

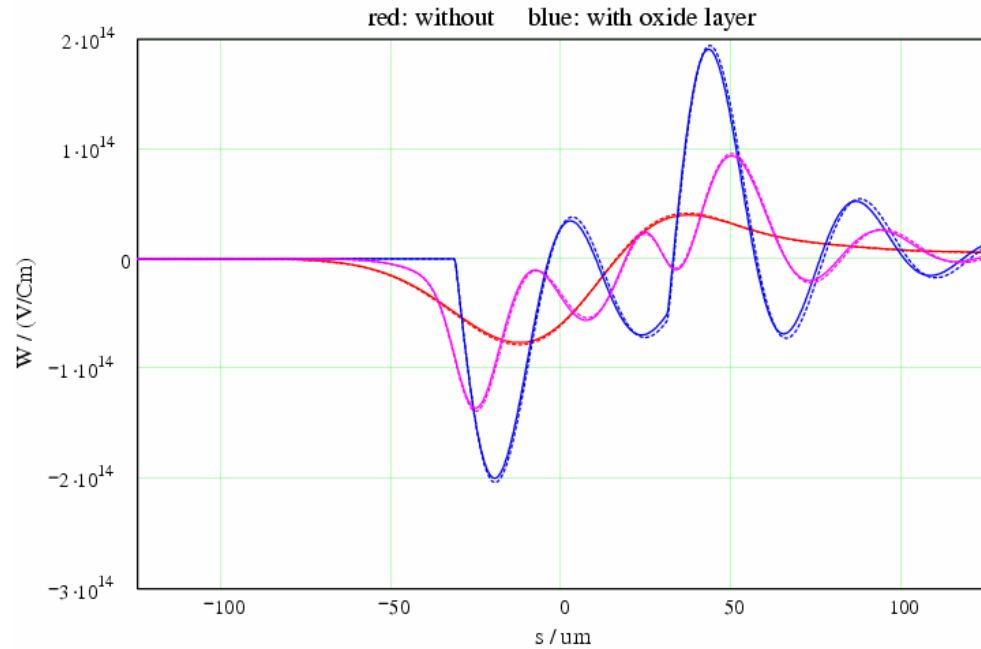
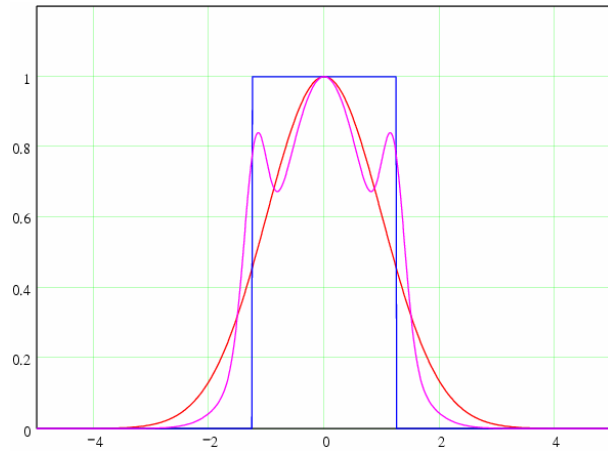
undulator wakes

1. resistive wall wake in round pipe ($r = 4.5$ mm)
bunch shape: gaussian / rectangular / "g3"
material: cu / al / au with/without oxide
2. resistive wall wake, elliptic cross section
estimation from Holger's DA
3. screens
4. resistive wakes \leftrightarrow screen / length
5. losses

round cu pipe, 1nm oxide

bunch: $\sigma = 2.5 \times 10^{-5}$

pipe: $R = 4.5 \times 10^{-3}$ $\kappa_0 = 5.8 \times 10^7$ $\tau = 2.46 \times 10^{-14}$ (this is cu)
 $\Delta = 1 \times 10^{-9}$ $\epsilon_\Delta = 4$

