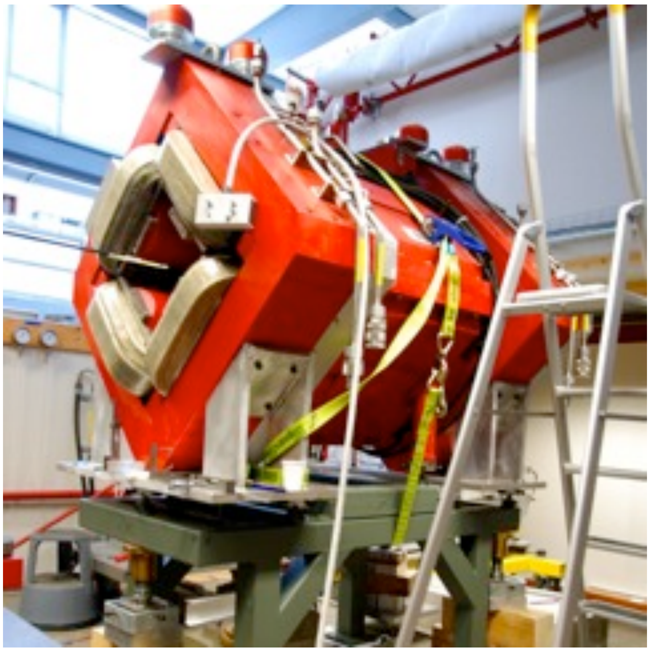
QSE-QSL-QSE Triplet (μSR HMF)



QSE-QSL-QSE quadrupole triplet

2R (QSE) = 254 mm
2R (QSL) = 250 mm

I_{MAX} = 100 A

MEASUREMENT DATE:
21.Jul.–13.Aug.2010

MEASUREMENT ARM:
brass cylinder interface Ø 40 mm
aluminum pipe Ø 28 mm, 1 m
carbon pipe Ø 12.1 mm, 1.5 m

MEASURING SPEED:
4.5 mm/sec (X-axis)
40 mm/sec (Z-axis)

INTEGRATION TIME:
20 msec

DVM-1 (1 V RANGE):
Hall probe sbv397 (150 mA)

DVM-2 (10 V RANGE):
50 V / 200 A (MSG-2.1), 2 A/s

AIR CONDITIONING:
ON (T_{SET} = 24°)

OPERATORS:
Roland Deckardt
Sascha Graf
Vjeran Vranković (report)

