

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

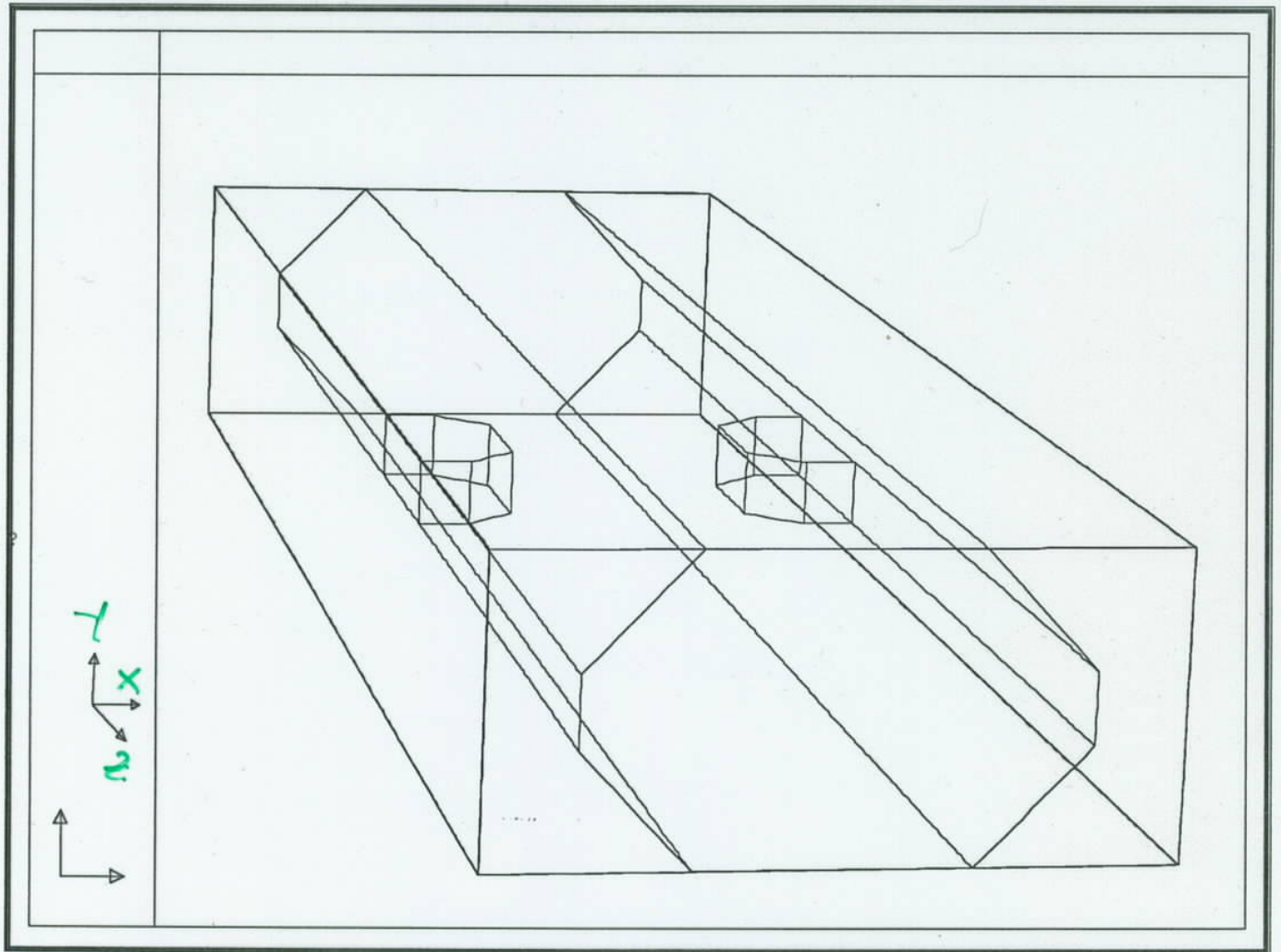
Taper Longitudinal Coupling Impedance (K. Yokoya)

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

Shunt Impedance of a HOM:

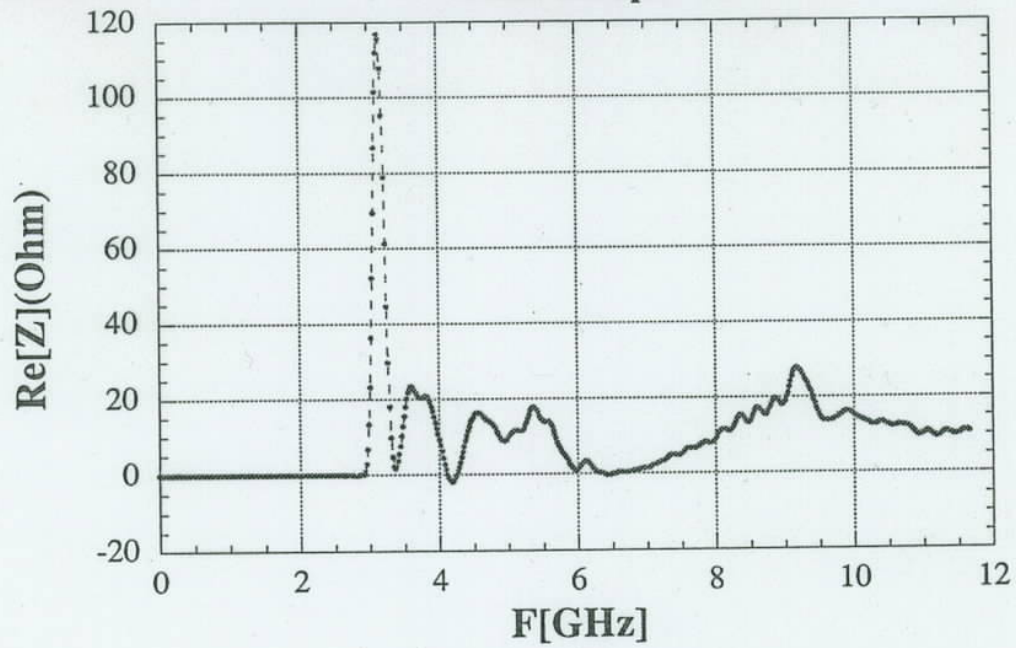
$$\frac{R_{sh}}{Q} = \frac{1}{(kr_0)^2} \frac{\left| \int_0^L E_z(z, r_0) e^{j\omega \frac{z}{v}} dz \right|^2}{2PQ}$$

