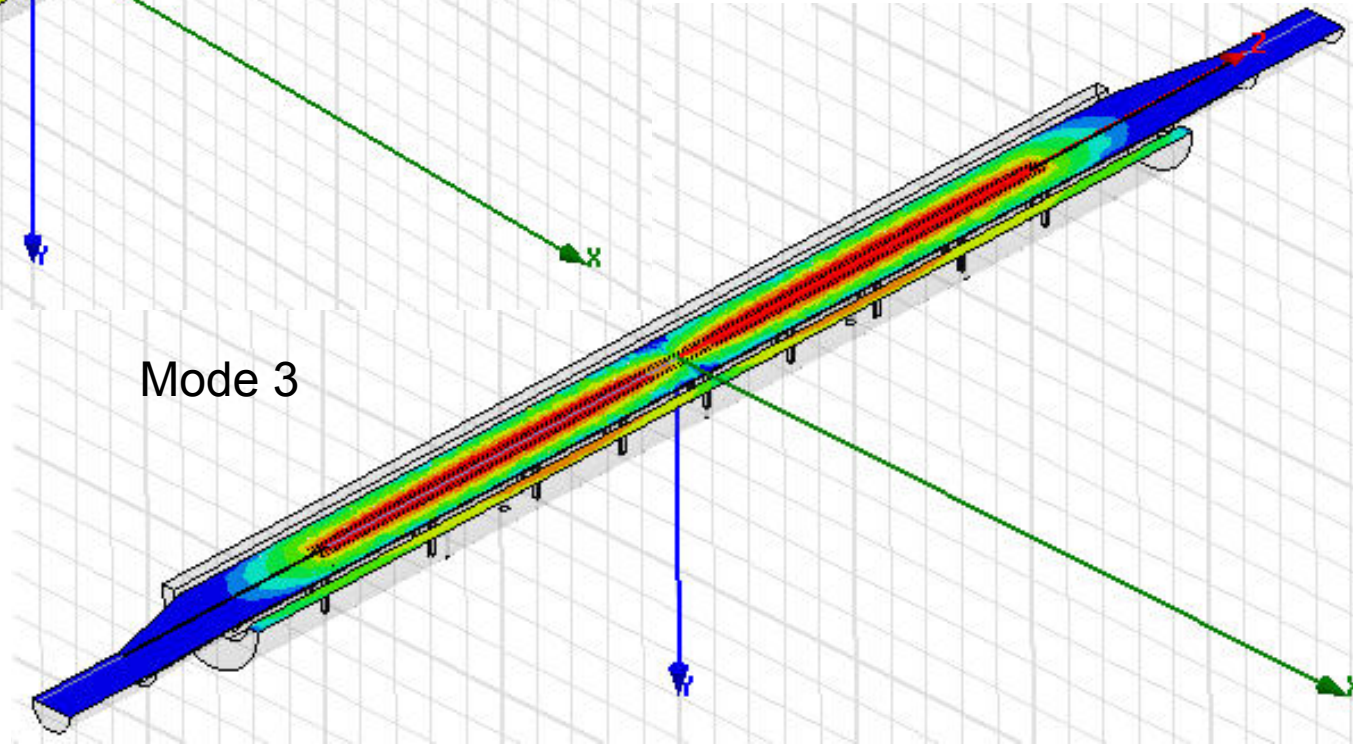
Dipole modes with closed jaw ends (no 15 mm slot)

