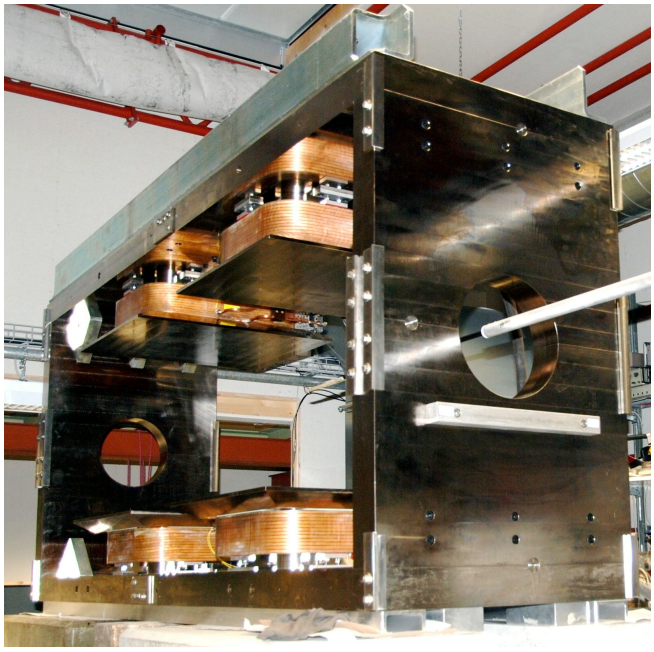
SR 3&4 Spin-Rotators (HMF, muSR, piE3)



SR spin-rotator (and separator) magnet

gap = 610 mm
2 separate poles
spin rotation angle = 45°

I_{MAX} = 200 A
4 coils (12x6=69 turns/coil)

MEASUREMENT DATE:
6.Jun.–8.Jul.2011

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:
49 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), 5 A/s

AIR CONDITIONING:
ON (T_{SET} = 24°)

OPERATORS:
Roland Deckardt
Ivan Meier
Nicola Berger
Vjeran Vranković (report)