Scut-off $\approx 2 \text{ GHz}$ (beam pipe)

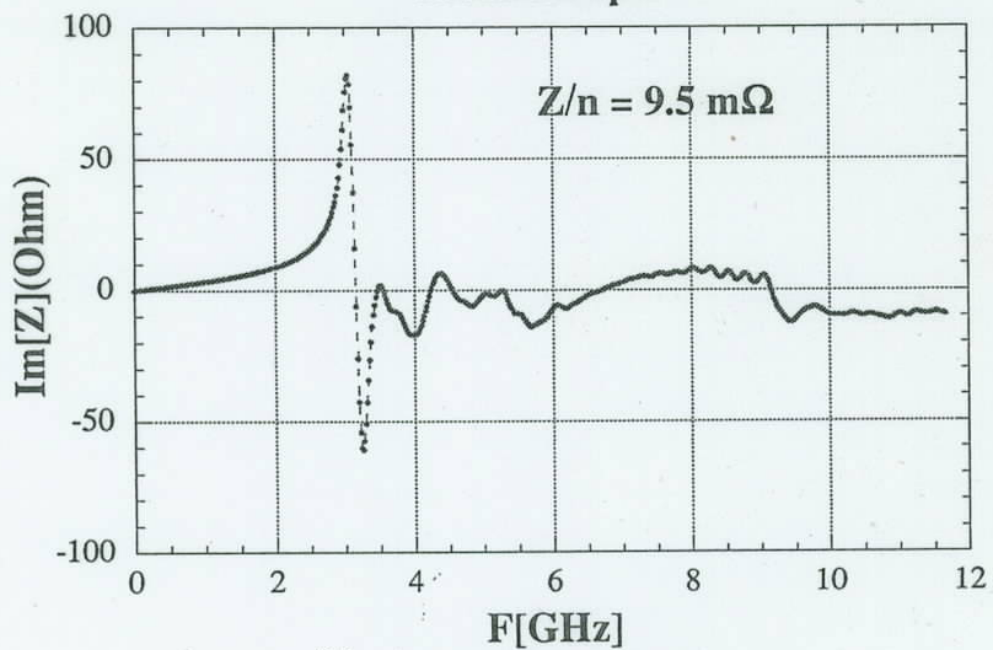


LONGITUDINAL

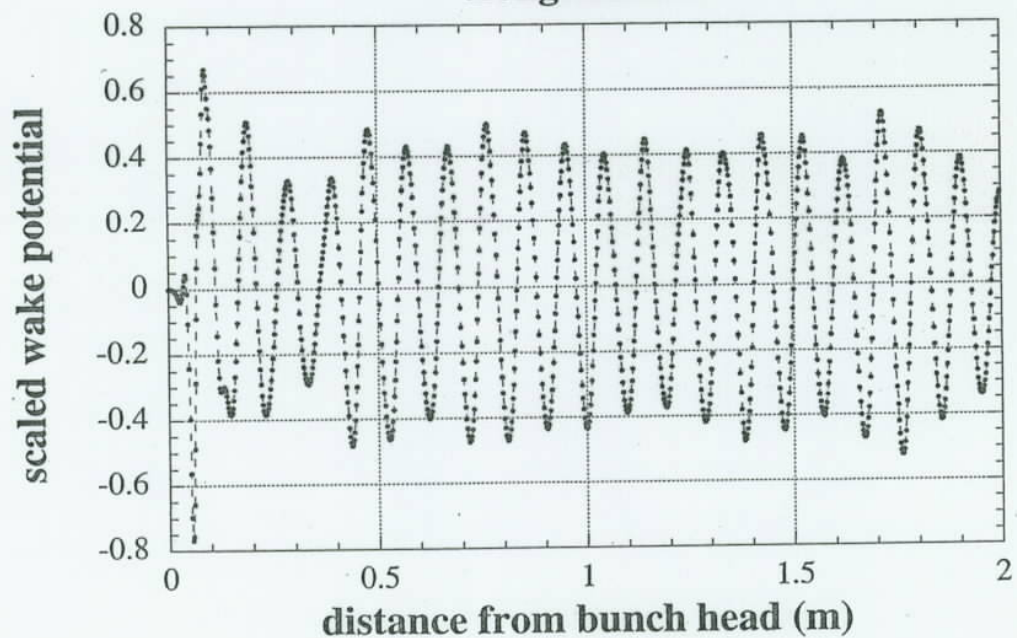
