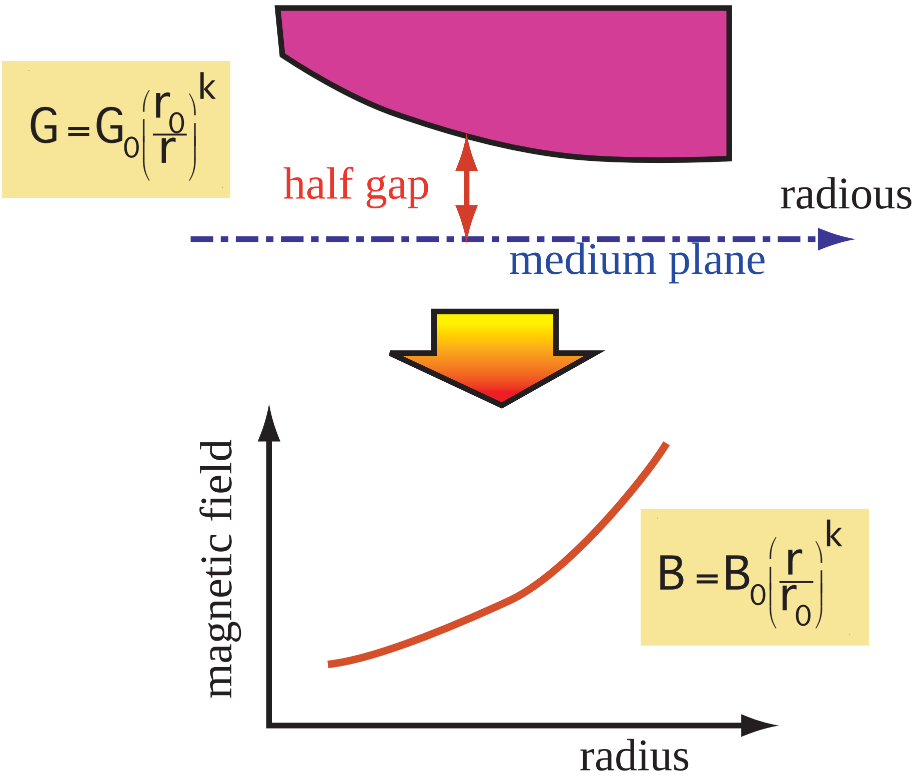
The pole shape type

The field can be made by the pole shape!

for example : PoP-FFAG, & 150MeV-FFAG



merit vs demerit ?

merit : - easy design !

- easy operation !

demerit : - impossible to change the k-value !

- impossible to make the long pole !

(fringing fields at the edge is differren

between the inner and the outer)

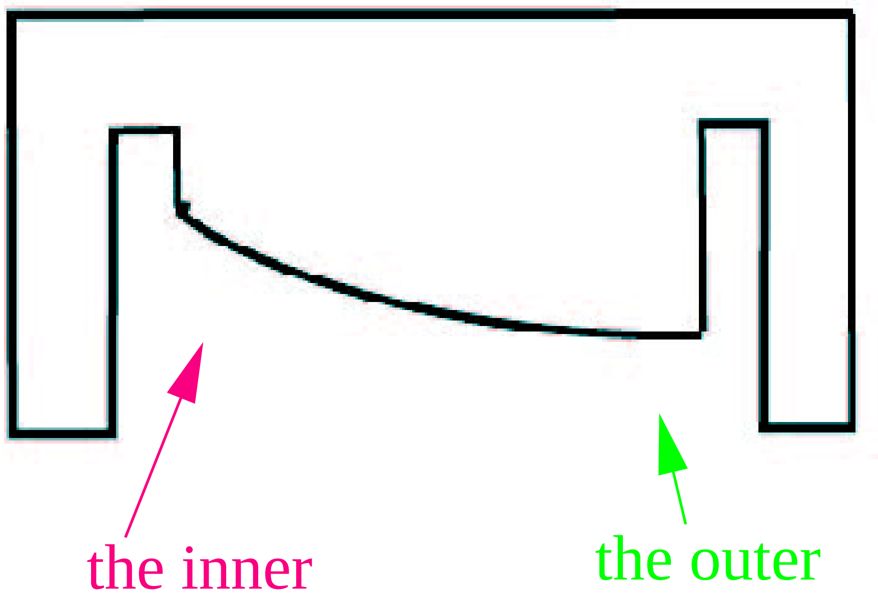
- impossible to make the high field !

