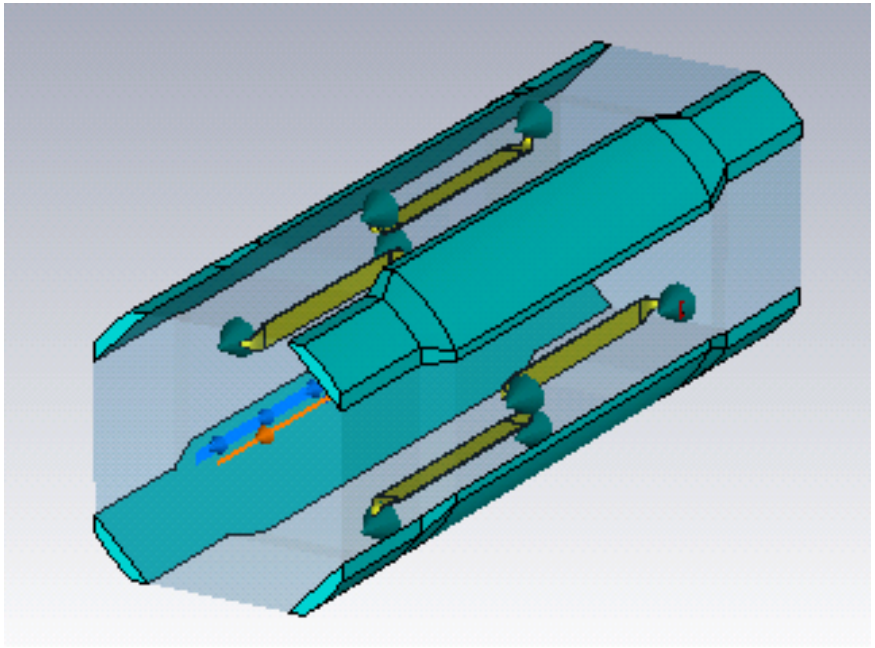
Update on the impedance of stripline BPMs in the HL-LHC triplet region