Mode 1



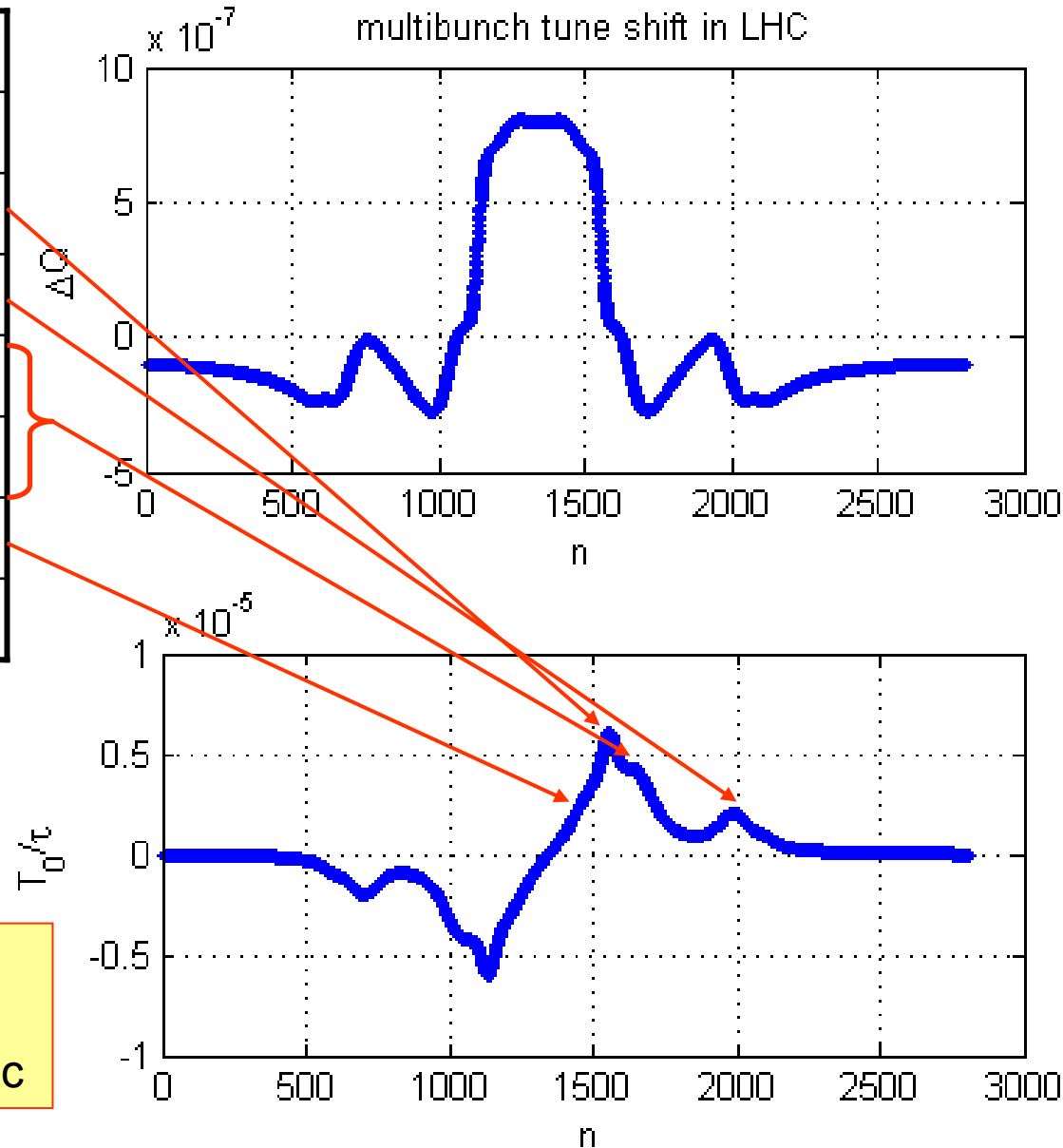
An example of electric field distribution in the ZX-plane for two modes

Mode 3



Dipole modes with closed jaw ends (no 15 mm slot)

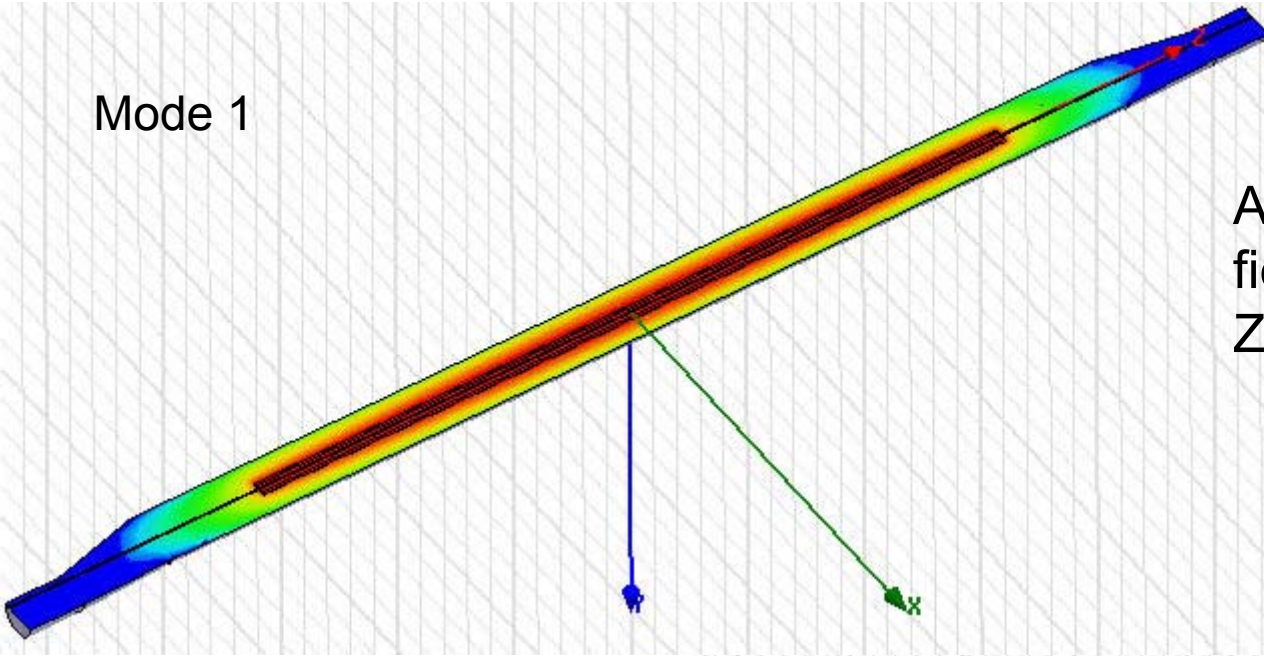
n	f [MHz]	Q	R _t [kΩ/m]
1	38.9	40	8
2	45	55	95
3	71.7	46	46
4	75.6	50	35
5	107	55	51
6	109	56	53
7	233	82	0.6