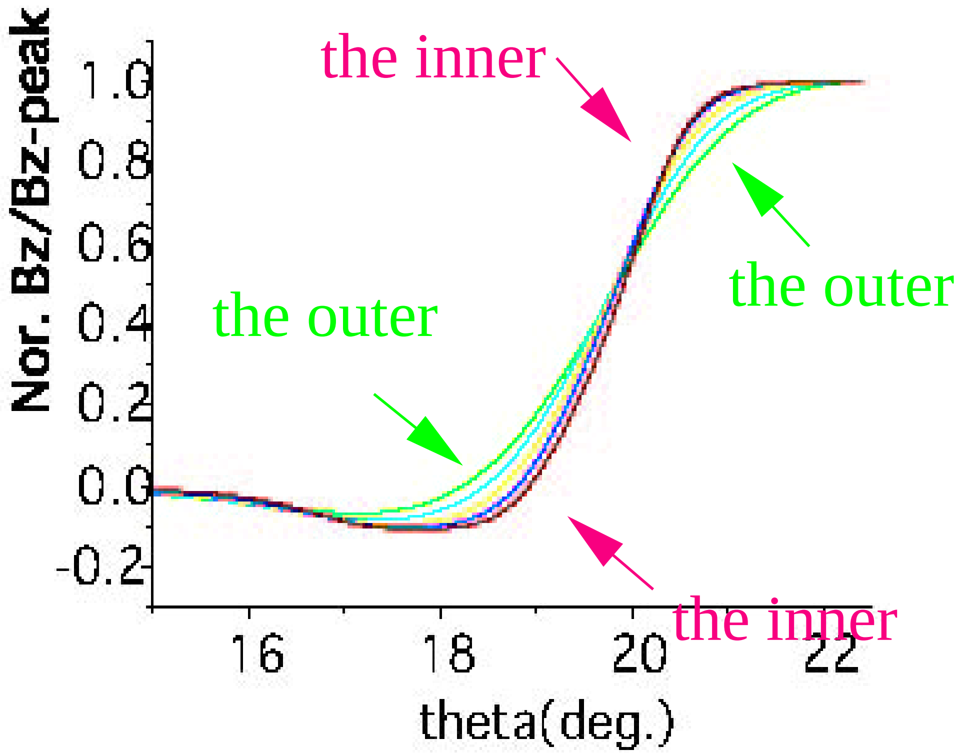
(the field in the ion is saturated)

It is difficult to use this method to large gap magnets !!

Normalized Field on Median Plane

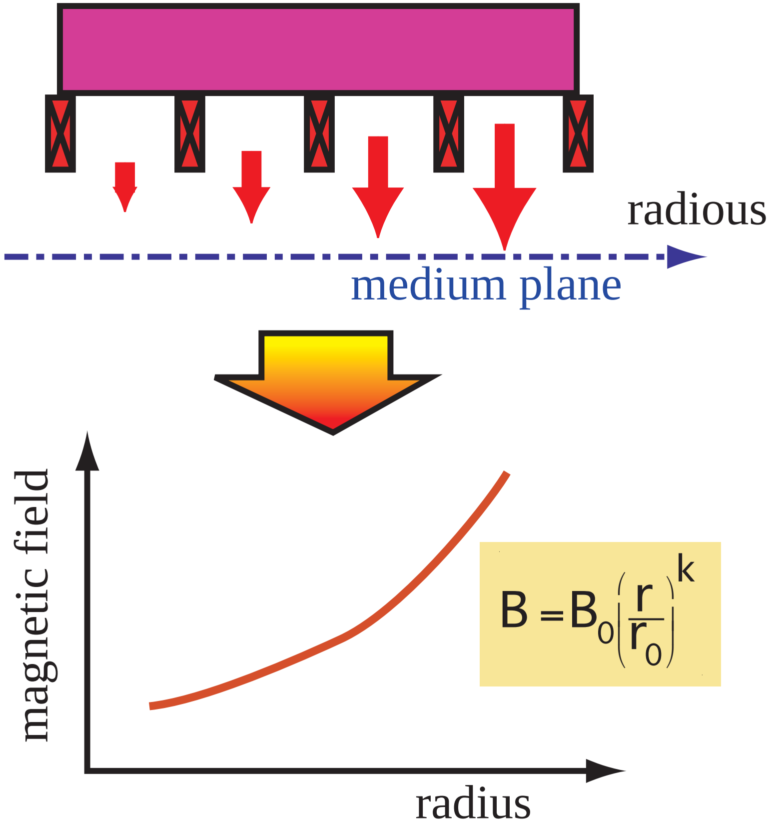
(Typical results of the field made by the shape of the pole)





The distributed coil type

The field can be made by the distributed coil!



$$B = B_0\left(\frac{r}{r_0}\right)^k$$

merit vs demerit ?

merit :
- possible to change the k-value !
- possible to make the long pole !
- possiple to make the high field !

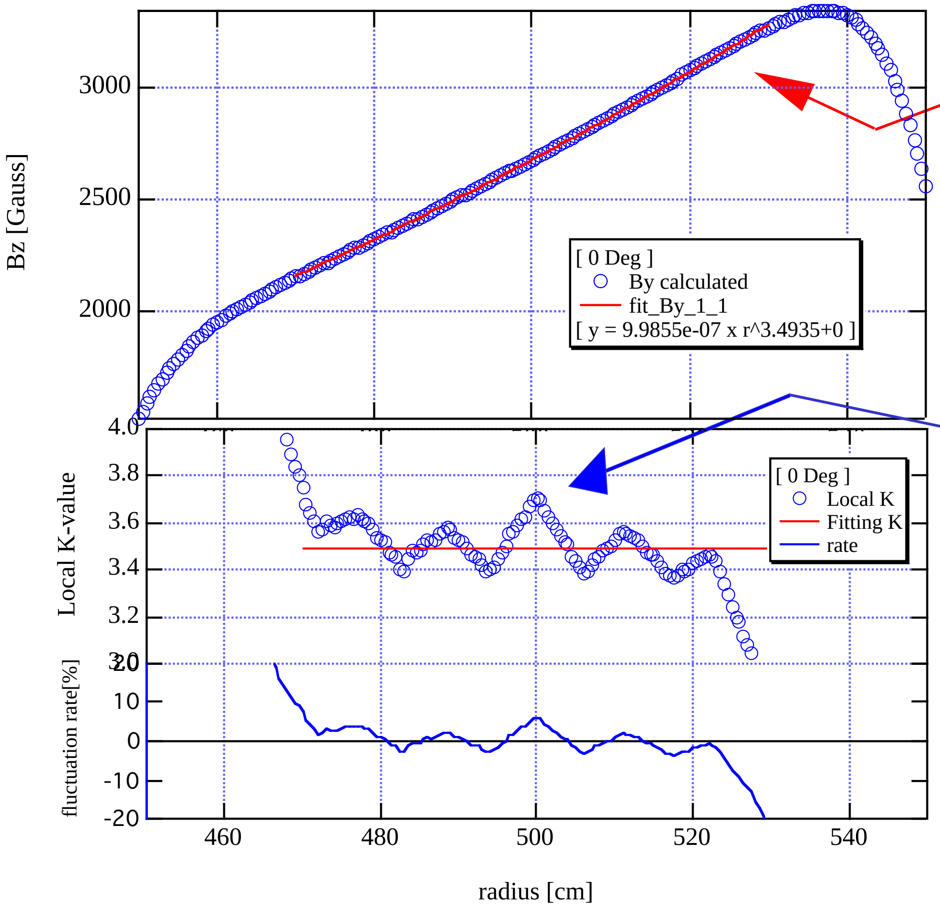
demerit :
- complicated operation ! (each coil is needed to set a different current)
- the field quarity is not so good ! (the field swings according to the distribution of the coils)

