

LHC COLLIMATORS IMPEDANCE WITH SECONDARIES (TCSG) IN COPPER

E. Métral

- ◆ **Zotter's formula for all the collimators (42, including the TCDQ, TDI, etc.) of PHASE 1 (Data sent by Guillaume on 10-05-05) assuming the secondaries (TCSG) made of copper instead of graphite**

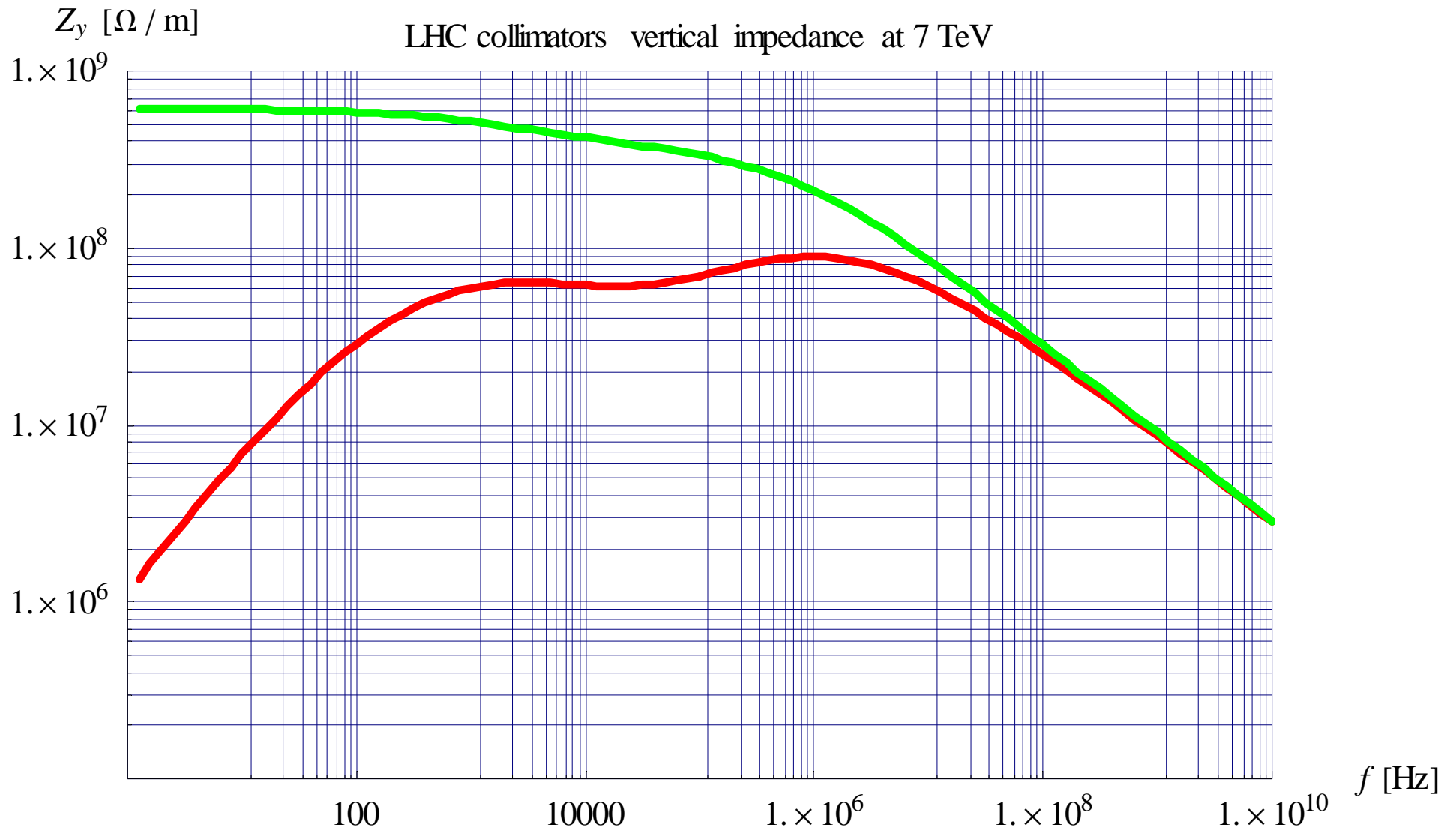
42 collimators (nominal)

