B. Spataro and M. Zobov

DAΦNE Scraper Coupling Impedance

Why did we undertake the study?

- Estimate the impedance contribution of the new scrapers
- Evaluate the possibility to eliminate tapers of the old scrapers in order to improve their efficiency in background reduction.

USEFUL FORMULAE

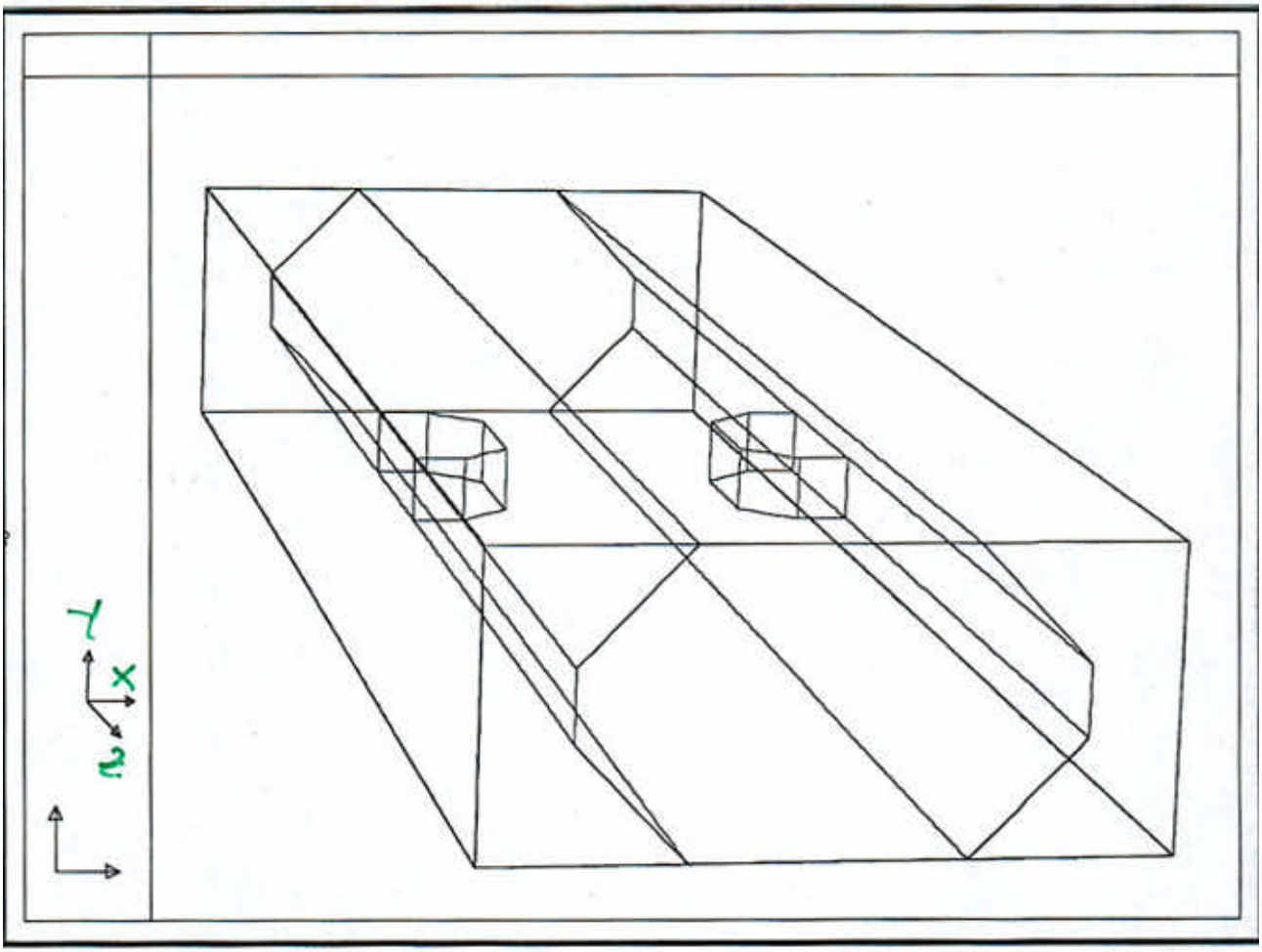
Taper Longitudinal Coupling Impedance (K. Yokoya)

$$Z_L = \frac{ikZ_0}{4\pi}\int_{-\infty}^{\infty} dz\left(\frac{da}{dz}\right)^2$$

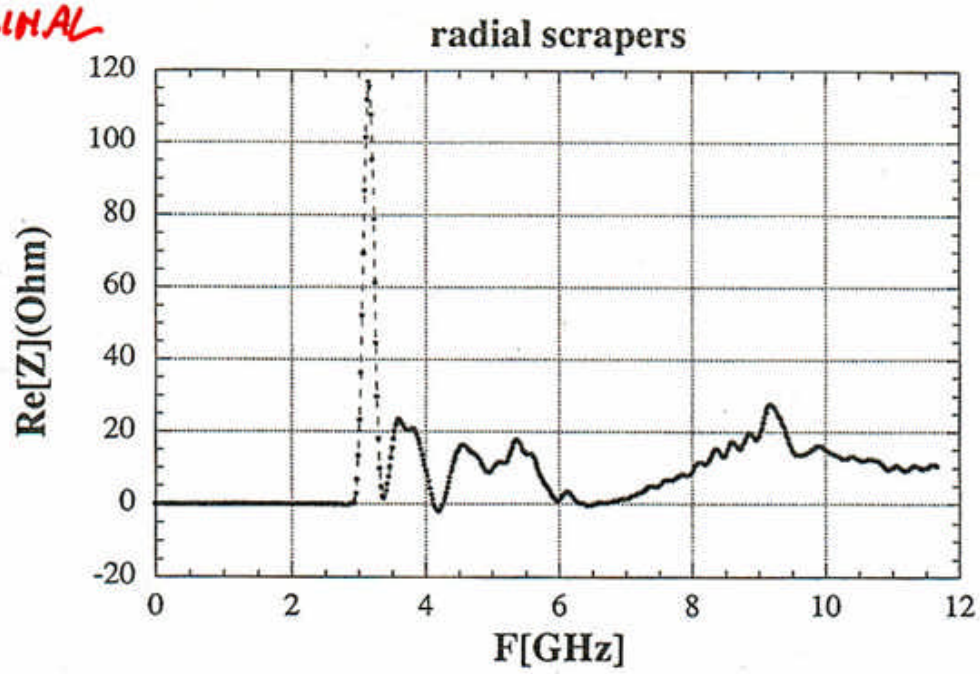
Shunt Impedance of a HOM:

