

A preliminary design of straight section magnet for nuSTORM_RFFAG ring

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Issues

- Exponential field $\sim \exp(mx)$: including many higher orders
- Lager apertures (full size)
 - H: 0.3m(emittance) + 0.1m(dispersion: $dp/p = \pm 20\%$)
 - V: 0.3m (emittance)
- Ordinary scheme(pole shaping) is difficult.
- Solution \rightarrow

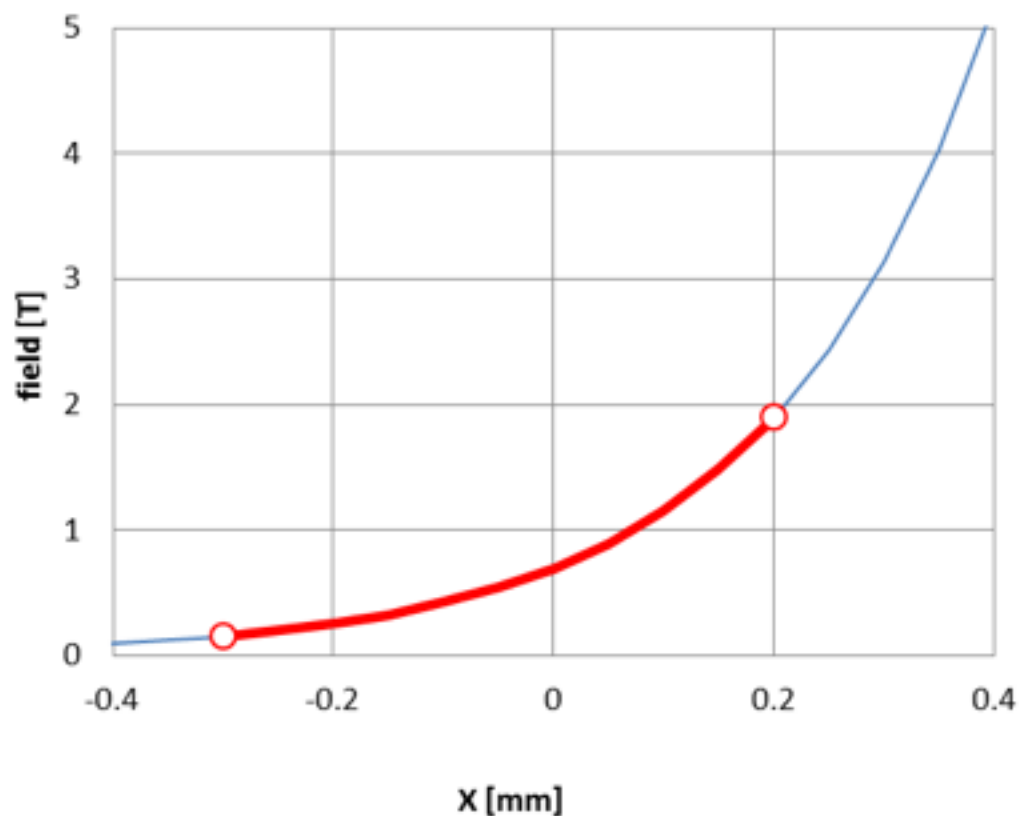
Pole face winding coils

Requirement

- FFAG exponential field:

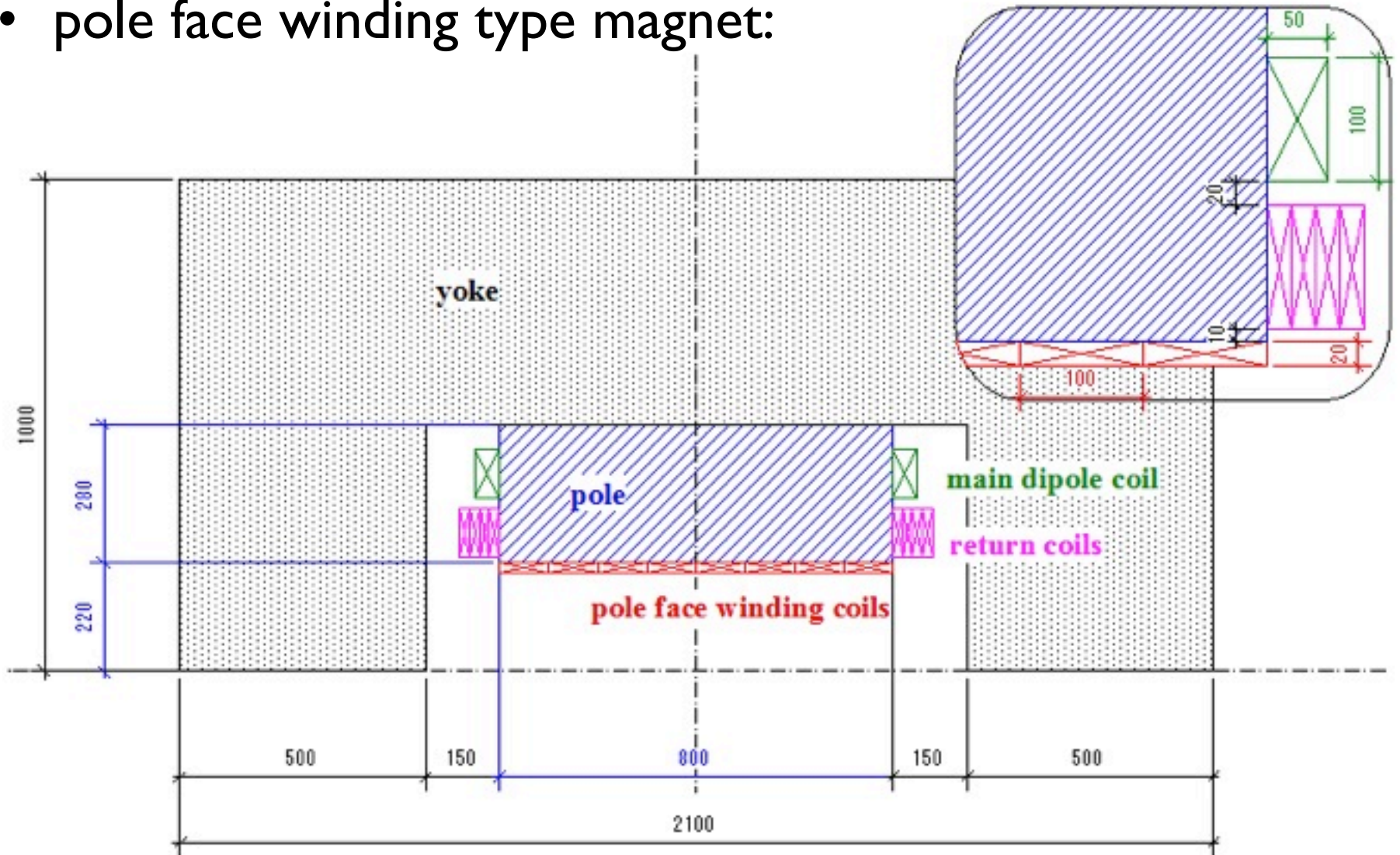
$$B = B_0 \exp(mx)$$

parameter	design value
B0	0.7[T]
m-value	5
x range	-0.3 ~ 0.2 [m]
B range	0.16 ~ 1.9 [T]
pole gap (full)	0.4 [m]

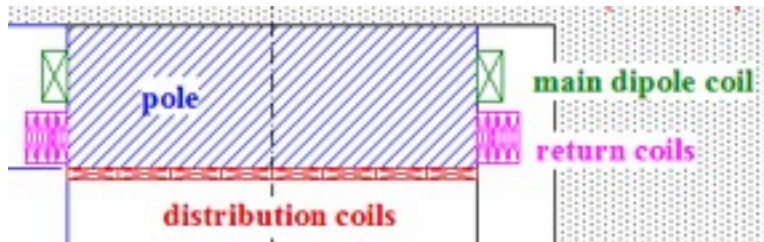


Magnet design (ver01)

- pole face winding type magnet:



Coils configuration

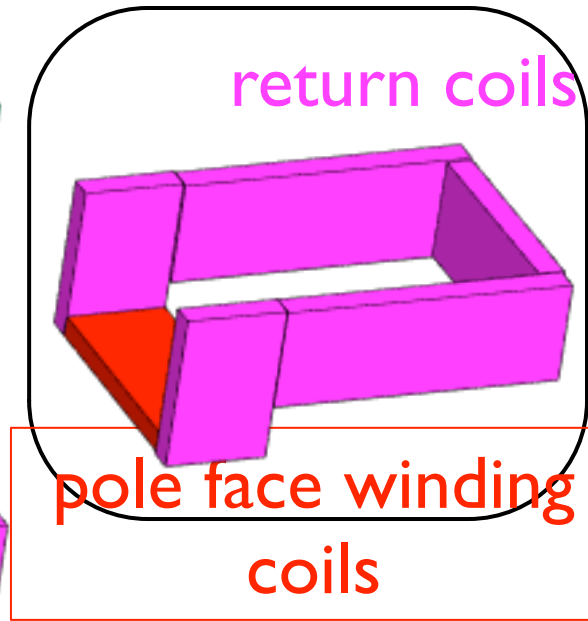
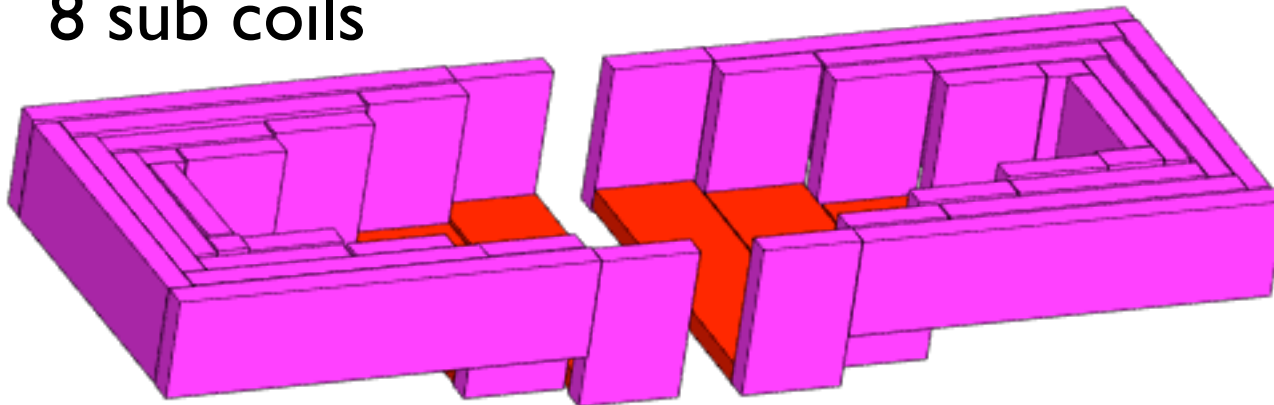


- 8 sub coils:
 - modified saddle-shaped coils
 - for magnetic field shaping