N. Biancacci, R. De Maria, B.Salvant

Acknowledgement: T.Lefevre, D.Draskovic

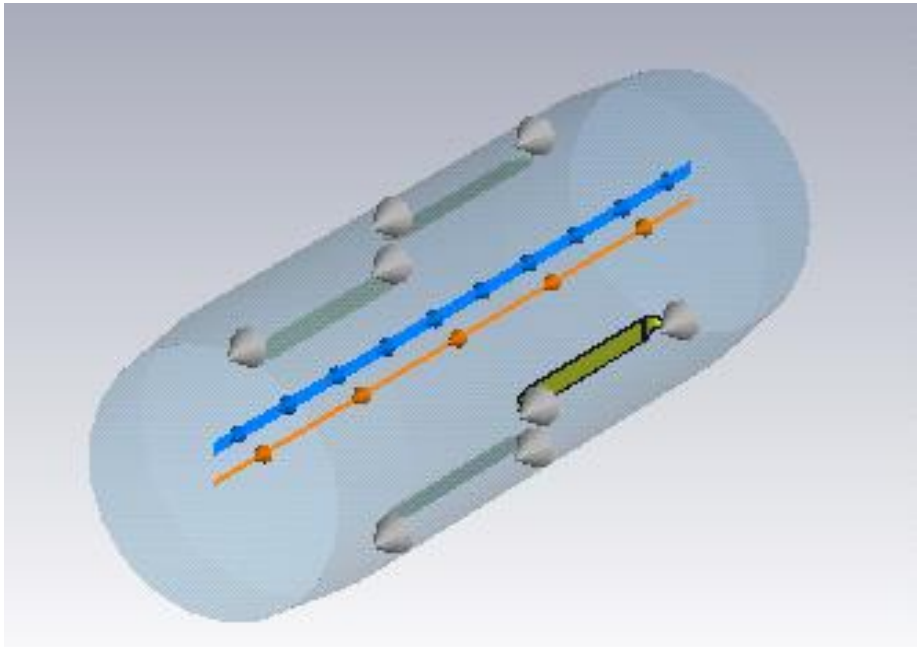
Studied models

Octagonal- with tungsten



Strip to strip = 112mm

Circular – no tungsten

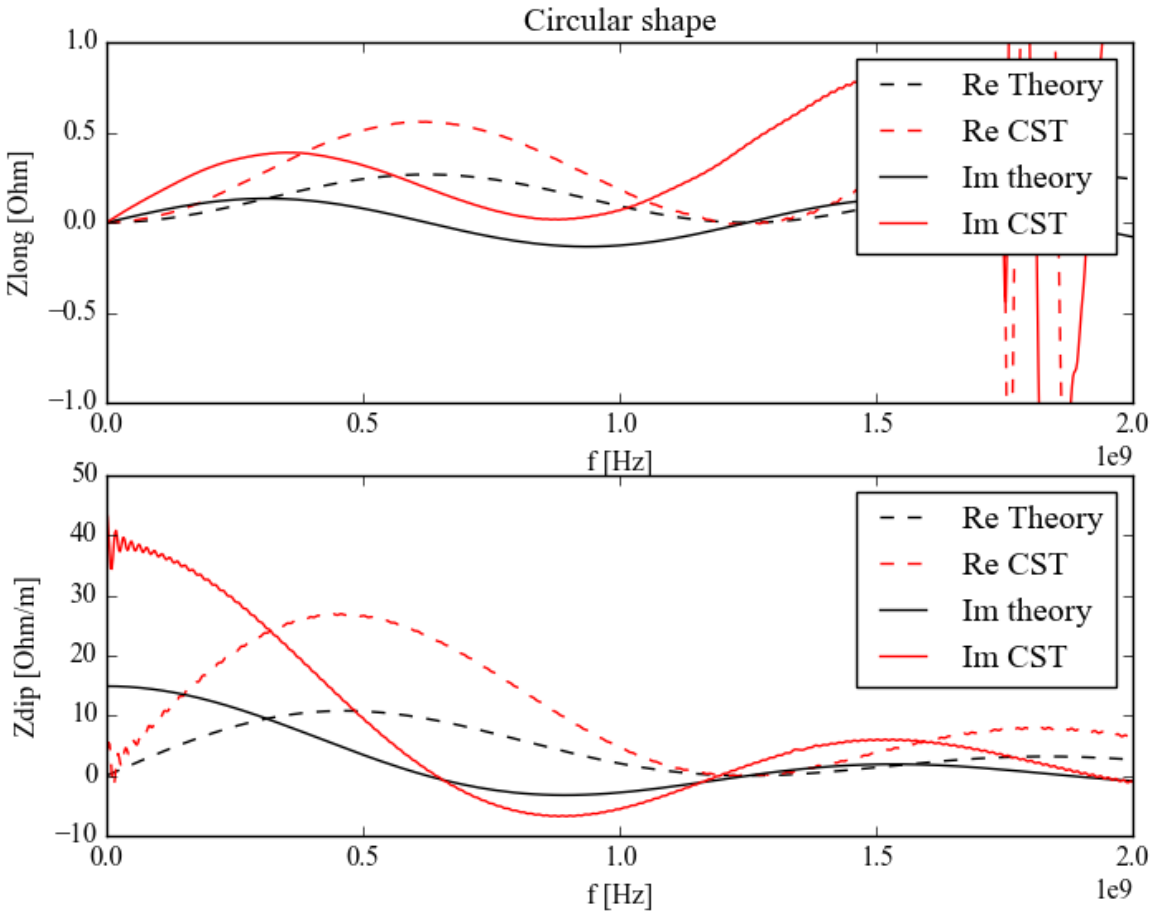


Strip to strip = 123mm

PS: No inermet anymore.