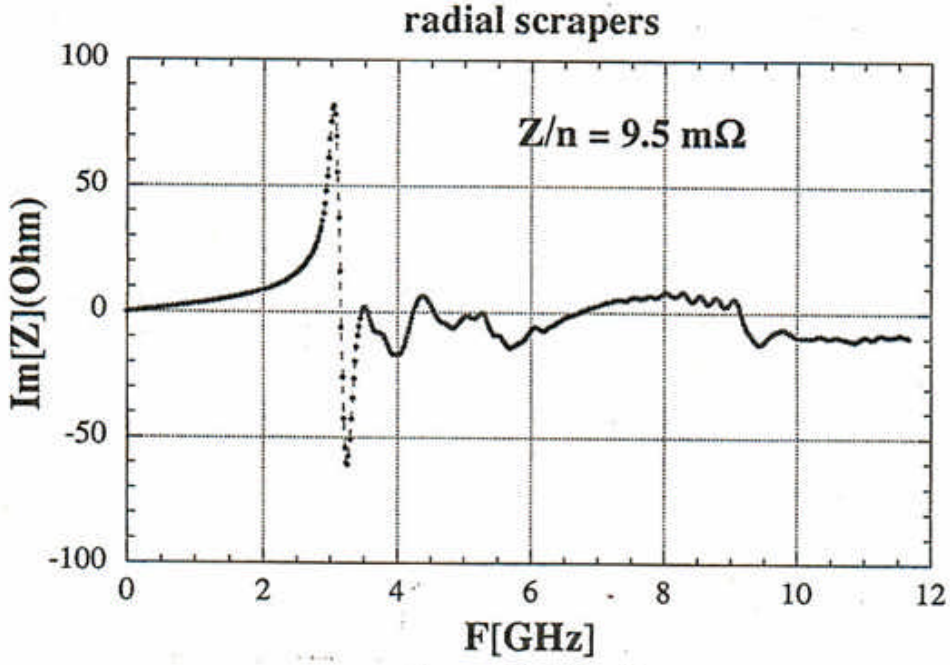
$$\frac{R_{sh}}{Q} = \frac{1}{(kr_0)^2}\frac{\left|\int_0^L E_z(z,r_0)e^{j\omega\frac{z}{v}}dz\right|^2}{2PQ}$$

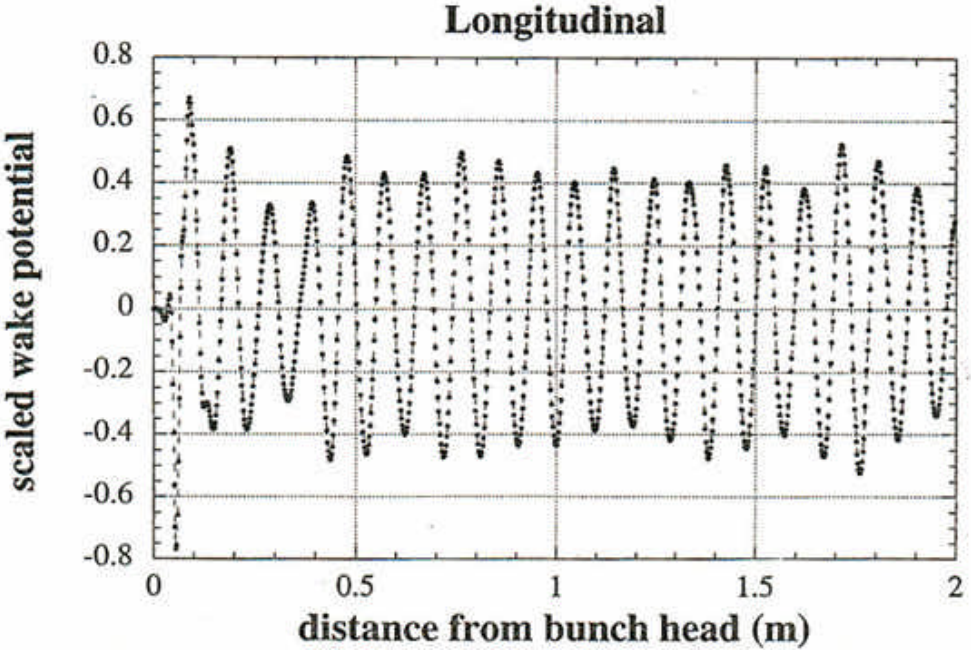
$f_{cut-off} \simeq 2\ GHz$ (beam line)

