AC conductivity and Resistive Wall impedance of LHC collimator

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AC conductivity and Resistive Wall impedance of circular pipe of radius a

$$Z_l(k) = \left(\frac{Z_0}{4\pi a}\right)\frac{2}{\lambda/k - ika/2}$$

$$\lambda = \sqrt{Z_0\sigma\,|k|/2}\,[i + sign(k)]$$

K. L. F. Bane,
SLAC/AP-87, (1991)

$$\sigma = ne^2\tau/m$$

$$\sigma_{AC} = \sigma/(1 - ikc\tau)$$

$$Z_t(k) = \frac{2}{ka^2}Z_l(k)$$

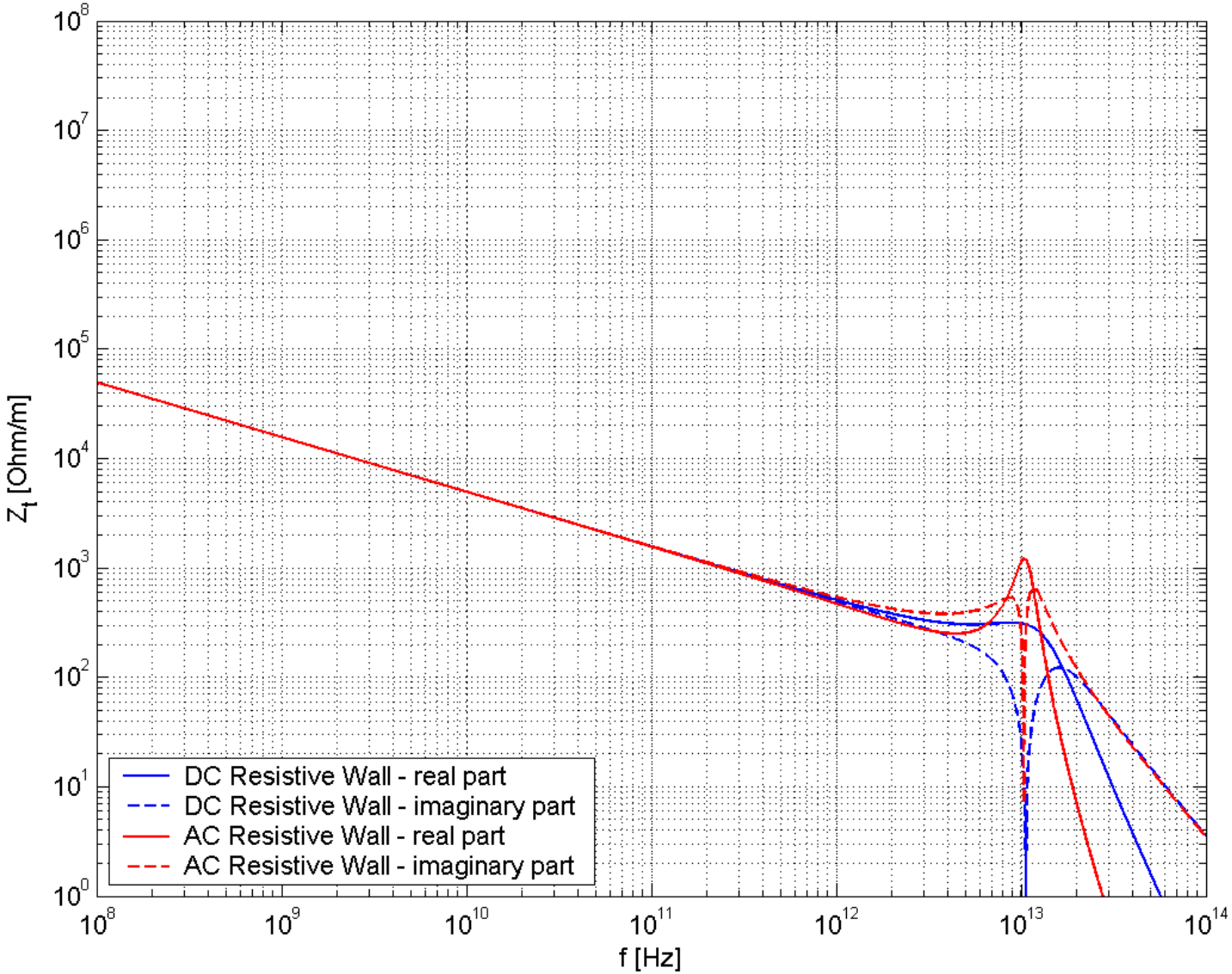
A.V. Fedotov, R.L.Gluckstern, M. Venturini,
PRST-AB 2, (1999)