radial scrapers

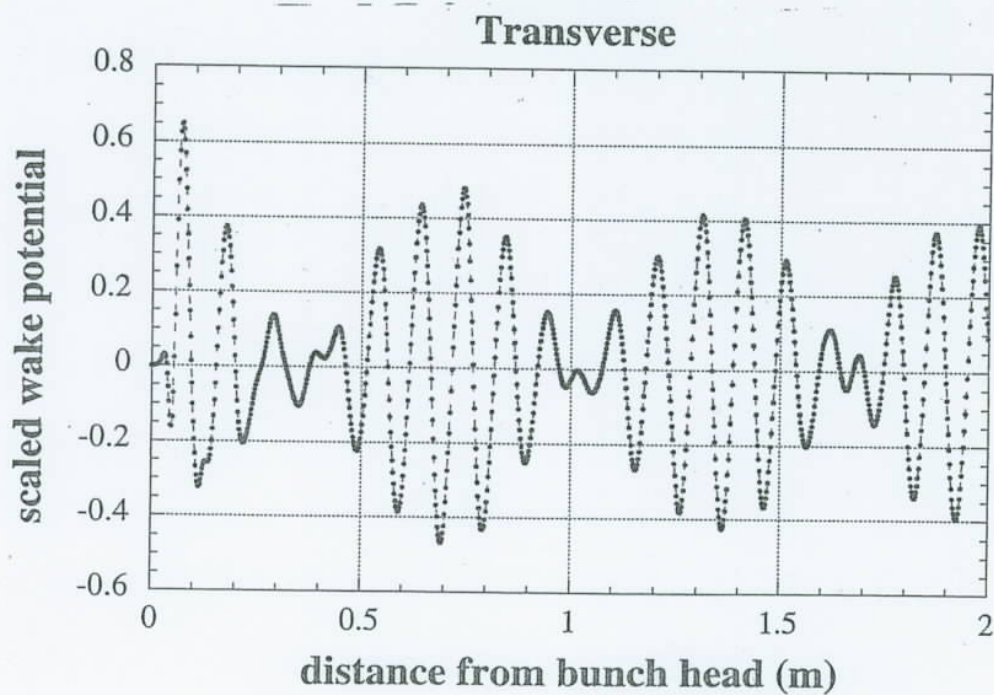
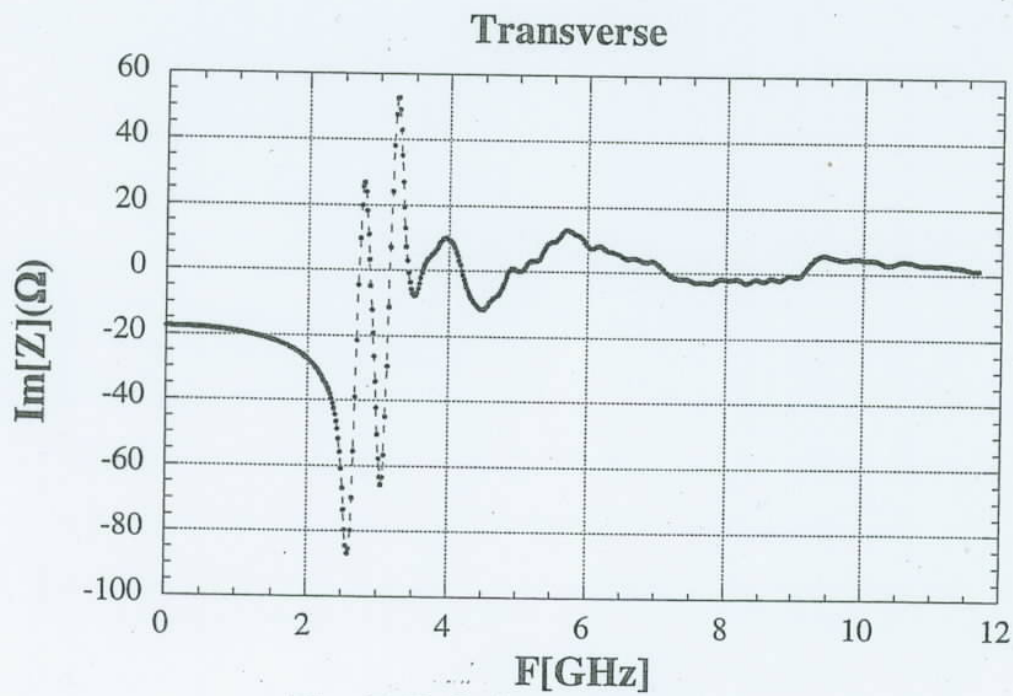
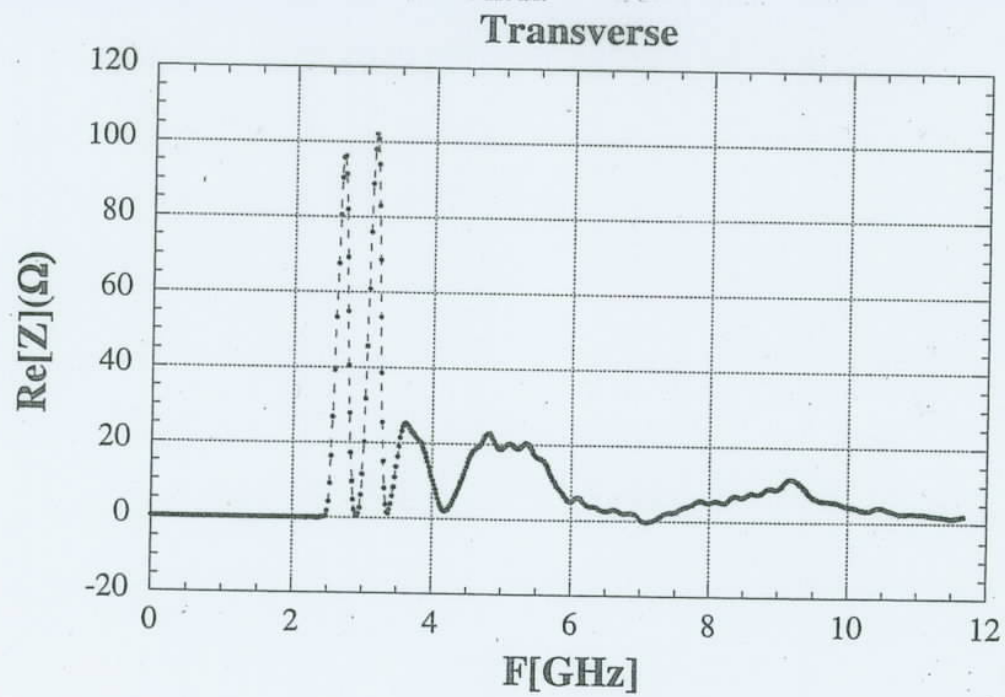