We shuld take careful to design the magnet with this method!!

fitting k-value and local k-value

typical results of the field calculated

by the distrubution of the coils



k_fitting

fit : y=a*r^b

with Levenberg-Marqurdt algorizm

$$k\_local = \frac{\Delta B}{\Delta r}\frac{r}{B}$$

$$B = B_0\left(\frac{r}{r_0}\right)^k$$

$$\frac{\Delta B}{\Delta r} = k\frac{B_0}{r_0}\left(\frac{r}{r_0}\right)^{k-1}$$

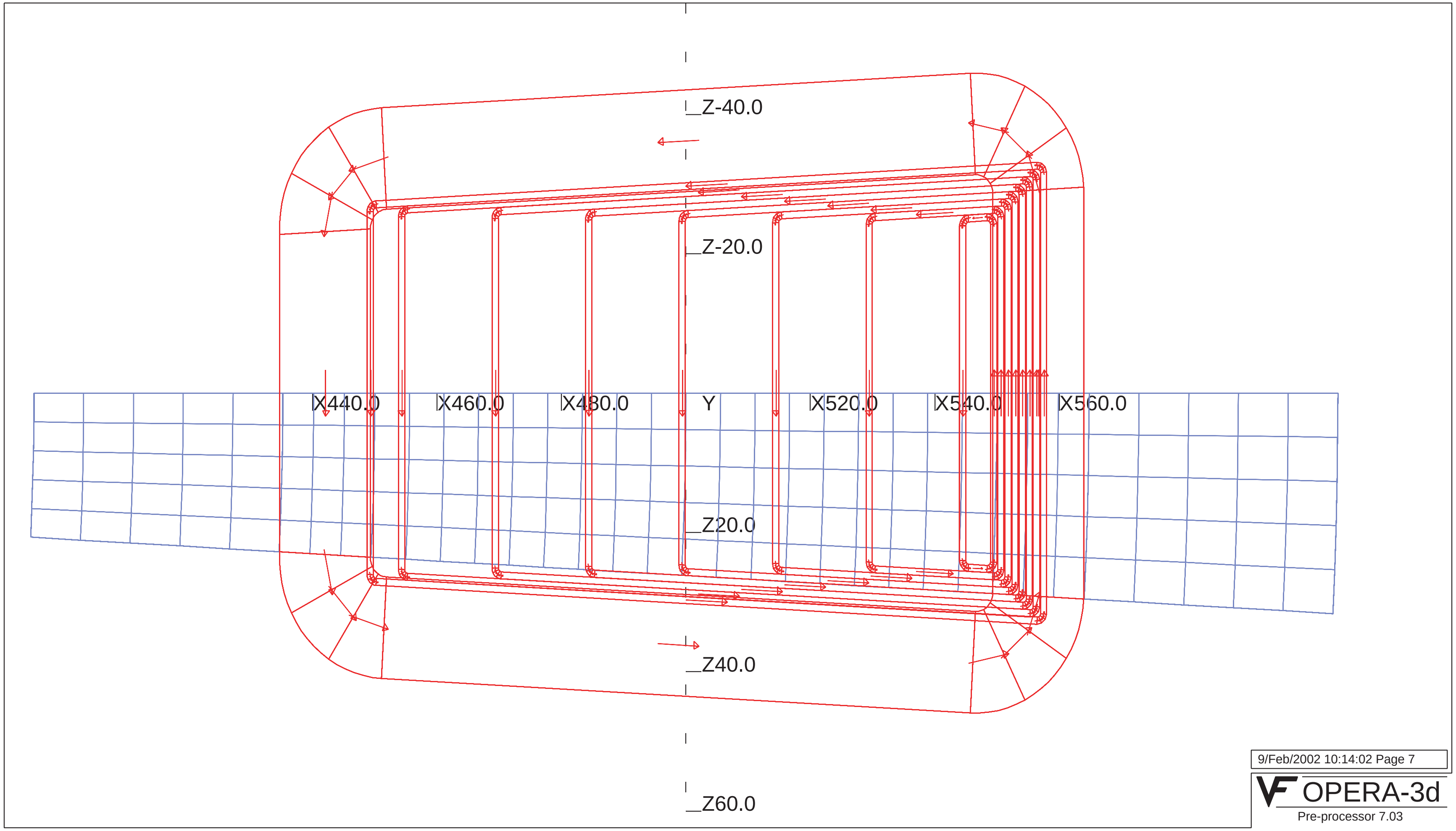
$$= k\frac{B_0}{r_0}\left(\frac{r}{r_0}\right)^{k}\frac{r_0}{r}$$