1 main coil



8 sub coils

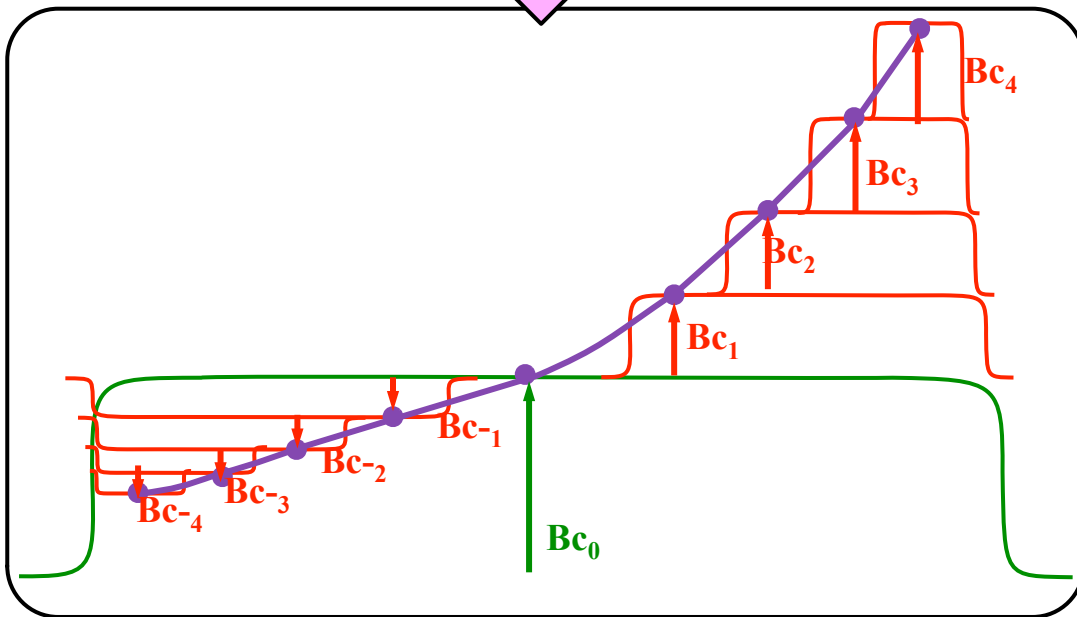
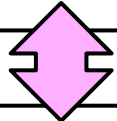
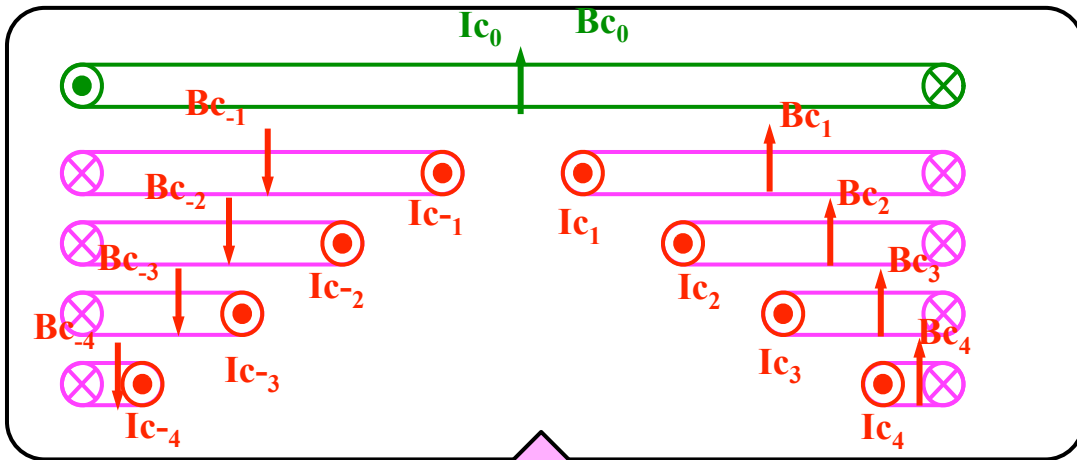


