Wakes in Cavities

transverse **short range wake** in TESLA modules and 3rd harmonic cavities

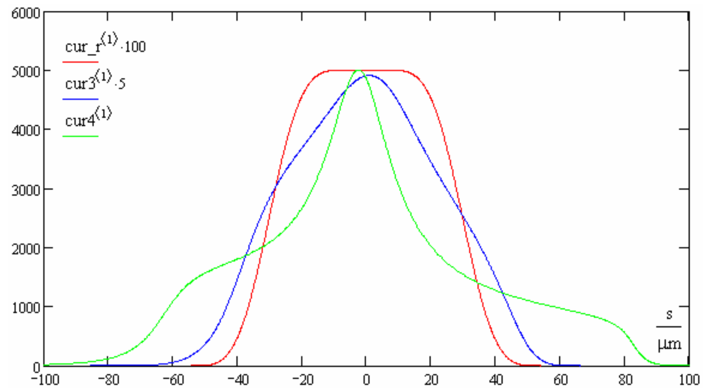
estimated contribution to emittance growth (3rd harm.) !

long range: HOM damping - 3rd harmonic cavities (some bands)

- TESLA cavities

possible working point

1.3 GHz system: 130 MV @ 0 deg --> 130 MeV
447.5 MV @ 0.74 deg --> 577.5 MeV
3.9 GHz system: 97.3 MV @ -142.2 deg --> 500 MeV
BC2 r56 = -103.5 mm --> compression factor = 20
1.3 GHz system: 1500 MV @ 0 deg --> 2000 MeV
BC3 r56 = -20.7 mm --> compression factor = 5



sensitivity (10% change of compression)

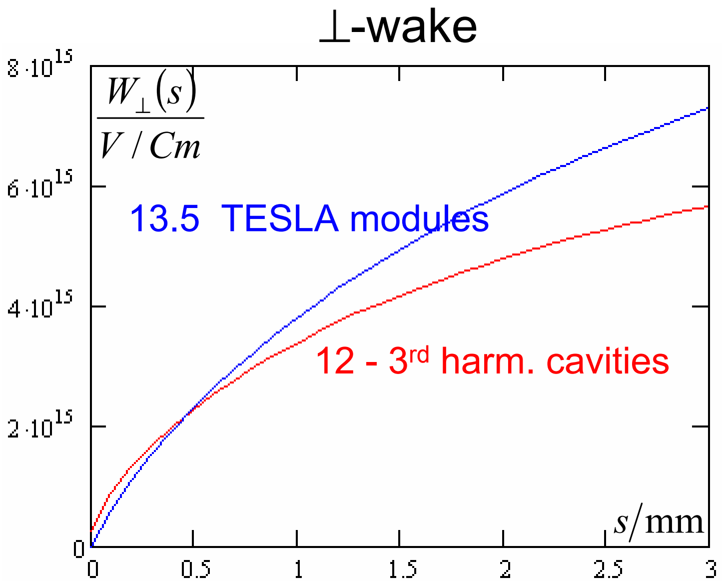
1.3 GHz system before BC2: $|\Delta V| < 0.19$ MV, $|\Delta\varphi| < 0.023$ deg
3.9 GHz system: $|\Delta V| < 0.071$ MV, $|\Delta\varphi| < 0.060$ deg

transverse **short range wake** in TESLA modules and 3rd harmonic cavities

⊥-wake / cavity scales with fundamental mode frequency ** 2

12 / 24 3rd harm. cavities ~ 13 / 27 TESLA modules !