radial scrapers



Longitudinal





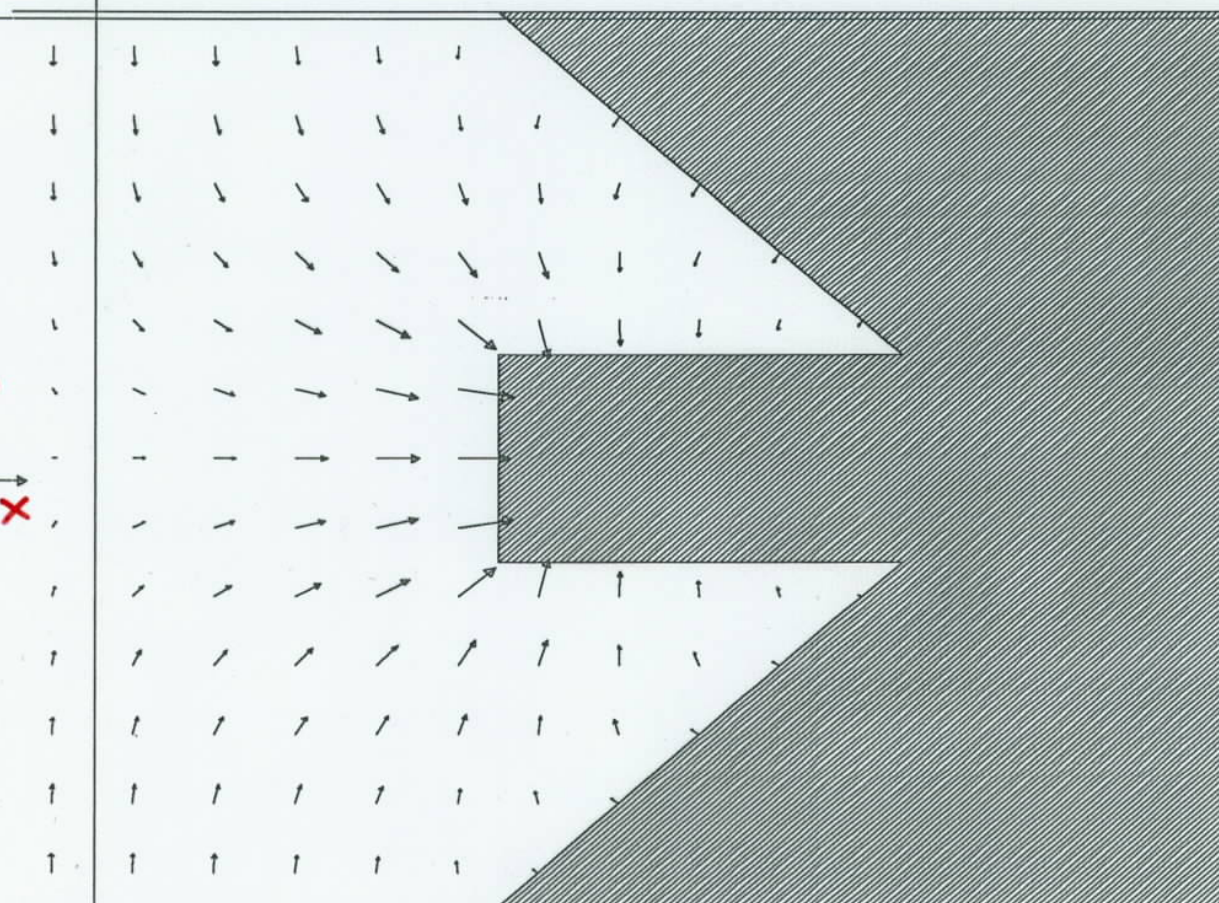
$$F \approx 3.15 \text{ GHz}$$



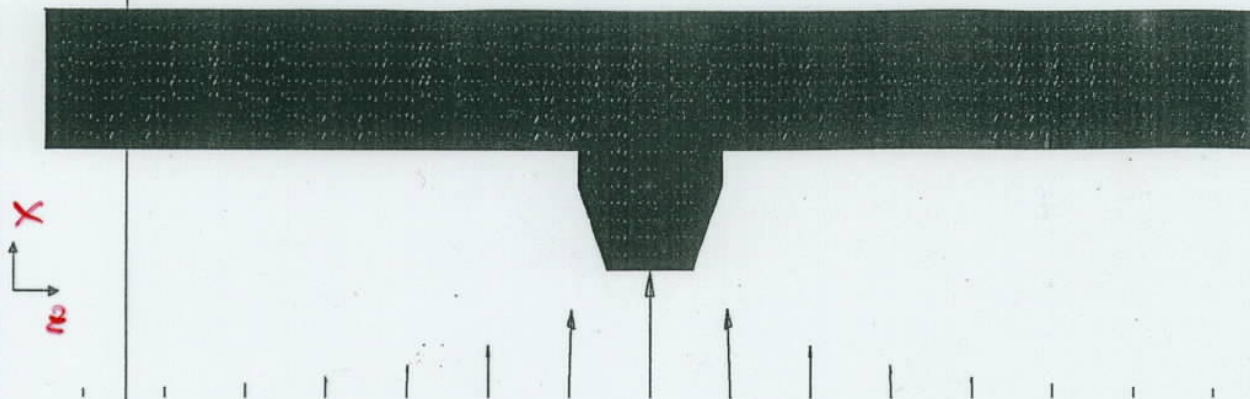
