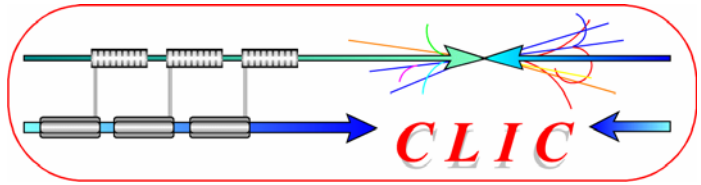


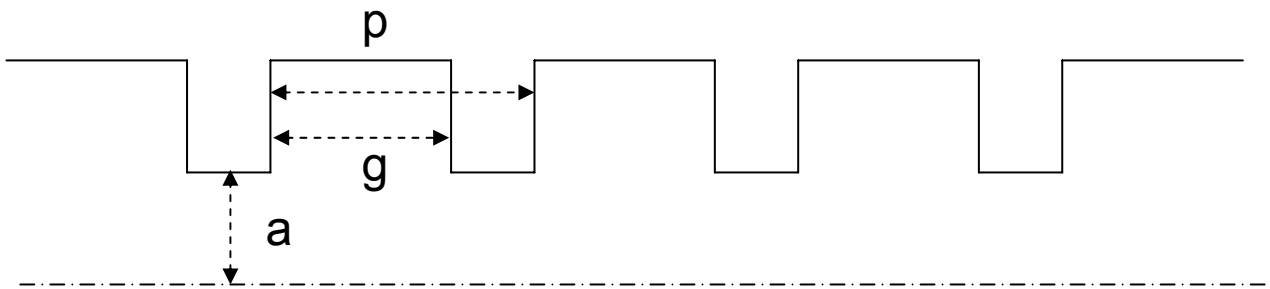
Short-range wakefields

R. Zennaro

Introduction

- Validity and limits of Karl Bane function
- 2D and 3D codes
- Possible modification of K. B. function
- Comments on non-periodic structure and rounded irises effects

K.B. for periodic structures



Longitudinal wake function

$$W(s) = \frac{Z_0 c}{\pi a^2} \exp\left(-\sqrt{s/s_1}\right)$$

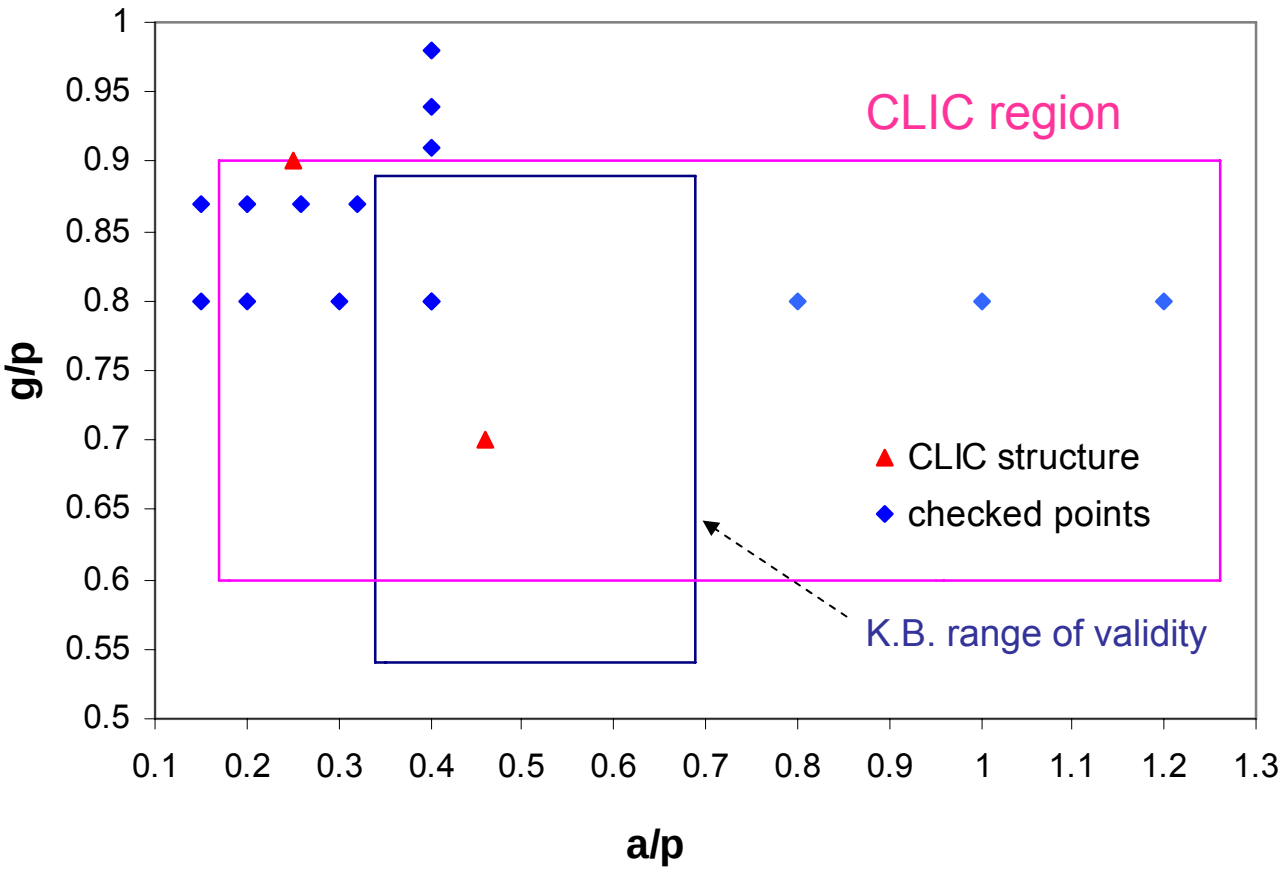
$$s_1 = 0.41 \frac{a^{1.8} g^{1.6}}{p^{2.4}}$$

Transverse wake function

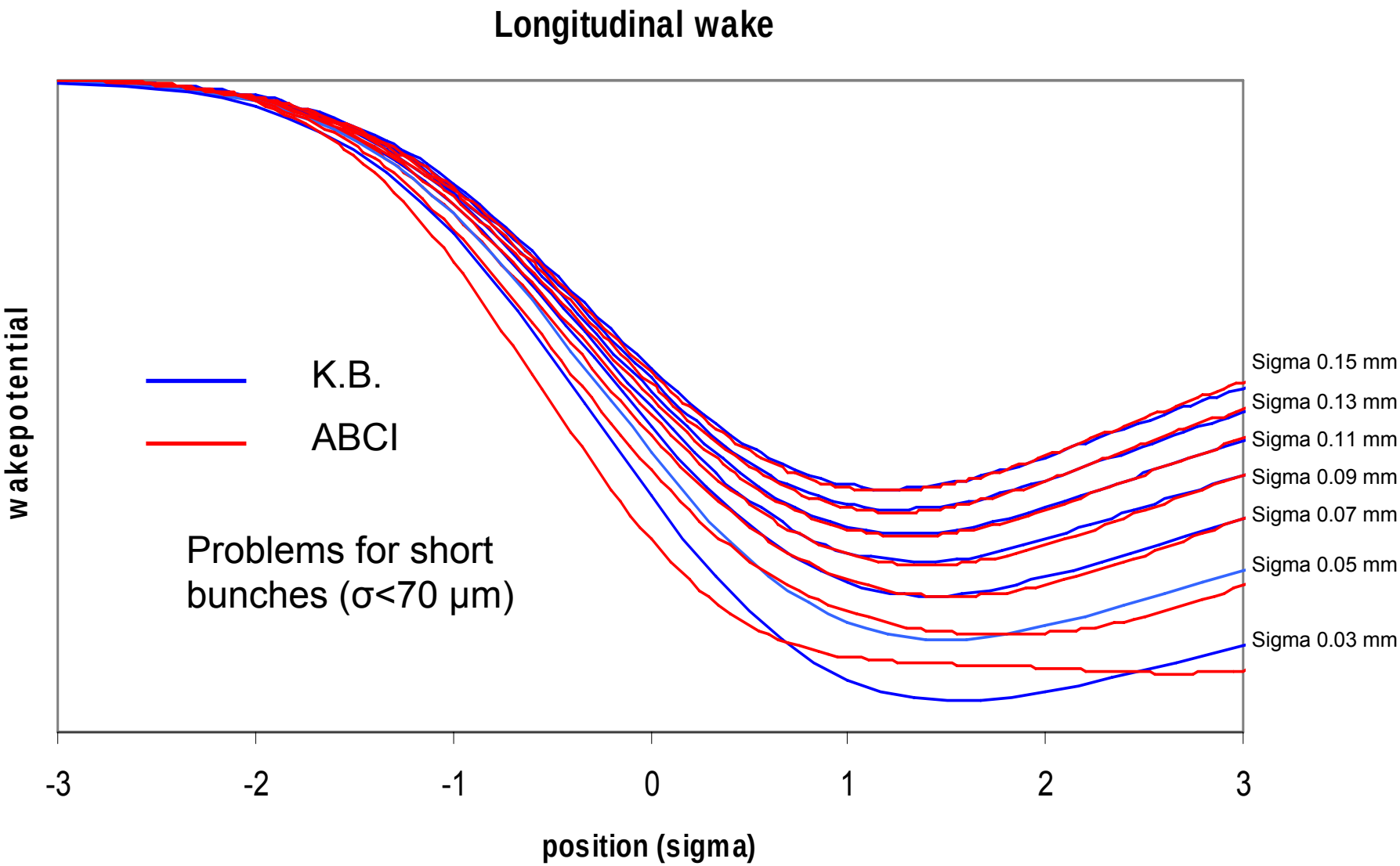
$$W_x(s) = \frac{4 Z_0 c s_0}{\pi a^4} \left[1 - \left(1 + \sqrt{\frac{s}{s_0}}\right) \exp\left(-\sqrt{\frac{s}{s_0}}\right)\right]$$