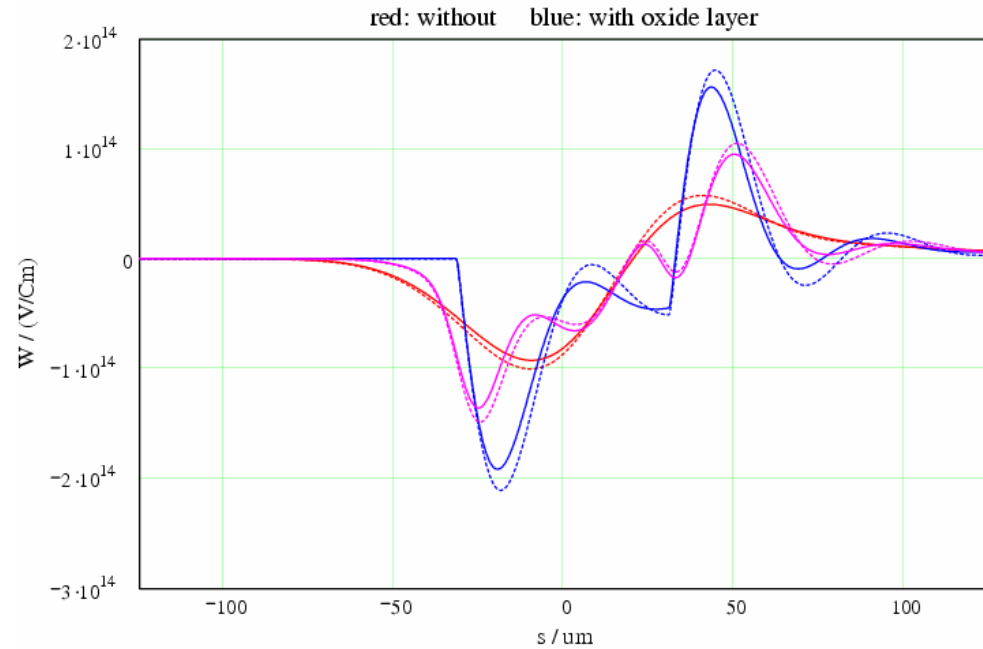
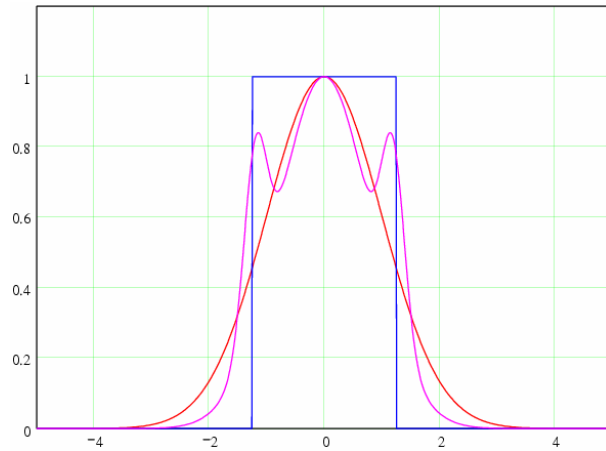


	without oxide layer:	with oxide layer:
Gauss:	$K_{met_av1} \cdot 10^{-12} = -31.109$ $K_{met_rms1} \cdot 10^{-12} = 39.469$	$K_{met_ox_av1} \cdot 10^{-12} = -31.486$ $K_{met_ox_rms1} \cdot 10^{-12} = 40.654$
rect:	$K_{met_av2} \cdot 10^{-12} = -65.095$ $K_{met_rms2} \cdot 10^{-12} = 71.019$	$K_{met_ox_av2} \cdot 10^{-12} = -65.858$ $K_{met_ox_rms2} \cdot 10^{-12} = 73.773$
3g:	$K_{met_av3} \cdot 10^{-12} = -37$ $K_{met_rms3} \cdot 10^{-12} = 44.709$	$K_{met_ox_av3} \cdot 10^{-12} = -37.406$ $K_{met_ox_rms3} \cdot 10^{-12} = 45.461$

round al pipe, 5nm oxide

bunch: $\sigma = 2.5 \times 10^{-5}$

pipe: $R = 4.5 \times 10^{-3}$ $\kappa_0 = 3.66 \times 10^7$ $\tau = 7.1 \times 10^{-15}$ (this is al)
 $\Delta = 5 \times 10^{-9}$ $\epsilon_\Delta = 4$

