TOSCA Field-map with different F/D currents

2014. 05. 08 (10min)

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Purpose

Experiments on Mar 20-28

Injection trajectory of off-energy H- beam is to be measured,
but changing and measuring H- energy is very difficult.

Instead, we changed F/D currents by a factor with keeping vertical tune, such that F/D ratio is kept constant.
This situation can simulate a off-energy beam.
(→ next page)

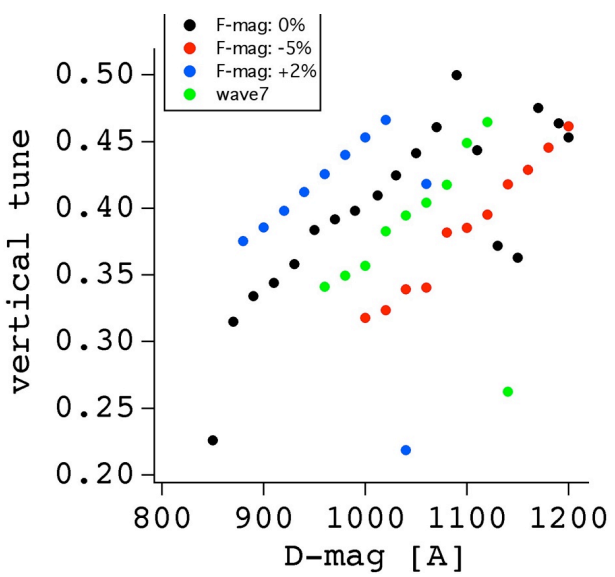
We must know the field reduction factor, which is not proportional to excitation current.

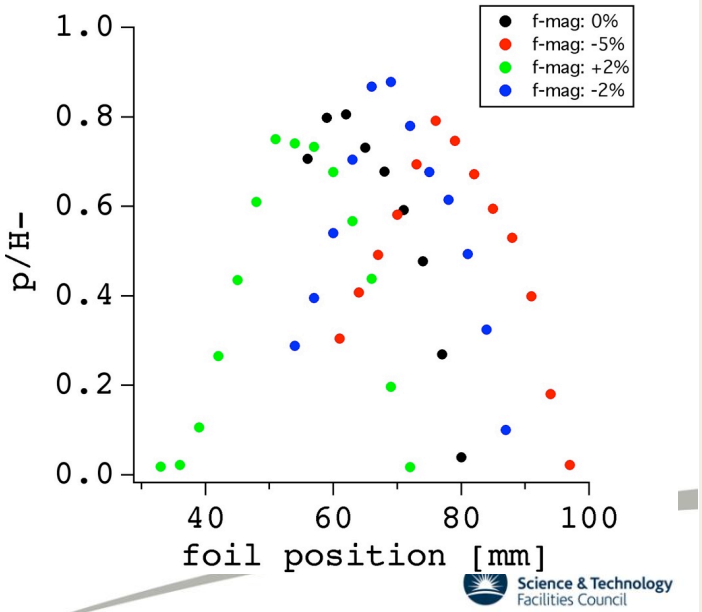
We calculated the field-map with different excitation currents, employing TOSCA code.