$$s_0 = 0.17 \frac{a^{1.79} g^{0.38}}{p^{1.17}}$$

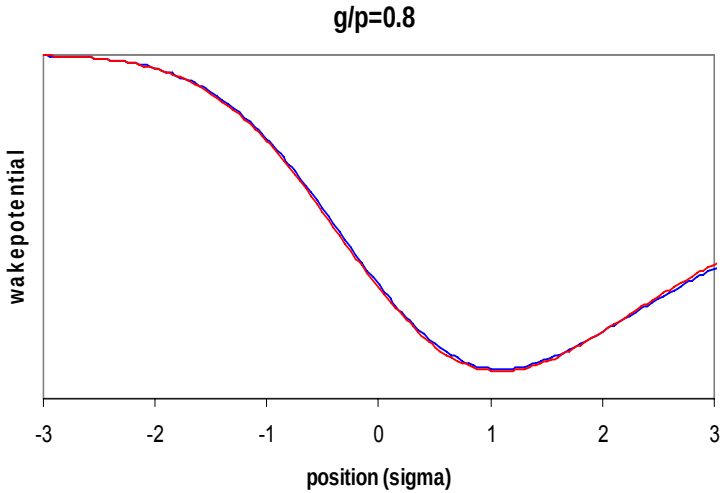
Range of validity

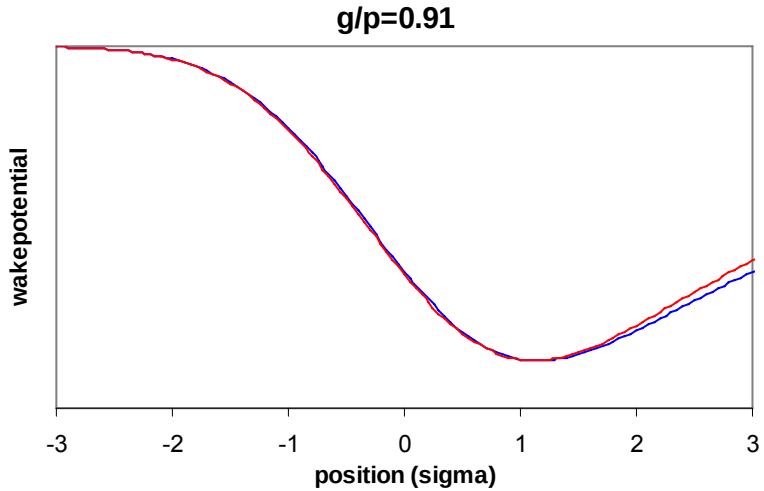


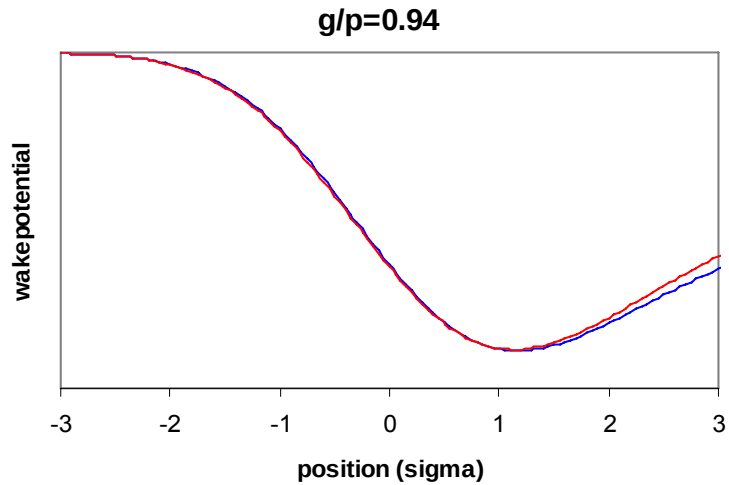
2D codes: ABCI

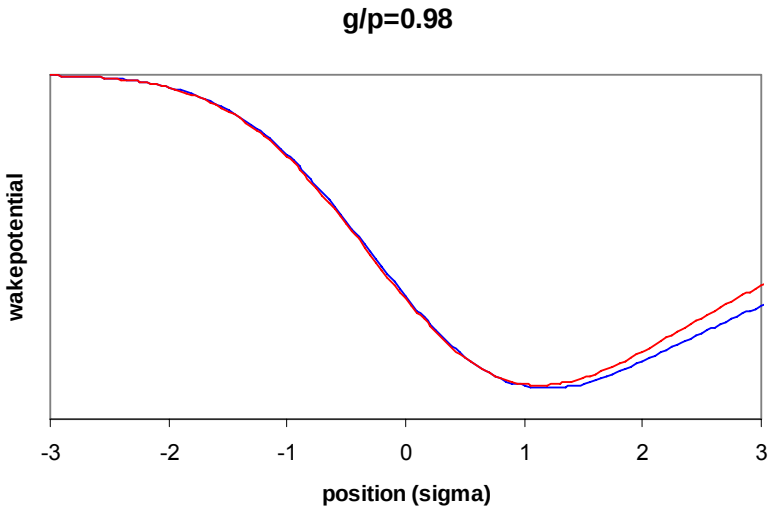


Longitudinal K.B.: Range of validity (g/p)

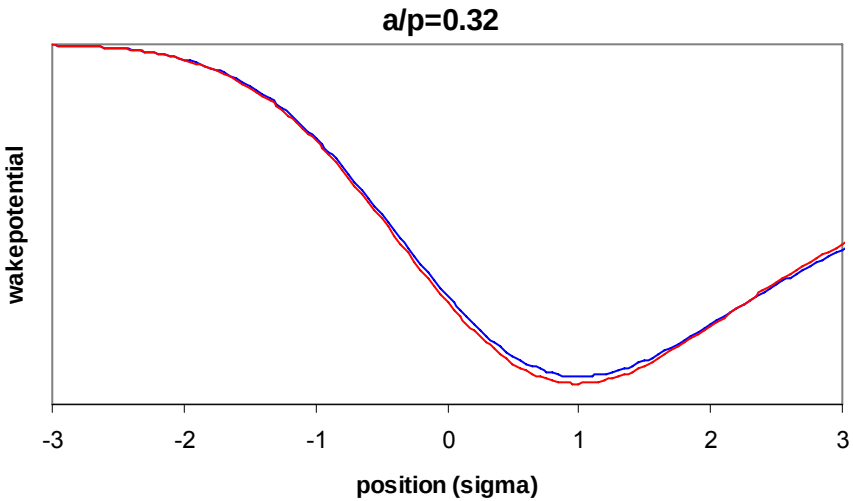


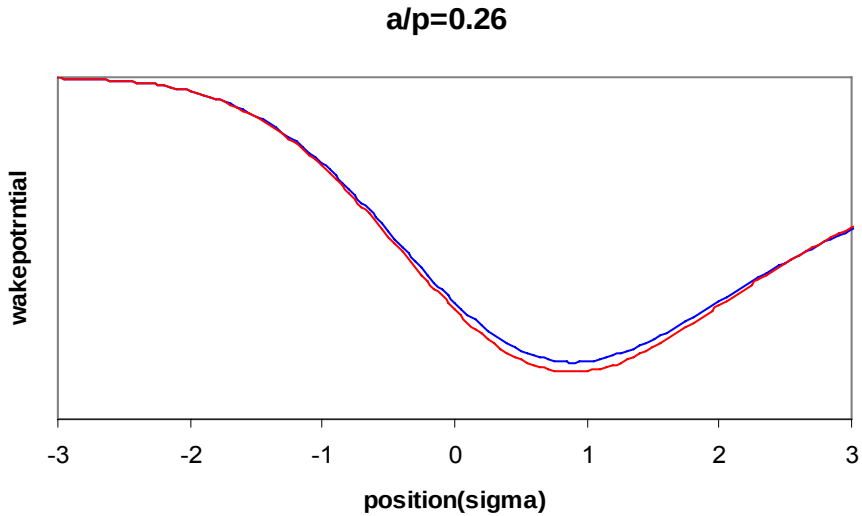


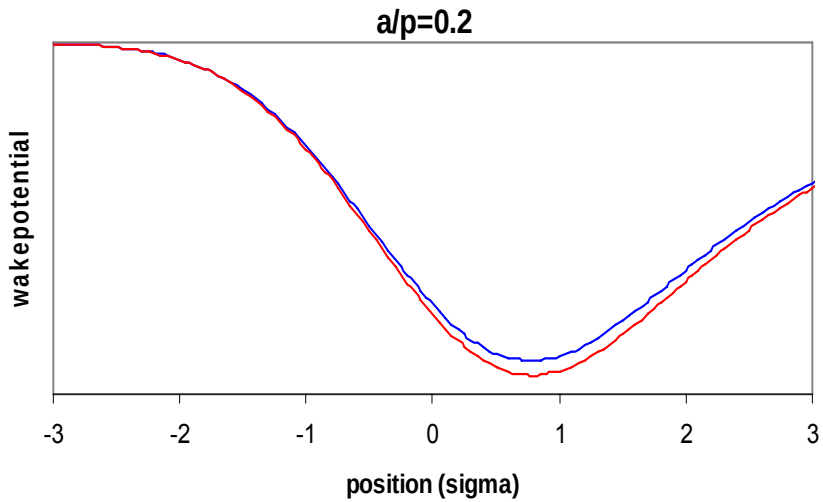


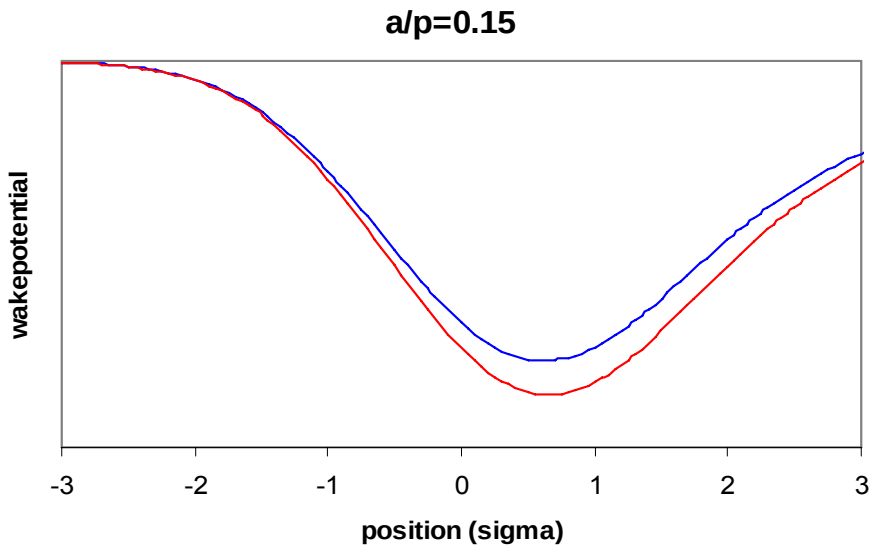


Longitudinal K.B.: Range of validity (a/p)