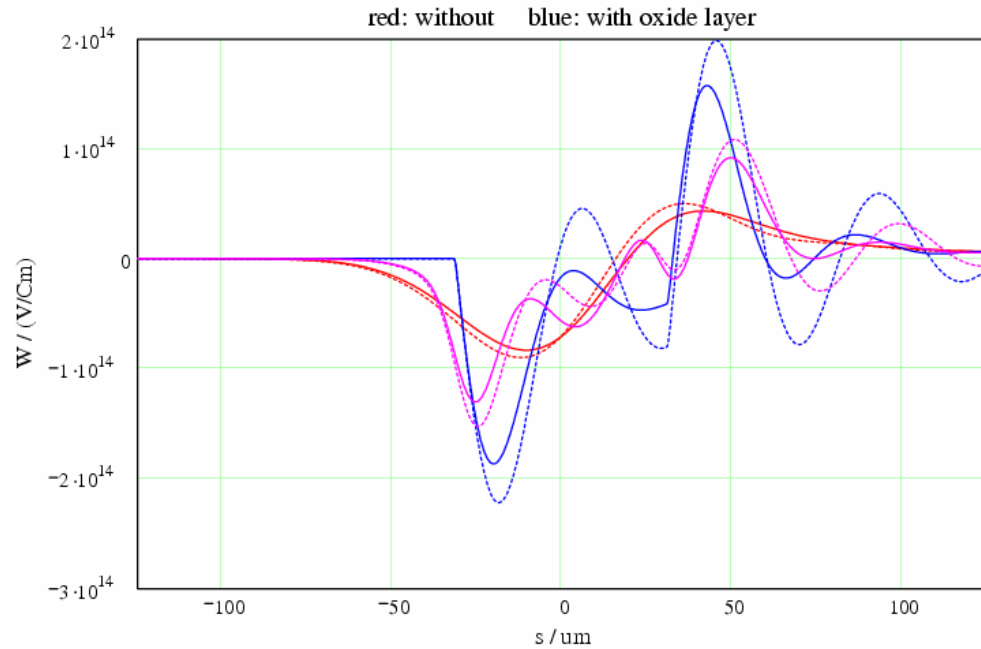
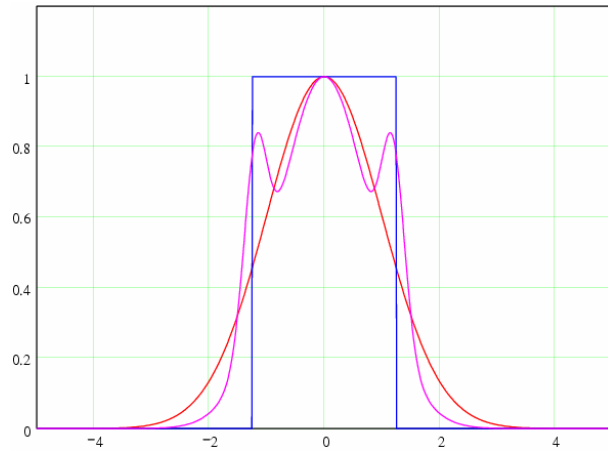


	without oxide layer:	with oxide layer:
Gauss:	$K_{met_av1} \cdot 10^{-12} = -42.932$ $K_{met_rms1} \cdot 10^{-12} = 45.549$	$K_{met_ox_av1} \cdot 10^{-12} = -44.43$ $K_{met_ox_rms1} \cdot 10^{-12} = 51.212$
rect:	$K_{met_av2} \cdot 10^{-12} = -77.337$ $K_{met_rms2} \cdot 10^{-12} = 58.337$	$K_{met_ox_av2} \cdot 10^{-12} = -80.462$ $K_{met_ox_rms2} \cdot 10^{-12} = 70.001$
3g:	$K_{met_av3} \cdot 10^{-12} = -49.505$ $K_{met_rms3} \cdot 10^{-12} = 43.192$	$K_{met_ox_av3} \cdot 10^{-12} = -50.999$ $K_{met_ox_rms3} \cdot 10^{-12} = 48.329$