#name	angle[rad]	betax[m]	betay[m]	halfgap[m]	Resistivity [Ohm m]	Length[m]
TCL.5R1.B1	0	131.93	925.95	0.0025752	0.000000017	1
TCTH.L2.B1	0	50.891	49.763	0.0013275	0.000000005	1
TDI.4L2	1.571	112.57	49.684	0.14223	0.000000017	4
TCTV.4L2.B1	1.571	132.88	57.748	0.0014141	0.000000005	1
TCLIA.4R2.B	1.571	54.939	126.7	0.22712	0.00001	1
TCLIB.6R2	1.571	271.59	30.888	0.11214	0.00001	1
TCP.6L3.B1	0	131.79	144.07	0.0038606	0.00001	0.2
TCSG.5L3.B1	0	54.598	297.51	0.0029819	0.00001	1
TCSG.4R3.B1	0	26.253	396.73	0.0020677	0.00001	1
TCSG.A5R3.B	2.981	35.949	345.36	0.0026726	0.00001	1
TCSG.B5R3.B	0.1885	45.627	313.84	0.0029941	0.00001	1
TCLA.A5R3.B	1.571	142.59	176.74	0.0059612	0.000000017	1
TCLA.B5R3.B	0	151.67	169.39	0.0055222	0.000000017	1
TCLA.6R3.B1	0	129.27	168.71	0.0050981	0.000000017	1
TCLA.7R3.B1	0	62.901	100.24	0.0035562	0.000000017	1
TCTH.L5.B1	0	1646.5	623.78	0.0075507	0.000000005	1
TCTV.L5.B1	1.571	1651.6	657.58	0.0047718	0.000000005	1
TCL.5R5.B1	0	128.6	907.77	0.0025425	0.000000017	1
TCDQ.4R6.B1	0	485.26	160.88	0.0049388	0.00001	8
TCS.TCDQ.B1	0	501.16	165.5	0.0045172	0.00001	1
TCP.D6L7.B1	1.571	161.93	76.835	0.0011791	0.00001	0.2
TCP.C6L7.B1	0	153.51	81.276	0.0016667	0.00001	0.2
TCP.B6L7.B1	2.215	145.36	85.943	0.0013939	0.00001	0.2
TCSG.A6L7.B	2.463	40.93	224.39	0.0016699	0.00001	1
TCSG.B5L7.B	2.504	155.67	165.97	0.0019809	0.00001	1
TCSG.A5L7.B	0.71	180.91	145.59	0.0020214	0.00001	1
TCSG.D4L7.B	1.571	323.86	69.276	0.0013062	0.00001	1
TCSG.B4L7.B	0	136.69	132.92	0.0018349	0.00001	1
TCSG.A4L7.B	2.349	125.98	143.27	0.0018218	0.00001	1
TCSG.A4R7.B	0.808	115.95	154.24	0.0018299	0.00001	1
TCSG.B5R7.B	2.47	124.91	268.08	0.0021075	0.00001	1
TCSG.D5R7.B	0.897	218.64	158.38	0.0021163	0.00001	1
TCSG.E5R7.B	2.277	246.63	135.83	0.0021201	0.00001	1
TCSG.6R7.B1	0.009	341.67	46.546	0.0029008	0.00001	1
TCLA.A6R7.B	1.571	296.69	47.528	0.0015456	0.000000017	1
TCLA.C6R7.B	0	157.1	77.269	0.0028101	0.000000017	1
TCLA.E6R7.B	1.571	65.302	156.52	0.0028049	0.000000017	1
TCLA.F6R7.B	0	60.053	166.17	0.0017374	0.000000017	1
TCLA.A7R7.B	0	63.26	147.05	0.0017832	0.000000017	1
TCTV.4L8.B1	1.571	128.8	52.857	0.0013529	0.000000005	1
TCTH.L1.B1	0	1648.7	624.84	0.0075558	0.000000005	1
TCTV.L1.B1	1.571	1653.8	658.72	0.004776	0.000000005	1