DATA DIRECTORY:
afs: sys/alpha_dux51/swdir/
magnet/meas/qse-qsl-qse

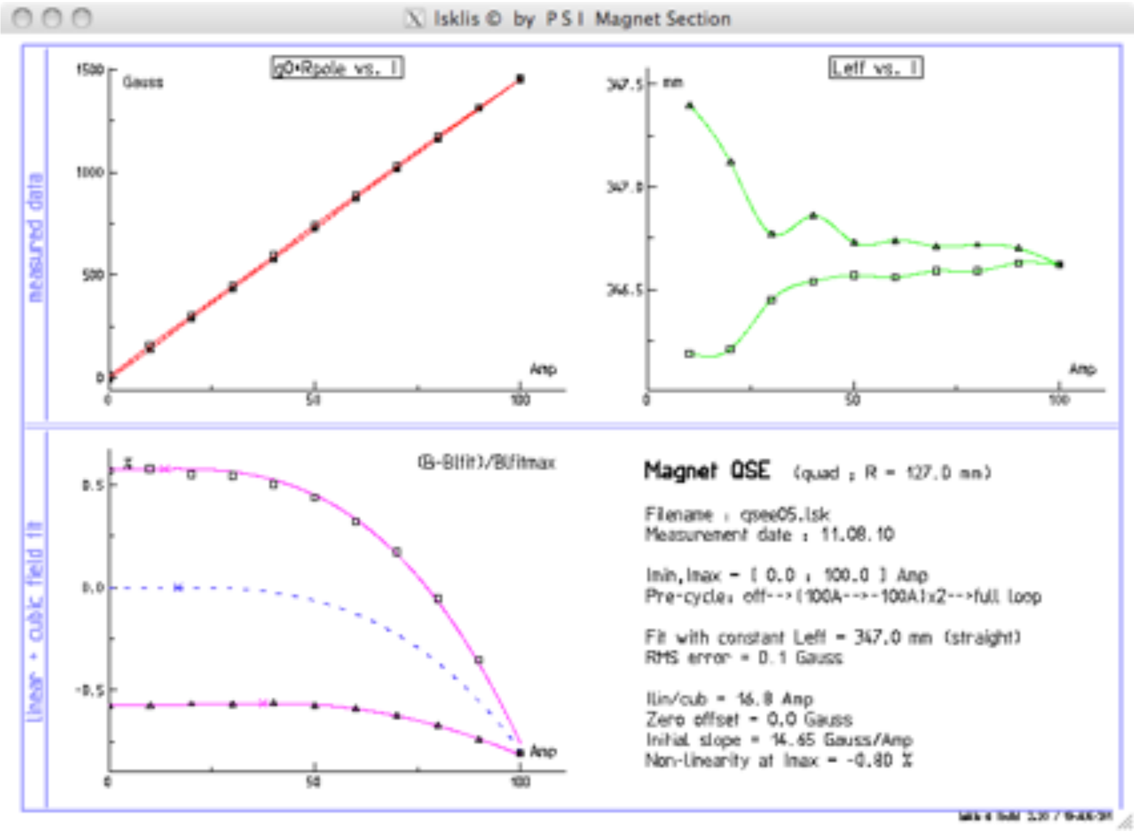
Alignment and positioning

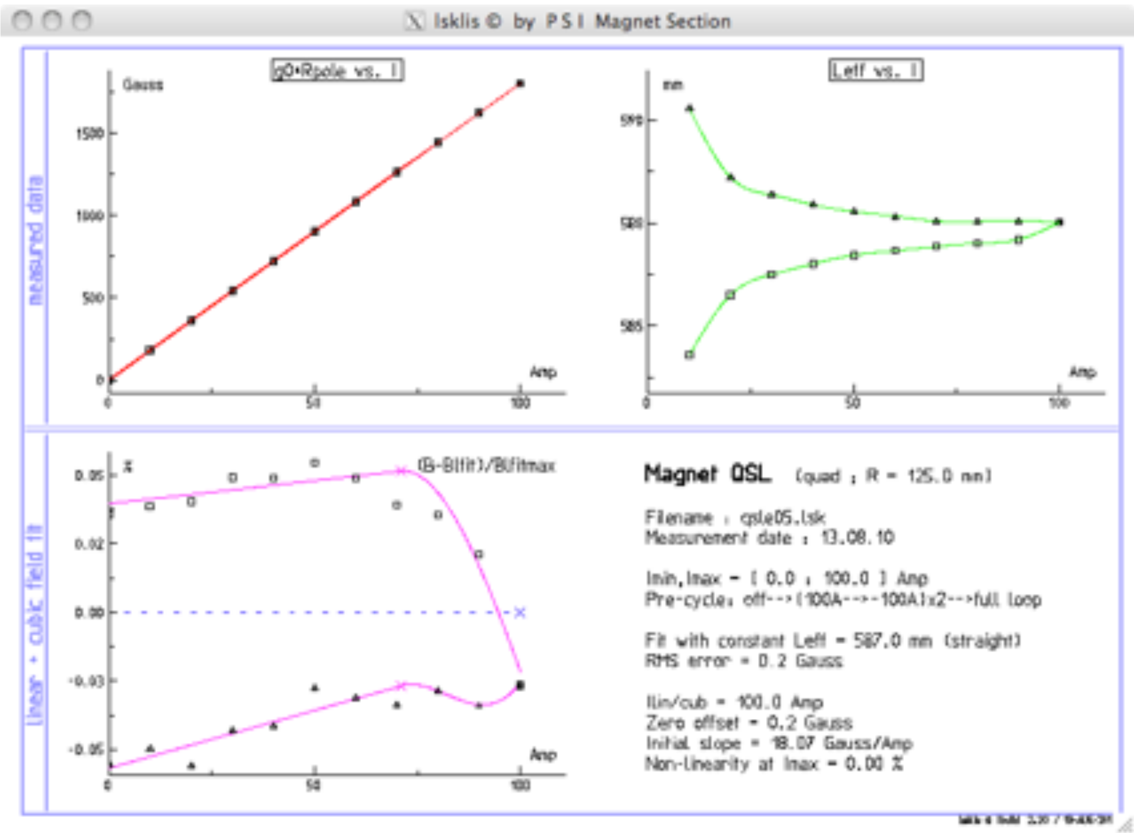
The quadrupole triplet together was brought in the measurement lab and placed on its stand.