S Machida, Mar 31

Summary

- Tune and profile at foil with different magnetic strength





Current (%)	-5	-2	0	+2
Peak (mm)	76	68	60	55

TOSCA MODEL

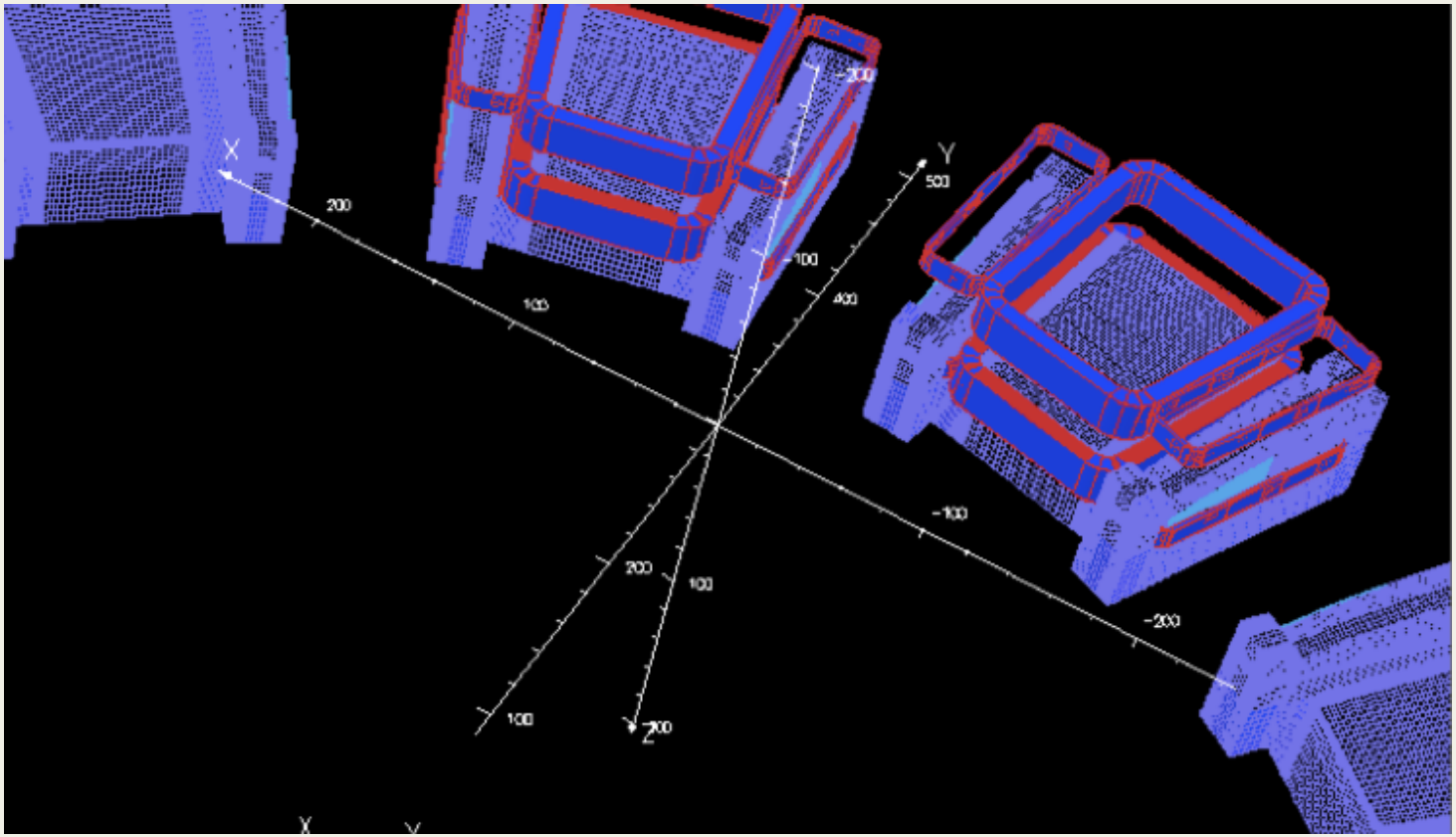
Configuration

MR_f841_81_d597_04.oppre

This file is made by Mitsubishi elec. (Ishi-sama?)