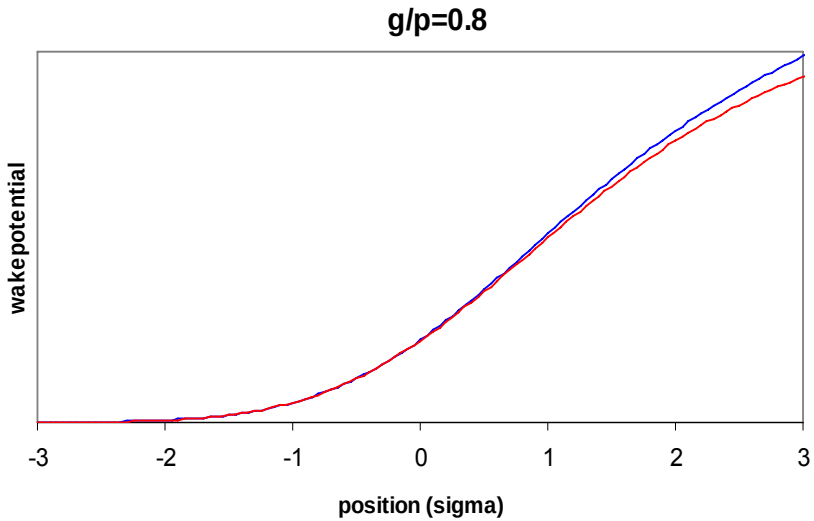


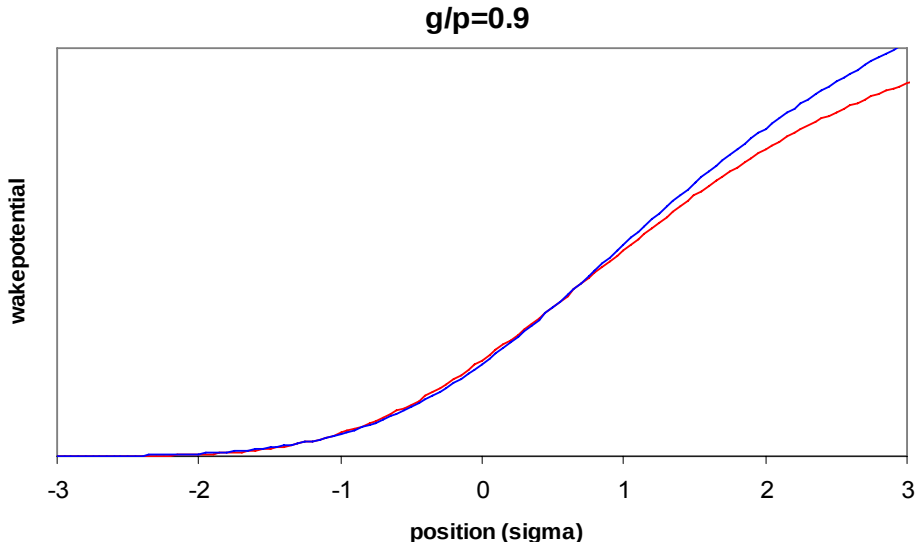


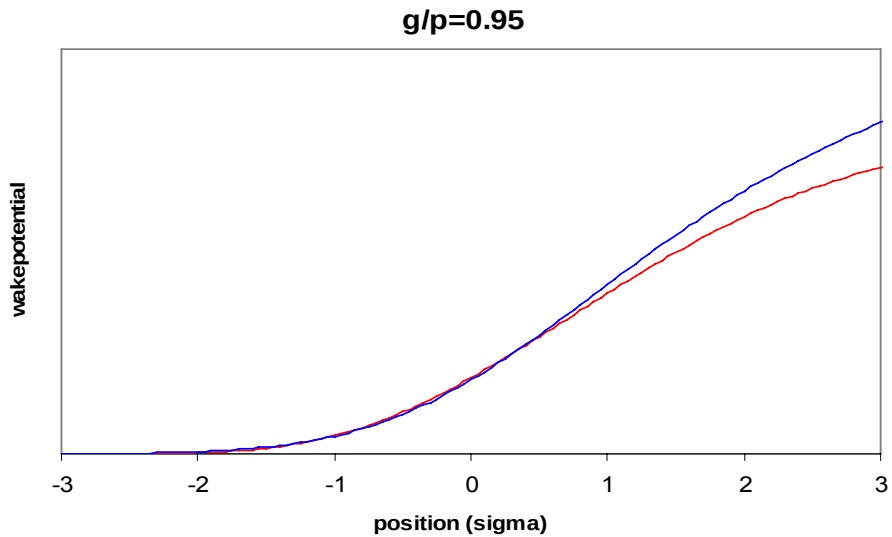


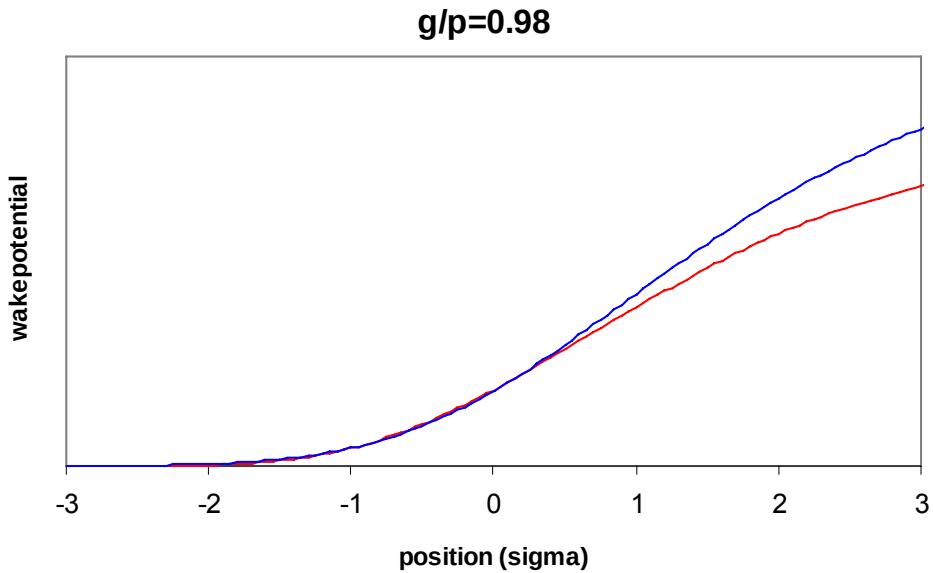


Transverse K.B.: Range of validity (g/p)

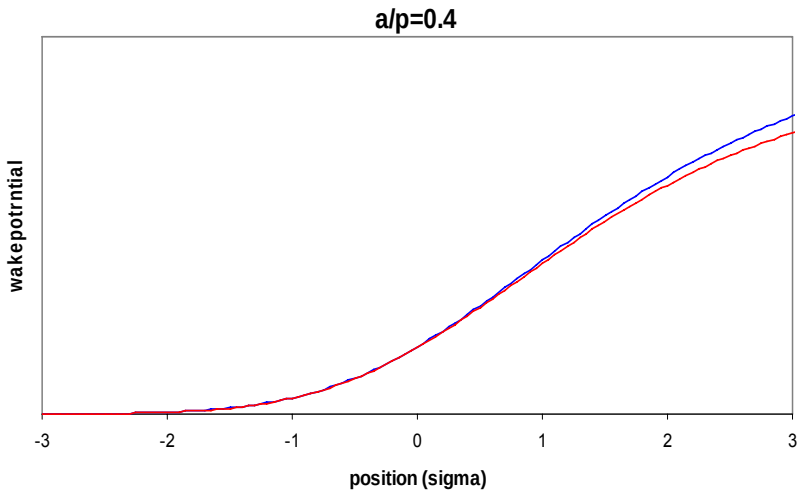


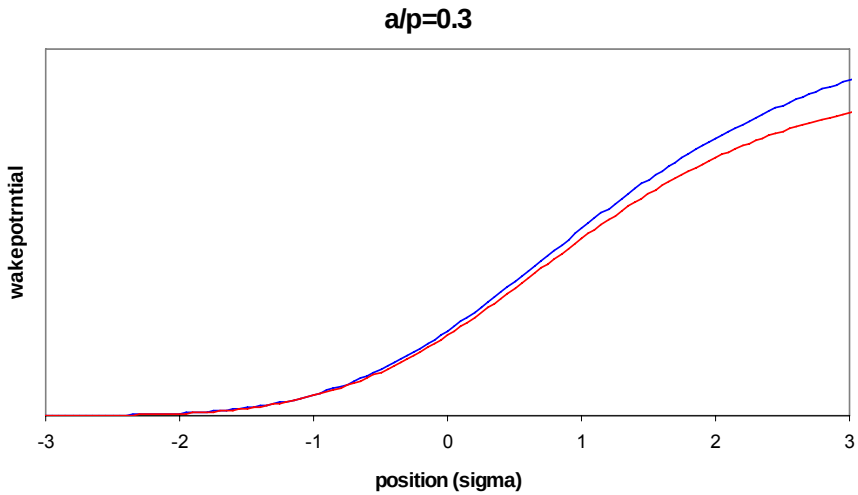


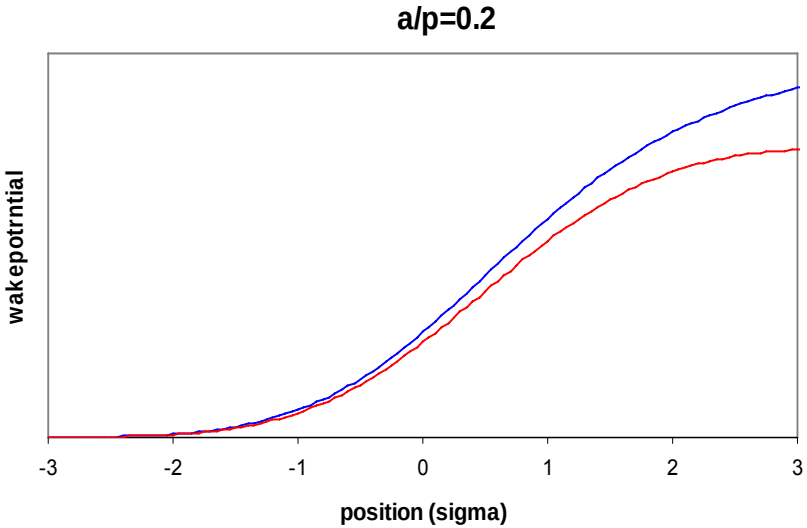


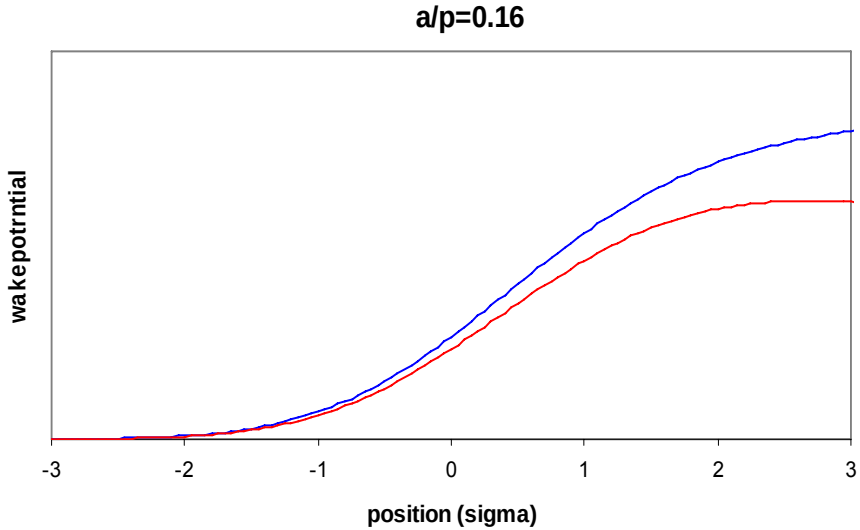


Transverse K.B.: Range of validity (a/p)