return coils

pole face winding coils



Calculation algorithm ①



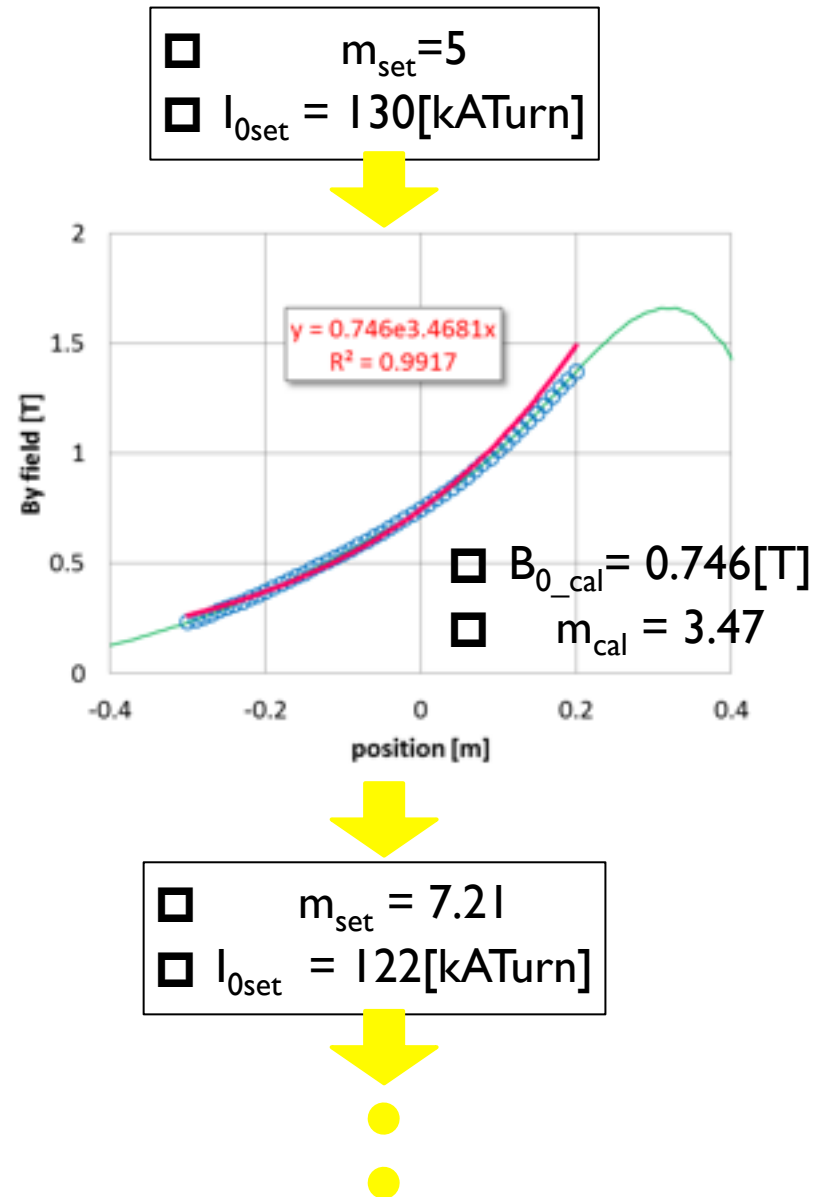
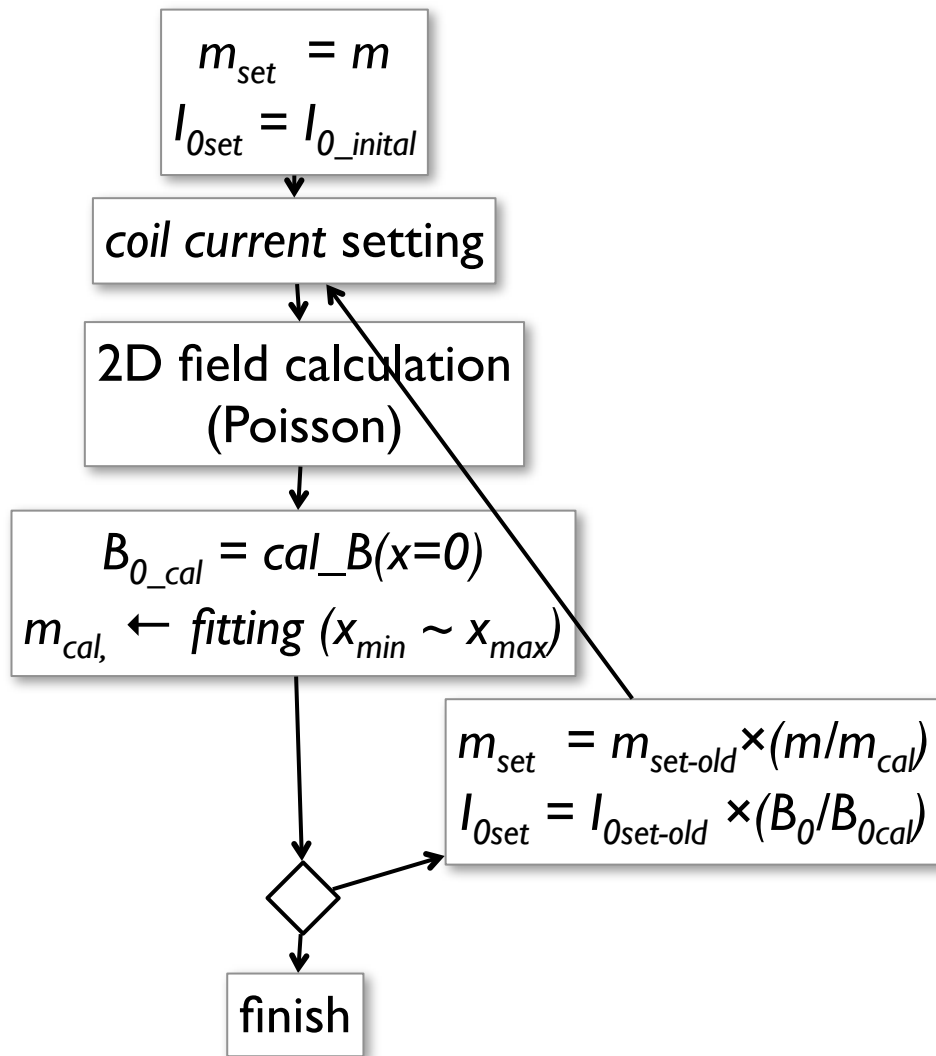
- Concept of field shaping
 - i. Field distribution is in directly proportional to the current distribution.
 - ii. Field on a given point is obtained to combine all fields generated by coils which located upon the point.