DATA DIRECTORY:
afs: sys/alpha_dux51/swdir/
magnet/meas/srhmf

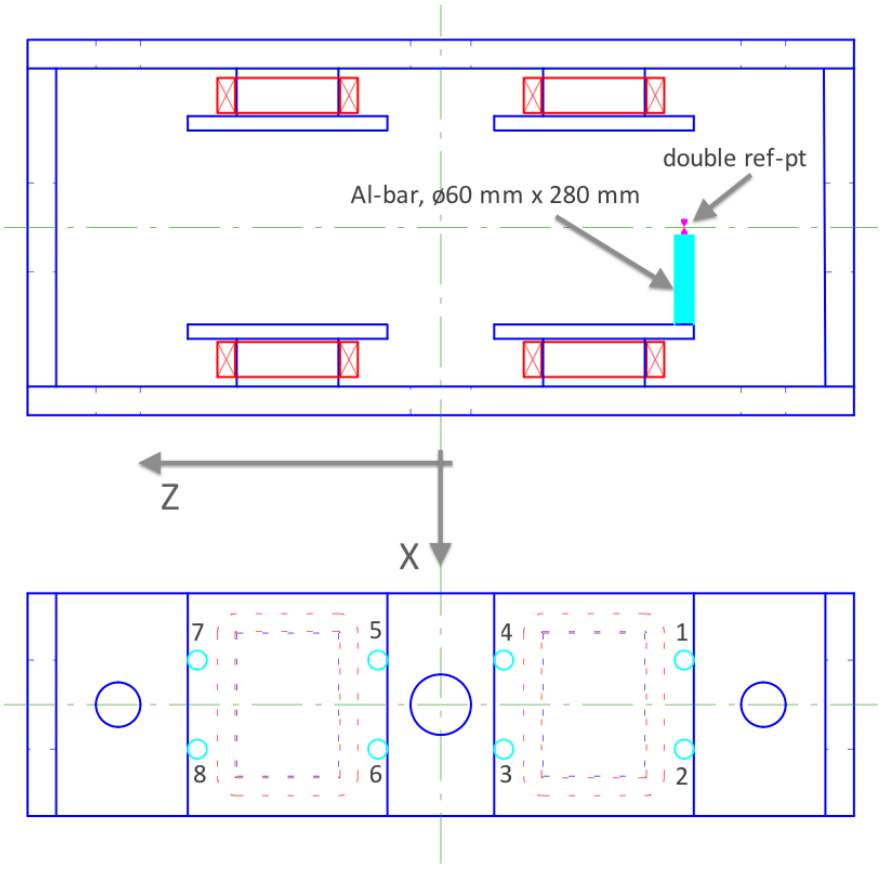
Alignment and positioning

The magnets were placed on aluminum bars lying on stones. There were no alignment possibility with the bars so only a coarse rotation around the vertical Y axis and leveling the bottom poles in water while the magnet was hanging on the crane was carried out.

The magnets were measured from one end. Due to the magnet 2.6 m length only a half of the magnet was measured. But, before the measurements the measuring arm has been extended in order to reach over the magnet half and check the field symmetry along Z-axis (beam).

The positioning was done magnetically by finding positions of the double reference pin placed on 4 corners of the **bottom** poles as shown on the sketch. The middle of all 8 points is chosen to be