$$R_{SH} \approx 40 \text{ k}\Omega$$

$$Q \approx 8800$$

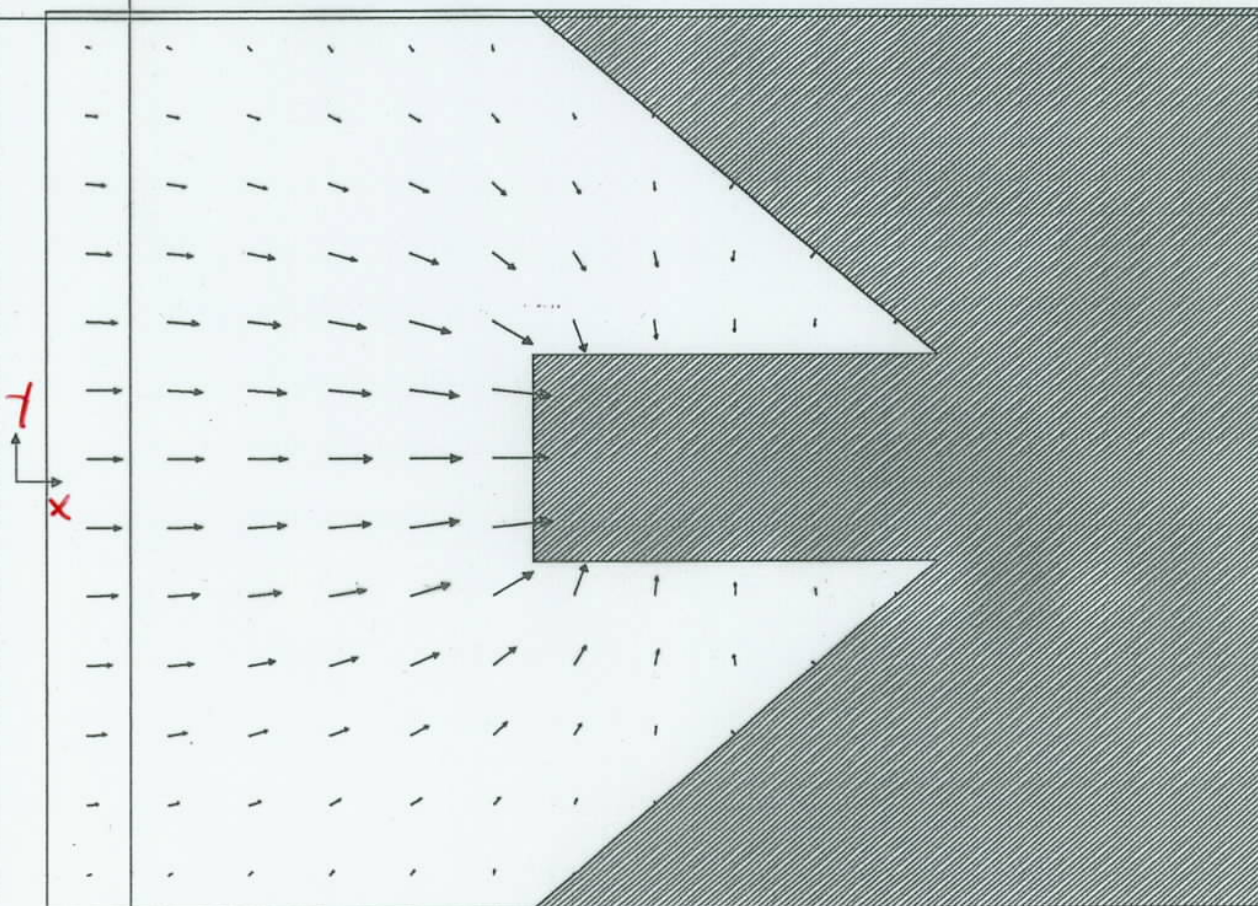
$$R_t \approx 9 \frac{\text{M}\Omega}{\mu\text{m}}$$