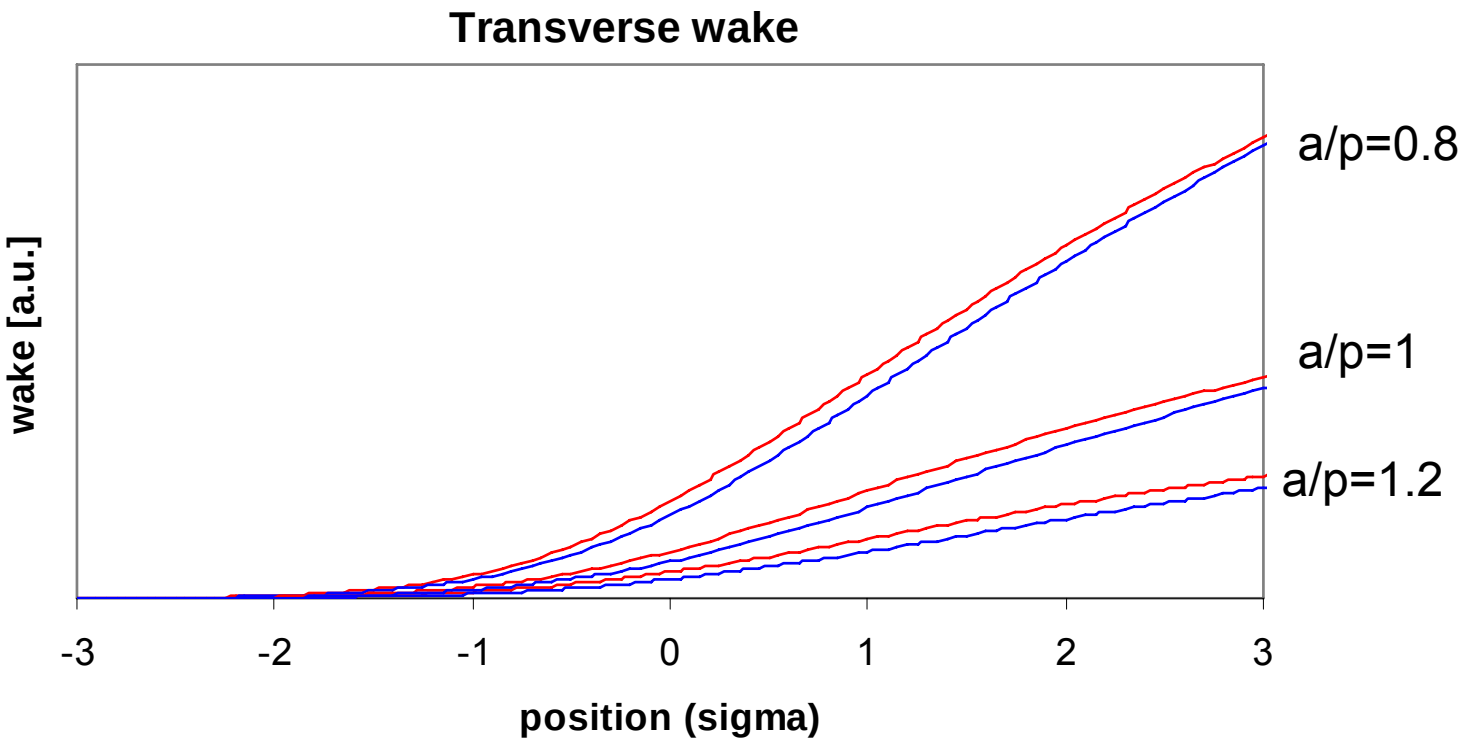




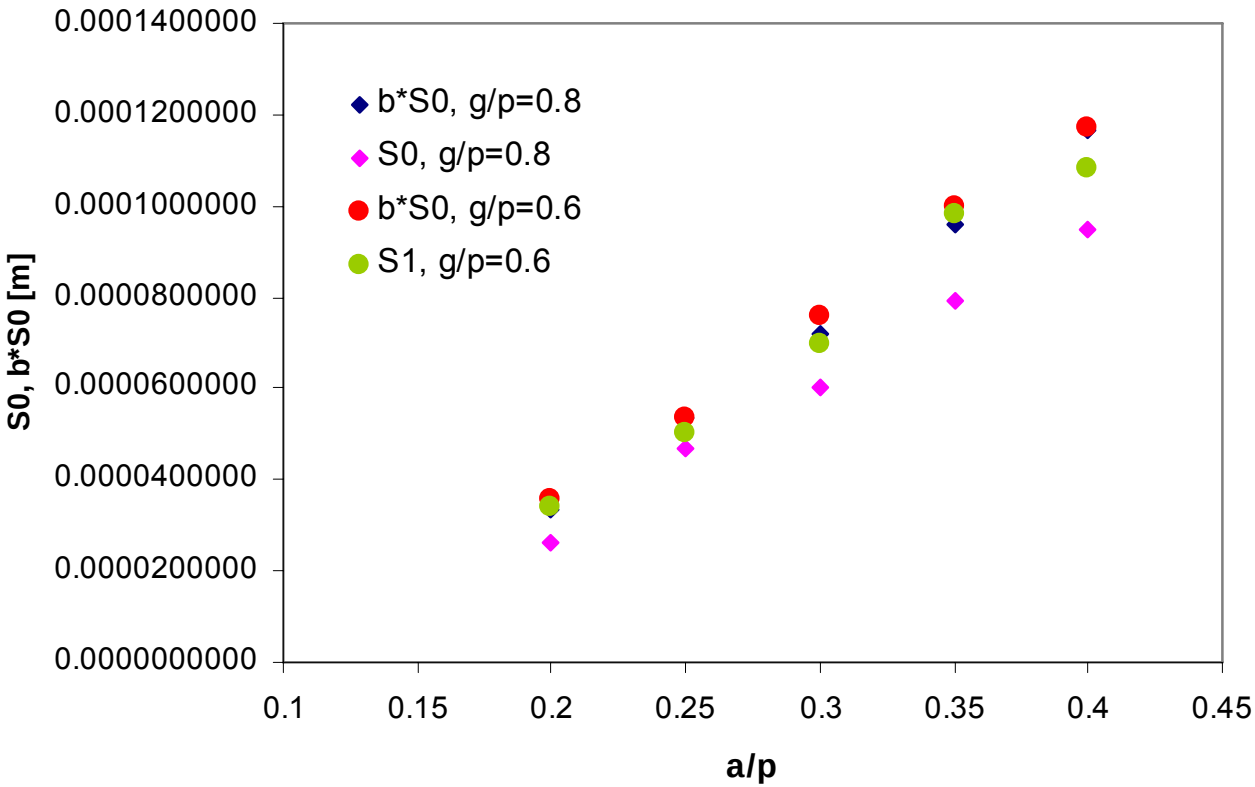




Transverse K.B.: Range of validity (a/p)



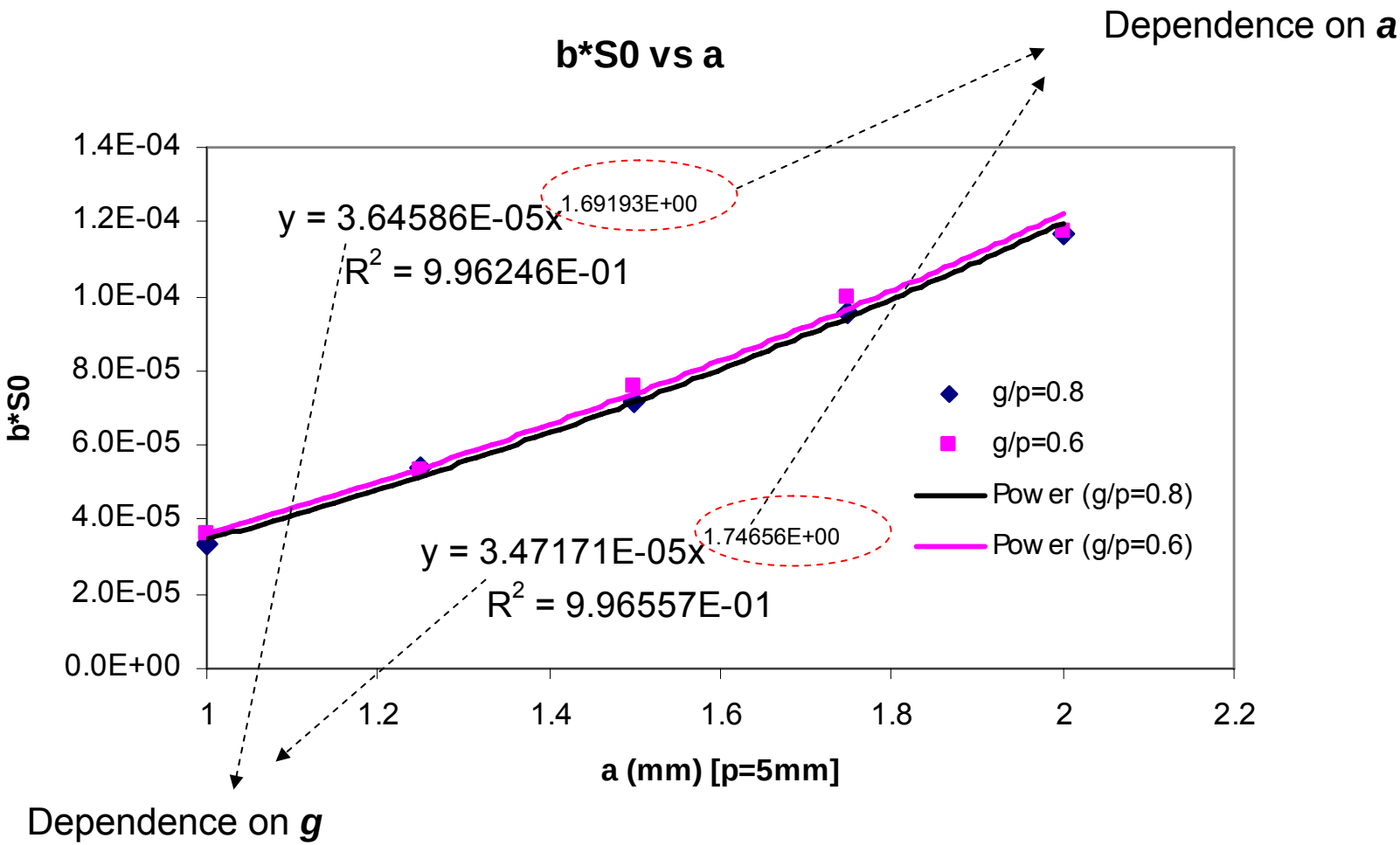
Fitting (transverse wake)