In the measurements coordinate system the triplet axis is the Z-axis, vertical axis is the Y-axis.

The aligning and positioning of the magnet was done by eye. The probe was leveled with a spirit level built into the measuring arm. The probe axis angle was adjusted in the calibration magnet to be perpendicular to the vertical field component. The X and Y axis were found by aligning the Hall probe with the centre of a plexiglass disk placed between two bottom poles (for X=0) and placed between the two side poles (for Y=0).

Excitation curve





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Magnet QSE

File : qsee05.lsk
Date : 11.08.10

Pre-cycle : off-->(100A-->-100A)x2-->full loop

#Curr: 21 (nPaths=2)
Z-dir: from -1070.00 mm, steps of 2.00 mm
X-dir: at -100.00 mm & at 100.00 mm
Rpole: 127.00 mm

 linear_<1:Ilin> and cubic_<Ilin:Imax> approximation of Bp:
 Blin = b0 + b1 * Irel                         ;   Irel = I / Imax
 Bcub = Blin + b2 * Irel^2 + b3 * Irel^3   ;   Irel = (I - Ilin) / (Imax - Ilin)

       Ilin_A     Imax_A       b0_G       b1_G       b2_G       b3_G      RMS_G
       ======     ======       ====       ====       ====       ====      =====
 /       37.5      100.0       -8.4     1464.6       -3.7       -0.3        0.0
 \       13.7      100.0        8.4     1464.7       -5.5      -14.5        0.3
 ¯       16.8      100.0        0.0     1464.2       -2.1       -9.6        0.1

 / = increasing current branch
 \ = decreasing current branch
 ¯ = average

constLeff (straight) = 347.0 mm

   I_Amp         gdz_G      Bp_G     err_G
   =====         =====      ====     =====
    0.00*        -22.8      -8.3       0.0
   10.00/        377.4     138.1       0.0
   20.00/        778.0     284.7       0.1
   29.99/       1177.6     431.0      -0.1
   39.99/       1578.2     577.6       0.1
   49.98/       1977.4     723.7      -0.1
   59.98/       2377.0     870.0       0.0
   69.97/       2775.6    1015.8       0.0
   79.97/       3173.8    1161.6       0.0
   89.97/       3571.2    1307.0      -0.1
   99.96*       3968.4    1452.4      -0.3 (average of 2 fits)
   89.97\       3586.7    1312.7       0.3
   79.97\       3198.5    1170.6       0.2
   69.97\       2807.4    1027.5       0.2
   59.98\       2413.5     883.3      -0.2
   49.98\       2018.0     738.6      -0.2
   39.99\       1620.8     593.2      -0.3
   29.99\       1222.1     447.3      -0.3
   20.00\        822.6     301.1      -0.4
   10.00\        423.5     155.0       0.0
    0.00*         22.8       8.3      -0.1

   Bp = gdz / constLeff * Rpole
   err = Bp - Bfit
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Magnet QSL

File : qsle05.lsk
Date : 13.08.10

Pre-cycle : off-->(100A-->-100A)x2-->full loop

#Curr: 21 (nPaths=2)
Z-dir: from -650.00 mm, steps of 2.00 mm
X-dir: at -100.00 mm & at 100.00 mm
Rpole: 125.00 mm

 linear_<1:Ilin> and cubic_<Ilin:Imax> approximation of Bp:
 Blin = b0 + b1 * Irel                      ;   Irel = I / Imax
 Bcub = Blin + b2 * Irel^2 + b3 * Irel^3    ;   Irel = (I - Ilin) / (Imax - Ilin)