the center of the magnet coordinate system with a correction of 1 mm in the Y direction. The magnet gap is 610 mm so the distance from the poles to the mid-plane is 305 mm but the reference pin was at the hight of 306 mm (280 mm of the aluminum bar plus 26 mm of the reference pin).

The probe was leveled with a spirit level built into the measuring arm. The probe axis angle was adjusted in the magnet to be perpendicular to the vertical field component.



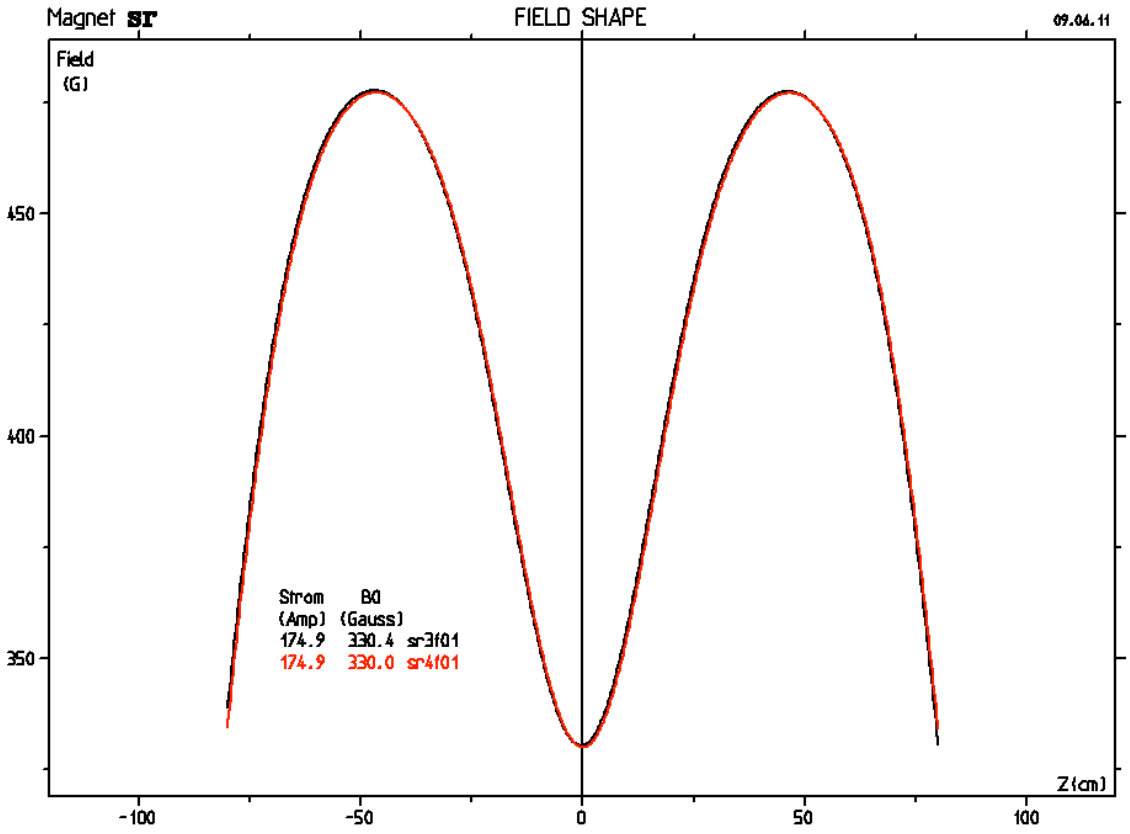
The reference pin measurements results summarised in the following table showed alignment errors (pitch and yaw angles) of around 1 mrad which is acceptable error for the size of the magnet. Plus, the accuracy of these particular measurements is not better than few tenths of mm and the geometry errors of the assembled magnet are in the order of a mm.