$$= k\frac{B_0}{r}\frac{B}{B_0}$$

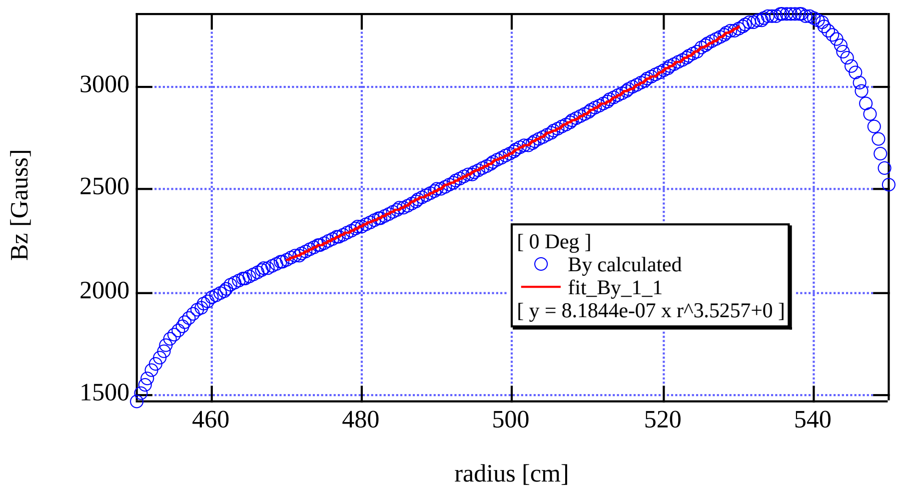
$$= k\frac{B}{r}$$

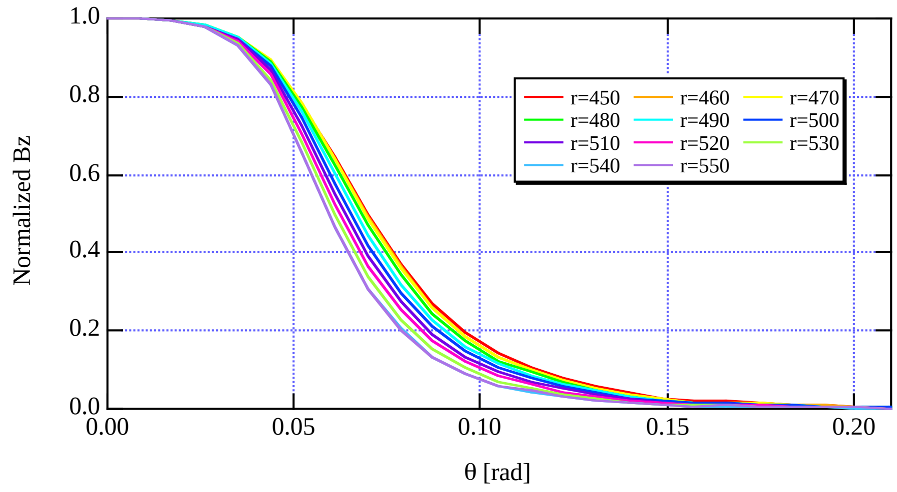
The field quality is judged by k_local/k_fitting !