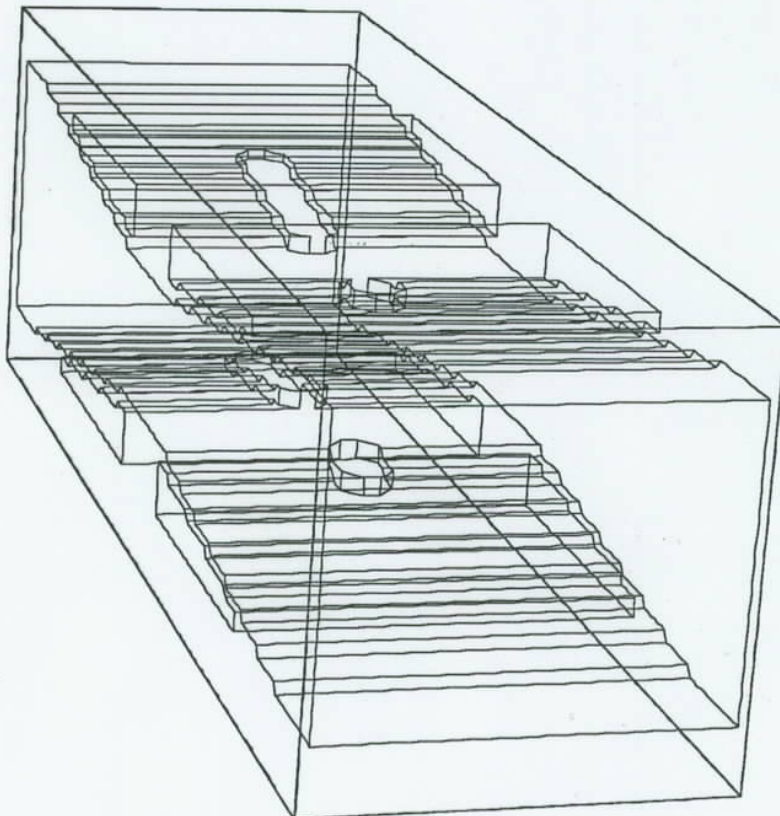
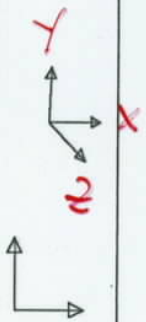
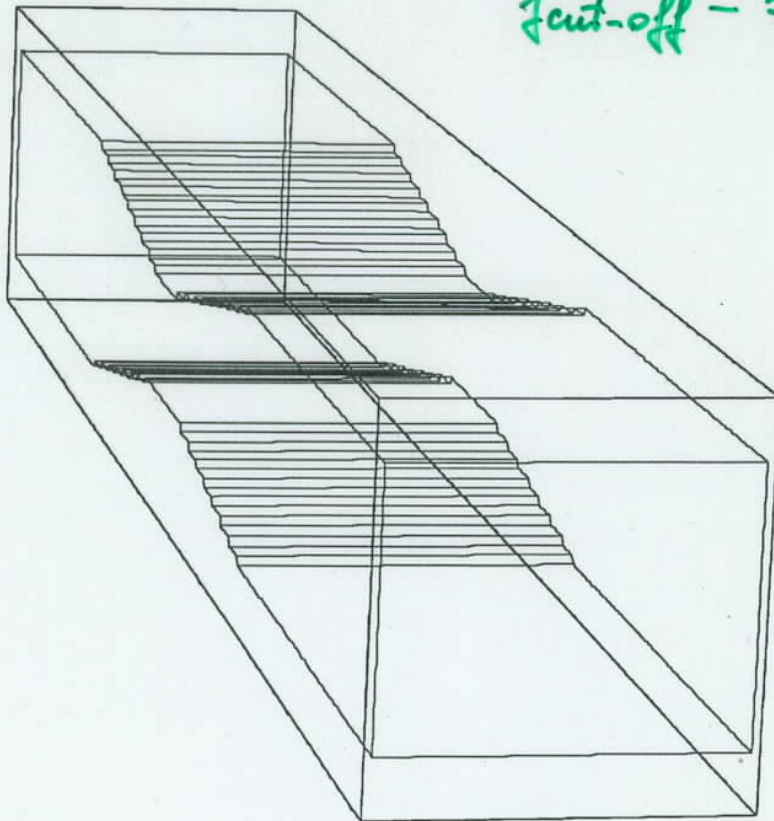
$$F \approx 2.4 \text{ GHz}$$