round au pipe, no oxide

bunch: $\sigma = 2.5 \times 10^{-5}$

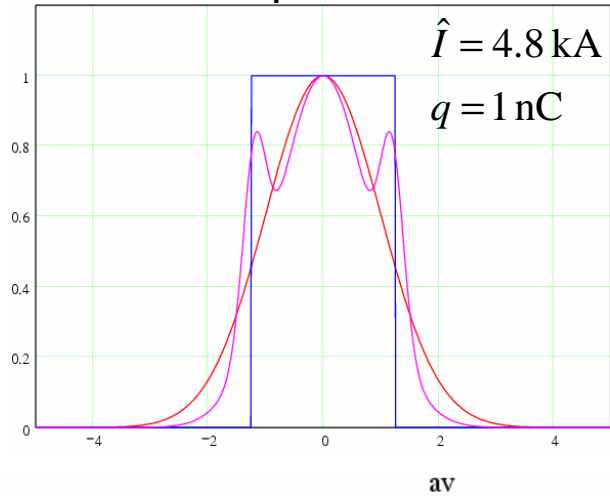
pipe: $R = 4.5 \times 10^{-3}$ $\kappa_0 = 4.52 \times 10^7$ $\tau_1 = 1 \times 10^{-14}$ **(this is au)**
 $\Delta = 1 \times 10^{-9}$ $\epsilon_\Delta = 4$ $\tau_2 = 3 \times 10^{-14}$



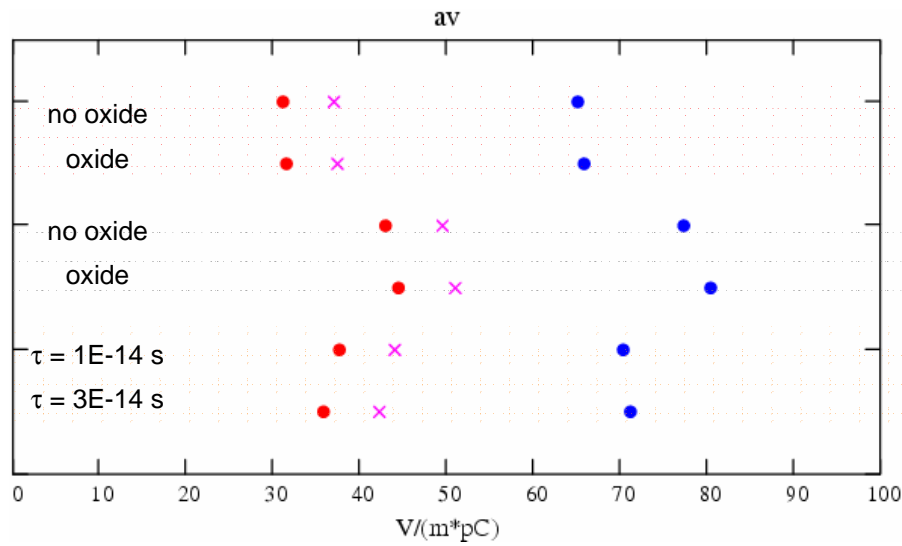
	tau = 1E-14 sec:	tau = 3e-14 sec:
Gauss:	$K_{au_av1} \cdot 10^{-12} = -37.616$	$K_{auu_av1} \cdot 10^{-12} = -35.796$
	$K_{au_rms1} \cdot 10^{-12} = 41.313$	$K_{auu_rms1} \cdot 10^{-12} = 47.475$
rect:	$K_{au_av2} \cdot 10^{-12} = -70.367$	$K_{auu_av2} \cdot 10^{-12} = -71.18$
	$K_{au_rms2} \cdot 10^{-12} = 57.199$	$K_{auu_rms2} \cdot 10^{-12} = 85.003$
3g:	$K_{au_av3} \cdot 10^{-12} = -44.011$	$K_{auu_av3} \cdot 10^{-12} = -42.217$
	$K_{au_rms3} \cdot 10^{-12} = 41.424$	$K_{auu_rms3} \cdot 10^{-12} = 49.058$