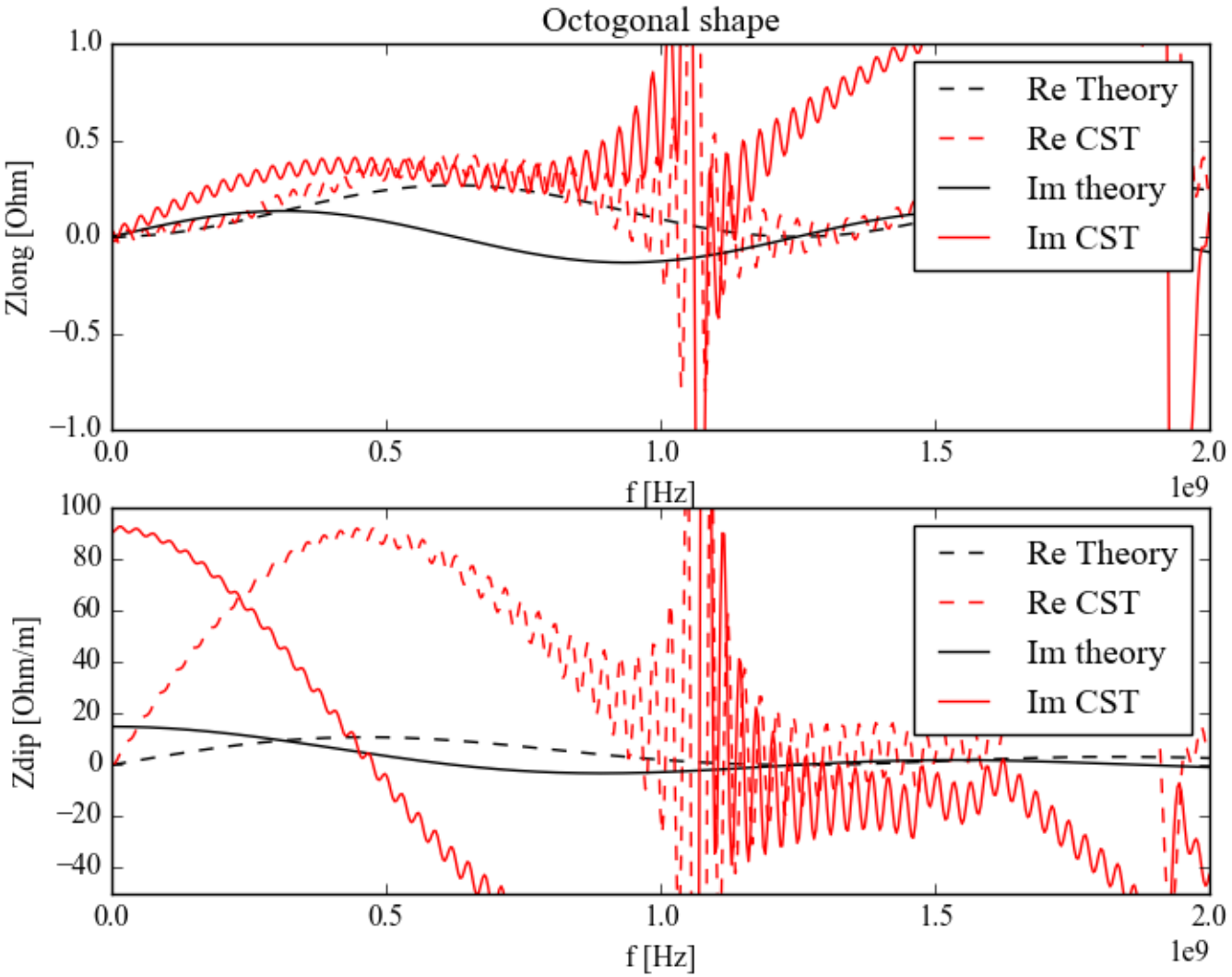
Simulations: circular shape

Discrepancy between theory and simulation….
Still investigating it.