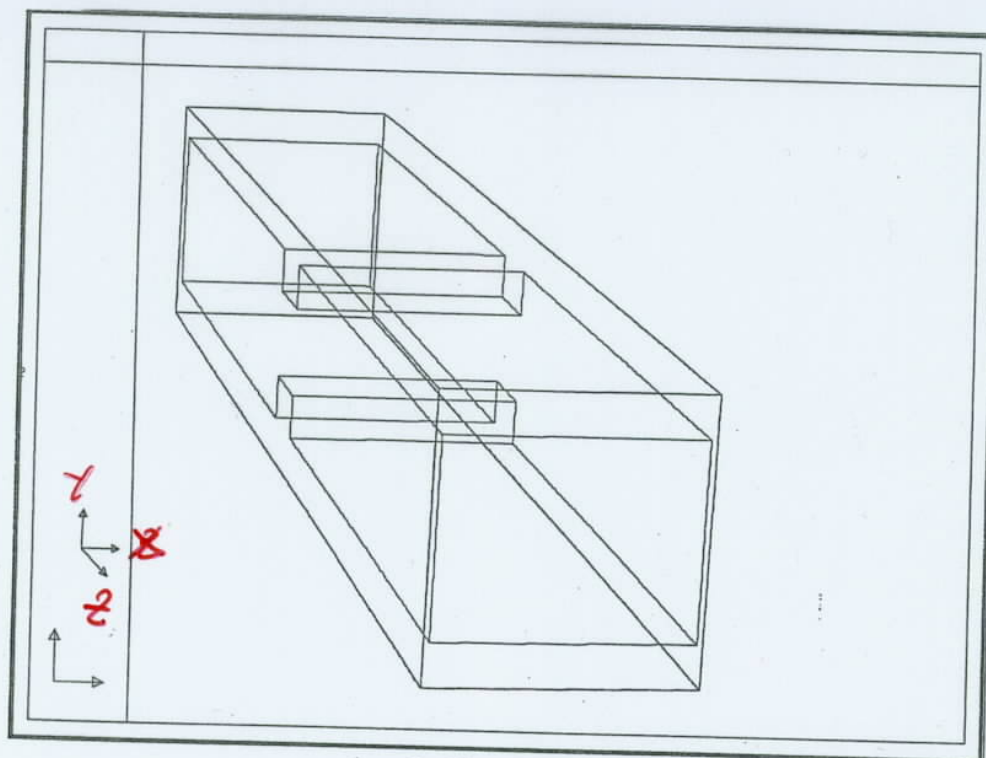


$$R_t \approx 4 \frac{\mu \Omega}{\text{cm}} ; Q = 10970$$

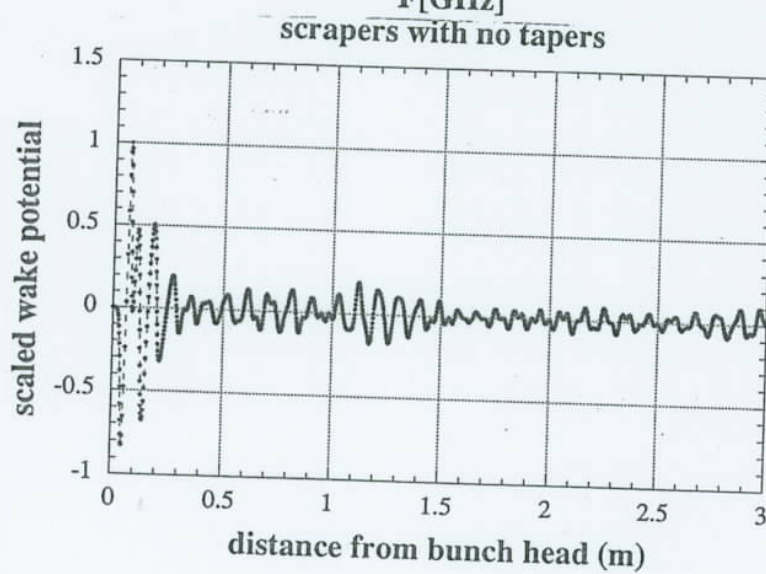
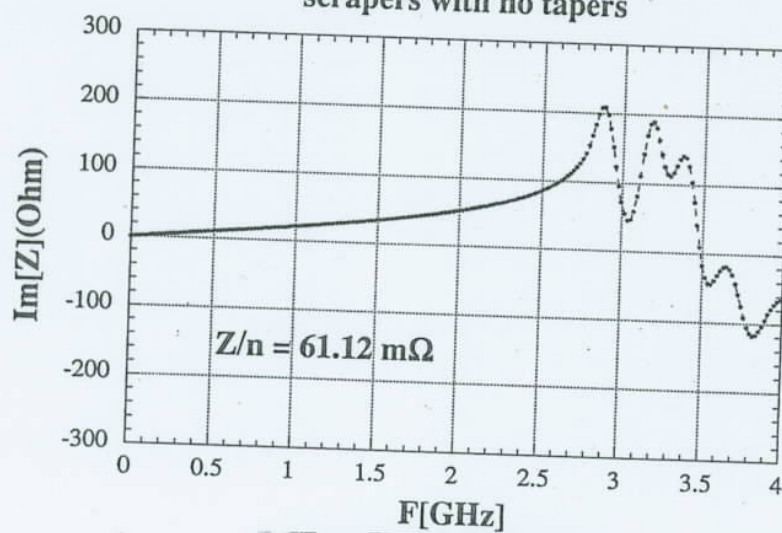


cut-off $\approx 1.7 \text{ GHz}$
(beam pipe)