        Ilin_A     Imax_A      b0_G      b1_G      b2_G      b3_G      RMS_G
        ======     ======      ====      ====      ====      ====      =====
 /        70.9      100.0      -0.8    1806.8      -1.4       1.2        0.1
 \        71.1      100.0       0.9    1806.3      -2.0       0.5        0.1
 ¯       100.0      100.0       0.2    1806.0       0.0       0.0        0.2

 / = increasing current branch
 \ = decreasing current branch
 ¯ = average

constLeff (straight) = 587.0 mm

   I_Amp         gdz_G      Bp_G     err_G
   =====         =====      ====     =====
    0.00*         -3.9      -0.8       0.0
   10.00/        845.1     180.0       0.1
   20.00/       1693.0     360.5      -0.1
   29.99/       2541.7     541.2       0.0
   39.99/       3390.3     722.0       0.0
   49.98/       4239.1     902.7       0.1
   59.98/       5087.2    1083.3       0.0
   69.98/       5935.5    1263.9      -0.1
   79.97/       6783.5    1444.5       0.0
   89.97/       7631.5    1625.1       0.0
   99.96*       8479.7    1805.7      -0.1 (average of 2 fits)
   89.97\       7636.2    1626.1       0.1
   79.97\       6788.9    1445.7      -0.1
   69.98\       5941.6    1265.3      -0.2
   59.98\       5094.0    1084.8       0.0
   49.98\       4246.0     904.2       0.1
   39.99\       3398.0     723.6       0.1
   29.99\       2549.5     542.9       0.1
   20.00\       1701.2     362.3       0.0
   10.00\        852.6     181.6       0.0
    0.00*          3.9       0.8      -0.1