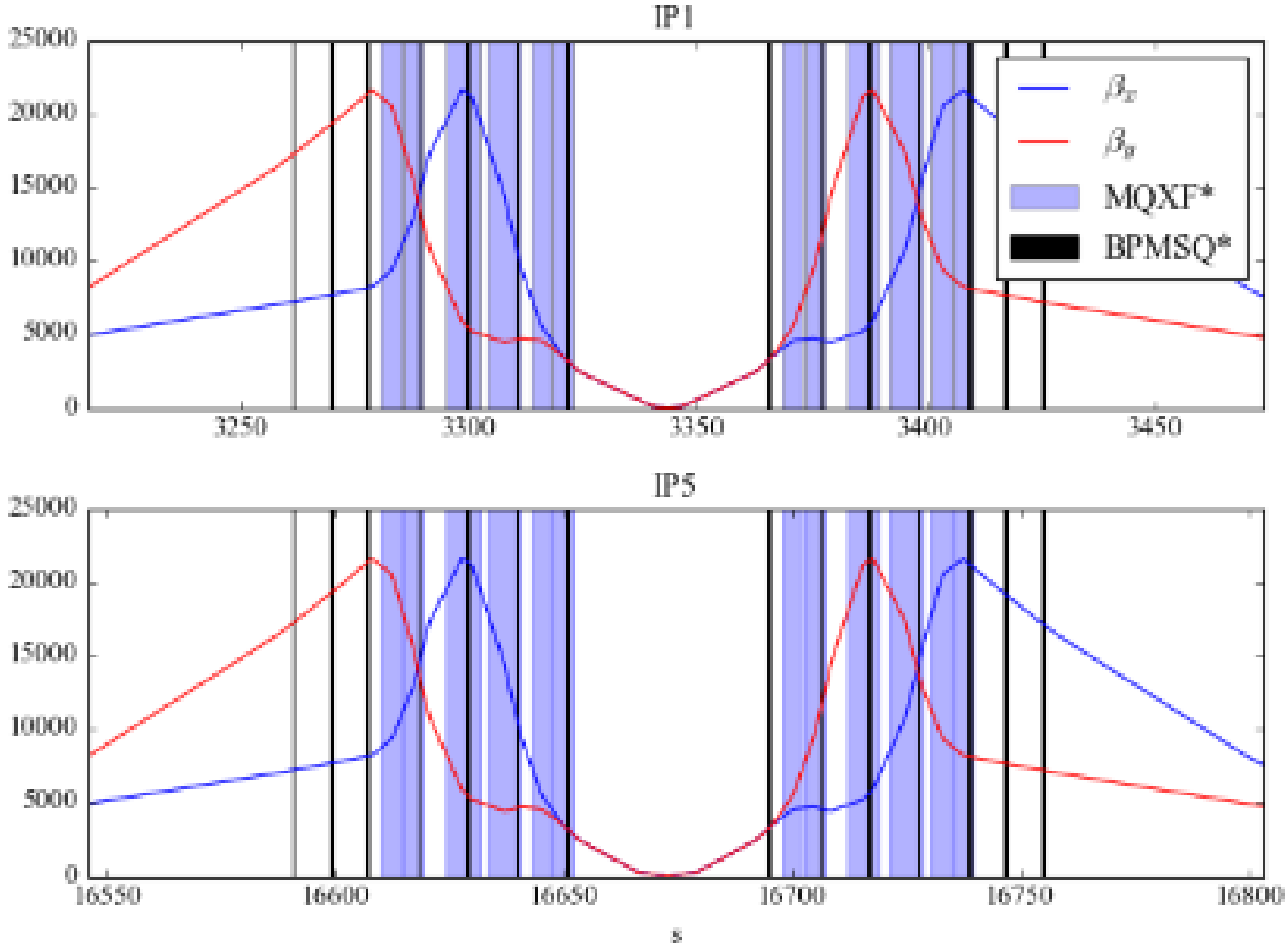


Simulations: octogonal shape

Discrepancy between theory and simulation….
Still investigating it.

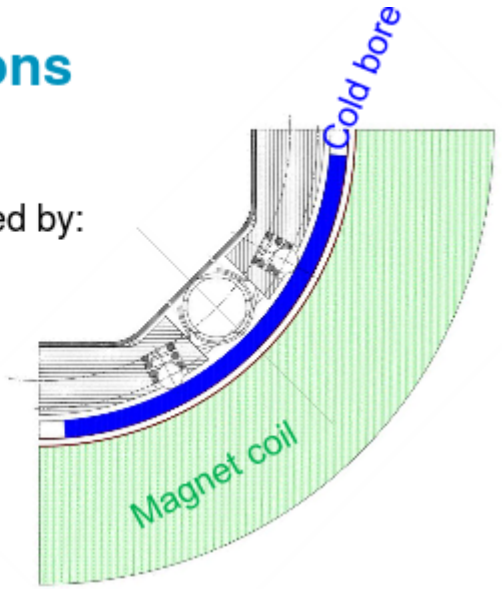


BPMSQ optics at 15cm beta*



Beam screen dimensions

Nominal dimensions



Nominal values of the beam screen aperture are defined by:

Cold Bore:

1. The coil inner radius at 1.9 K is 74.350 mm [P. Ferracin]
   a. The insulated cable inner radius position at room temperature, with no stress, is 75 mm.
   b. The deformation due to pre-load and cool-down is 0.400 mm
   c. Quench heaters and insulation: 0.1 mm + 0.15 mm
2. Gap coil/insulated cold bore at 1.9 K:1.5 mm [R. Van Weelderen]
3. Cold bore insulation: 0.2 mm [P. Ferracin]
4. Tolerance on the cold bore outer diameter (thickness): 0/+0.5 mm

→ Nominal cold bore outer radius at 1.9 K: 72.15 mm
→ Nominal cold bore outer radius at room temperature: 72.35 mm

→ Nominal cold bore inner radius (**thickness 4 mm for Q1 to D1**) at room temperature: 68.35 mm

Beam screen:

1. Gap w.r.t cold bore: 1.5 mm
2. Shielding thickness Q1: 16mm , Q2-D1: 6 mm
3. Beam screen wall thickness: 1 mm

→

	Nominal aperture H(V);+/-45 °
Q1	99.7; 99.7
Q2-D1	119.7; 110.7

C.Garion, 7th HL-LHC TCC
http://indico.cern.ch/event/515629/contributions/2145081/

All BPMS

	s from IP [m]	β_x [m]	β_y [m]	d [mm]	b [mm]
BPMSQ.4L1.B1	-82.0	7221.0	17233.0	123.0	65.5
BPMSQ.B3L1.B1	-74.0	7694.0	19296.0	123.0	65.5
BPMSQT.A3L1.B1	-66.0	8150.0	21327.0	123.0	65.5
BPMSQT.B2L1.B1	-55.0	14113.0	14111.0	123.0	65.5
BPMSQT.A2L1.B1	-44.0	21430.0	5553.0	123.0	65.5
BPMSQ.1L1.B1	-33.0	10870.0	4654.0	123.0	65.5
BPMSQW.1L1.B1	-22.0	3213.0	3213.0	112.0	65.5
BPMSQW.1R1.B1	22.0	3284.0	3284.0	112.0	65.5
BPMSQ.1R1.B1	33.0	4635.0	11185.0	123.0	65.5
BPMSQT.A2R1.B1	44.0	5630.0	21483.0	123.0	65.5
BPMSQT.B2R1.B1	55.0	14439.0	13829.0	123.0	65.5
BPMSQT.A3R1.B1	66.0	21263.0	8135.0	123.0	65.5
BPMSQ.B3R1.B1	74.0	19234.0	7680.0	123.0	65.5
BPMSQ.4R1.B1	82.0	17175.0	7208.0	123.0	65.5