F/D magnets in 12 fold symmetry

No rf cavity and other magnetic materials

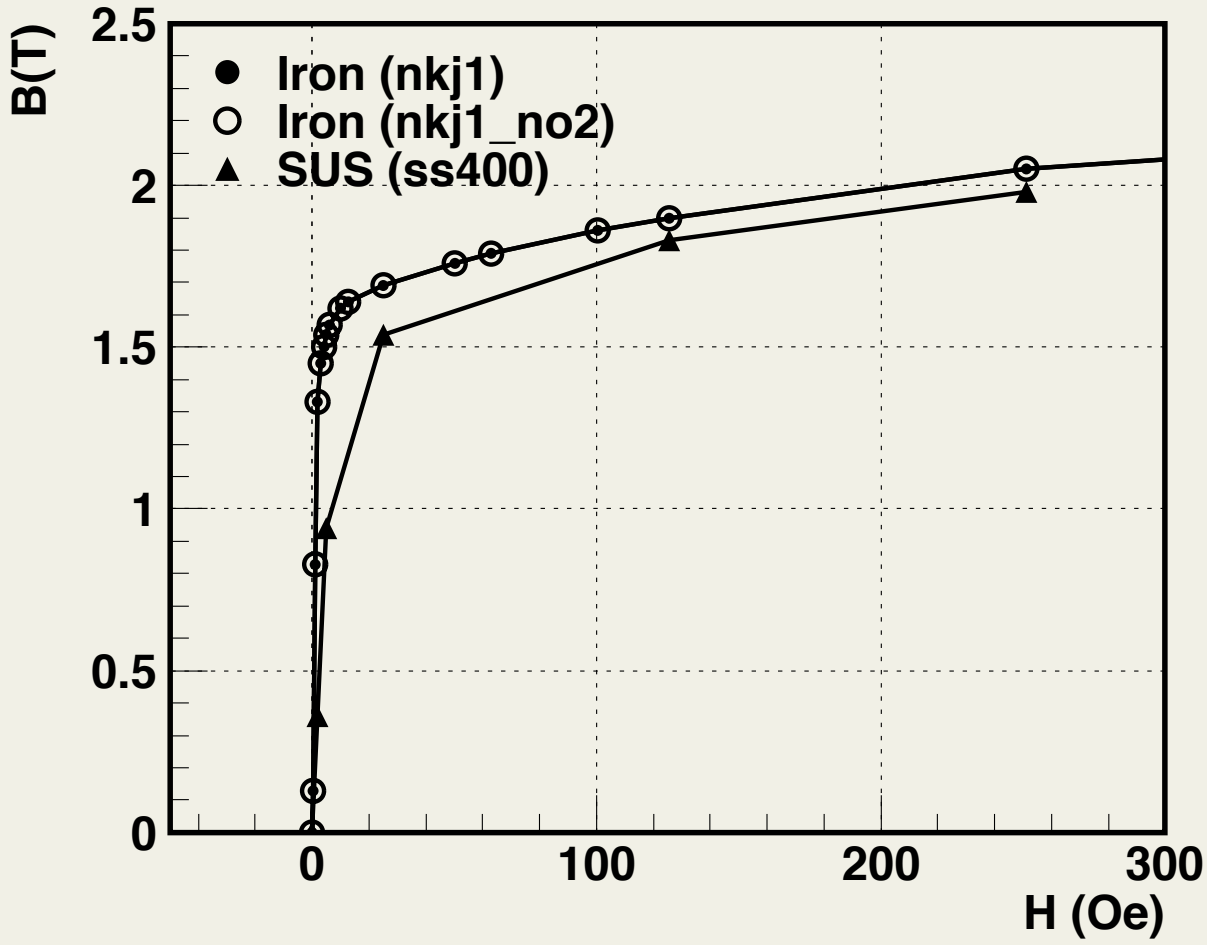


B-H characteristic

Nkj1_no2.bh

Data given by Mitsubishi elec.

Special high quality iron is used in F/D yoke



Excitation current

Real F/D current in Power supply

CurrentSearch.xls (calibration tool)

$$\begin{bmatrix} 85.41 \\ -107.76 \end{bmatrix} + \begin{bmatrix} 0.9486 & 0.0117 \\ -0.4151 & -1.02 \end{bmatrix} \begin{bmatrix} I_F \\ I_D \end{bmatrix}_{\mathrm{PS}}$$

Equivalent TOSCA current

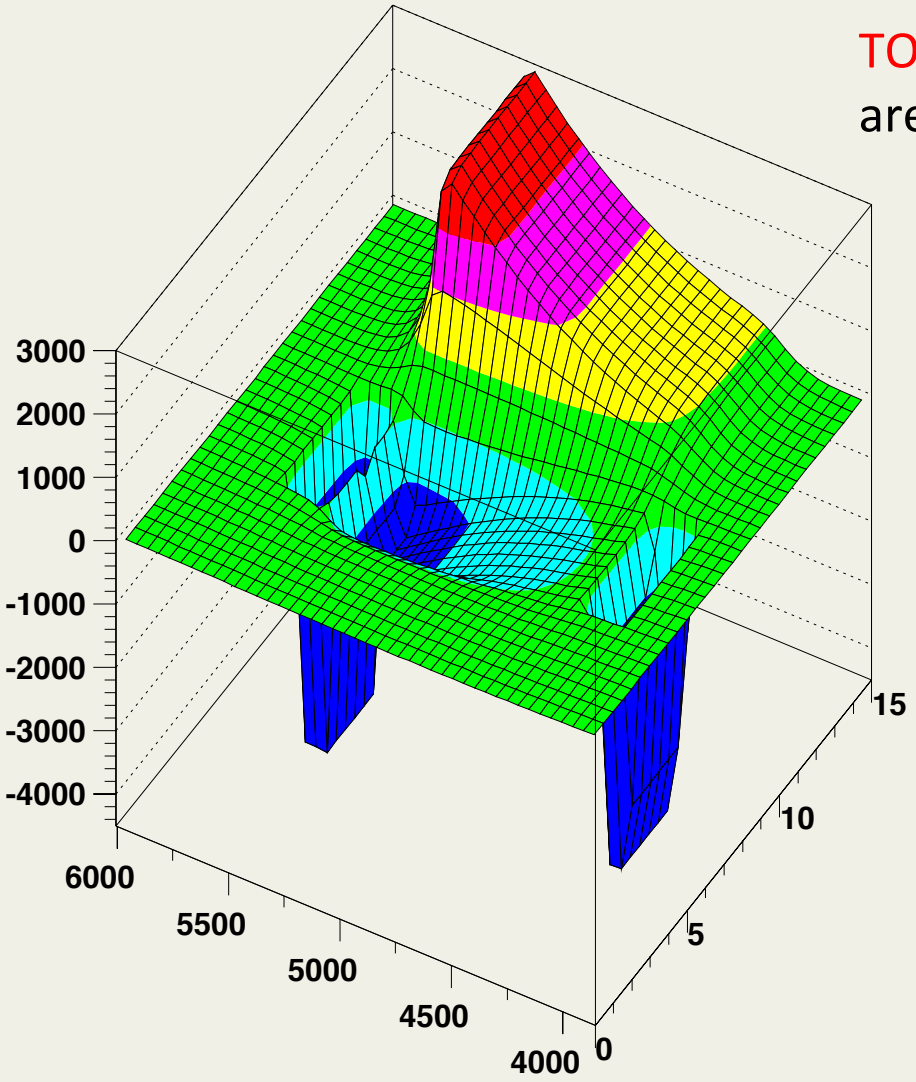
x 50 turns/174.96 cm^2 (F)