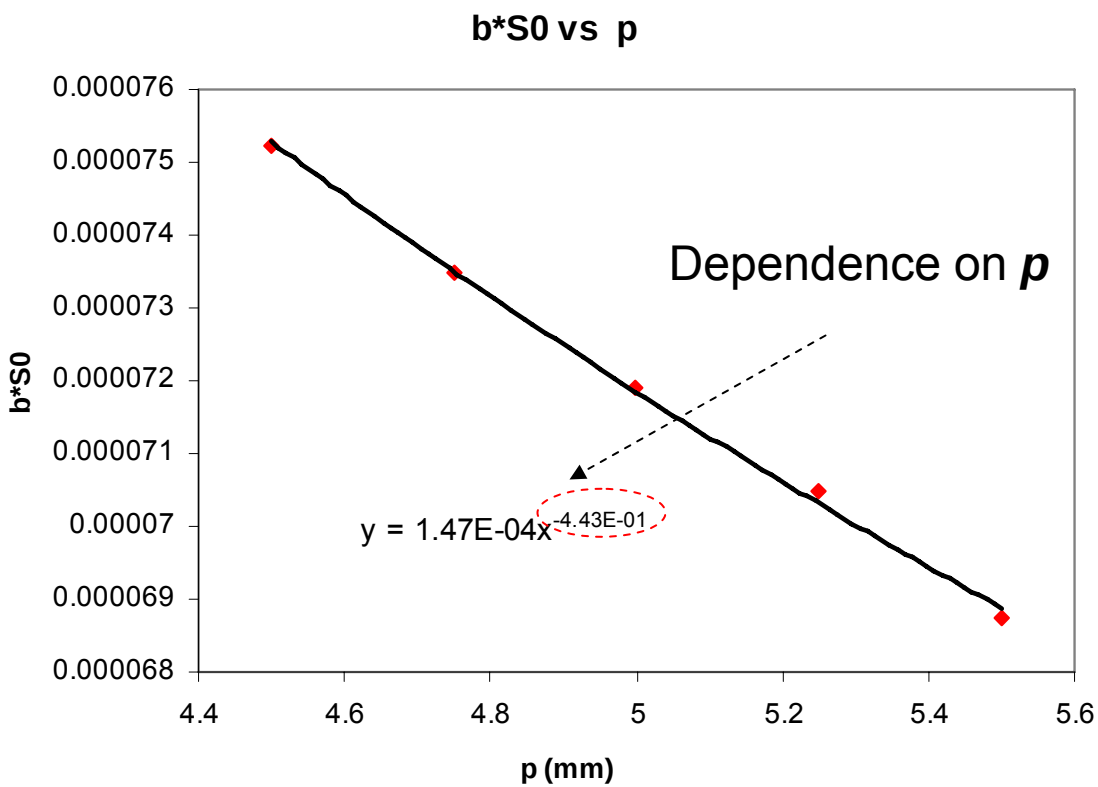
$$W_x(s) = b\frac{4Z_0 c s_0}{\pi a^4}\left[1-\left(1+\sqrt{\frac{s}{s_0}}\right)\exp\left(-\sqrt{\frac{s}{s_0}}\right)\right]$$

b=1 ?

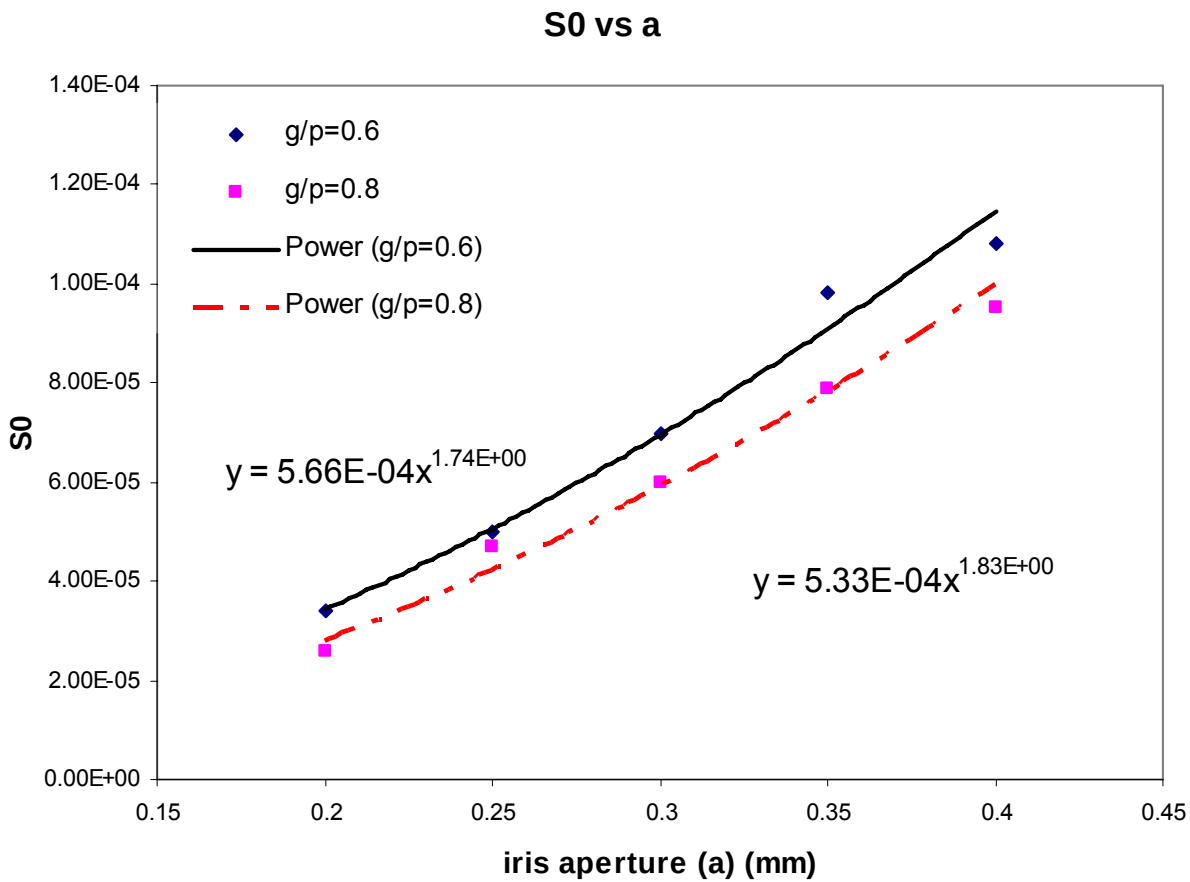
Fitting ($b*S_0$)


Dependence on *a*
b*S0 vs a
1.4E-04
1.2E-04
1.0E-04
8.0E-05
6.0E-05
4.0E-05
2.0E-05
0.0E+00
b*S0
y = 3.64586E-05x
1.69193E+00
R2 = 9.96246E-01
y = 3.47171E-05x
1.74656E+00
R2 = 9.96557E-01
g/p=0.8
g/p=0.6
Power (g/p=0.8)
Power (g/p=0.6)
1
1.2
1.4
1.6
1.8
2
2.2
a (mm) [p=5mm]
Dependence on *g*

Fitting ($b*S_0$)


b*S0 vs p
0.000076
0.000075
0.000074
0.000073
0.000072
0.000071
0.00007
0.000069
0.000068
b*S0
4.4
4.6
4.8
5
5.2
5.4
5.6
p (mm)
Dependence on p
y = 1.47E-04x-4.43E-01

Fitting (S_0)


S0 vs a
1.40E-04
1.20E-04
1.00E-04
8.00E-05
6.00E-05
4.00E-05
2.00E-05
0.00E+00
S0
g/p=0.6
g/p=0.8
Power (g/p=0.6)
Power (g/p=0.8)
y = 5.66E-04x^1.74E+00
y = 5.33E-04x^1.83E+00
0.15
0.2
0.25
0.3
0.35
0.4
0.45
iris aperture (a) (mm)

Fitting results

$$W_x(s) = b\frac{4Z_0 c s_0}{\pi a^4}\left[1-\left(1+\sqrt{\frac{s}{s_0}}\right)\exp\left(-\sqrt{\frac{s}{s_0}}\right)\right]$$

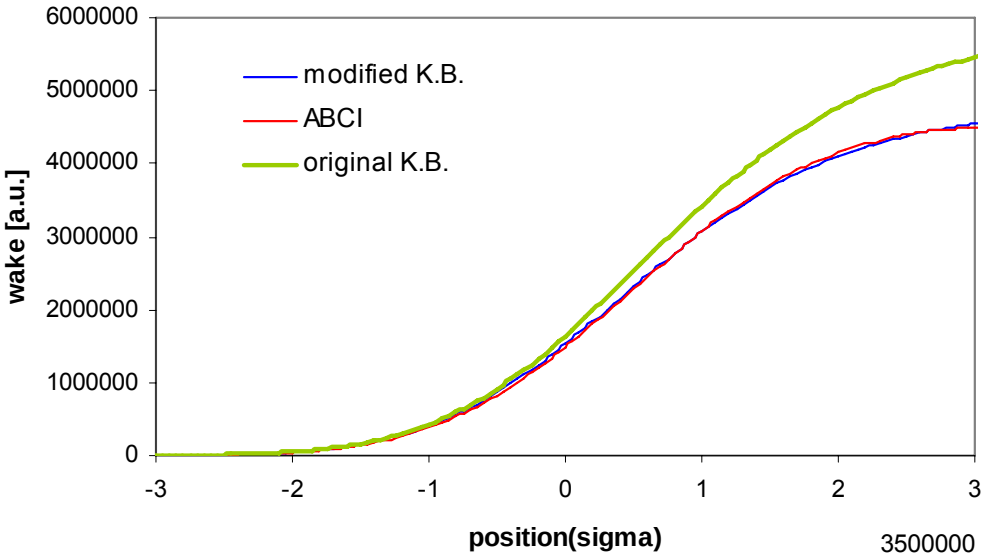
$$s_0 = 0.17\frac{a^{1.79}g^{0.38}}{p^{1.17}}$$