Properties of materials

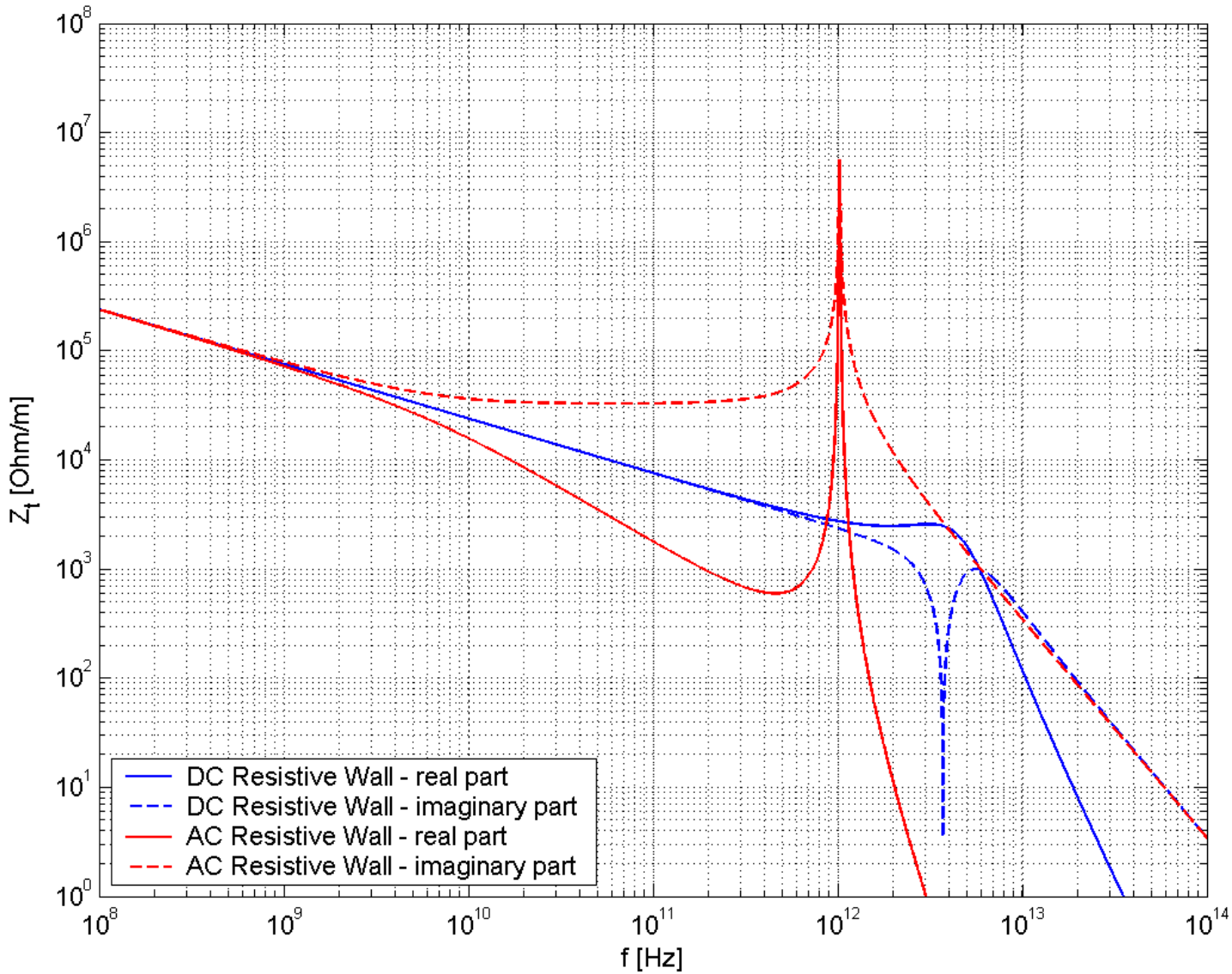
	Cu	Graphite parallel	Graphite perp.	Carbon-Carbon
DC conductivity: σ [(Ohmm)$^{-1}$]	5.8×10^{7}	2.5×10^{6}	8.3×10^{2}	1×10^{5}
Free carrier density: n [m^{-3}]	8.5×10^{28}	6×10^{24}		(4.4×10^{24})*
Density [kg/m^{3}]	8920	2260		1650

* - scaled from graphite proportionally to the density

Transverse Impedance (a = 2mm; Copper)



Transverse Impedance (a = 2mm; Graphite parallel)



Transverse Impedance (a = 2mm; Carbon-Carbon)