summary: resistive wakes round pipe, $r = 4.5\text{mm}$

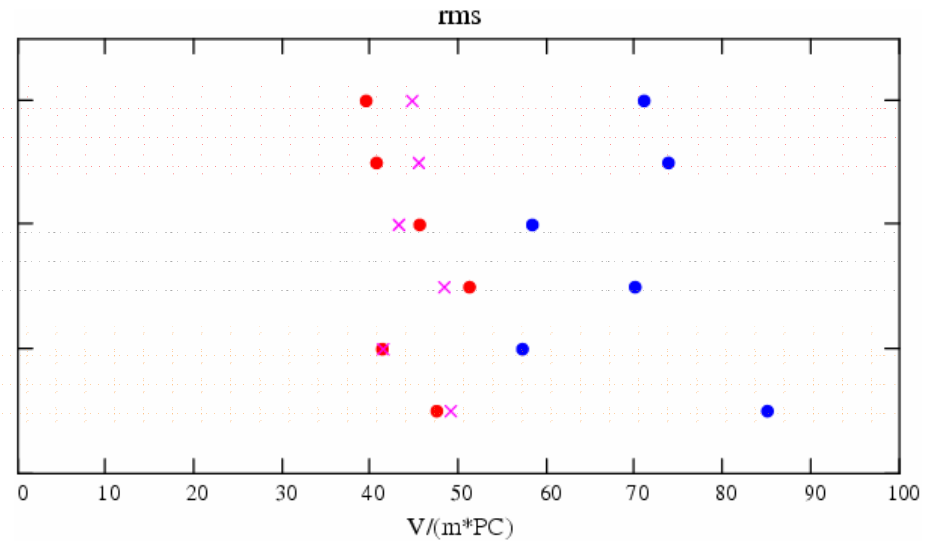
bunch shapes



$\sigma = 50\ \mu\text{m}$
 $b = 4.75\text{ mm}$
 $L = 28.7\text{ m}$
 $E_0 = 1\text{ GeV}$