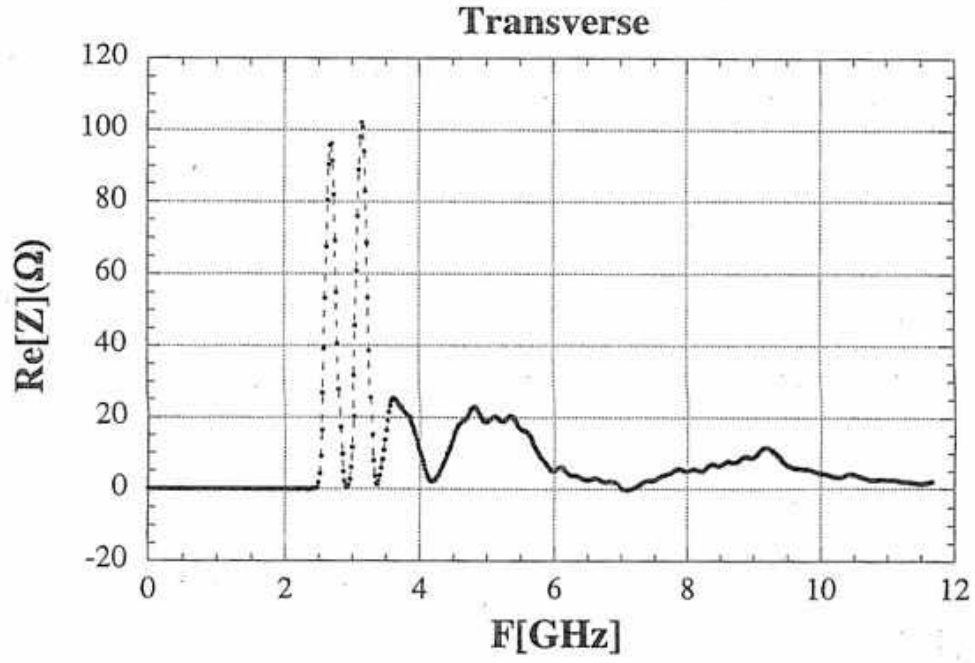


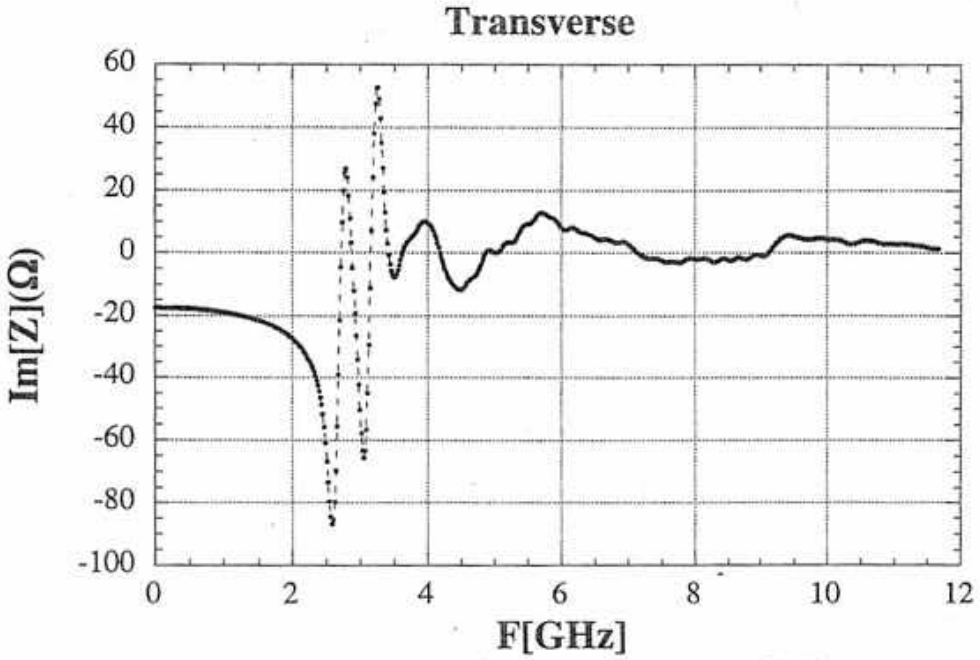
LONGITUDINAL

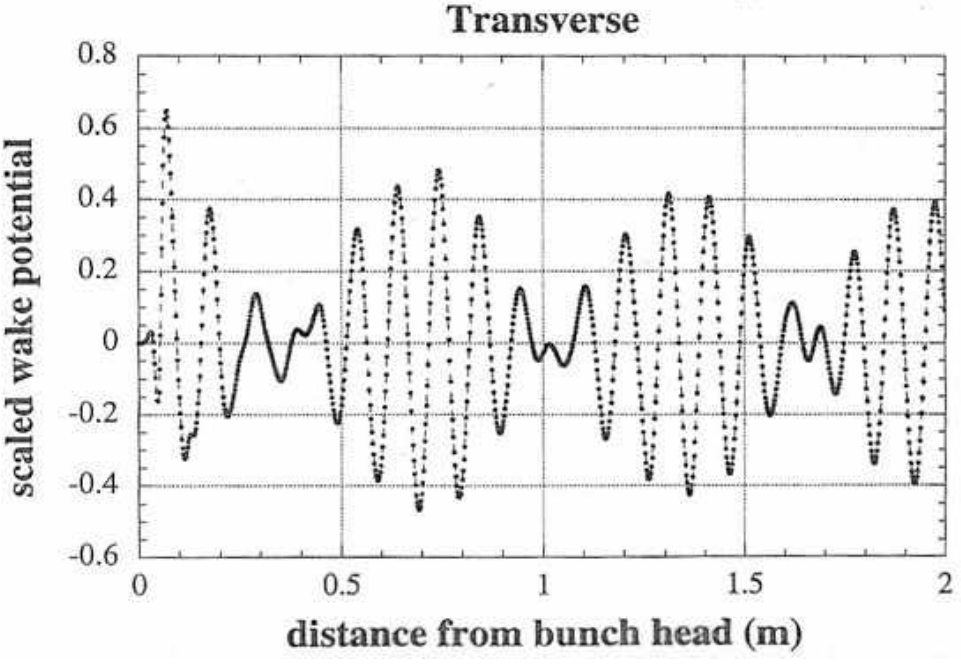




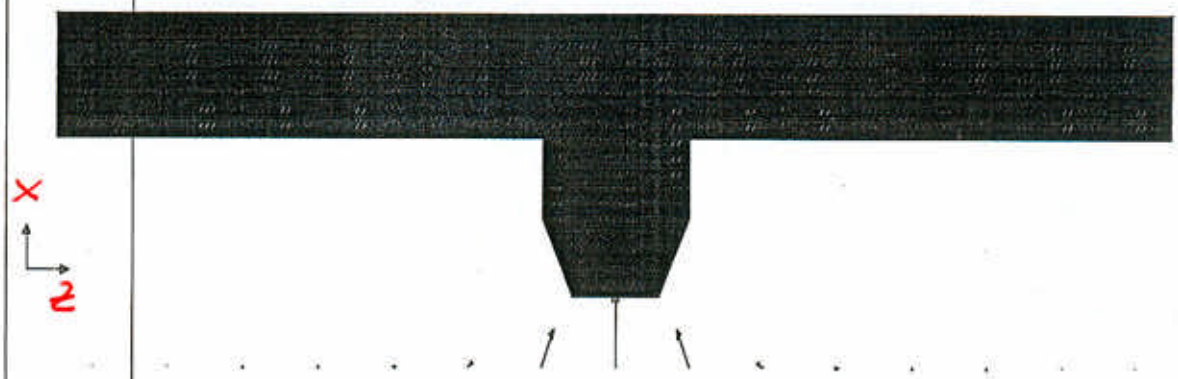



Transverse
Re[Z](Ω)
120
100
80
60
40
20
0
-20
0
2
4
6
8
10
12
F[GHz]


Transverse
Im[Z](Ω)
60
40
20
0
-20
-40
-60
-80
-100
0
2
4
6
8
10
12
F[GHz]


Transverse
scaled wake potential
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
0.5
1
1.5
2
distance from bunch head (m)