- i.
 - ✓ $B_i = B_0 \exp(mx_i)$
 - ✓ $\Rightarrow I_i = I_0 \exp(mx_i)$
- ii.
 - ✓ $Ic_0 = I_0$
 - ✓ $Ic_i = I_i - I_{i-1}$

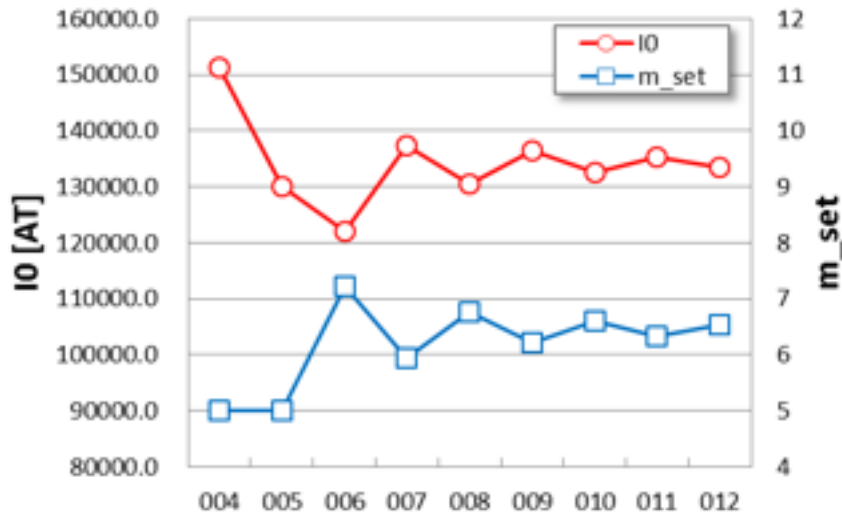
Calculation algorithm ②

- Iterative calculation

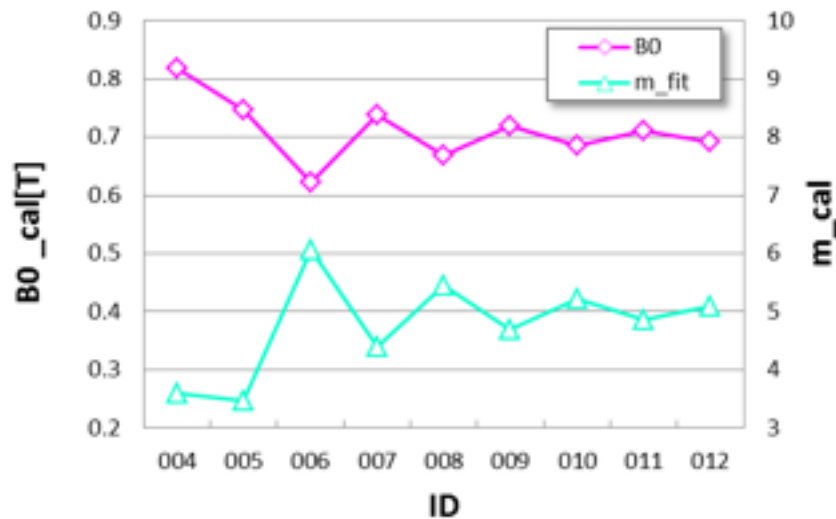


Result (1)