I. Zagorodnov: TESLA Report 2003-19 (TESLA module)
TESLA Report 2004-01 (LOLA & 3rd harm. cavity)

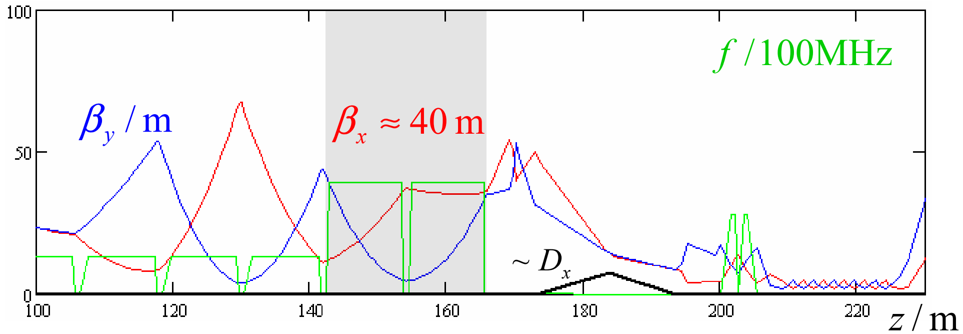


3rd harmonic cavity
emittance growth due to discrete slice centriod kick:

$$\tilde{\varepsilon} \approx \varepsilon \sqrt{1 + \frac{\beta}{\varepsilon} \langle \sigma_{x'} \rangle^2}$$

$$\langle \sigma_{x'} \rangle^2 = \left(\frac{q \cdot \mathrm{rms}\{W_\perp^{(\sigma)}\}}{V_\parallel} \right)^2 \left(N^2 \sigma_s^2 + N \sigma_r^2 \right)$$

systematic and random offset of cavity axis



$q \approx 1$ nC

$\sigma \approx 2.4$ mm

$\gamma_L \varepsilon \approx 1$ µm

$eV_\parallel = 500$ MeV

$N =$ number of cavities

$\sigma_s =$ systematic error

$\sigma_r =$ random error

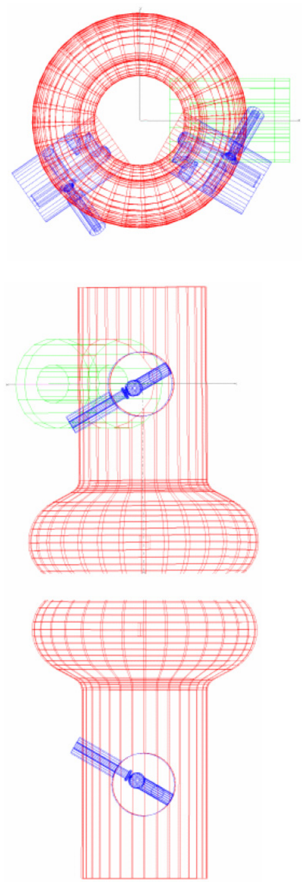
$\frac{\tilde{\varepsilon}}{\varepsilon}$	$\sigma_s = 1$ mm, $\sigma_r = 0$	$\sigma_s = 0$ mm, $\sigma_r = 1$ mm	$\sigma_s = 0$ mm, $\sigma_r = 0.5$ mm	$\sigma_s = 0.1$ mm, $\sigma_r = 0.5$ mm
N=12	1.23	1.02	1.005	1.008
N= 24	1.74	1.04	1.011	1.021