x 5 turns/19.3048 cm^2 (D)

TOSCA current density

OUTPUTS

Field Map



TOSCA field files listed below
are uploaded on the Collaboration web-cite

20140502_773_1140.table … -5%
20140503_797_1080.table … -2%
20140502_815_1012.table … 0%
20140504_830_0940.table … +2%

Table file format

20140502_814_1012.table

```
         0          0          0          1
1 X [LENGU]
2 Y [LENGU]
3 Z [LENGU]
4 BX [FLUXU]
5 BY [FLUXU]
6 BZ [FLUXU]
0
  0.00000000000      284.000000000      0.00000000000      0.00000000000     -0.164093484315E-07  -51.5724329776
 0.495673000000      284.000000000      0.00000000000      0.00000000000     -0.114580093942E-07  -51.5726629441
 0.991345000000      283.998000000      0.00000000000      0.00000000000     -0.705101792545E-08  -51.5720206636
  1.48701000000      283.996000000      0.00000000000      0.00000000000     -0.318920274981E-08  -51.5716493513
  1.98268000000      283.993000000      0.00000000000      0.00000000000      0.00000000000       -51.5709796655
  2.47834000000      283.989000000      0.00000000000      0.00000000000      0.00000000000       -51.5700772354
  2.97399000000      283.984000000      0.00000000000      0.00000000000      0.00000000000       -51.5689102099
```

Header + Array of

X(cm) Y(cm) Z(cm) Bx(gauss) By(Gauss) Bz(Gauss)

where

X=R sin(PH) and Y=R cos(PH)

with

R = 284, 285, 286, …. , 602 (cm)

Z = 0.0, 0.1, 0.2, …. , 1.0 (cm)

PH= 0.0, 0.1, 0.2, …. , 15.0 (deg)