$$s_0 = 83.6\frac{a^{1.77}}{g^{0.7}p^{0.07}}$$

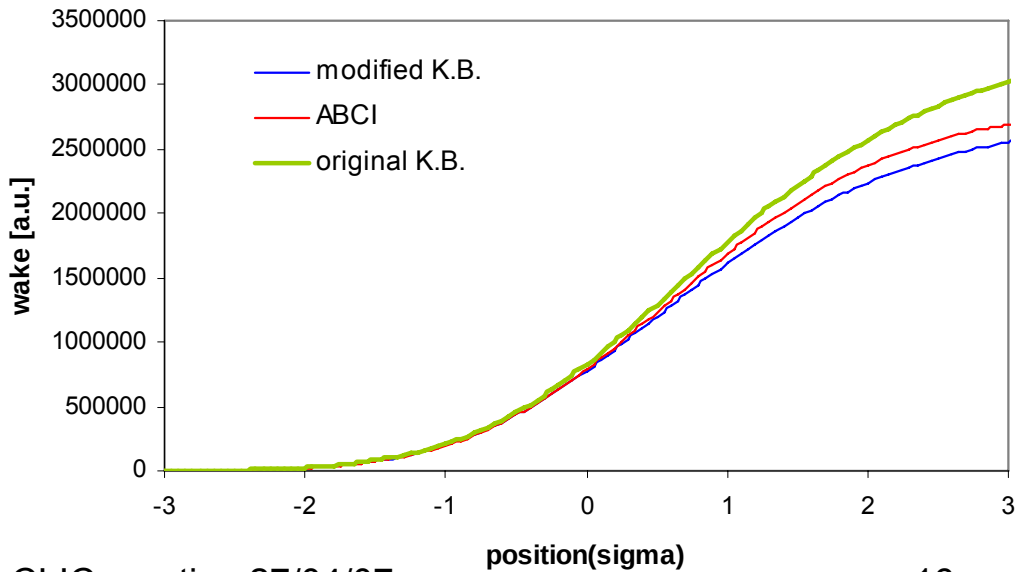
$$b = 0.00117\frac{g^{0.46}}{a^{0.08}p^{0.38}}$$