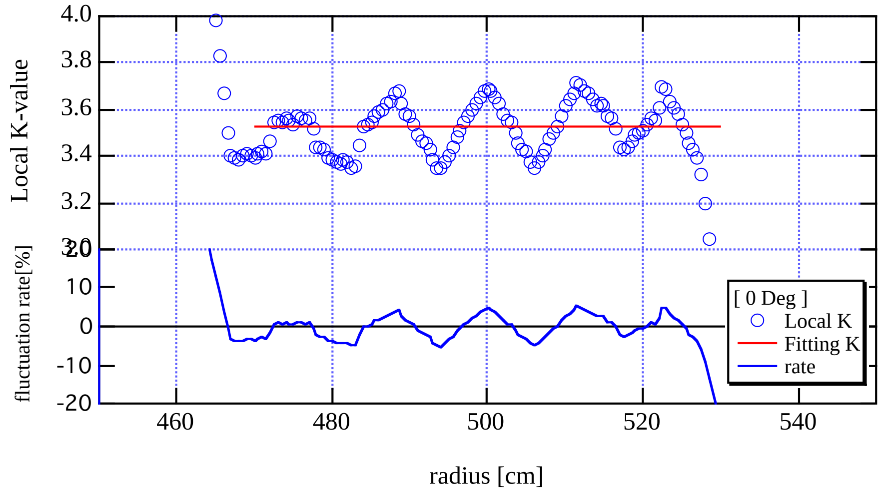
distributed coils type 1

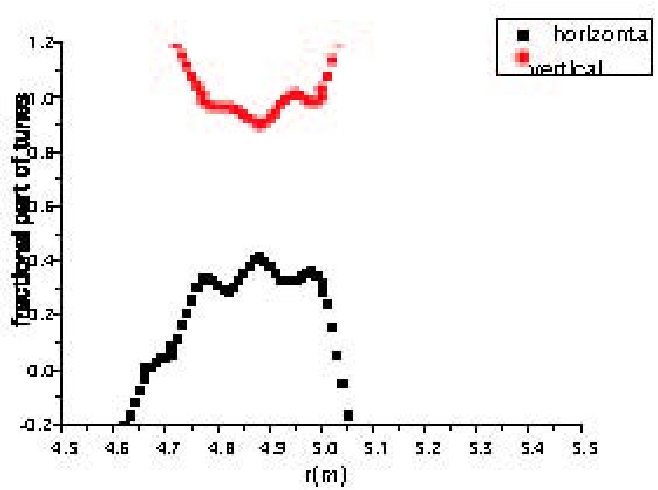


distributed coils type 1

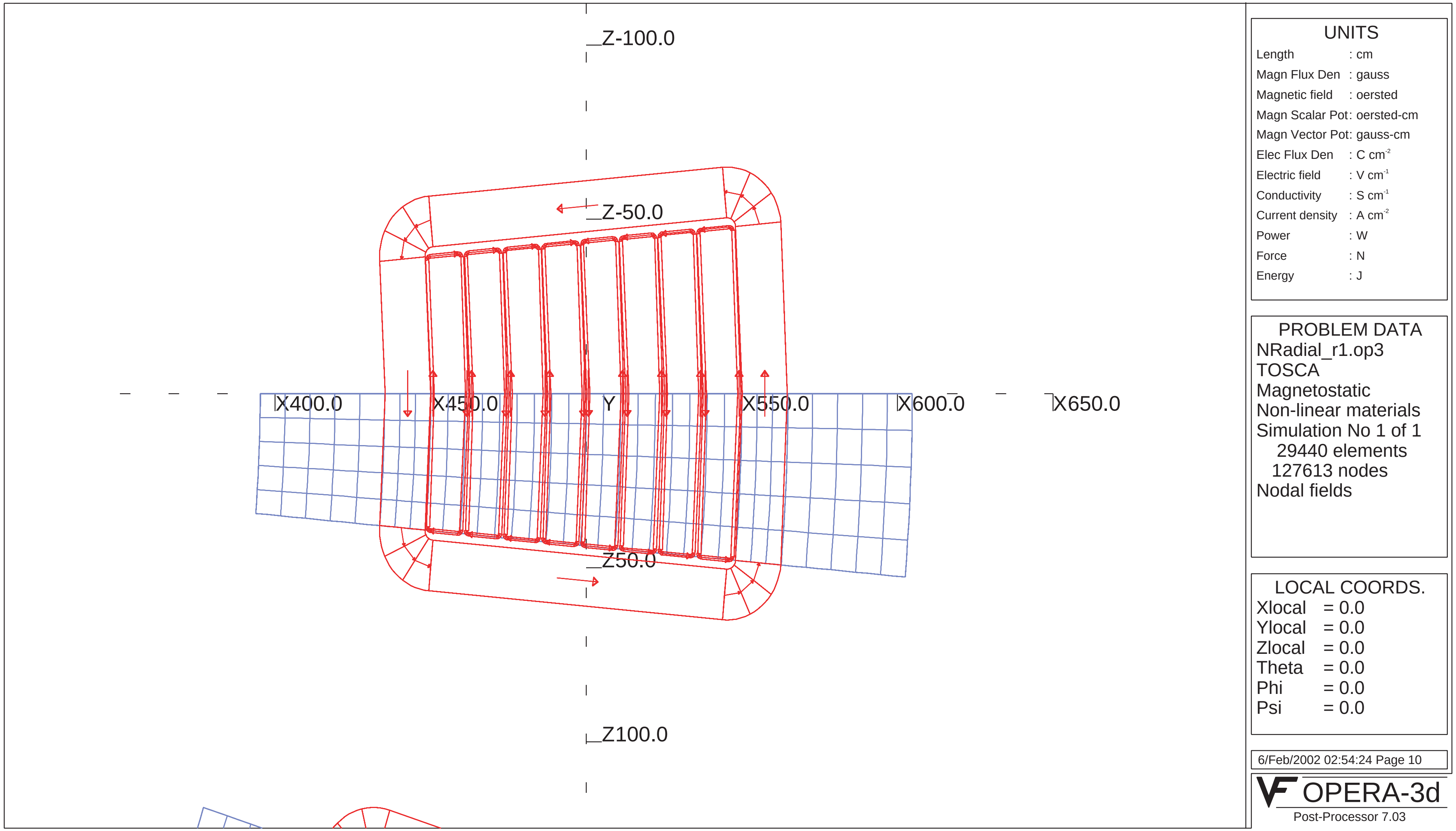