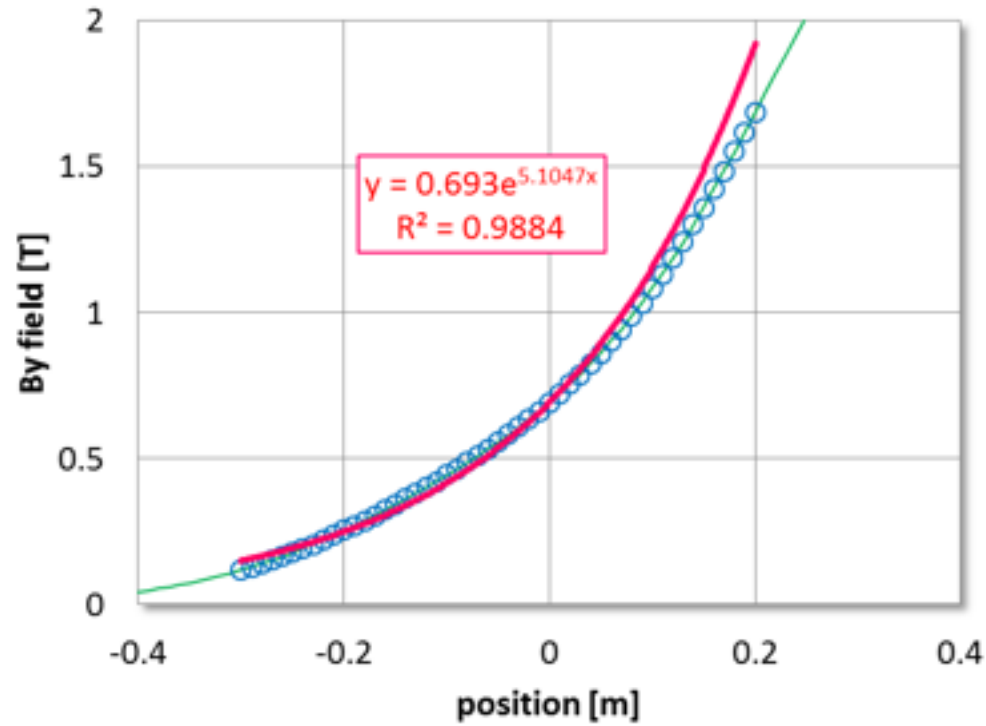
input parameters



calculation result



► ID 012



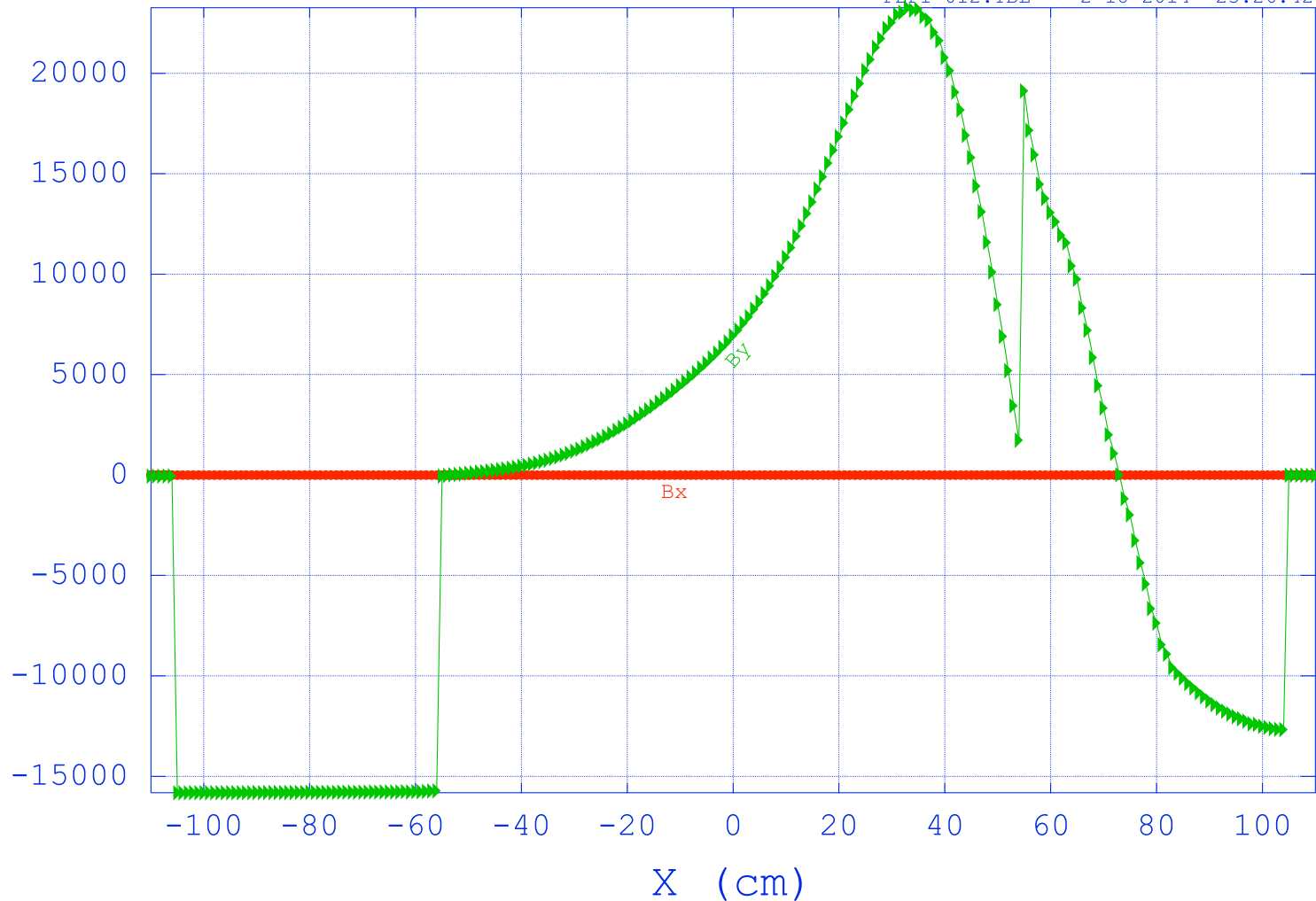
Result (2)

► ID 012

Magnetic field from Poisson run on file FEF1_012.AM

Problem title line 1: FFAG Magnet - Exponensital FFAG Field (EFE1) (file:EFE 1_00)