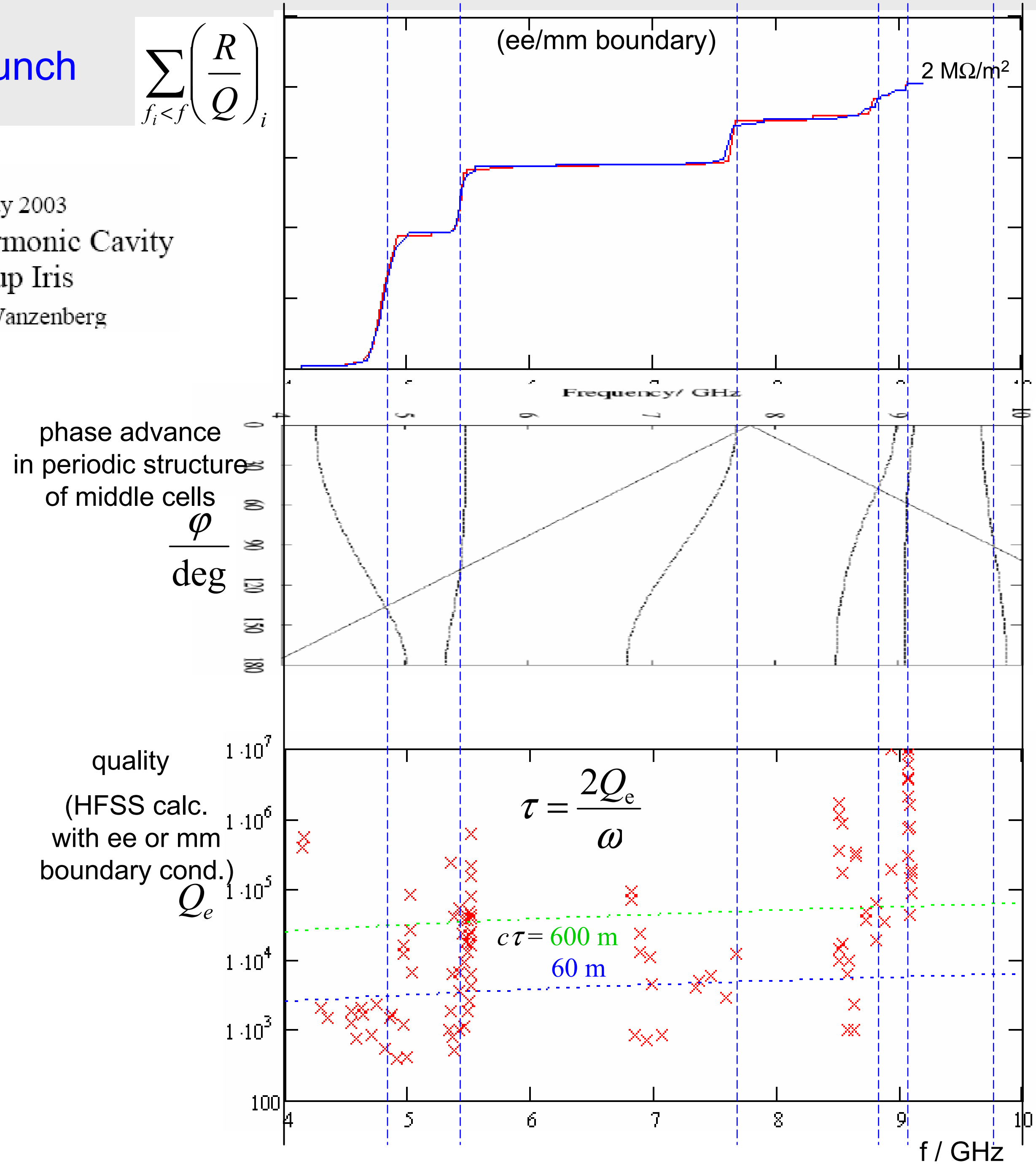
3rd harmonic cavity
long range / multi bunch