All modes are Landau-damped if the rf mode frequency separation is not a bunch frequency harmonic

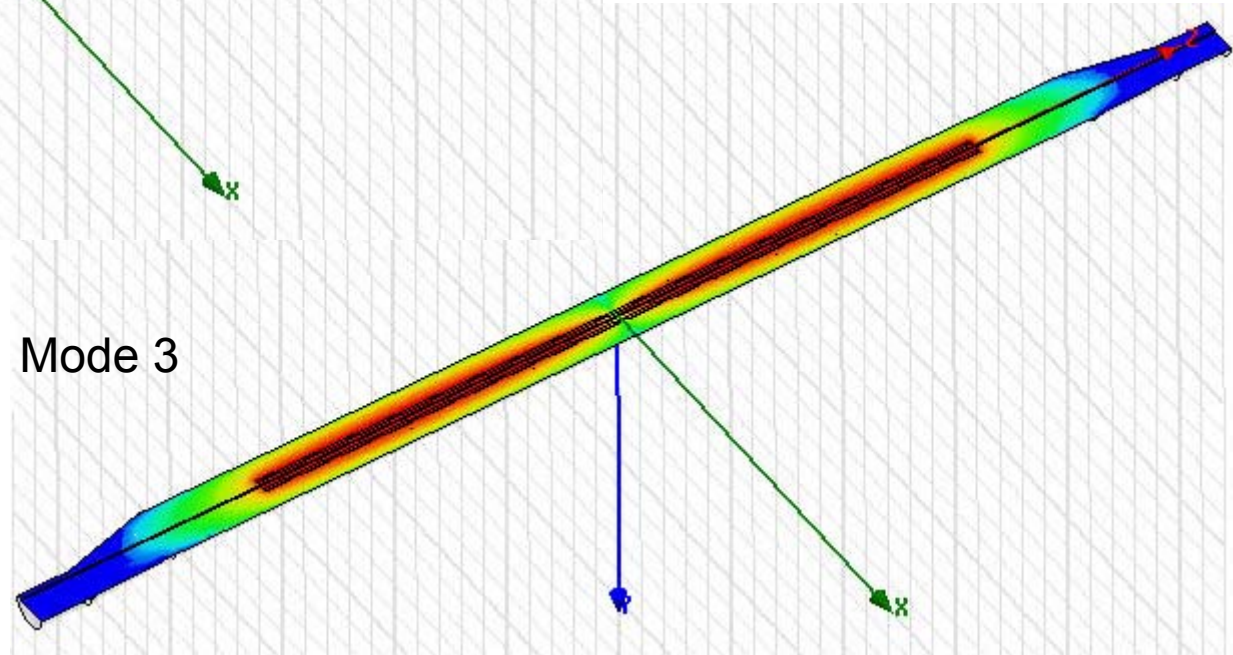
Dipole modes with closed jaw ends and sides (no slots)