Examples of the fitting

a/p=0.2, g/p=0.4

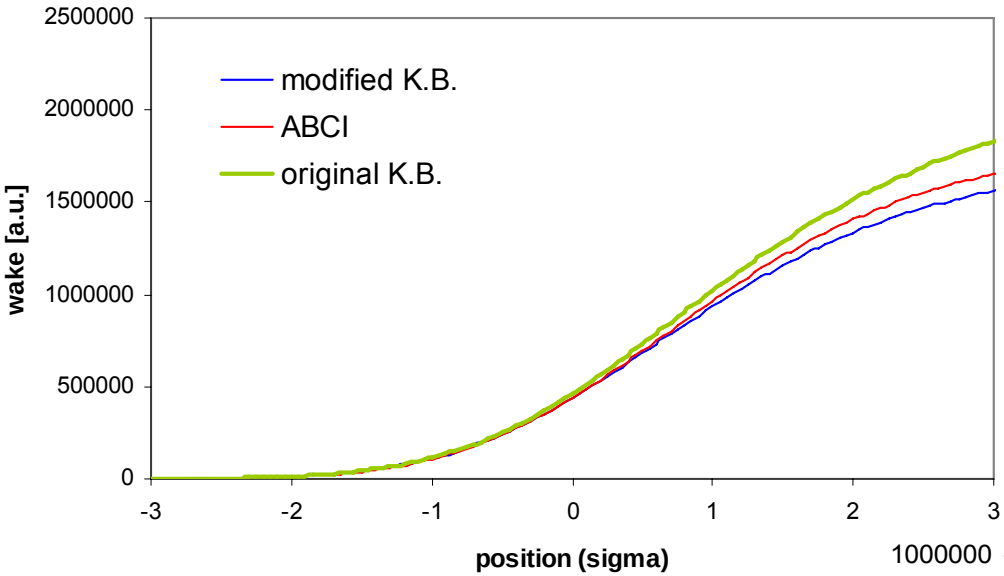


a/p=0.25, g/p=0.4

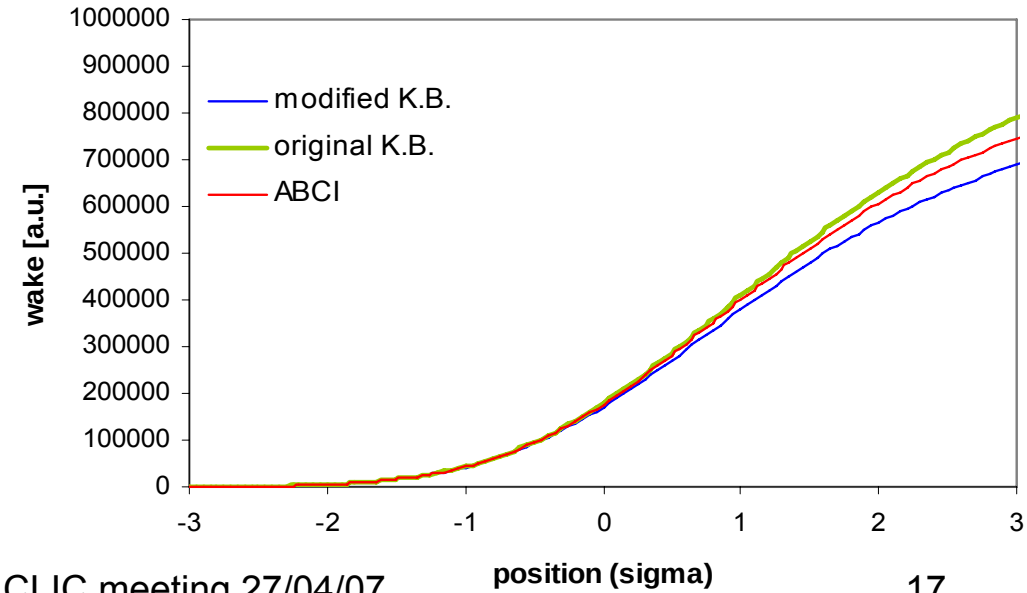


Examples of the fitting

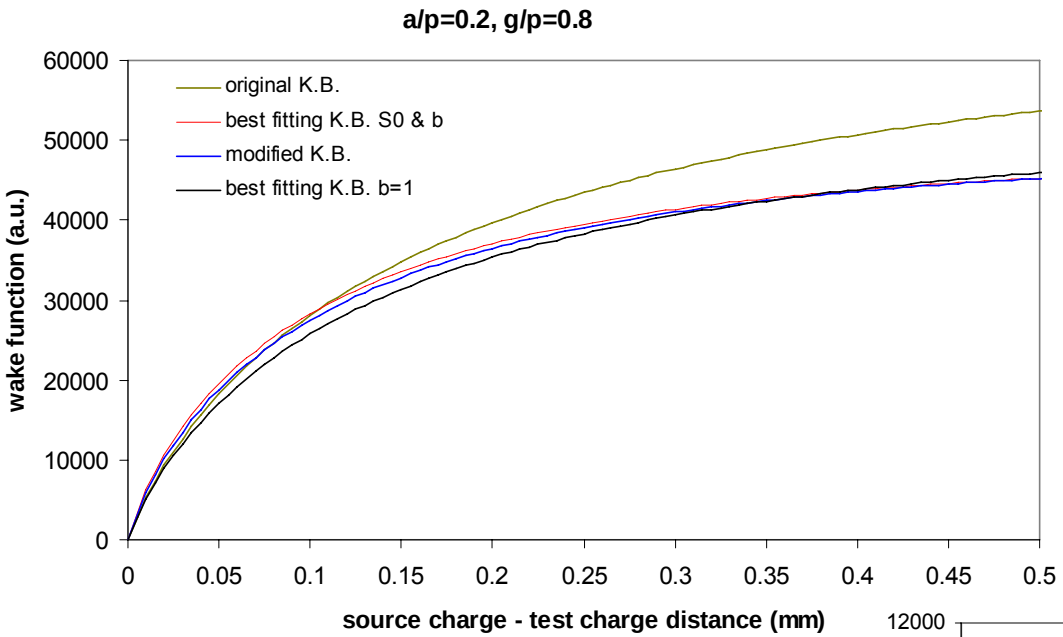
a/p=0.3,g/p=0.8

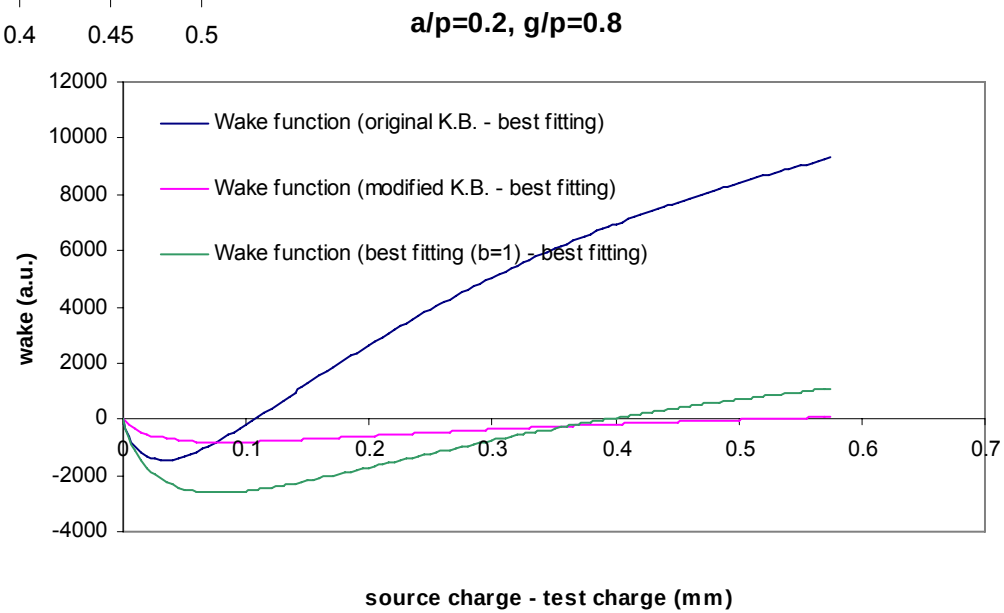


a/p=0.4 g/p=0.8

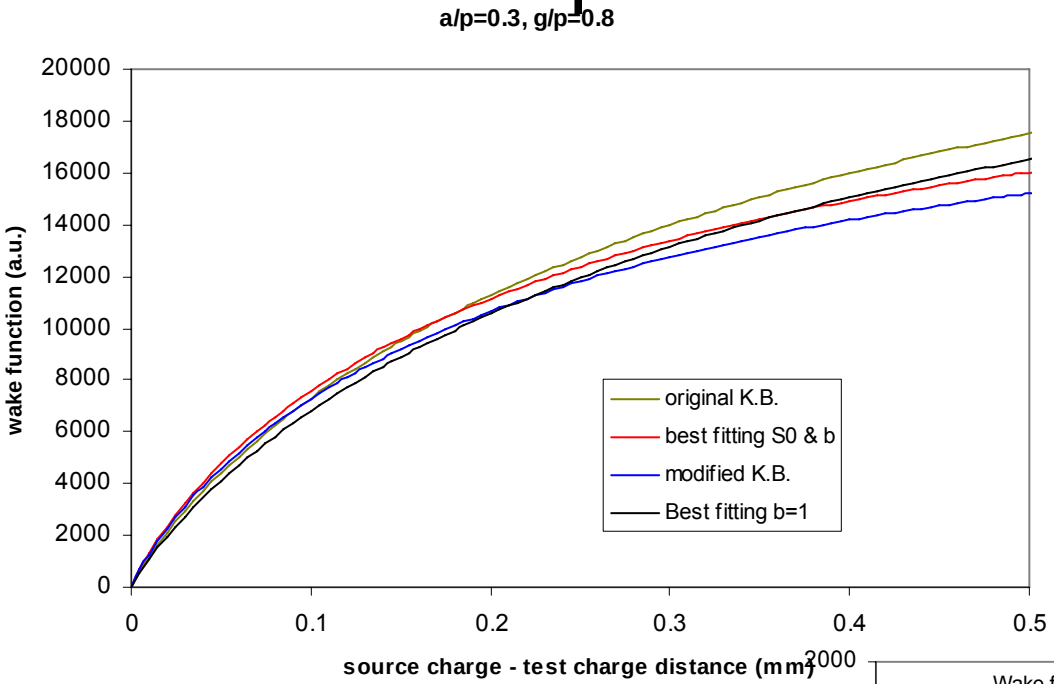


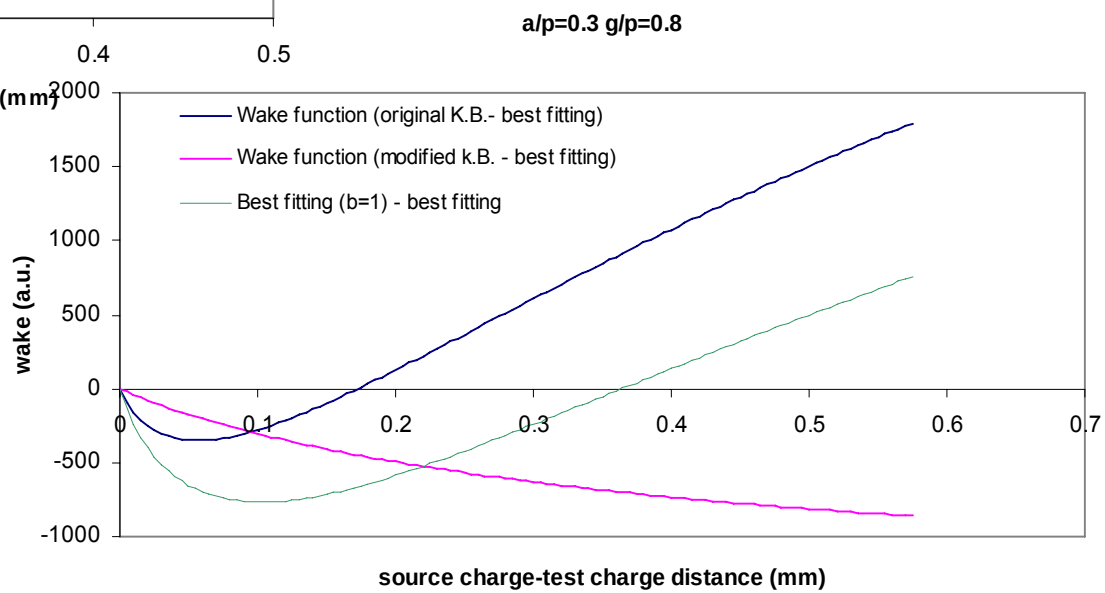
Examples of the fitting a/p=0.2





Examples of the fitting a/p=0.3

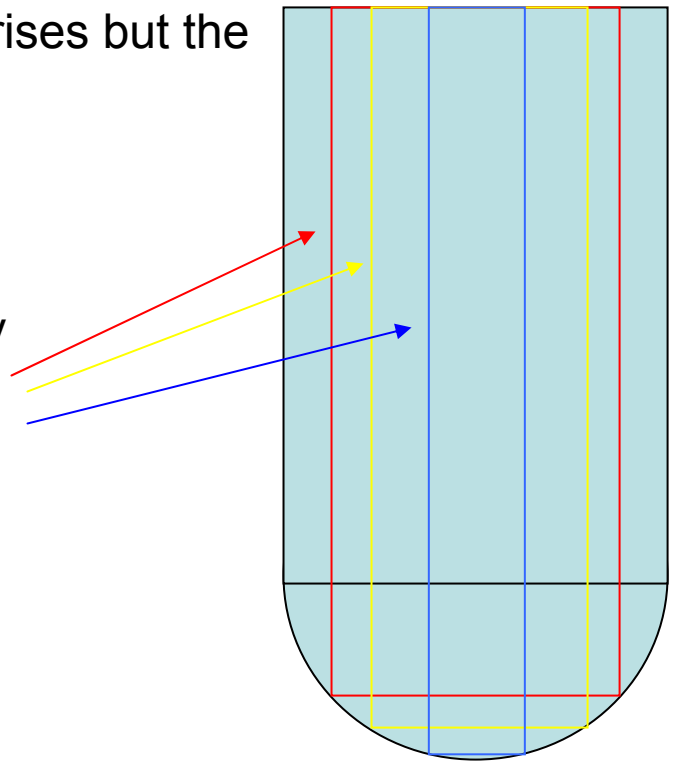




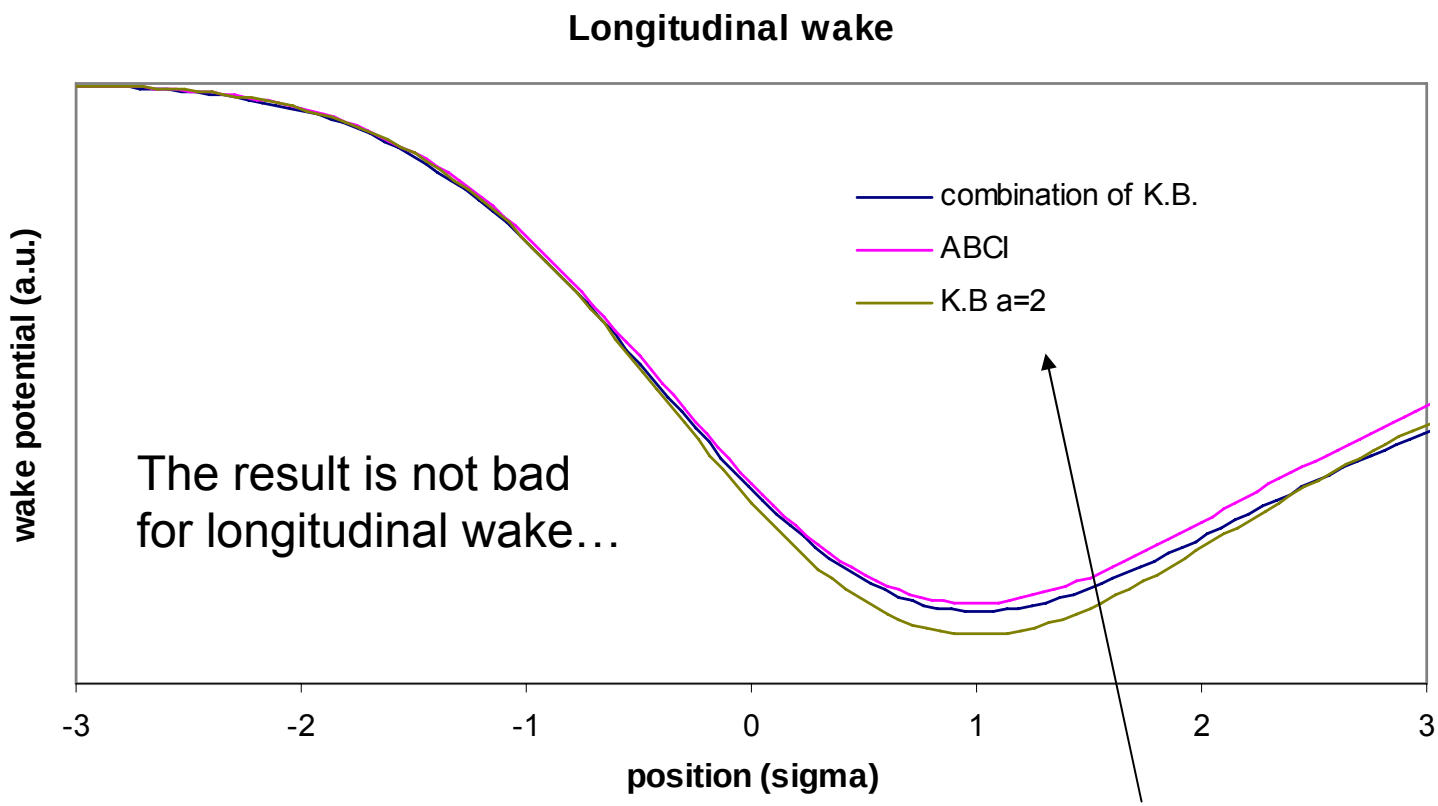
Rounded irises

K.B. is valid for rectangular irises but the reality is different…

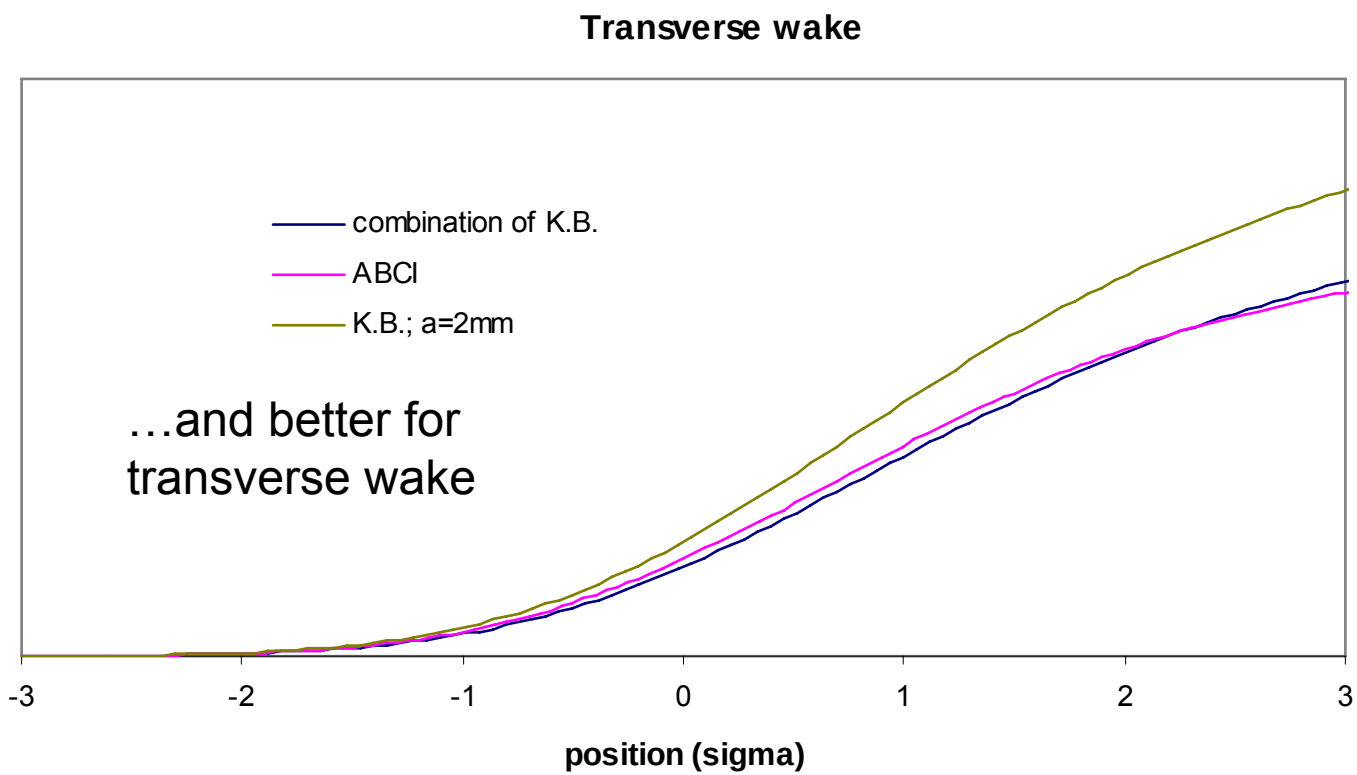
Let's consider the combination of different wakes originated by different geometries



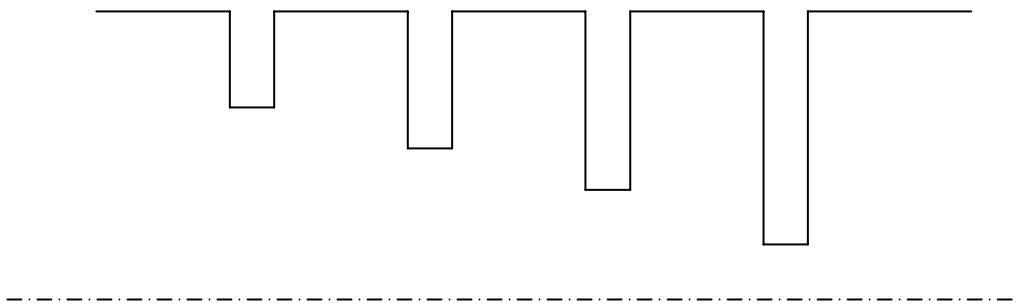
Rounded irises



Rounded irises