PH=0

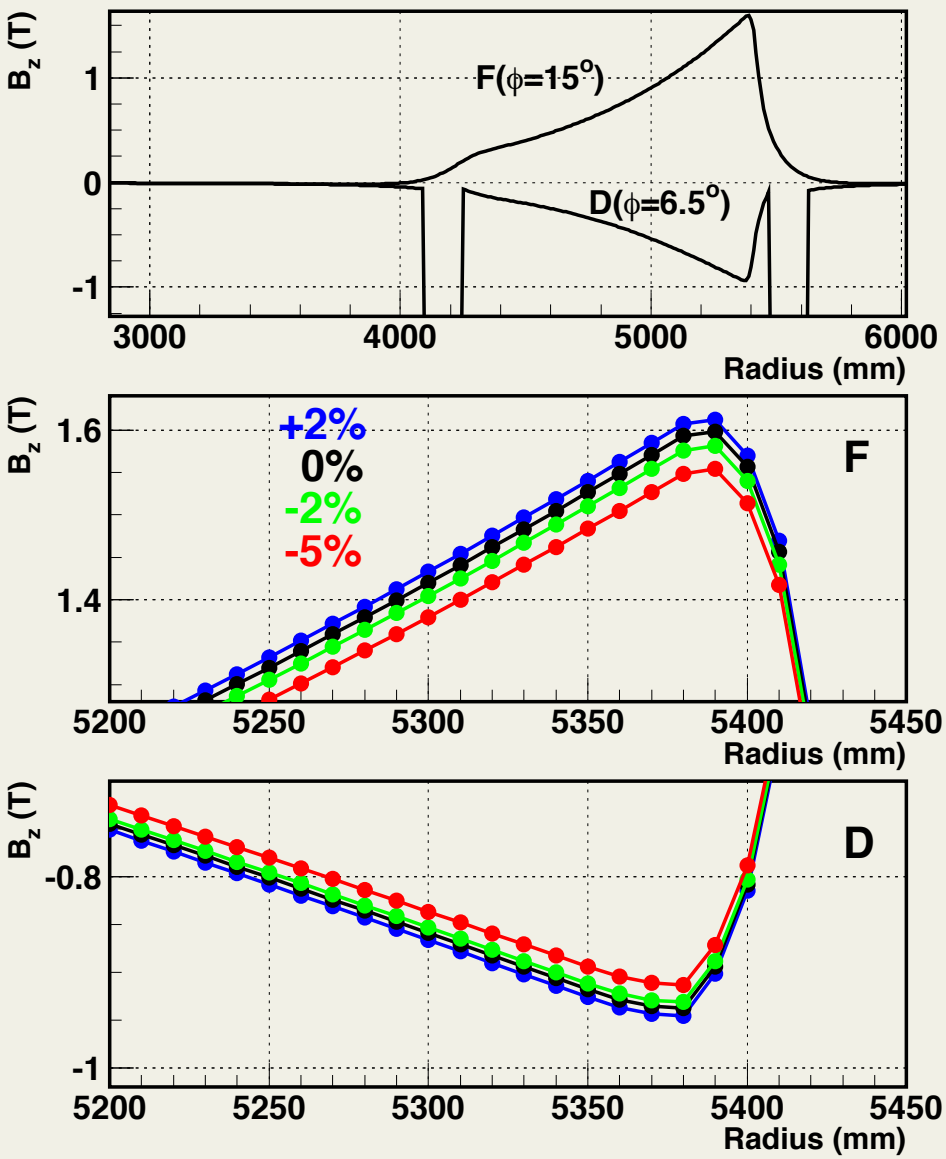
… center of straight section

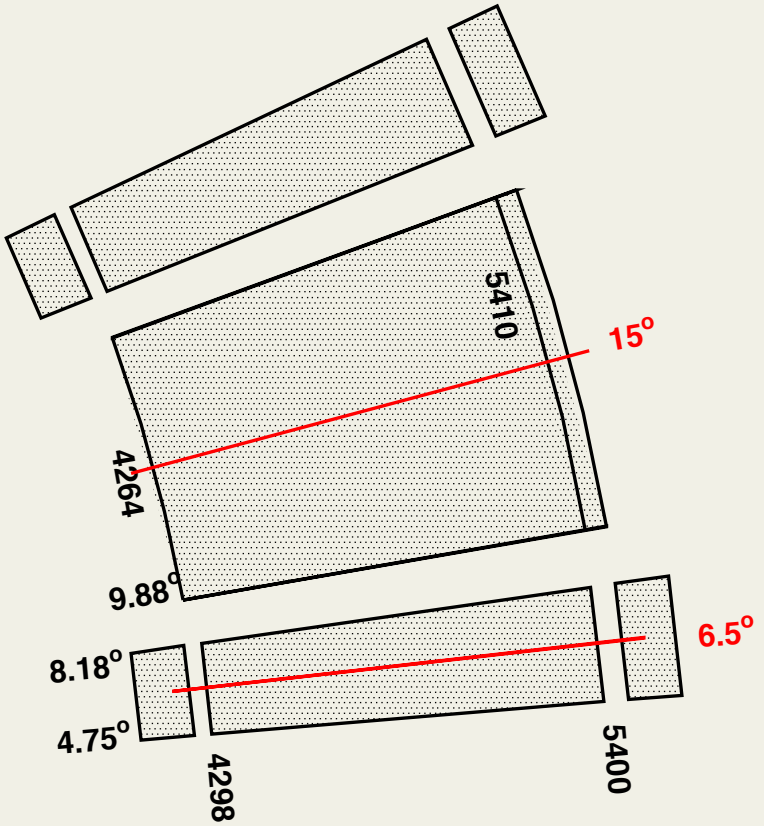
PH=15

… center of F magnet

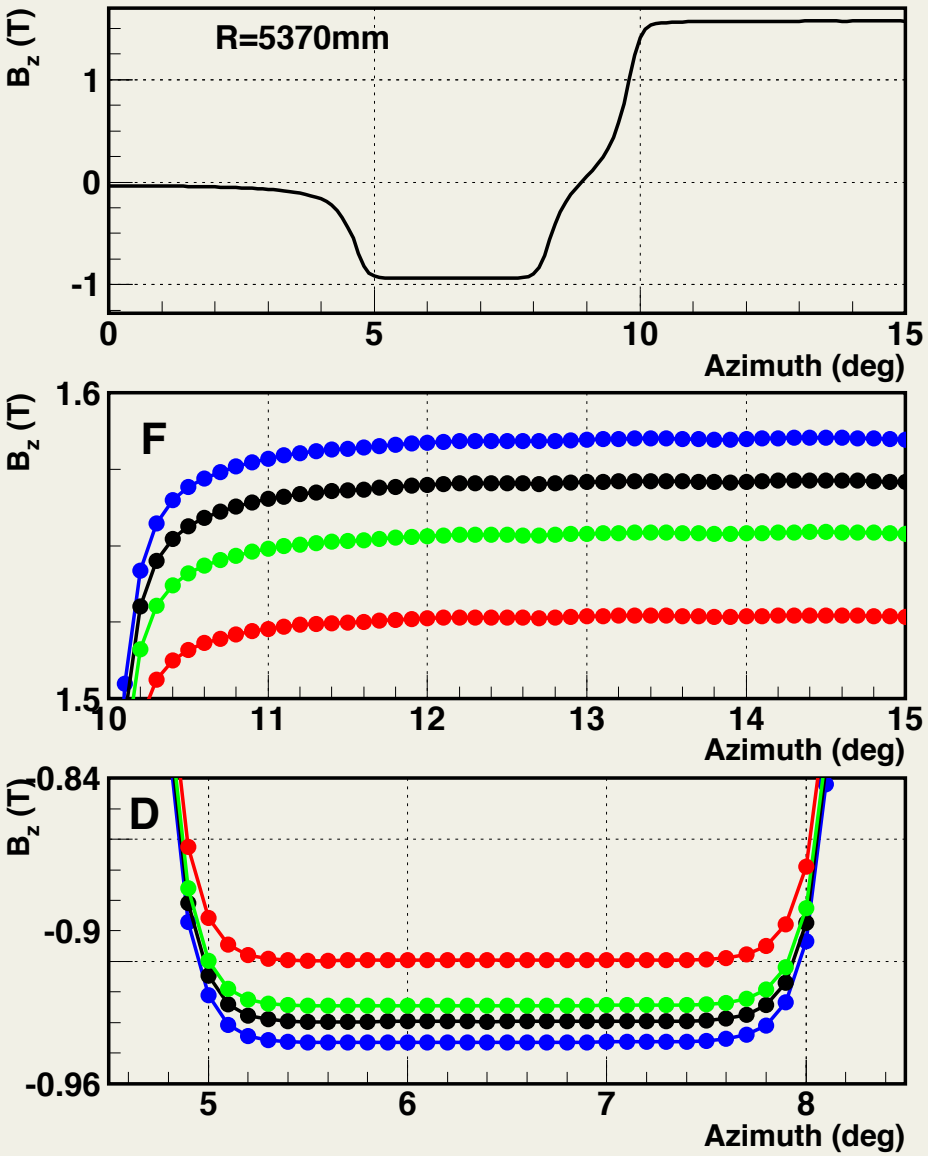