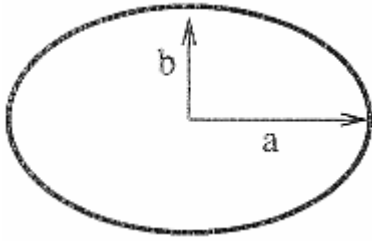


cu
al
ag



elliptic cross section

Holger Schlarb, DA
K. Yokoya: RWAC

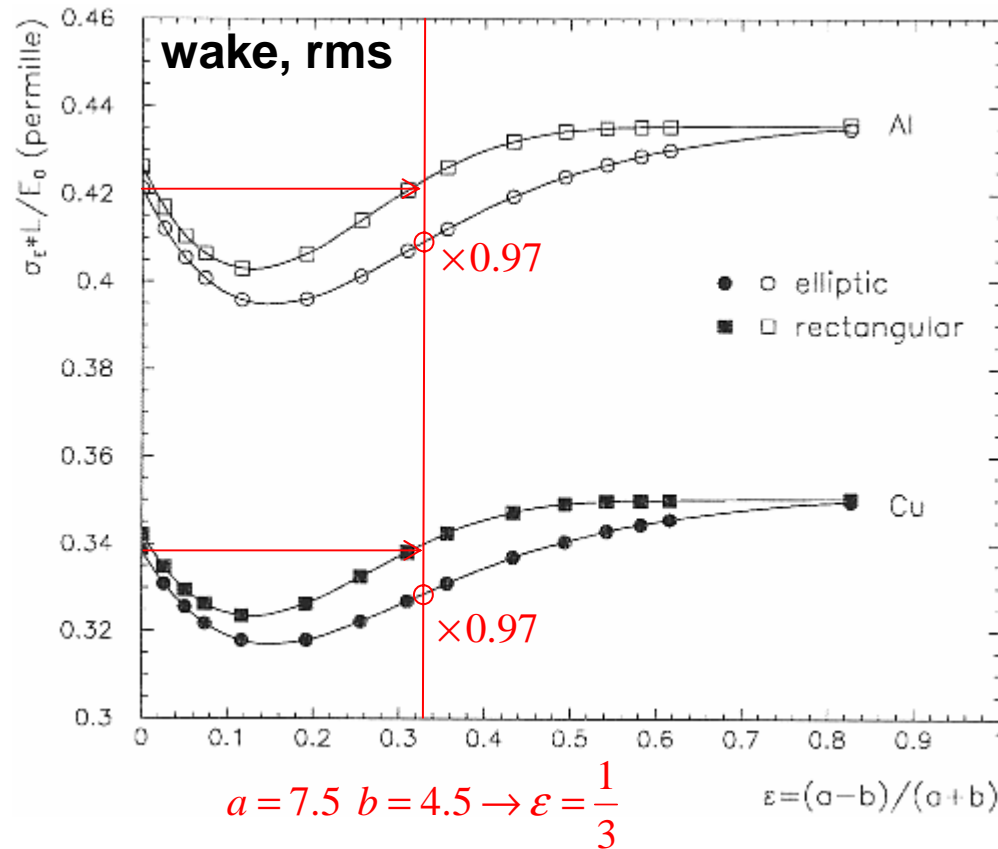


$$\sigma = 50 \mu\text{m}$$

$$b = 4.75 \text{ mm}$$

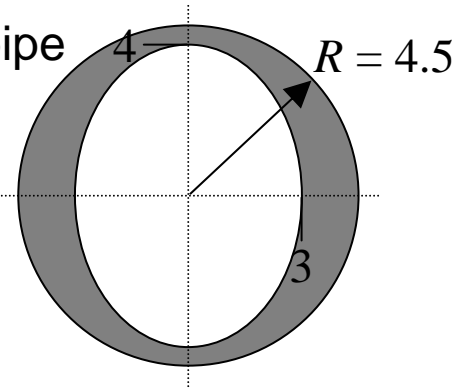
$$L = 28.7 \text{ m}$$

$$E_0 = 1 \text{ GeV}$$

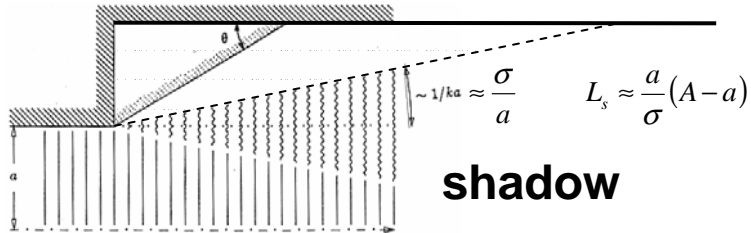
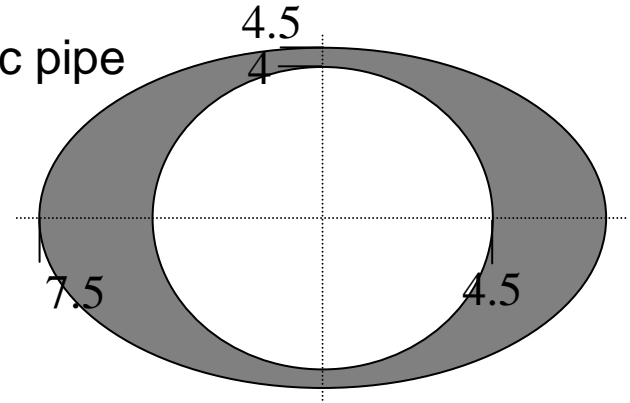


screens

round pipe



elliptic pipe



shadow

$$L_s \approx 8 \dots 18 \text{ cm}$$

$$L_s \approx 8 \dots 54 \text{ cm}$$

wake

Gaussian, $av / V/pC$

-110

-92

rms / V/pC

43.7

36.2

rectangular, $av / V/pC$

-156

-130

rms / V/pC

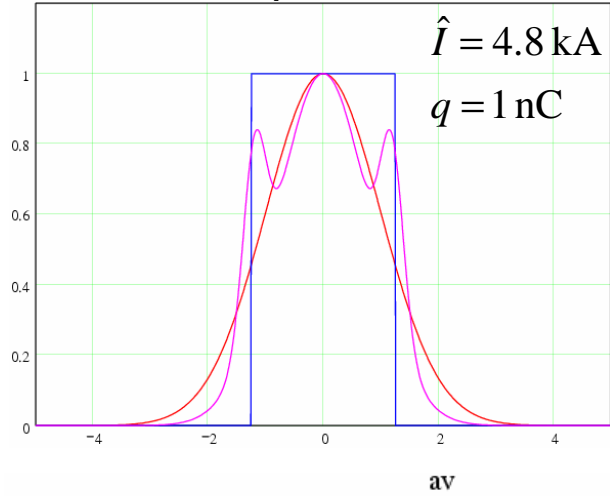
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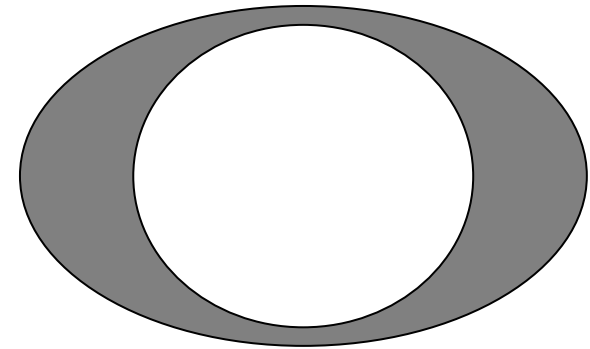
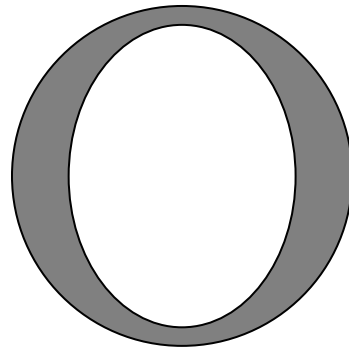
resistive wakes \leftrightarrow screen / length