	s from IP [m]	β_x [m]	β_y [m]	d [mm]	b [mm]
BPMSQ.4L5.B1	-82.0	7221.0	17233.0	123.0	65.5
BPMSQ.B3L5.B1	-74.0	7694.0	19296.0	123.0	65.5
BPMSQT.A3L5.B1	-66.0	8150.0	21327.0	123.0	65.5
BPMSQT.B2L5.B1	-55.0	14113.0	14111.0	123.0	65.5
BPMSQT.A2L5.B1	-44.0	21430.0	5553.0	123.0	65.5
BPMSQ.1L5.B1	-33.0	10870.0	4654.0	123.0	65.5
BPMSQW.1L5.B1	-22.0	3213.0	3213.0	112.0	65.5
BPMSQW.1R5.B1	22.0	3284.0	3284.0	112.0	65.5
BPMSQ.1R5.B1	33.0	4635.0	11185.0	123.0	65.5
BPMSQT.A2R5.B1	44.0	5630.0	21483.0	123.0	65.5
BPMSQT.B2R5.B1	55.0	14439.0	13829.0	123.0	65.5
BPMSQT.A3R5.B1	66.0	21263.0	8135.0	123.0	65.5
BPMSQ.B3R5.B1	74.0	19234.0	7680.0	123.0	65.5
BPMSQ.4R5.B1	82.0	17175.0	7208.0	123.0	65.5

Effective impedance

- Accounting for all the BPMs with analytical formulas, the effective impedance is:

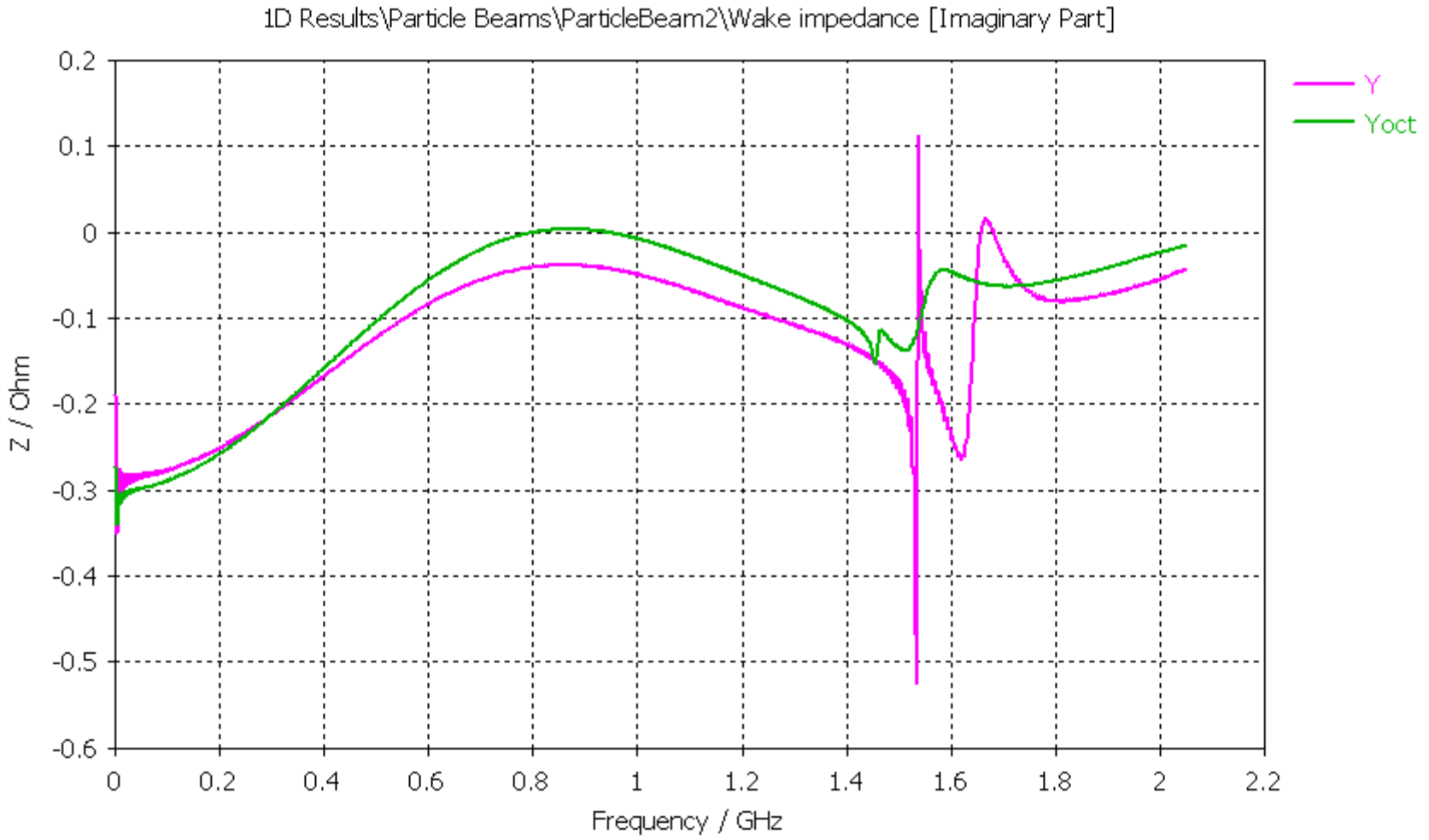
BPM total impedance	**HL-LHC (15cm)**
Zx= 4.8 kOhm/m,	Zx=20.8MOhm/m,
Zy= 4.6 kOhm/m	Zy=17.8MOhm/m
Z/n= 11.1 mOhm	Z/n=92.890 mOhm