DEPENDENCE ON CURRENT

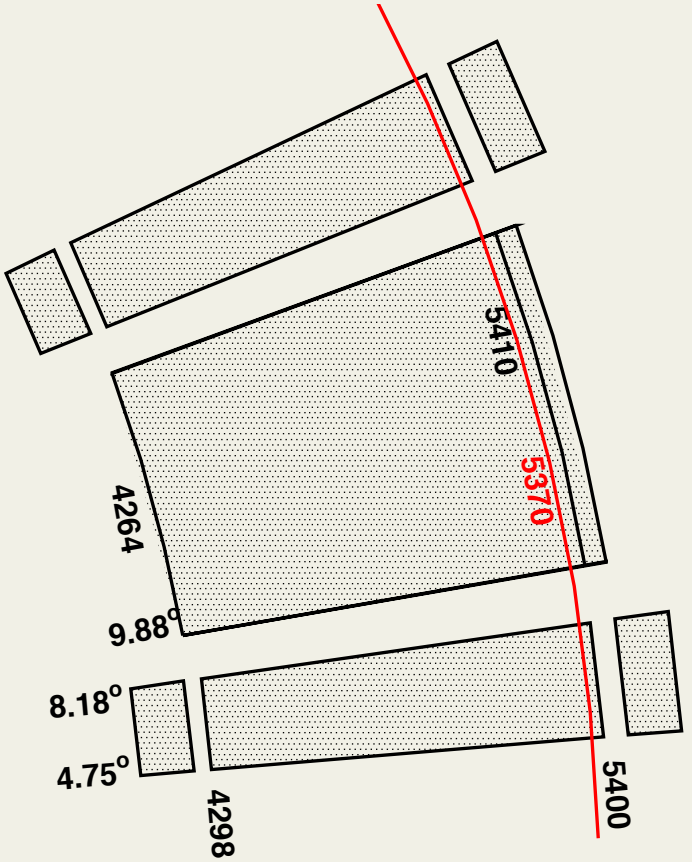
Plotting along R



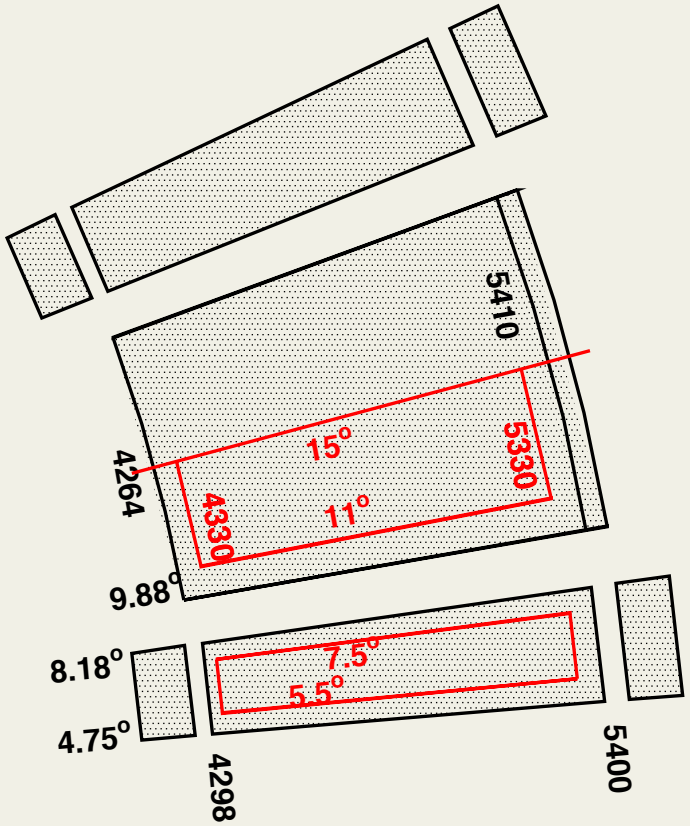


Plotting along PHI





Relative change by current



Vertical field strength was compared between different F/D currents, point by point in the central regions of F and D magnets in the mid-place.