FERMILAB-TM-2210
TESLA-FEL 2003-01, May 2003

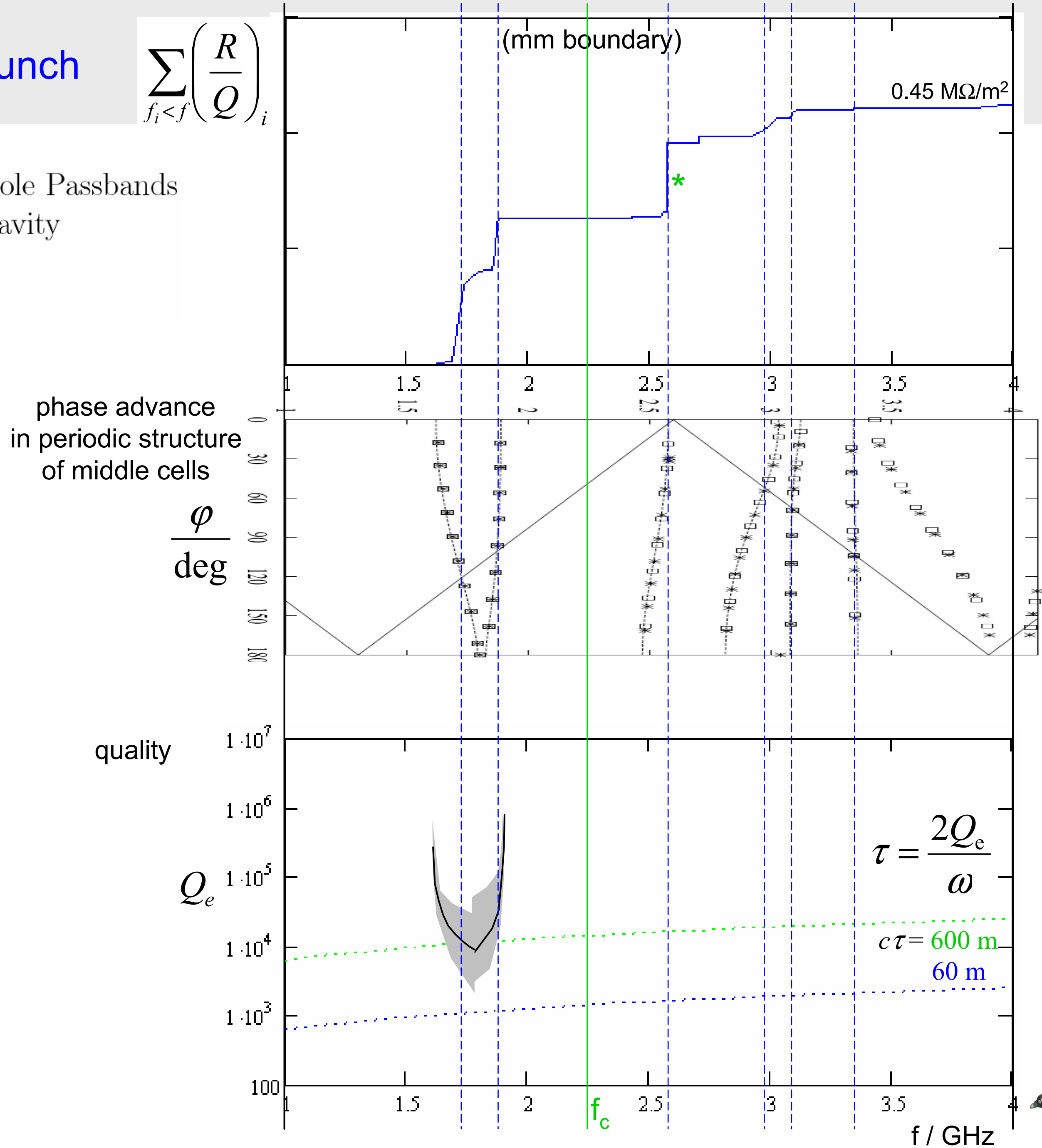
Higher Order Modes of a 3rd Harmonic Cavity with an Increased End-cup Iris