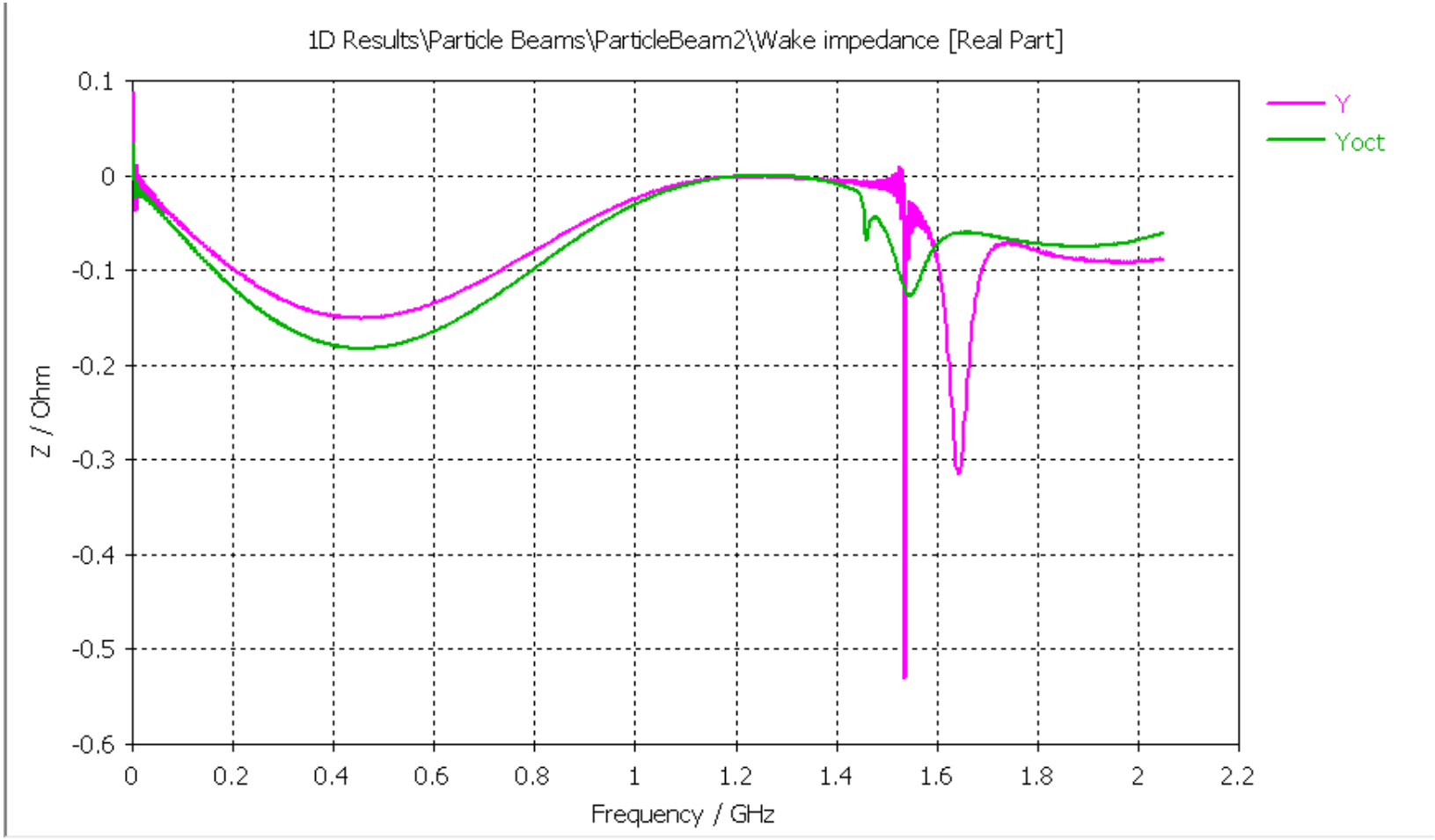
- If we account for only inductive impedance at max beta we get Zt_eff in the order of 500kOhm
- The longitudinal impedance is ~10%