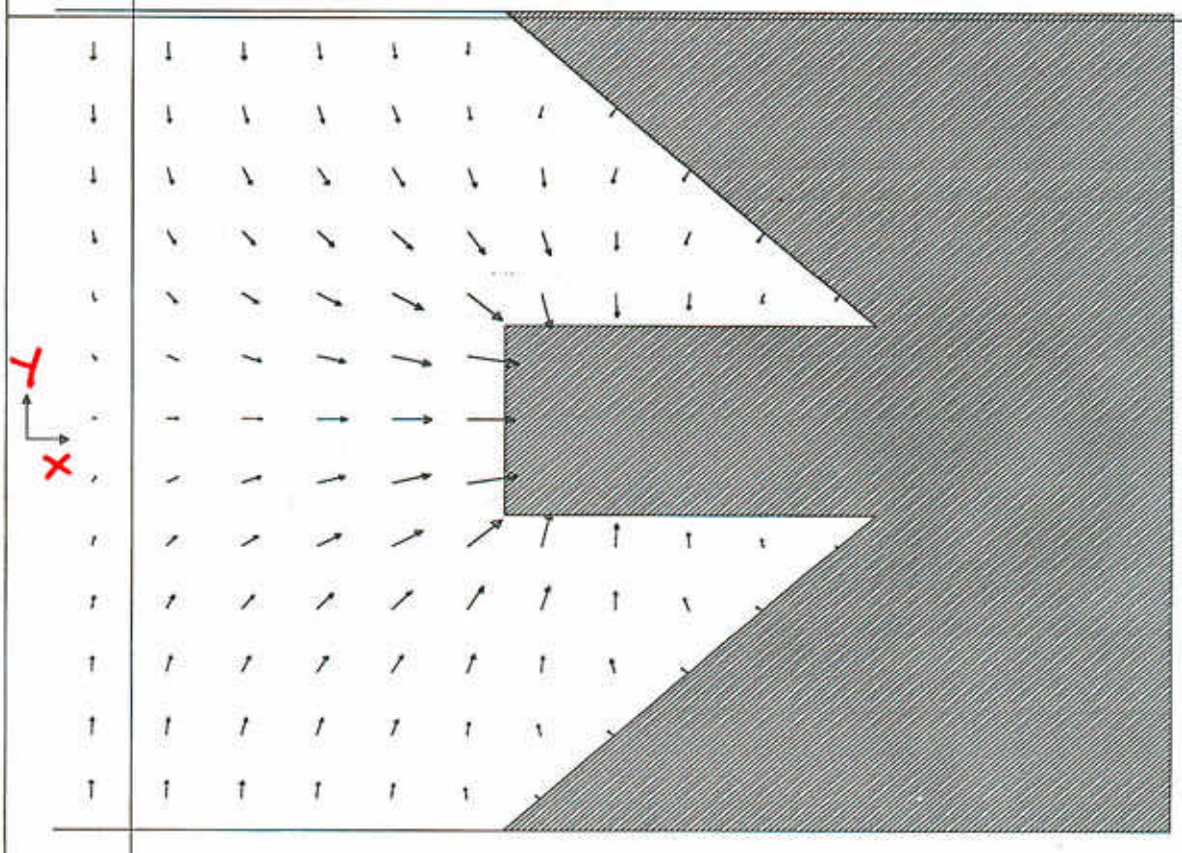
$F \cong 3.15\ GHz$

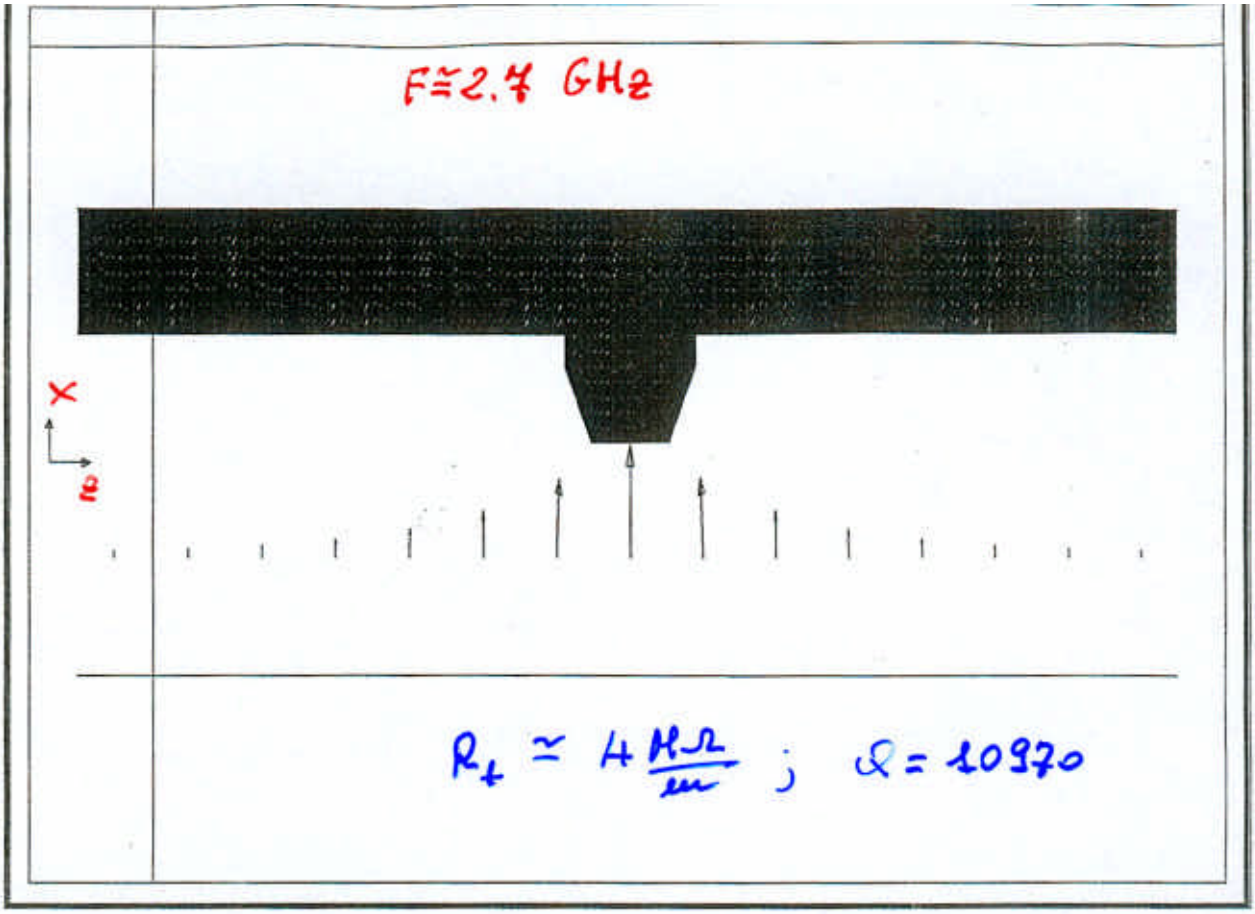


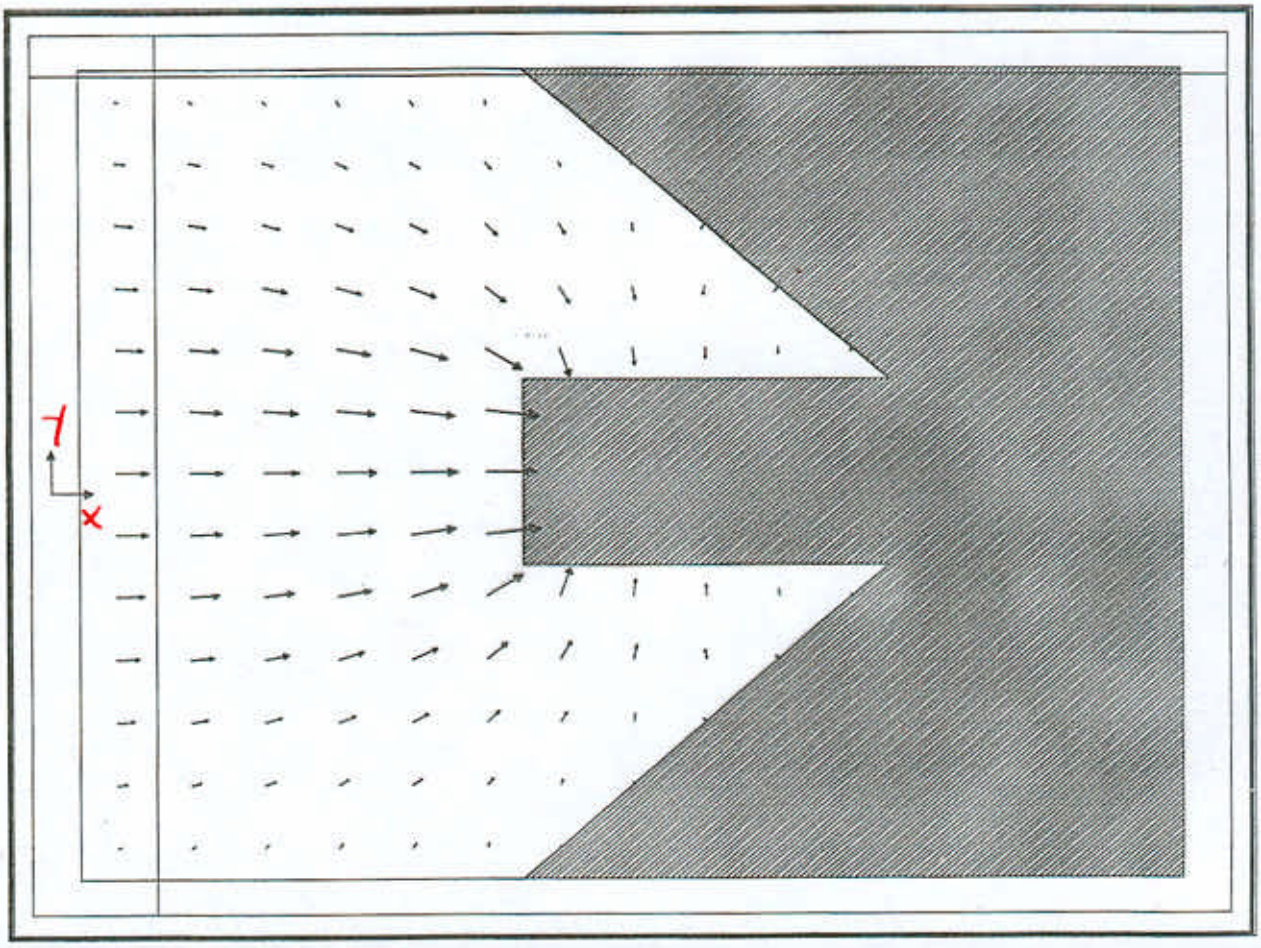
$R_{SH} \simeq 40 k\Omega$