SR 3	X [mm]	Y [mm]	Z [mm]
middle of points 5-8	0.6	0.5	482.2
pitch angle (Y/Z)	0.9 mrad		
yaw angle (X/Z)	1.3 mrad		
ref-point 1	198.6	-146.3	-1324.4
ref-point 2	-201.4	-146.1	-1324.0
ref-points 1 & 2 pitch and yaw corrected	200.3	-145.0	-1324.2
	-199.7	-144.9	-1324.4

SR 4	X [mm]	Y [mm]	Z [mm]
middle of points 5-8	-0.1	0.4	481.9
pitch angle (Y/Z)	0.8 mrad		
yaw angle (X/Z)	-0.1 mrad		
ref-point 1	199.5	-145.8	-1325.6
ref-point 2	-200.5	-145.7	-1325.70
ref-points 1 & 2 pitch and yaw corrected	199.3	-144.7	-1325.7
	-200.6	-144.7	-1325.8

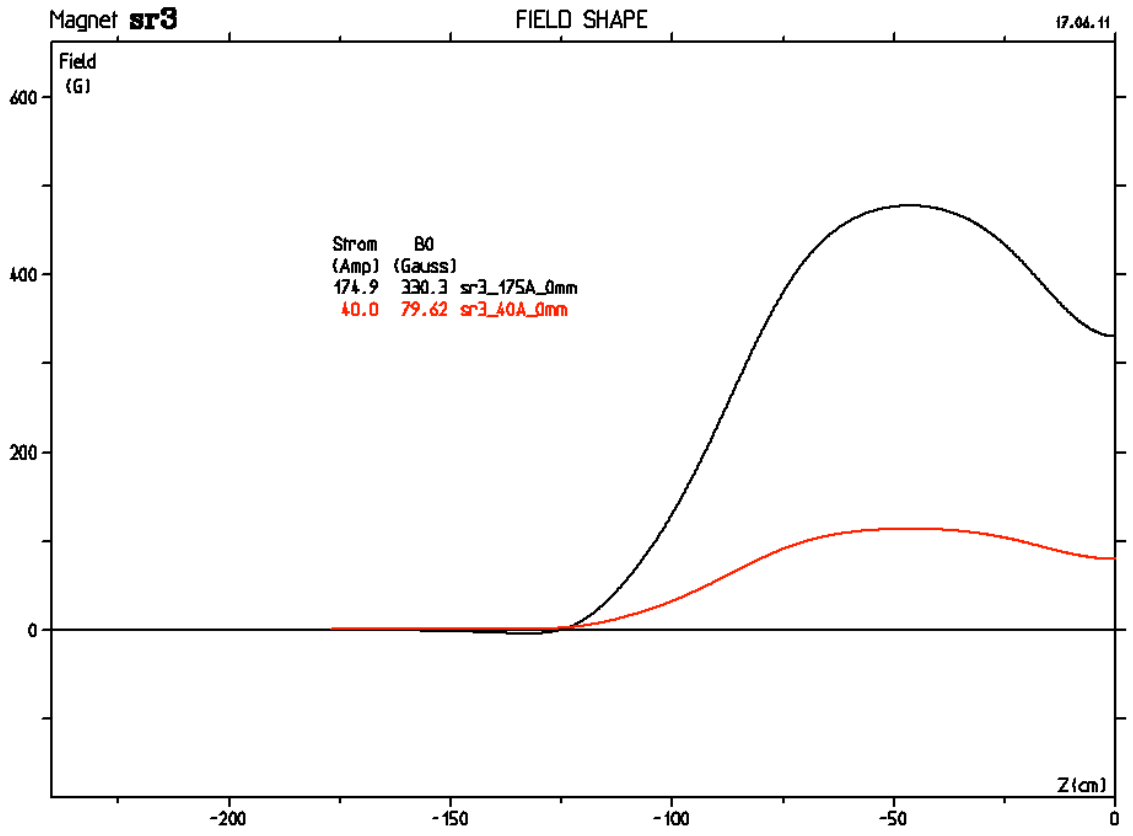
Field maps (*TRACK*)

