

Computed Transverse Impedance of LHC Collimators

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The transverse impedance of carbon collimators has been computed for 8 kHz, 10 MHz and 20 MHz. It stays reasonably constant in that range with a mild maximum at 10 MHz. Only values at this frequency are quoted. Half apertures, β values and lengths are data provided by R. Assmann (17.6.2003). Impedances are computed for two resistivities, $\rho = 14 \cdot 10^{-6} \Omega m$ and $\rho = 25 \cdot 10^{-6} \Omega m$. The effect of the inductive bypass, the harmonics (bunch spacing = 25 ns) and the Lasslett(Yokoya) coefficients has been taken into account. The impedances are normalised for $\beta = 70m$.

Table 1: Transverse impedance in $M\Omega/m$ for $\rho = 14 \cdot 10^{-6} \Omega m$.

location	injection > ramp				squeeze	
	HOR		VER		HOR	VER
LSS 7	9+10j	>12+14j	7+8j	>10+11j	208+254j	187+225j
LSS 3	2+2j	>3+3j	10+11j	>13+14j	24+28j	107+126j
<i>total</i>	11+12j>15+17j		17+19j>23+25j		232+282j	294+351j

Table 2: Transverse impedance in $M\Omega/m$ for $\rho = 25 \cdot 10^{-6} \Omega m$.

location	injection > ramp				squeeze	
	HOR		VER		HOR	VER
LSS 7	11+13j	>16+18j	10+11j	>13+14j	260+333j	235+295j
LSS 3	2+3j	>4+4j	12+14j	>16+18j	30+37j	135+166j
<i>total</i>	13+16j>20+22j		22+25j>29+32j		290+370j	370+461j

Main contributors :

LSS 7 Horizontal : TCS.A5R7.B1, TCS.B5R7.B1
 Vertical : TCS.A6L7.B1

LSS 3 Vertical: TCS.A4R3.B1, TCS.B4R3.B1

Reminder

The real part of the transverse impedance of the LHC without collimators at 8 kHz is 56 $M\Omega/m$ at injection and 110 $M\Omega/m$ at top energy. Part of this impedance has similar characteristics as the collimator impedance, i.e. reasonably flat between 8 kHz and 20 MHz. This part of the impedance amounts to **10 $M\Omega/m$** both at injection and top energy.

Table 3: Computed maximum power in Watt for ultimate beam

location	injection > ramp		squeeze	
	$\rho = 14 \mu\Omega m$	$\rho = 25 \mu\Omega m$	$\rho = 14 \mu\Omega m$	$\rho = 25 \mu\Omega m$
LSS 7	50 > 140	65 > 190	360	480
LSS 3	50 > 140	65 > 190	290	390

Table 4 :Real part of transverse impedance in $M\Omega/m$ of individual collimators, squeeze, $\rho = 14 \mu\Omega m$

location	HOR	VER
LSS7	2.7	9.5
	11.7	10.4
	2.8	5.2
	11.1	37.1
	2.8	5.5
	2.9	5.4
	29.9	13.6
	10.1	14.9
	14	22.3
	1.4	8.9
	1.7	8.3
	6.7	15.6
	54.9	15.2
	55.5	15.2
LSS3	0.7	0.5
	3.4	11.3
	4.5	30.2
	4.5	29.7
	4	16.8
	3.6	11.1
	3.3	7.5

75 ns bunch spacing

Impedance increases by a factor ~ **2.8**.