$R_t \simeq 9\ \frac{M\Omega}{m}$

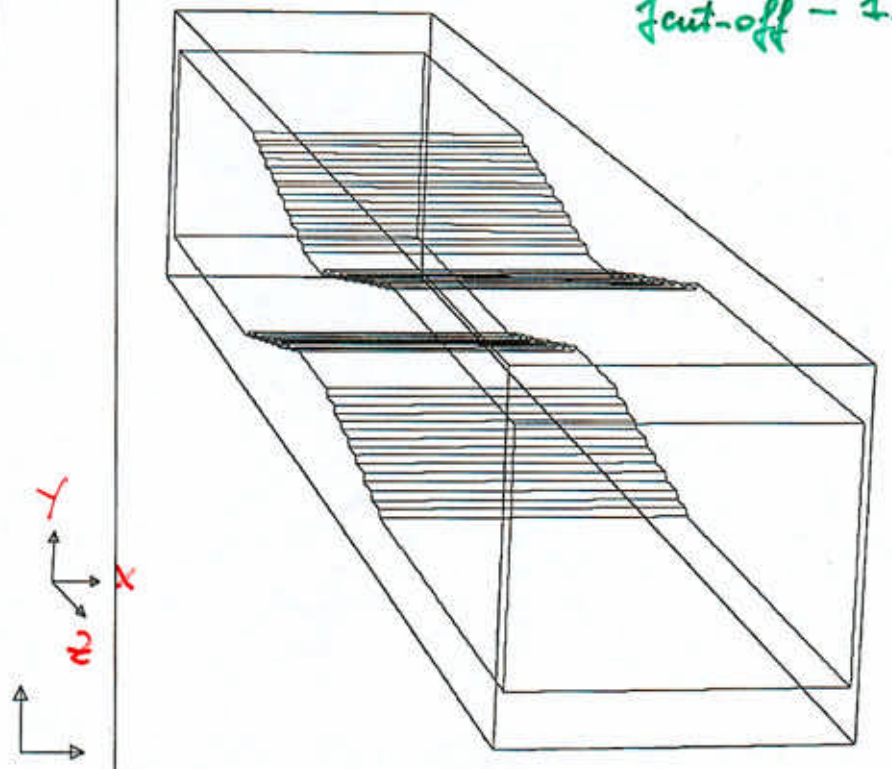
$Q \cong 8800$

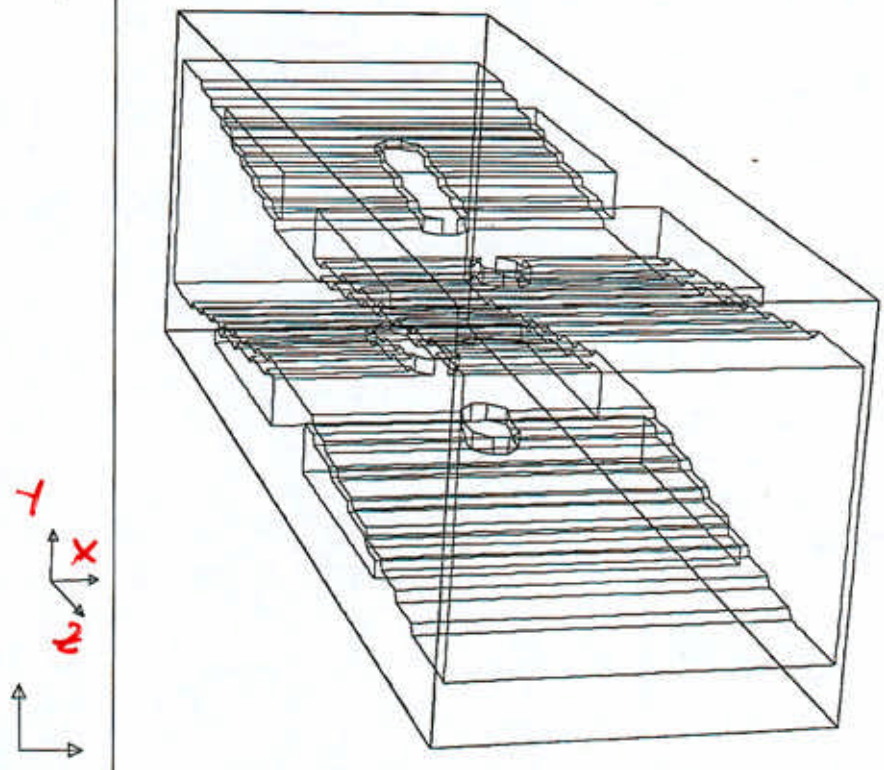


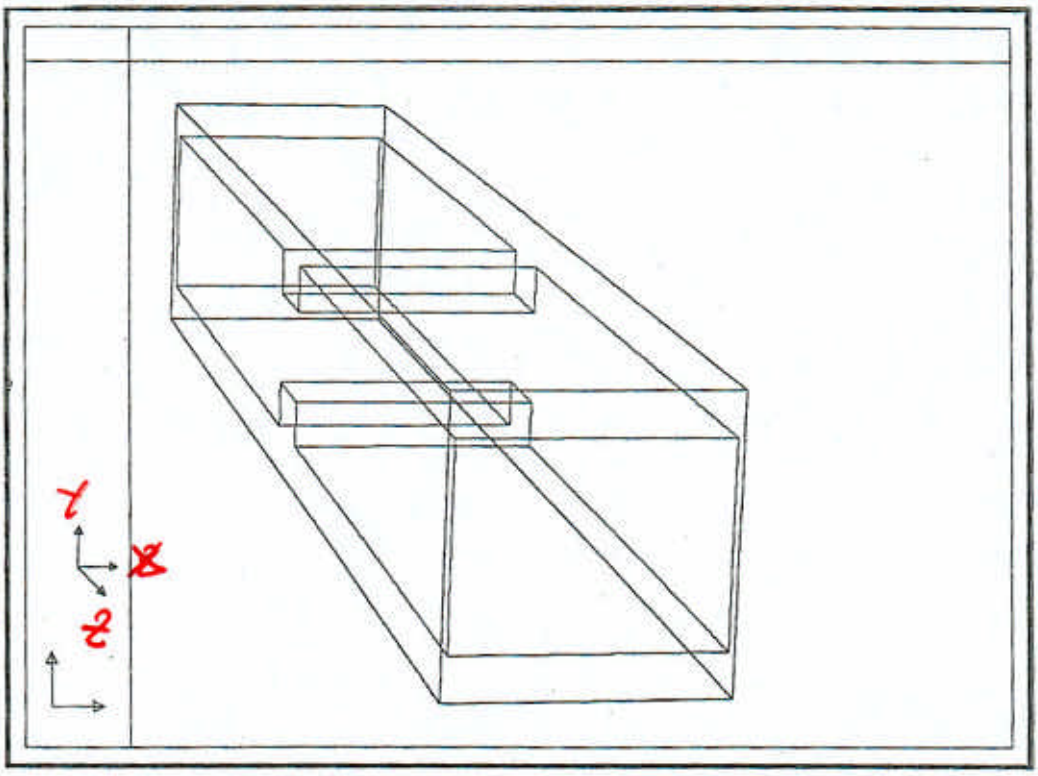