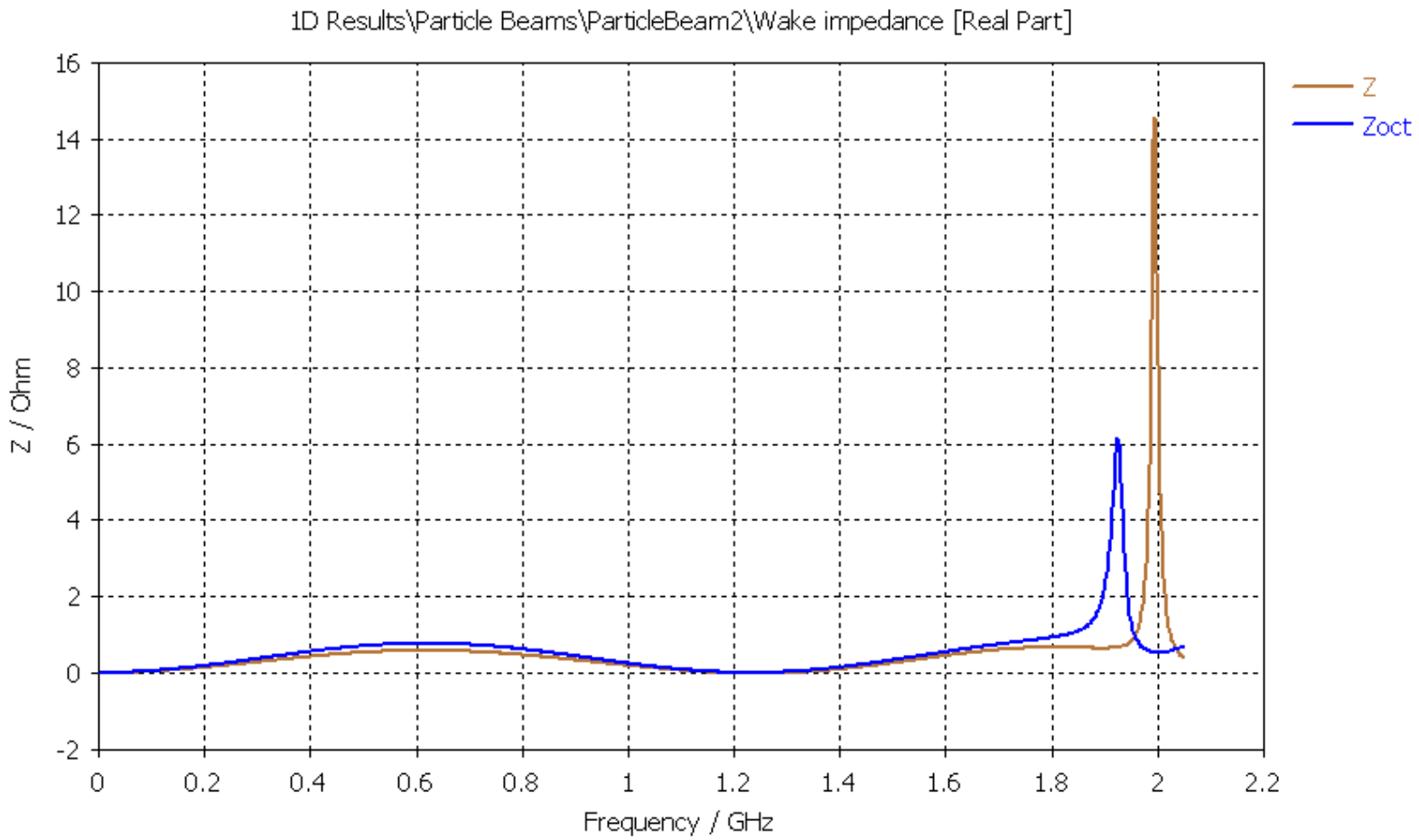
Conclusions and outlook

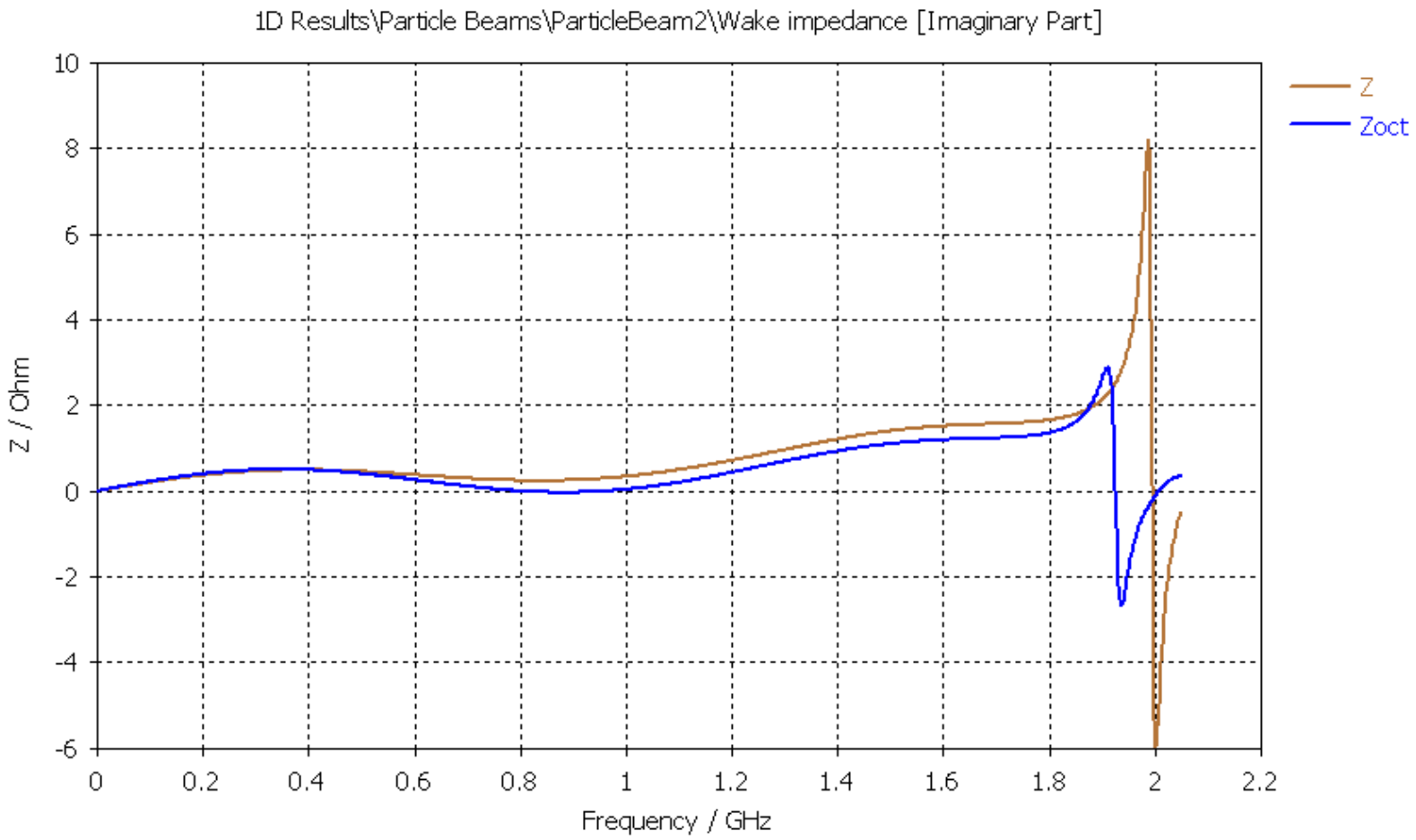
- The triplet stripline BPMs impedance look negligible in both configurations, octogonal and circular, wr.t. the full HLLHC impedance model.
- The longitudinal impedance is in the order of 10%
- CST simulations are being investigated w.r.t. analytical formulas for both shapes as in the past we got good agreements (even myself…)
- The device radius should be updated to the new beam screen specs and new simulations should be performed

Appendix


1D Results\Particle Beams\ParticleBeam2\Wake impedance [Imaginary Part]
Y
Yoct
Z / Ohm
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
Frequency / GHz


1D Results\Particle Beams\ParticleBeam2\Wake impedance [Real Part]
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Z / Ohm
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
Frequency / GHz
Y
Yoct


1D Results\Particle Beams\ParticleBeam2\Wake impedance [Real Part]
Z / Ohm
16
14
12
10
8
6
4
2
0
-2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
Frequency / GHz
Z
Zoct


1D Results\Particle Beams\ParticleBeam2\Wake impedance [Imaginary Part]
Z / Ohm
Frequency / GHz
Z
Zoct
10
8
6
4
2
0
-2
-4
-6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2