   Bp = gdz / constLeff * Rpole
   err = Bp - Bfit
```

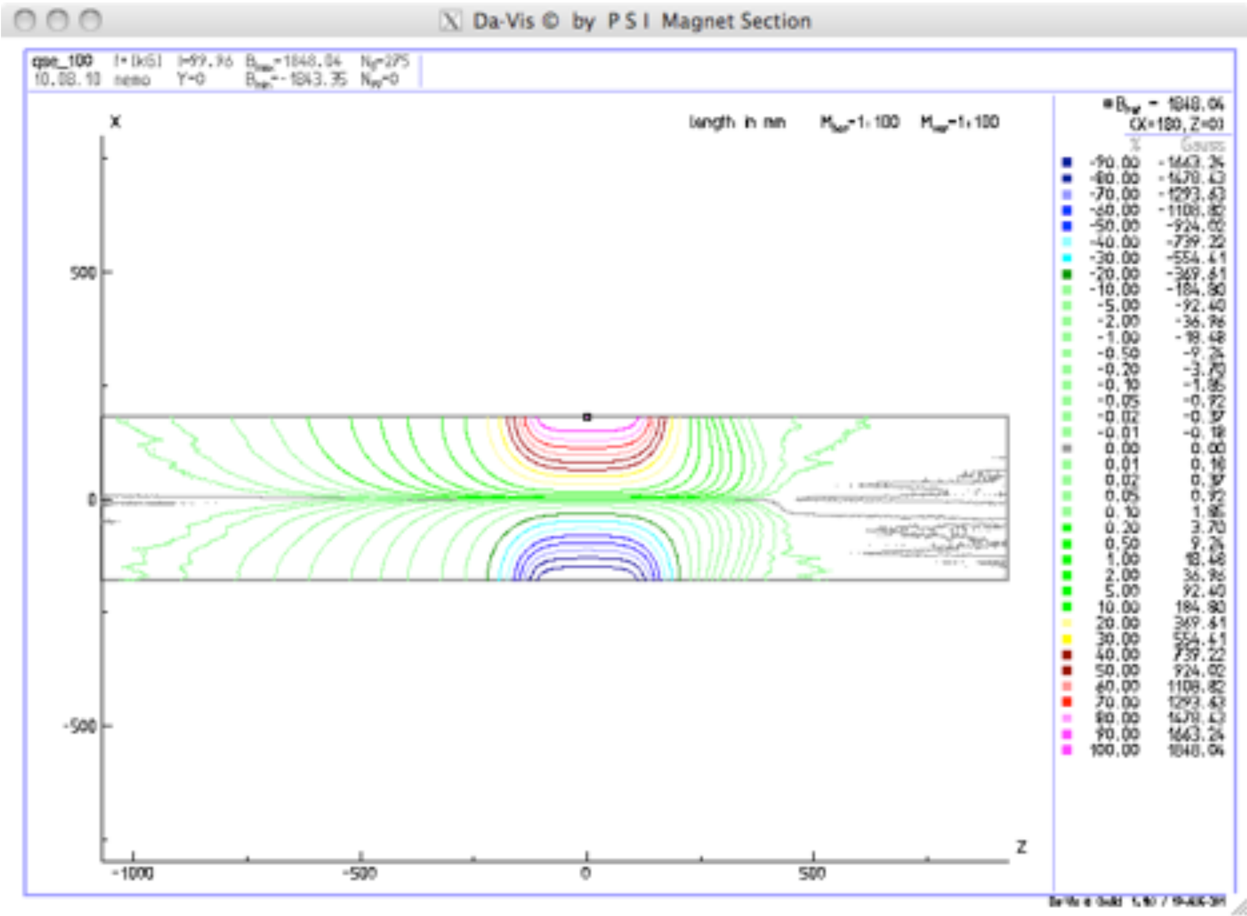
Field analysis

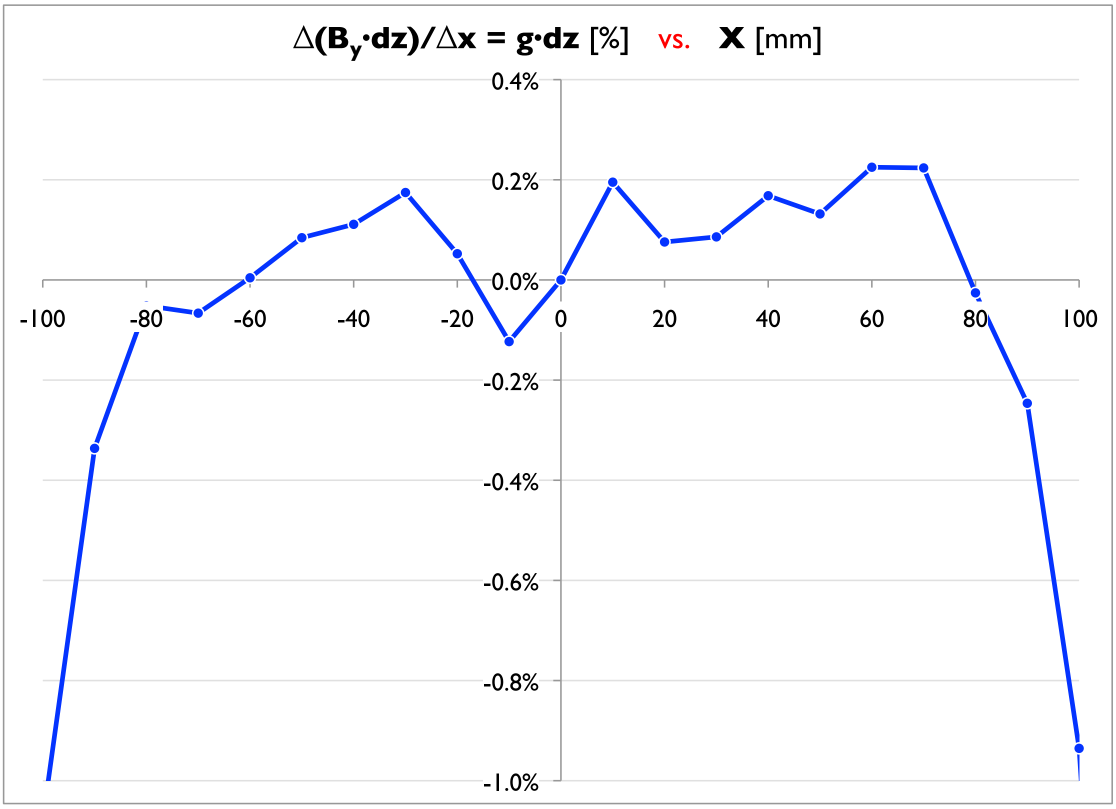
The earth and the background (remanent) fields are removed from the measured fields:

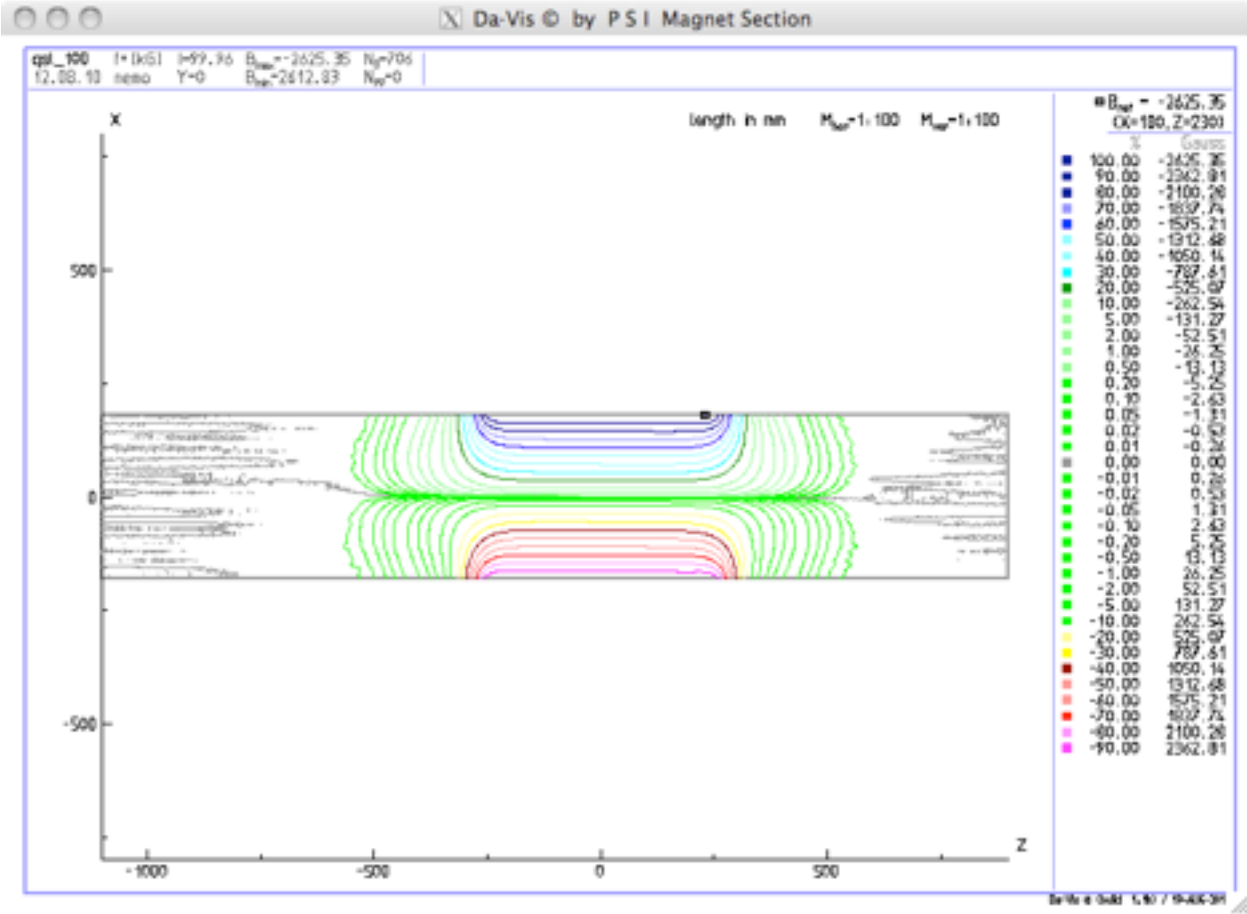
$$\frac{measurement(+current) - measurement(-current)}{2}$$