F≅2.4 GHz
X
z
$R_t \simeq 4 \frac{M\Omega}{m}$; $Q = 10970$


Y
X

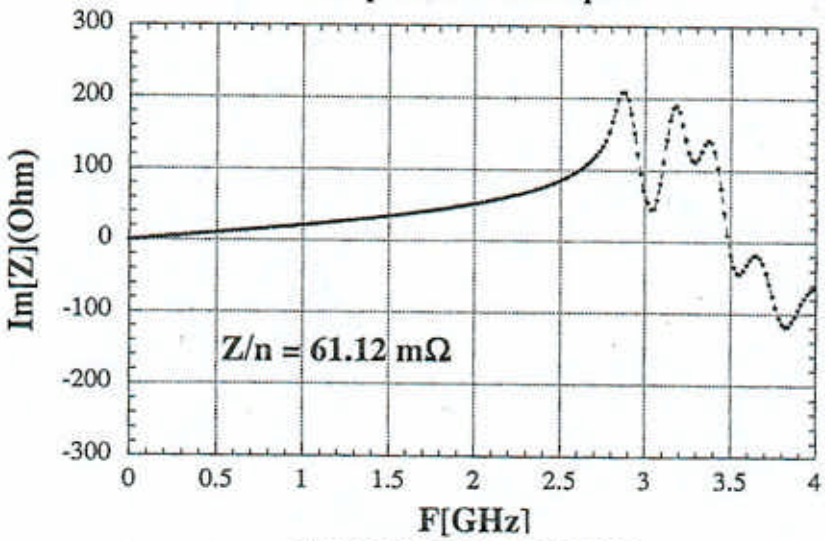
$f_{cut\text{-}off} \simeq 1.7$ GHz
(beam line)