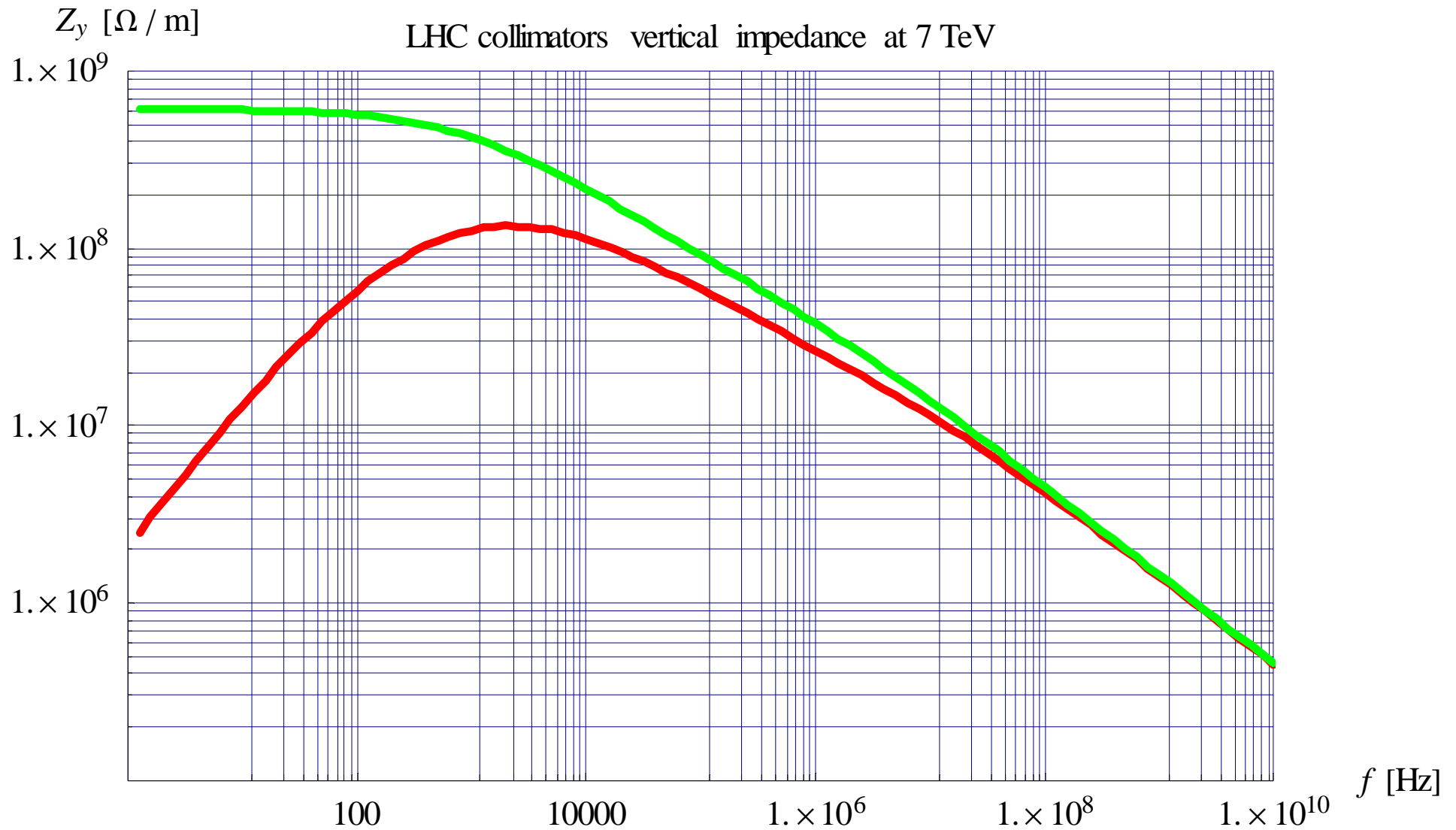
42 collimators with TCSG in copper

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TDI.4L2	1.571	112.57	49.684	0.14223	0.000000017	4
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TCLIB.6R2	1.571	271.59	30.888	0.11214	0.00001	1
TCP.6L3.B1	0	131.79	144.07	0.0038606	0.00001	0.2
TCSG.5L3.B1	0	54.598	297.51	0.0029819	1.70E-08	1
TCSG.4R3.B1	0	26.253	396.73	0.0020677	1.70E-08	1
TCSG.A5R3.B	2.981	35.949	345.36	0.0026726	1.70E-08	1
TCSG.B5R3.B	0.1885	45.627	313.84	0.0029941	1.70E-08	1
TCLA.A5R3.B	1.571	142.59	176.74	0.0059612	0.000000017	1
TCLA.B5R3.B	0	151.67	169.39	0.0055222	0.000000017	1
TCLA.6R3.B1	0	129.27	168.71	0.0050981	0.000000017	1
TCLA.7R3.B1	0	62.901	100.24	0.0035562	0.000000017	1
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TCS.TCDQ.B1	0	501.16	165.5	0.0045172	0.00001	1
TCP.D6L7.B1	1.571	161.93	76.835	0.0011791	0.00001	0.2
TCP.C6L7.B1	0	153.51	81.276	0.0016667	0.00001	0.2
TCP.B6L7.B1	2.215	145.36	85.943	0.0013939	0.00001	0.2
TCSG.A6L7.B	2.463	40.93	224.39	0.0016699	1.70E-08	1
TCSG.B5L7.B	2.504	155.67	165.97	0.0019809	1.70E-08	1
TCSG.A5L7.B	0.71	180.91	145.59	0.0020214	1.70E-08	1
TCSG.D4L7.B	1.571	323.86	69.276	0.0013062	1.70E-08	1
TCSG.B4L7.B	0	136.69	132.92	0.0018349	1.70E-08	1
TCSG.A4L7.B	2.349	125.98	143.27	0.0018218	1.70E-08	1
TCSG.A4R7.B	0.808	115.95	154.24	0.0018299	1.70E-08	1
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TCLA.E6R7.B	1.571	65.302	156.52	0.0028049	0.000000017	1
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TCLA.A7R7.B	0	63.26	147.05	0.0017832	0.000000017	1
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TCTV.L1.B1	1.571	1653.8	658.72	0.004776	0.00000005	1

Total (Zotter) vertical impedance for the 42 collimators (nominal)