T. Khabibouline N. Solyak R.Wanzenberg



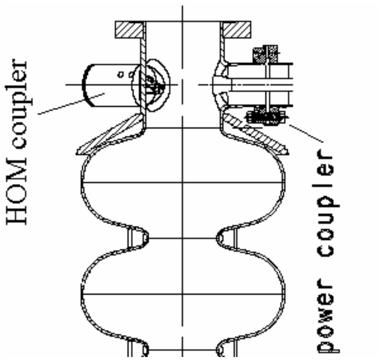


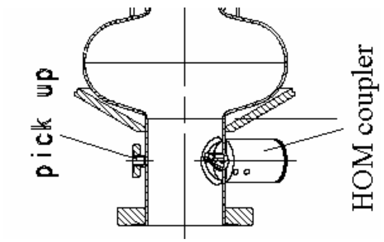
TESLA cavity
long range / multi bunch



Monopole, Dipole and Quadrupole Passbands
of the TESLA 9-cell Cavity

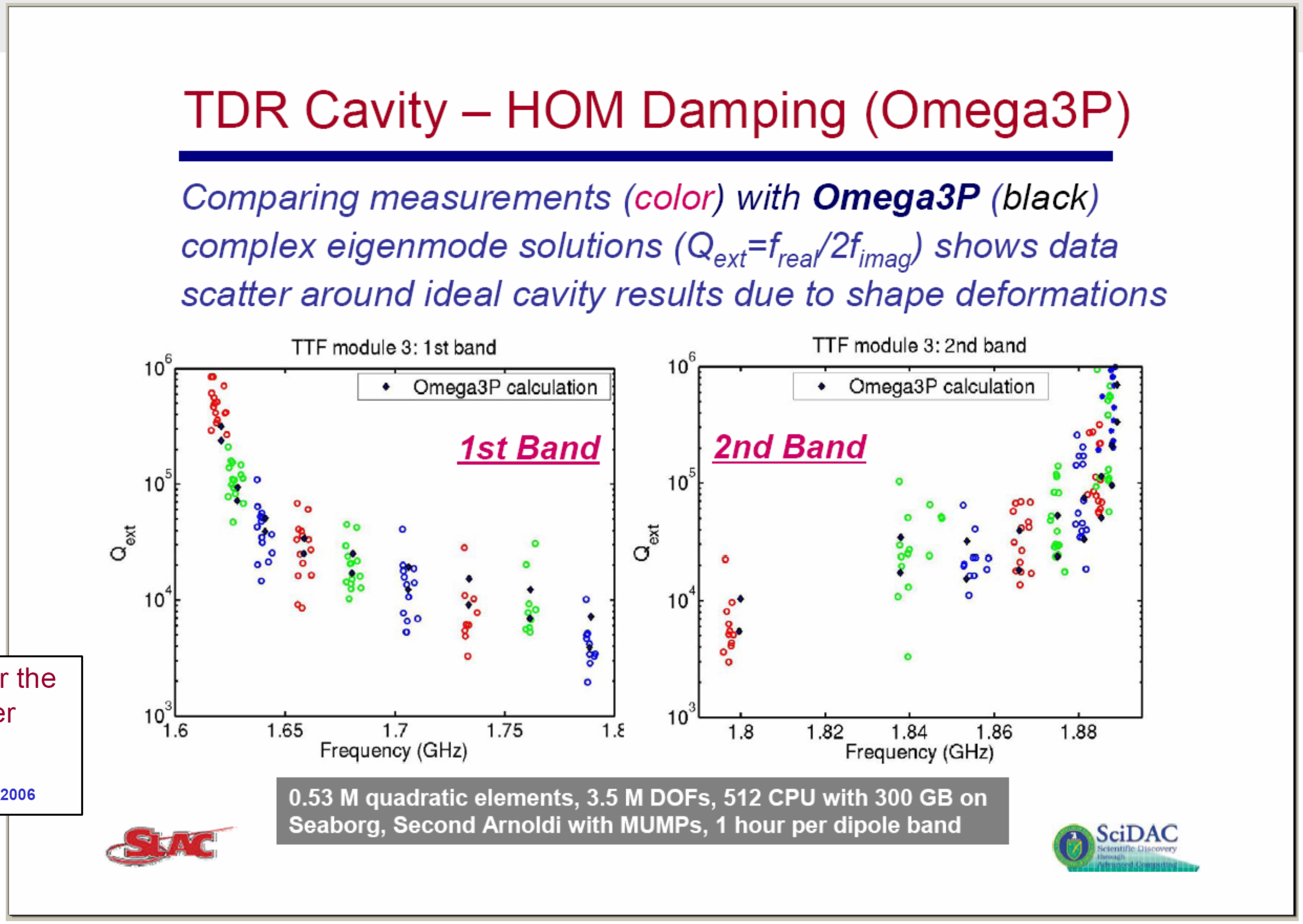
R. Wanzenberg
TESLA 2001-33





* Higher Order Mode Absorption in TTF Modules in the Frequency Range of the 3rd Dipole Band
M. Dohlus, V. Kaljuzhny, S.G.Wipf
TESLA 2002-05

TESLA cavity 1^{st} & 2^{nd} dipole band



from:

Accelerating Cavity Design for the International Linear Collider

A. Kabel, …

ICAP 2006, Chamonix Mont-Blanc, October 2-6, 2006

scatter of Q values ~ factor ten

??? field distribution

coupler tuning