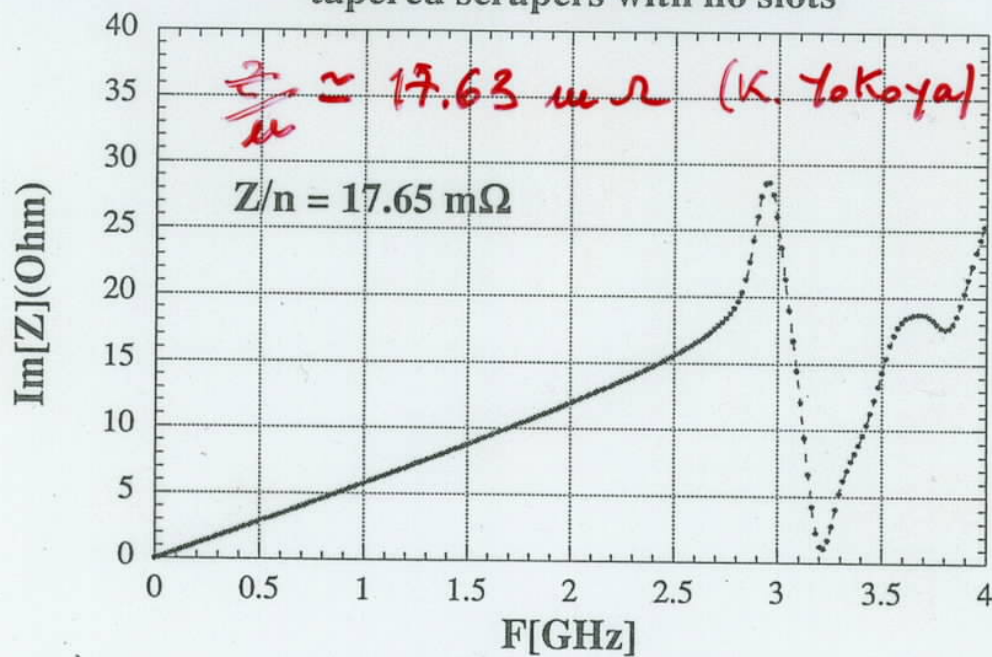




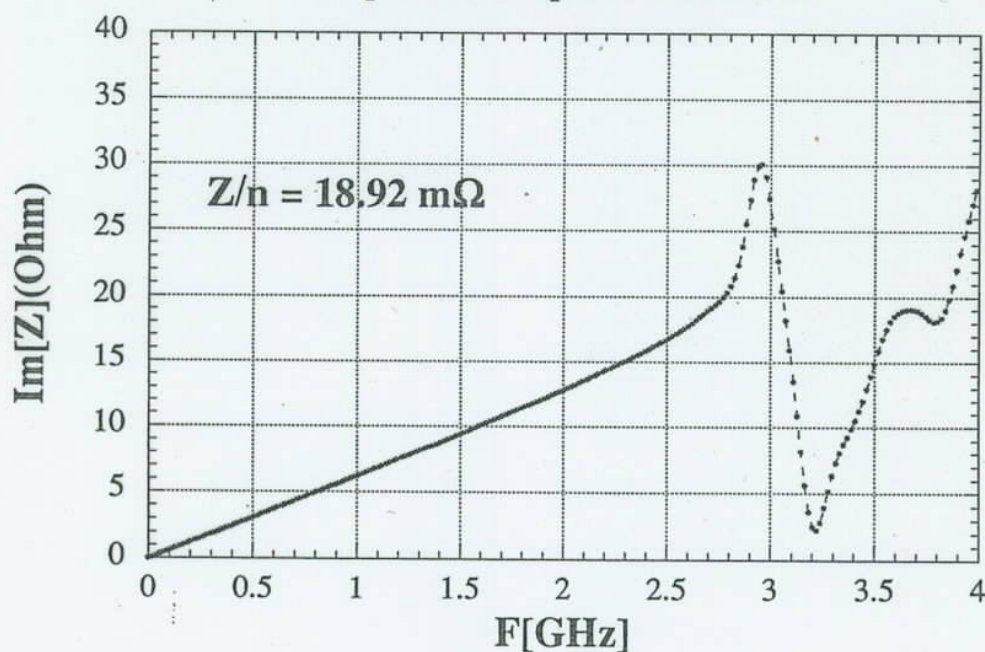
scrapers with no tapers



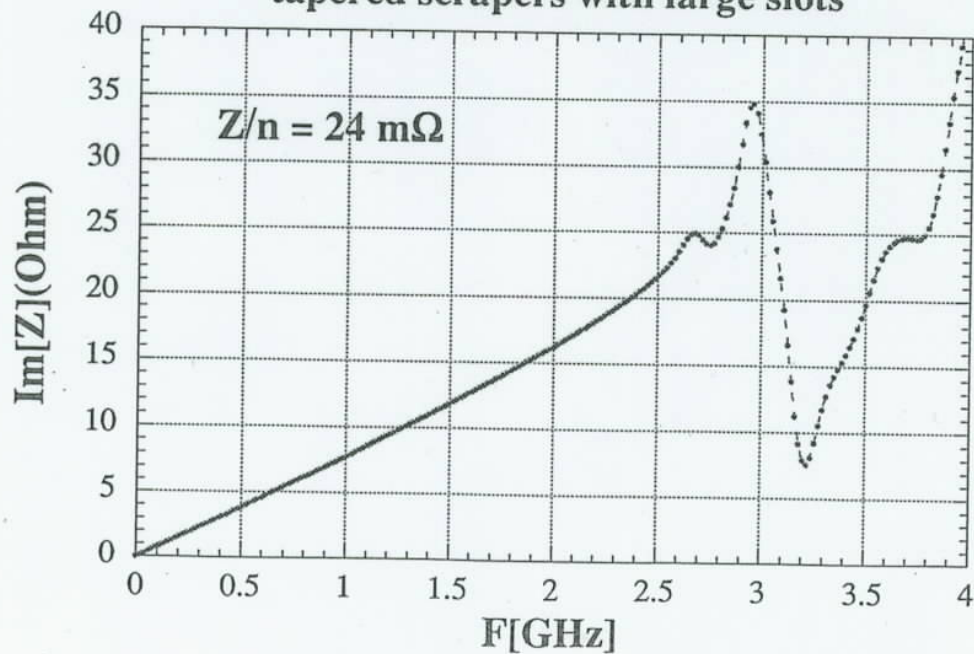
tapered scrapers with no slots



tapered scrapers with slots

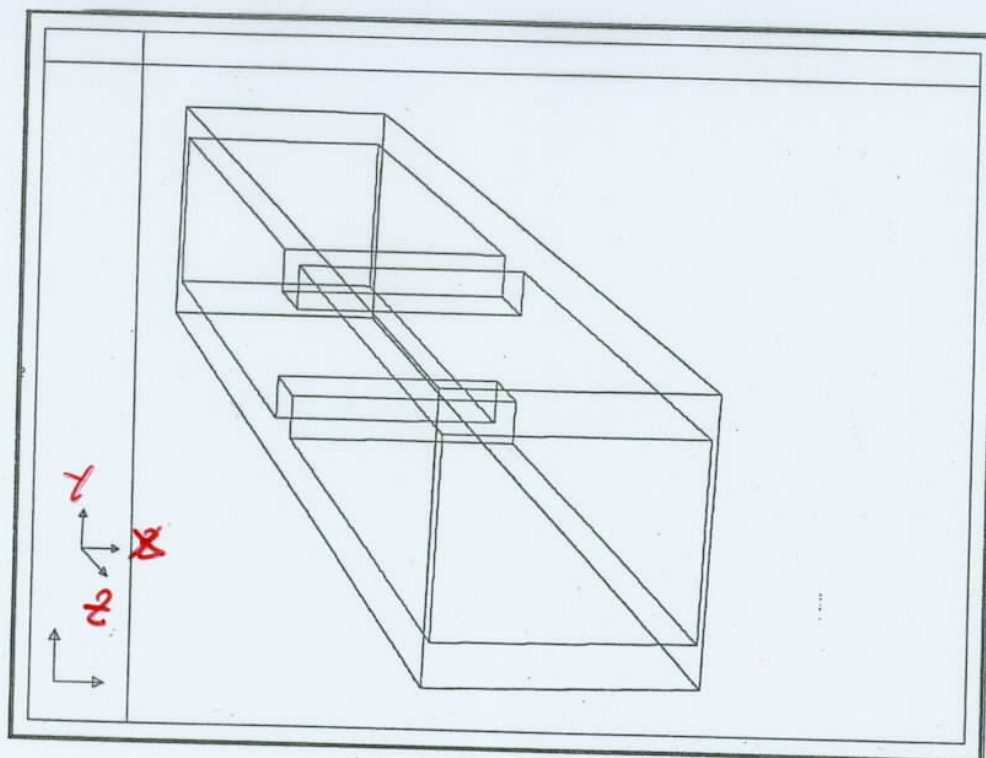


tapered scrapers with large slots



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%.



scrapers with no tapers