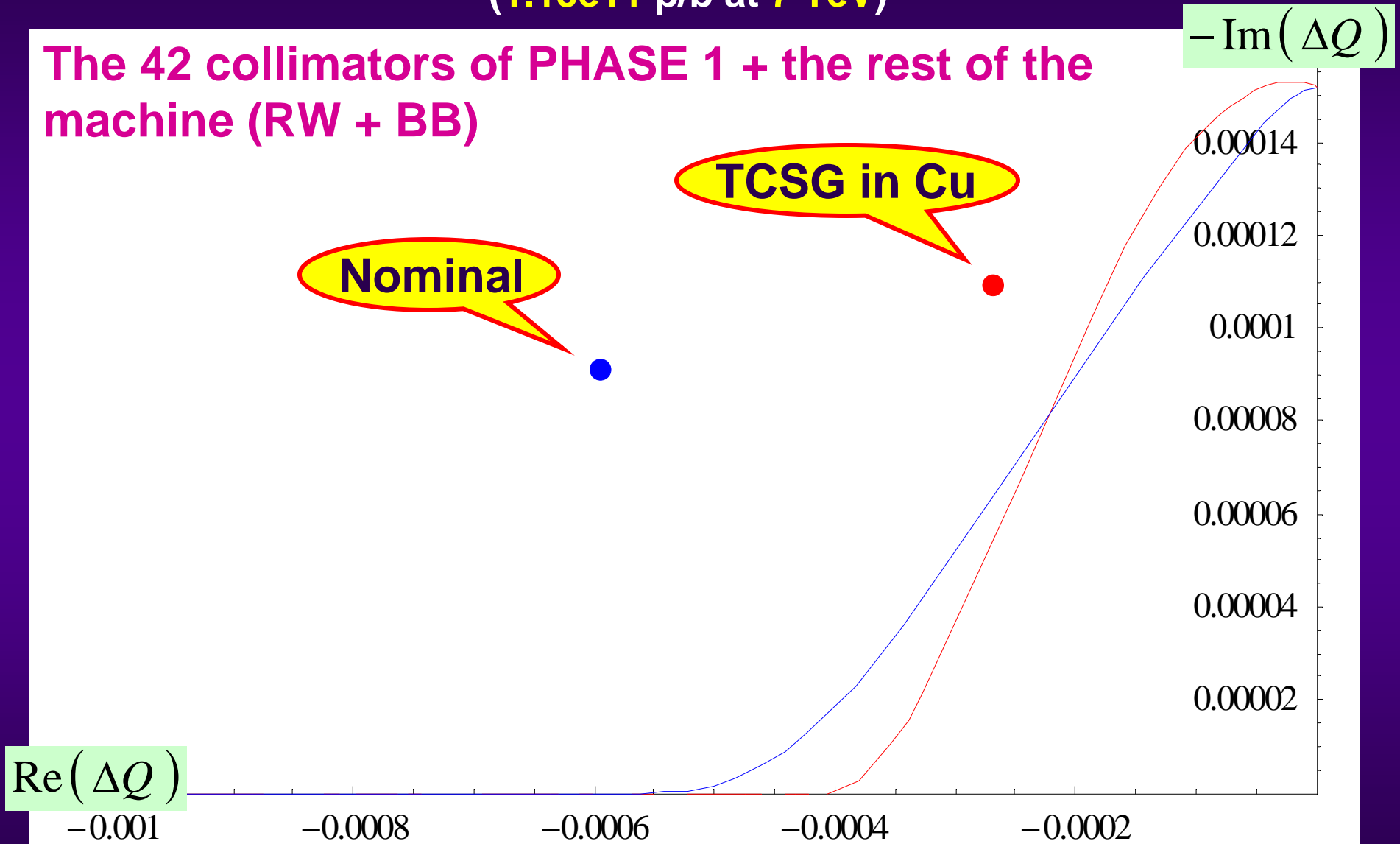


Total (Zotter) vertical impedance for the 42 collimators (with TCSG in Cu)



Stability diagram (maximum octupoles) and collective tune shift for the most unstable coupled-bunch mode and head-tail mode 0 (1.15e11 p/b at 7 TeV)

The 42 collimators of PHASE 1 + the rest of the machine (RW + BB)



Conclusion


- ◆ With the TCSG in copper, ~80% of the nominal beam is stable (compared to ~50% with TCSG in graphite)
- ◆ TCDQ is only 1-sided (usually, as here, considered 2-sided = worst case)

$$Z_x^{1\text{-sided}} = \frac{6}{\pi^2} Z_x^{2\text{-sided}} \approx 0.6 Z_x^{2\text{-sided}}$$

$$Z_y^{1\text{-sided}} = \frac{3}{\pi^2} Z_y^{2\text{-sided}} \approx 0.3 Z_y^{2\text{-sided}}$$

- ◆ Updated collimator data sent by Guillaume on 11-10-05

⇒ Therefore, my results still need to be updated
(The situation should be slightly better)



See my other
talk on Burov-
Danilov theory