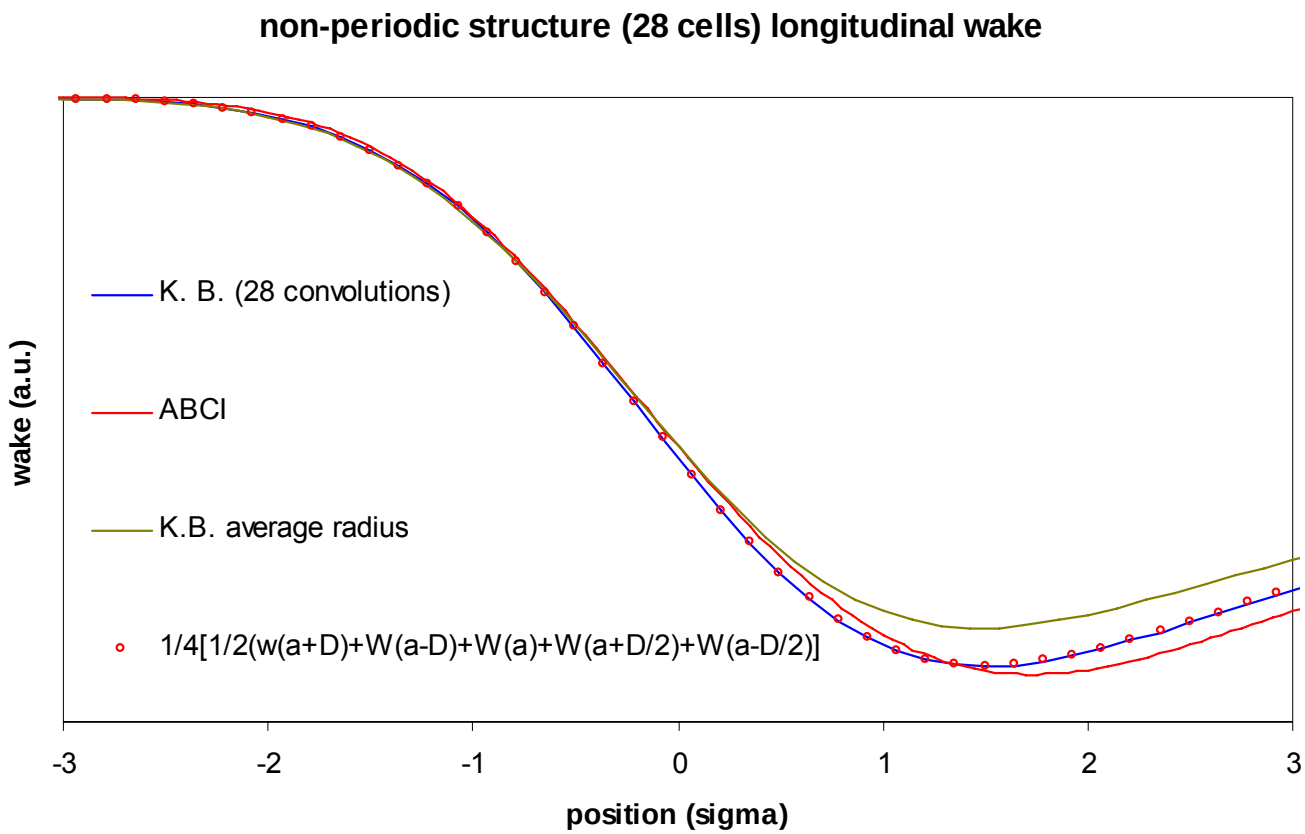


Non-periodic structures

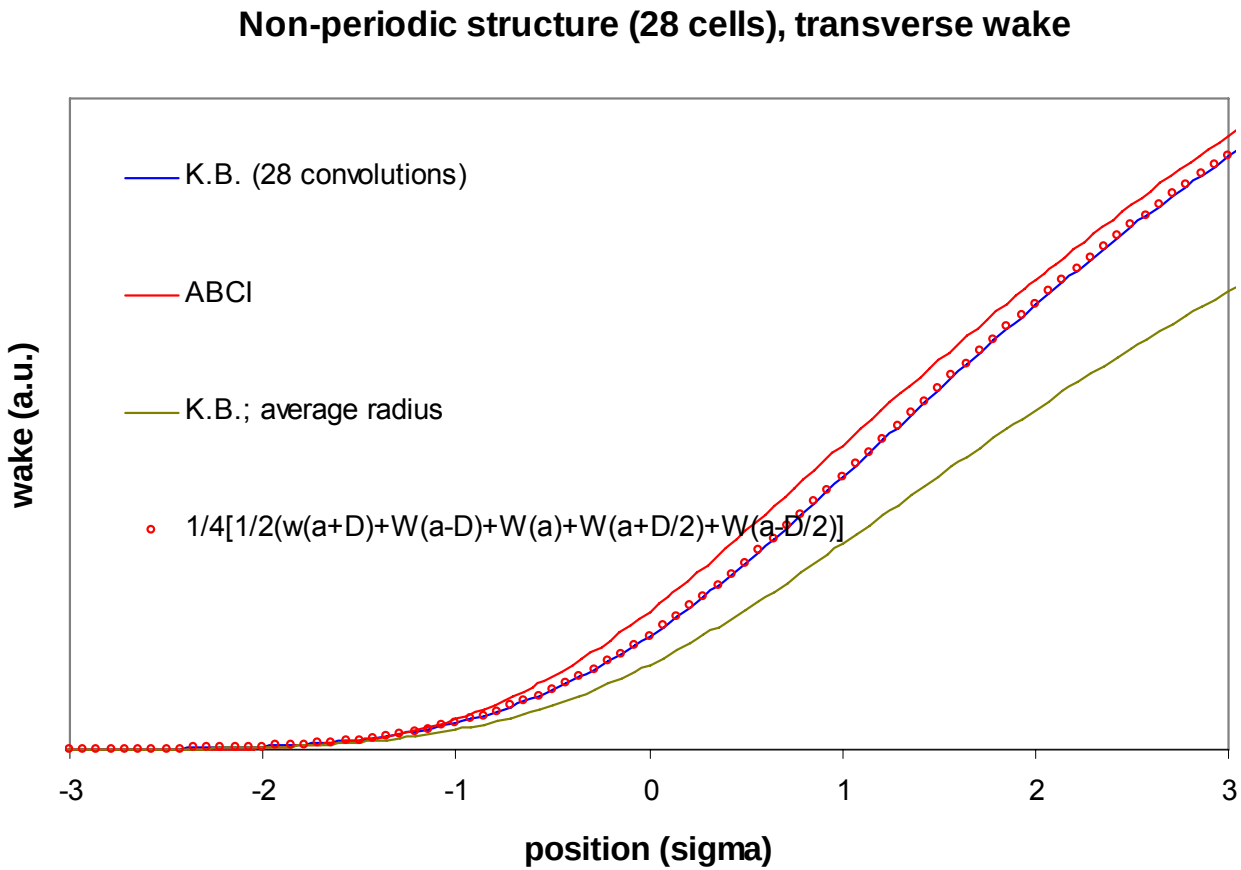


Example:0.335 < a/p < 0.603; 28 cells

Non-periodic structures: longitudinal wake



Non-periodic structures: transverse wake



Conclusions

- 2D computations with moving mesh are relatively fast and precise but limited in beam distributions
- K.B. functions are extremely useful tools for 2D periodic structures
- K.B. range of validity is larger than predicted but not enough to cover CLIC region
- A new fitting based on 2 free parameters gives better results in the region not covered by K.B. and is complementary to K.B.
- A fitting with only one free parameter is under investigation
- K.B. does not consider rounded irises, a possible correction is proposed
- K.B. can be used with good results also for non-periodic structures