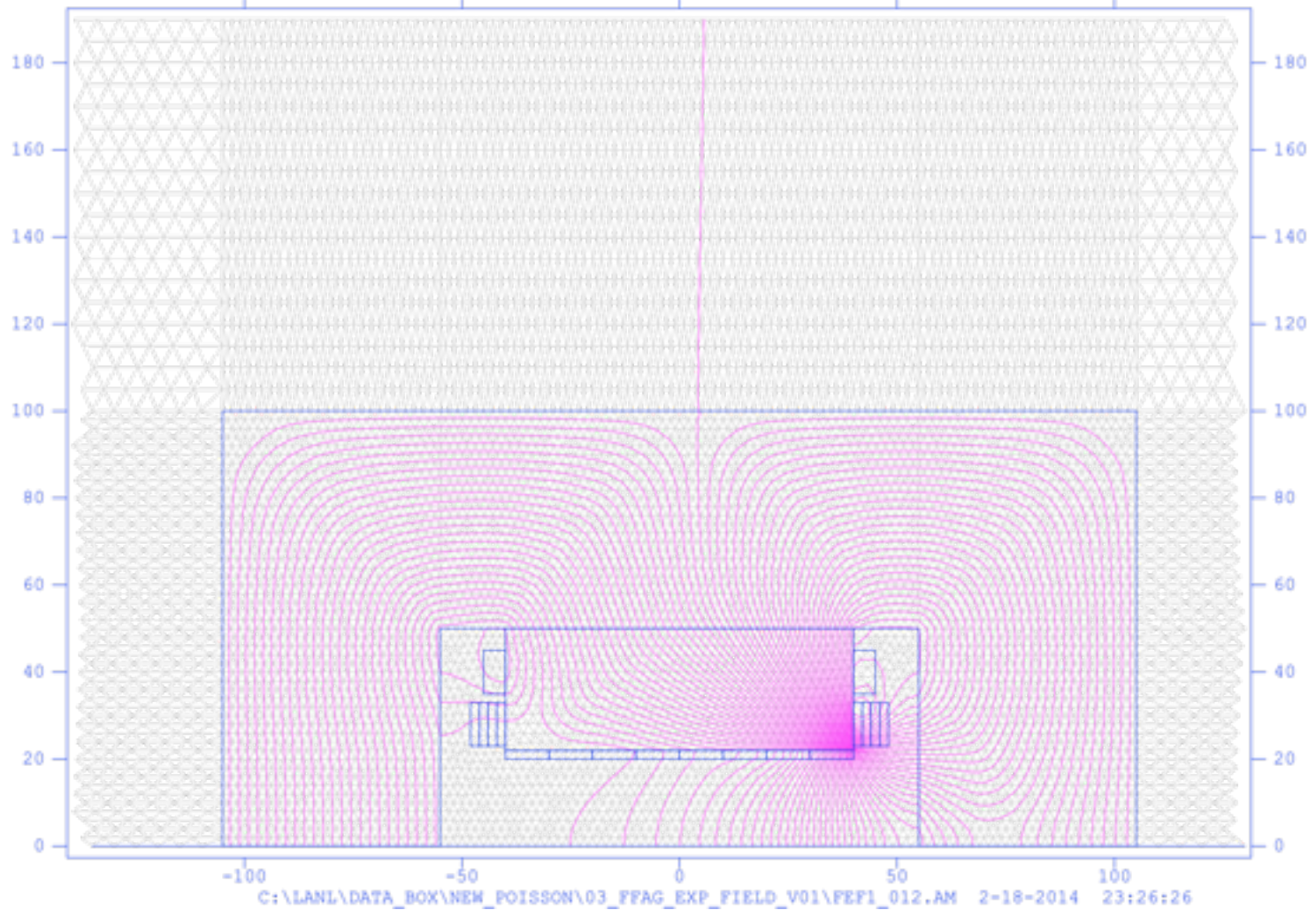
FEF1_012.TBL 2-18-2014 23:26:42



Result (3)

▶ ID 012

FFAG Magnet - Exponential FFAG Field (EFE1) (file:EFE 1_005)



Summary

- **A design of the straight-section magnet for RFFAG ring has been carried out. The preliminary results look promising.**
- **Next step:**
- *Optimization*
 - Increase the number of sub-coils
 - Shape the iron yoke for size and cost
- *New algorithm for iterative calculation*
 - evaluate the calculated field with local m-value
 - optimize the each coil currents