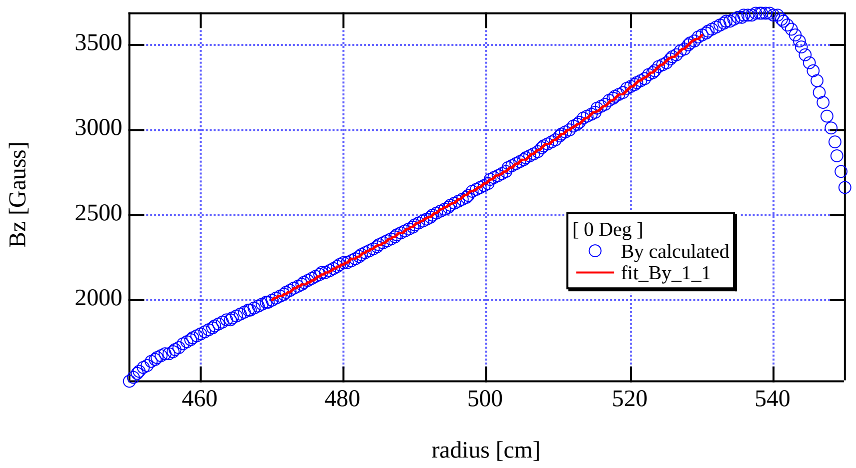


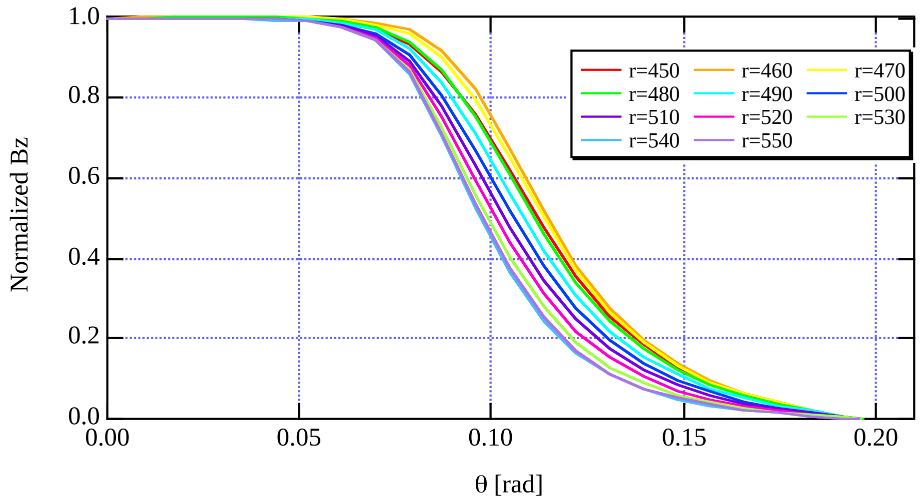


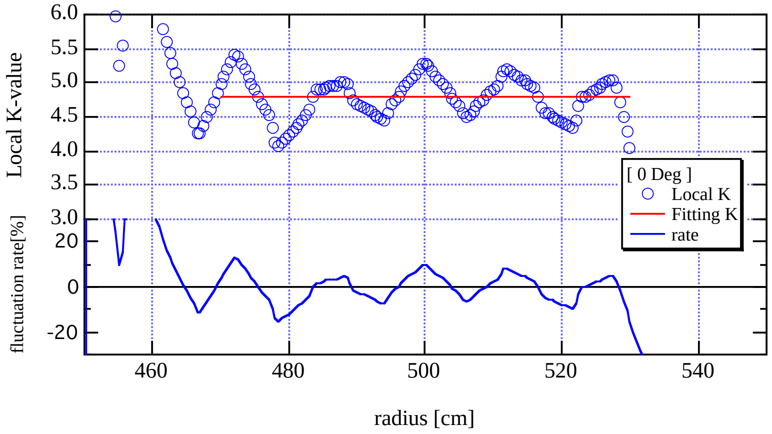
distributed coils type 2



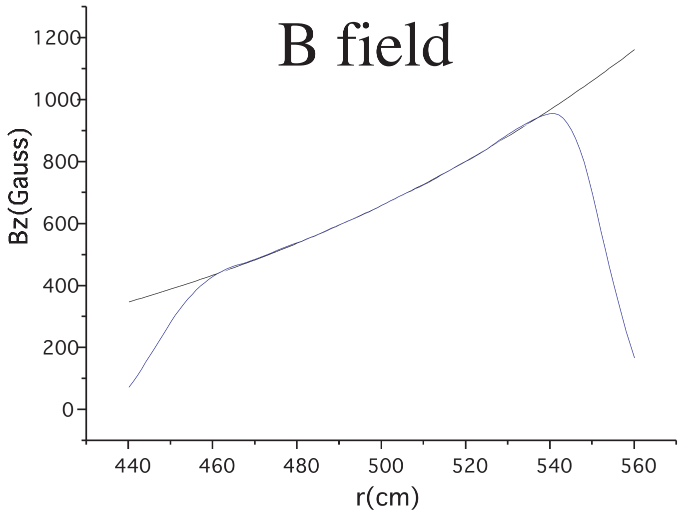
distributed coils type 2