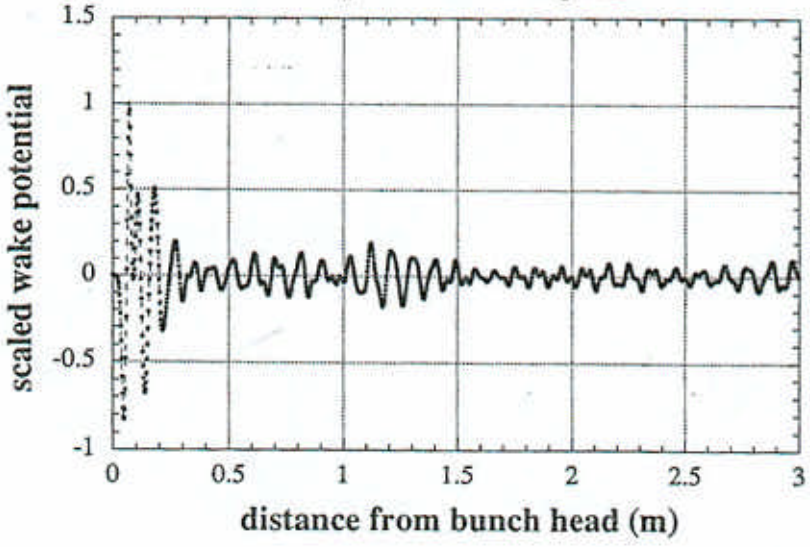


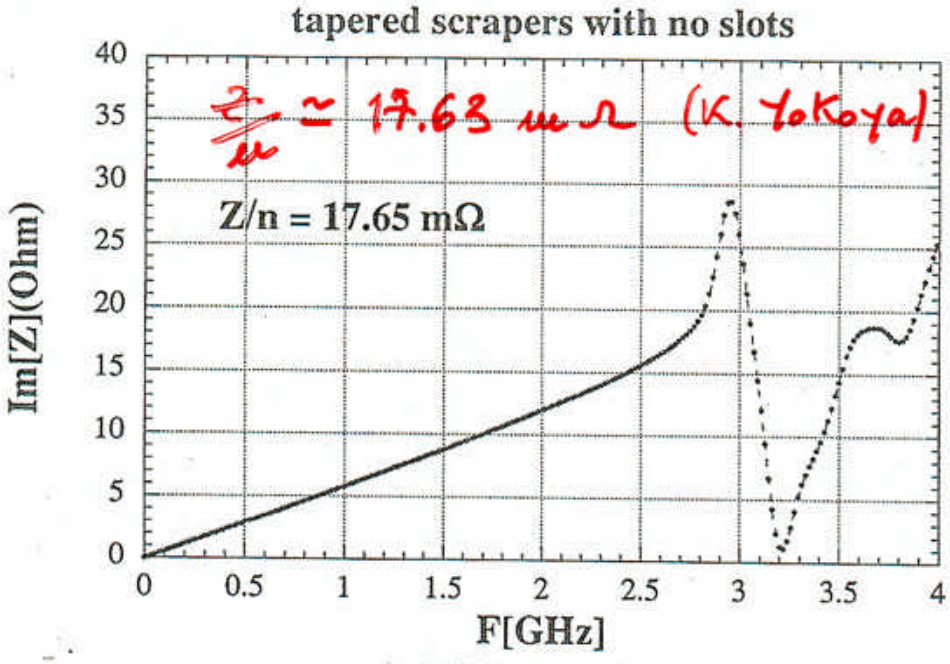


scrapers with no tapers

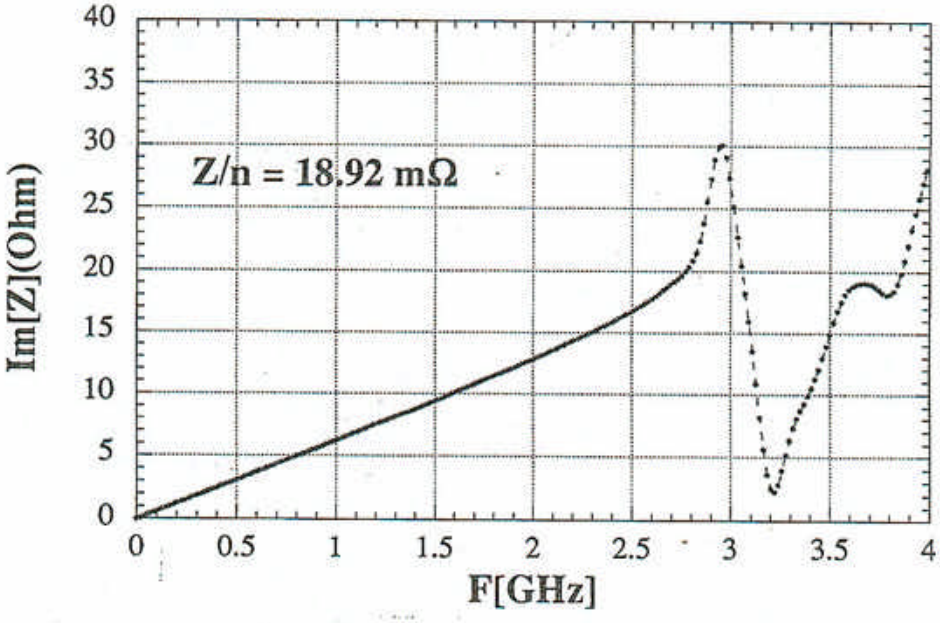


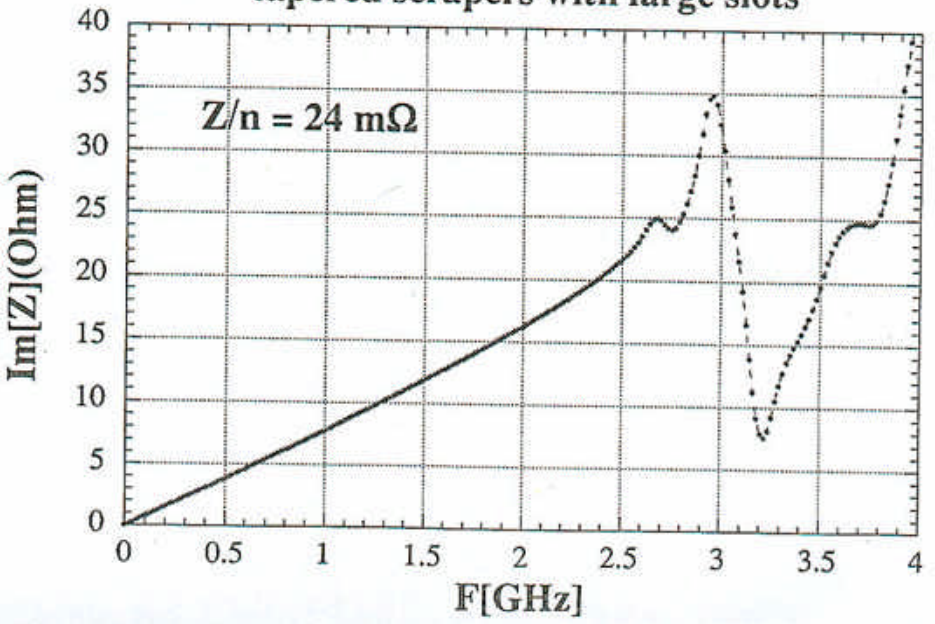
scrapers with no tapers





$\frac{Z_\perp}{w} \simeq 17.63\ m\Omega$ (K. Yokoya)





CONCLUSIONS

1. **The new scrapers have a broad-band longitudinal impedance by a factor of 2 lower than that of the old scrapers. However, the new scrapers introduce potentially dangerous HOMs, both longitudinal and transverse.**

2. **We consider impossible to eliminate the tapers of the old scrapers since it would increase their broad-band impedance by a factor of 4 and, as a consequence, the overall machine impedance by almost 30 %. Besides, the old scrapers without tapers would create long lasting wakes capable to couple bunches in a beam.**

3. **A possible solution is to enlarge the slot width along the tapers from 6 mm to 20 mm. This would increase the scraper inductive impedance only by 30%.**