length = 5m

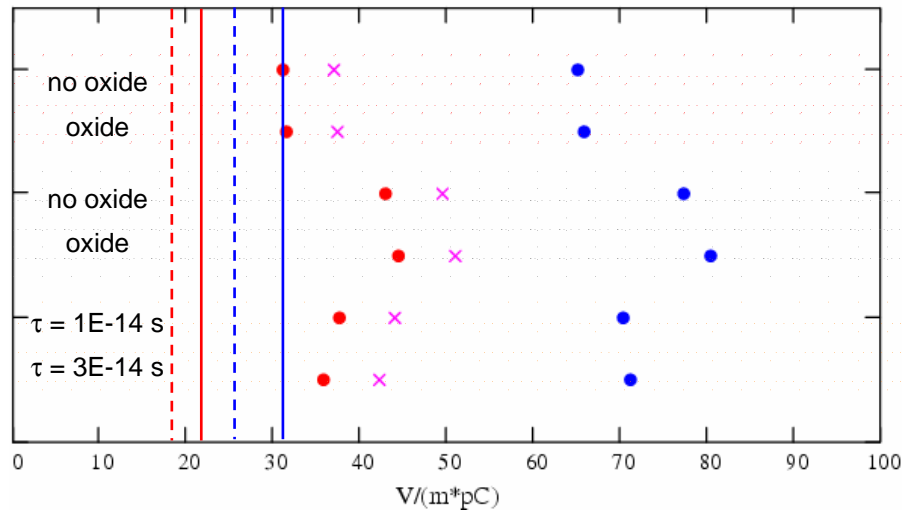
bunch shapes



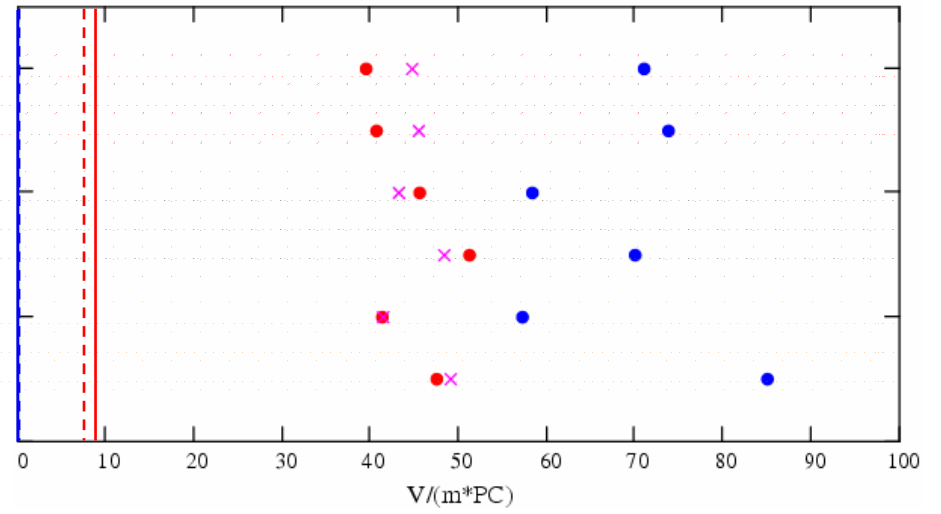
screen shapes



rms



cu
al
ag



losses

e.g. cu, Gaussian $\sigma = 25\mu\text{m}$, 1 nC, no oxide

$$\text{round pipe } r = 4.5 \text{ mm} \quad k_{av} \approx -31.1 \frac{\text{V}}{\text{m} \cdot \text{pC}}$$

$$\text{screen / 5m} \quad k_{av} \approx -\frac{110}{5\text{m}} \frac{\text{V}}{\text{pC}}$$

4000 bunches / train, $f_{\text{rep}} = 10 \text{ Hz}$

$$P' = N_b f_{\text{rep}} q^2 \sum k_{av} = 2.1 \frac{\text{W}}{\text{m}}$$

ERL: 10^6 bunches

$$P' = 53.1 \frac{\text{W}}{\text{m}}$$