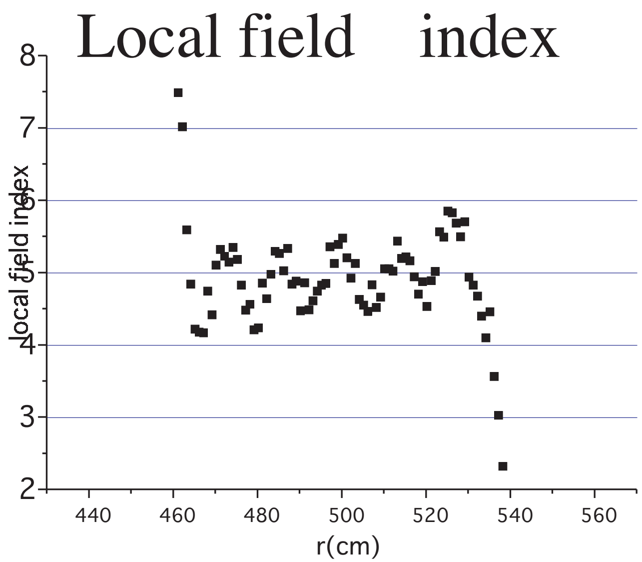


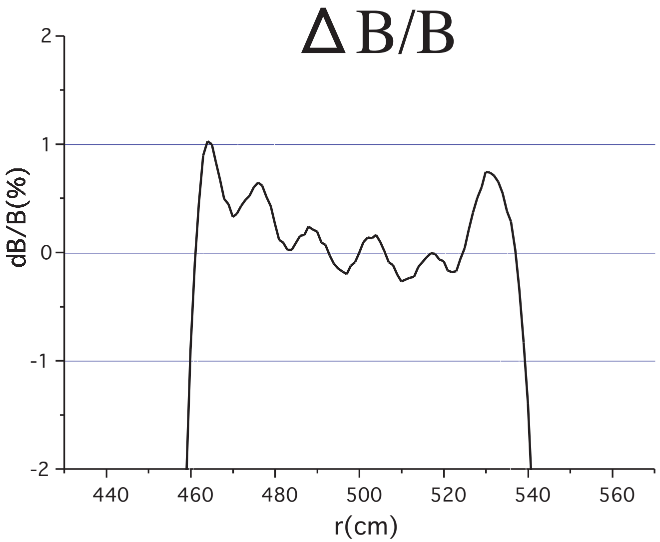


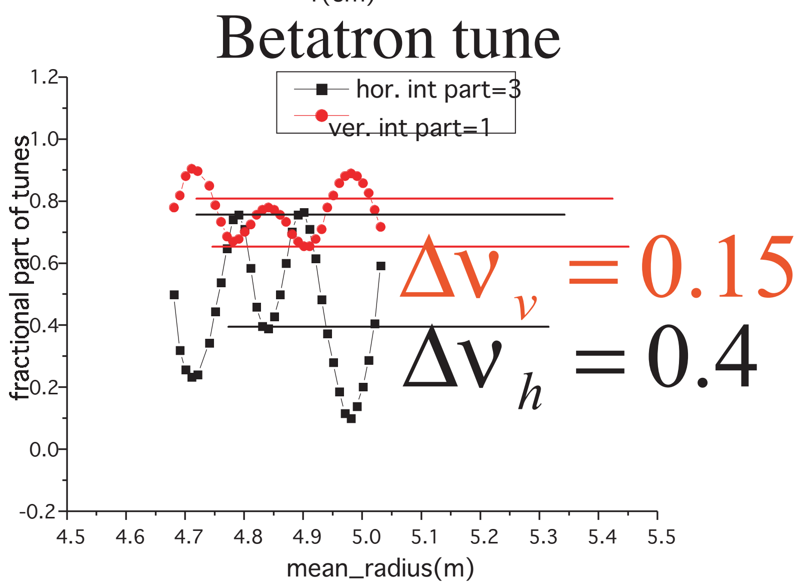


Results of Field Calculation and Tracking (separated push-pull)