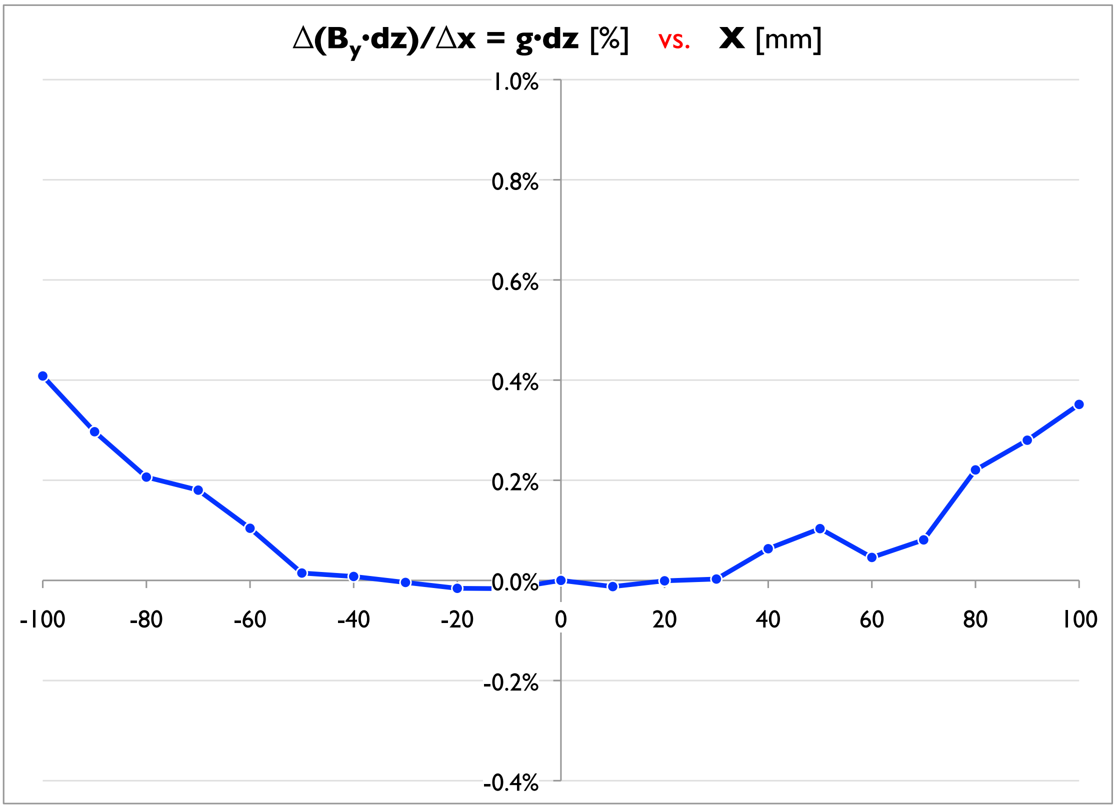
The field maps were measured at the maximal current I = 100 A and at I = 50 A (100 A → 50 A).

	I [A]	$g_0 \cdot dz$ [Gauss]	L_{eff} [mm]	g_0 [Gauss/mm]
QSE (ends)	100	3973.1	347	11.45
	50	2018.5		5.82
QSL (middle)	100	8471.5	587	14.43
	50	4241.2		7.23


Da-Vis © by PSI Magnet Section
length in mm
X
Z
500
0
-500
-1000


Δ(By·dz)/Δx = g·dz [%] vs. X [mm]
0.4%
0.2%
0.0%
-0.2%
-0.4%
-0.6%
-0.8%
-1.0%
-100
-80
-60
-40
-20
0
20
40
60
80
100


Da-Vis © by P S I Magnet Section
length in mm
x
z
500
0
-500
-1000
-500
0
500


$\Delta(B_y \cdot dz)/\Delta x = g \cdot dz$ [%] vs. X [mm]
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
-0.2%
-0.4%
-100
-80
-60
-40
-20
0
20
40
60
80
100