Mode 1



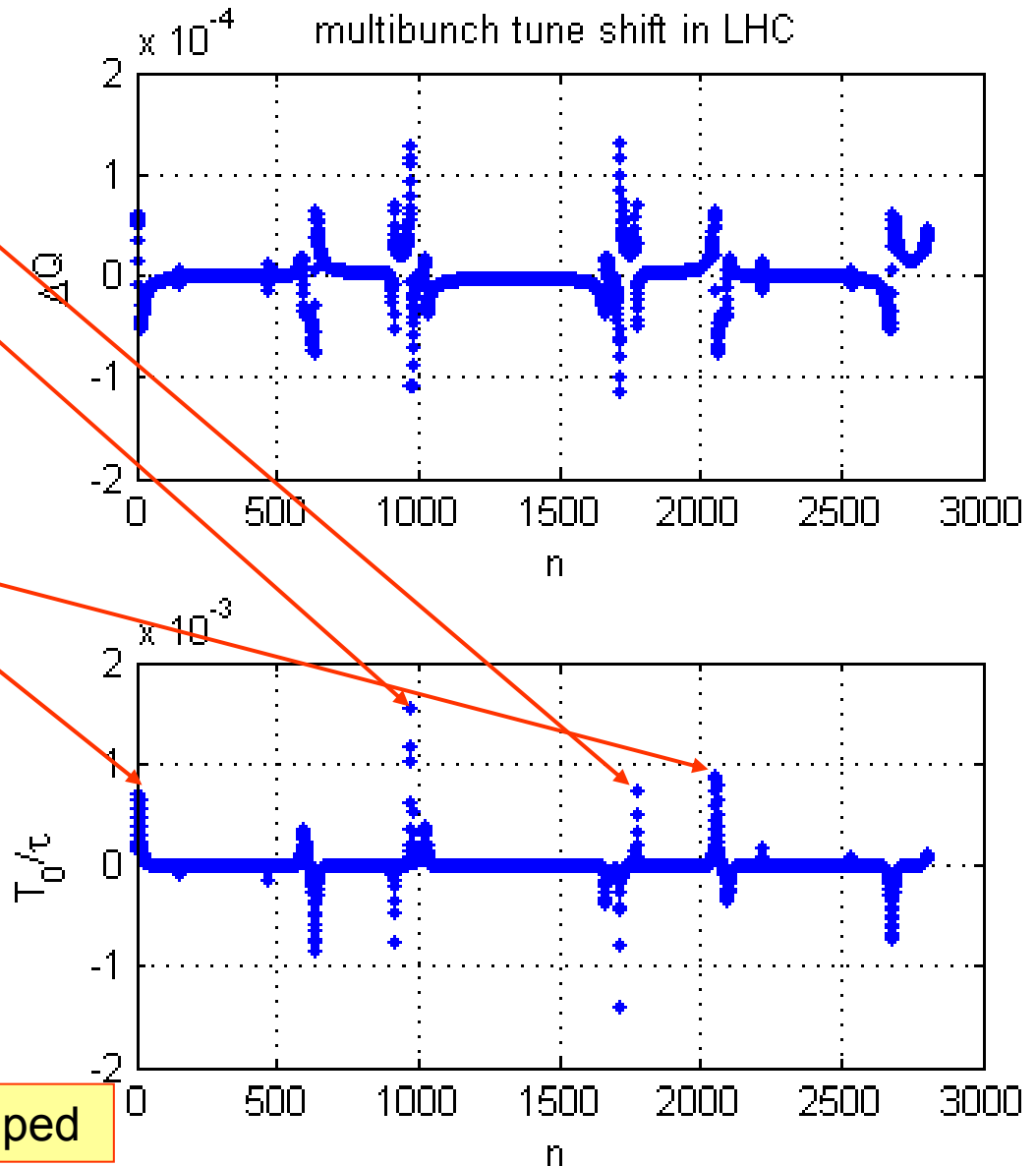
An example of electric field distribution in the ZX-plane for two modes

Mode 3



Dipole modes with closed jaw ends and sides (no slots)

n	f [MHz]	Q	R_t [k Ω /m]
1	227	12100	4900
2	232	9660	19500
3	241	7020	39300
4	255	5160	2350
5	272	4040	9400
6	292	3370	22300
7	315	2970	18300
8	340	2720	8900
9	367	2570	2700
10	395	2480	200



Several modes are not Landau-damped

Conclusions and recommendations

- Rf contacts between the ends of the jaws and the beam screen is necessary also for transverse impedance reduction (they were introduced already for longitudinal impedance reduction)
- Slots between side walls of the jaws and the beam screen reduce the impedance of dipole modes significantly
- No additional damping is necessary for gap of 16 mm (value from EM presentation on RLC meeting 11.06.2004) **BUT see next slide**

Conclusions and recommendations (cont.)

- The gap is 8 mm according to the last table provided by Collimation Working Group
- In this case, and given the uncertainty in impedance of higher frequency modes **additional damping is necessary** to keep trapped mode impedance below Landau damping limit
- BB impedance scaled from 40 k Ω /m for 16 mm gap to ~320 k Ω /m for 8 mm becomes significant part (16%) of LHC BB transverse impedance budget (2000 k Ω /m)
- Tapering the jaw ends is necessary to reduce BB impedance