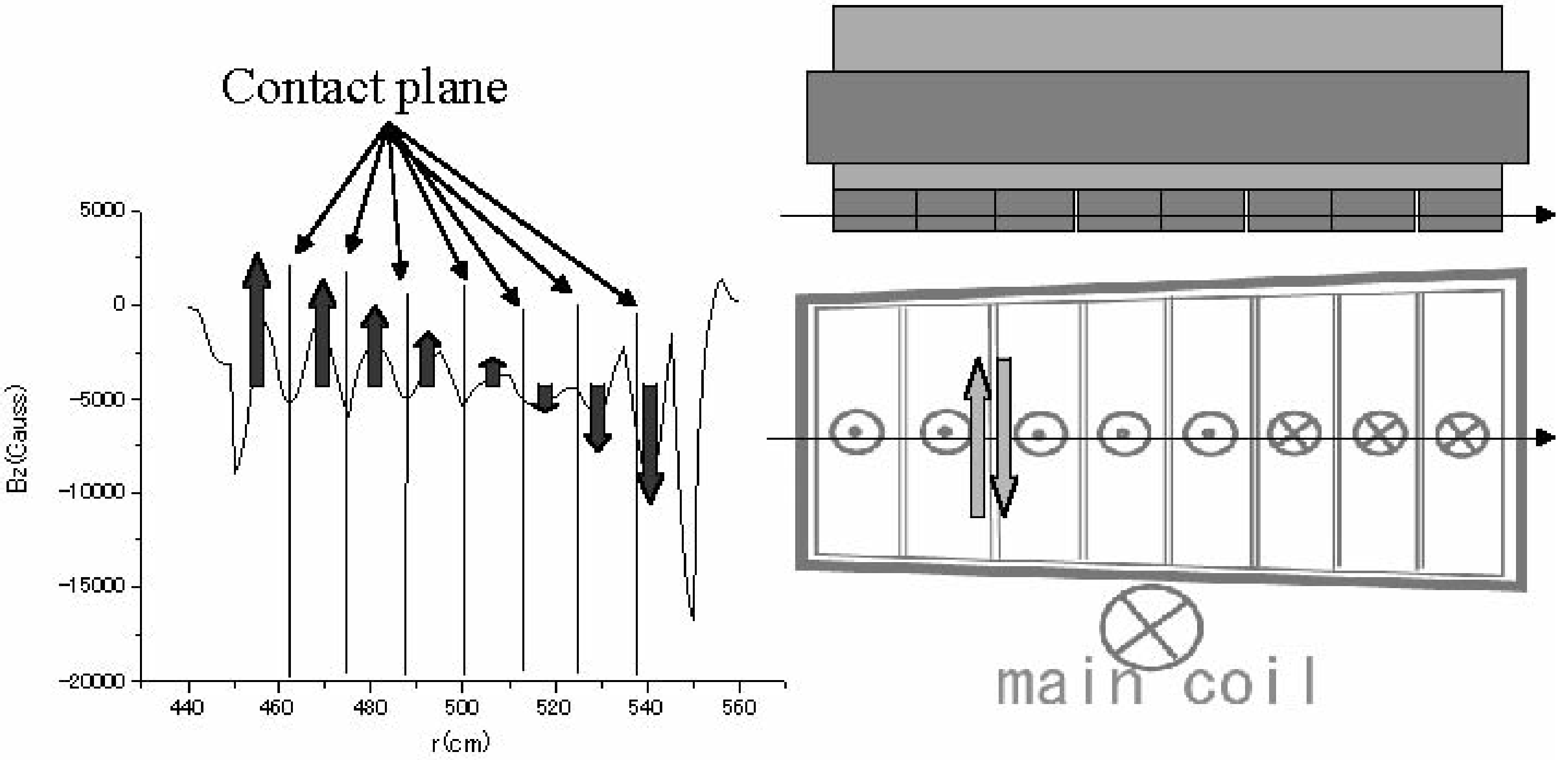








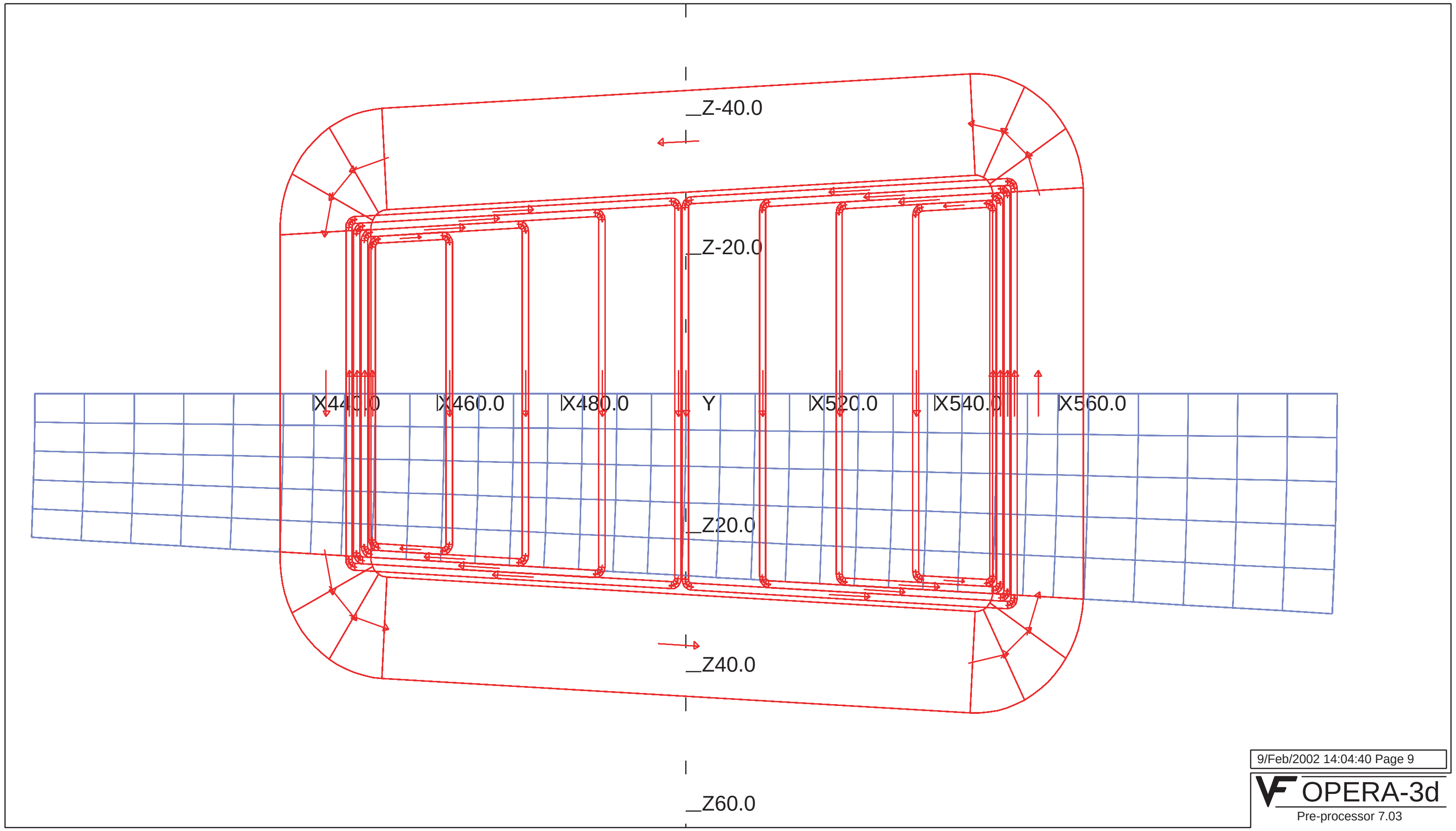
distributed coils type 2



Bz @coil plane of F-center

Opposite direction of current makes the kink

distributed coils type 3



distributed coils type 3