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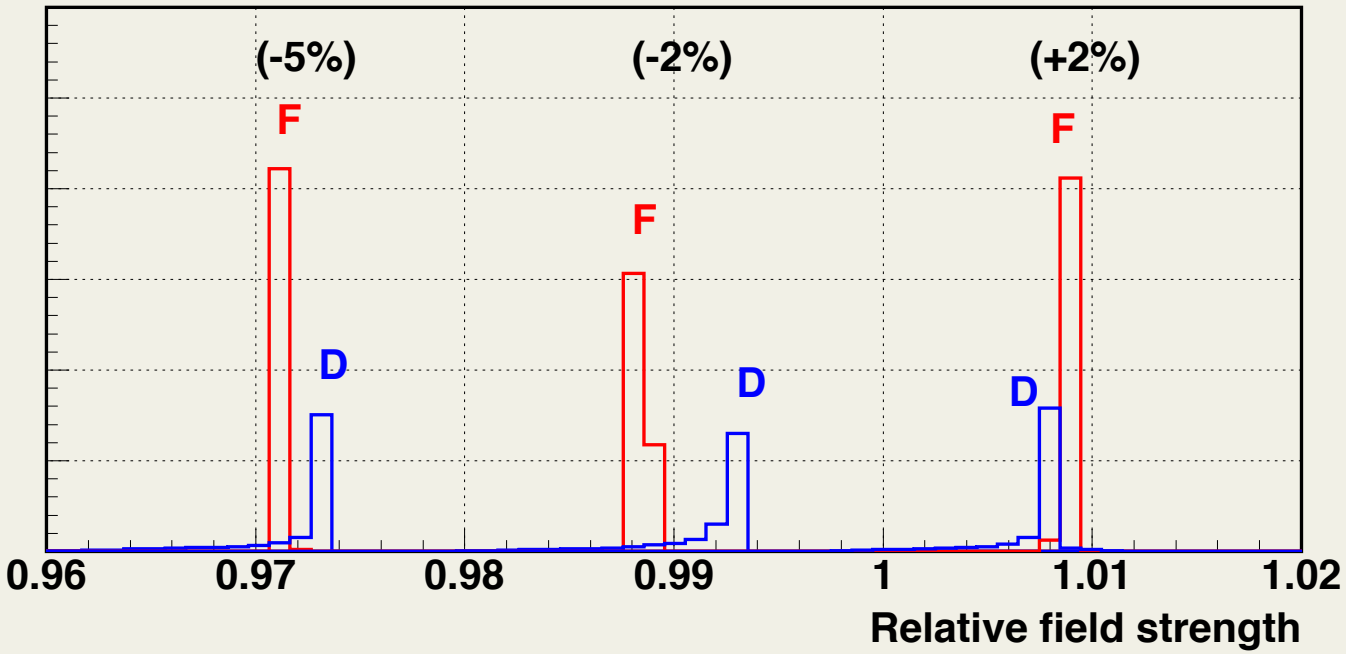
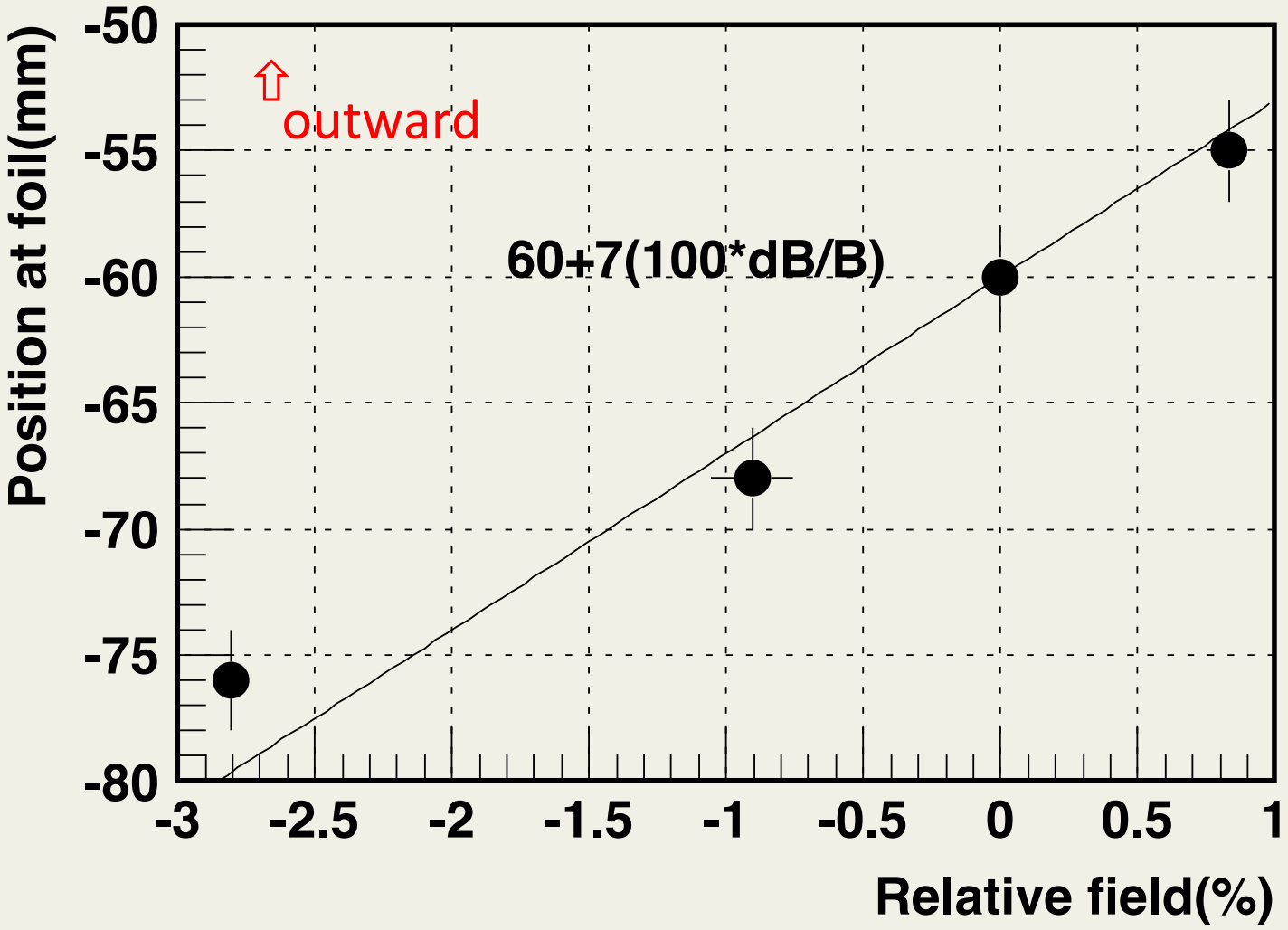
Field reduction (summary)

Current factor	Power supply I_F / I_D	File name	Average field dB_F / dB_D
-5%	773.30 / 1140	20140502_773_1140.table	-2.86% / -2.75%
-2%	797.72 / 1080	20140503_797_1080.table	-1.10% / -0.81%
0%	814.00 / 1012	20140502_814_1012.table	0% / 0%
+2%	830.28 / 940	20140504_830_0940.table	+0.87% / +0.80%



Dispersion


outward
60+7(100*dB/B)
Position at foil(mm)
-50
-55
-60
-65
-70
-75
-80
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
Relative field(%)