The magnets were first measured with the extended measuring arm along a straight line from Z=–800 mm to 800 mm and checked for the field symmetry in Z direction.

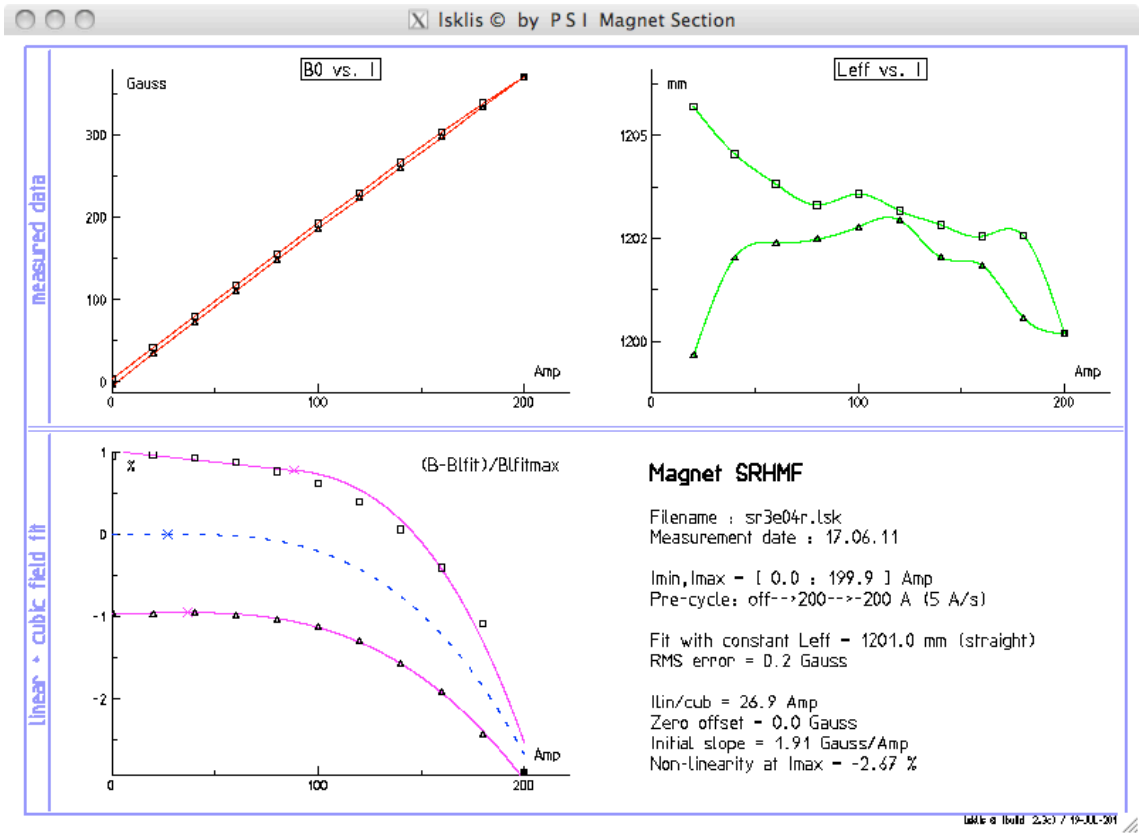


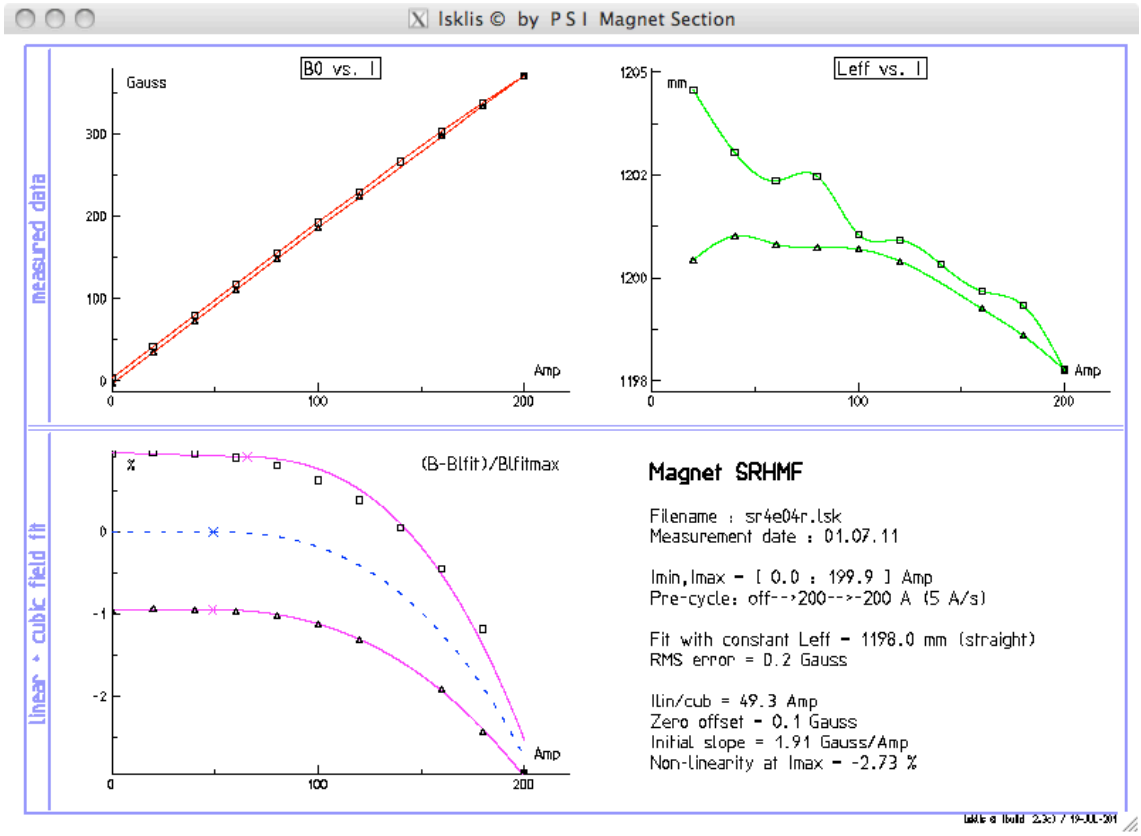
After the measuring arm was shortened the magnets were measured with the currents 175 A and 40 A in 5 planes (Y=0, ±50 mm and ±80 mm) on one magnet half from Z=–1770 mm to 0 mm and over X=±60 mm.

The 5 field maps were symmetrised and used for generating a full field map in volume. These maps contain interpolated measured By field components and calculated Bx and Bz field component.


Magnet sr3
FIELD SHAPE
17.06.11
Field
(G)
600
400
200
0
Strom
(Amp)
B0
(Gauss)
174.9
330.3
sr3_175A_0mm
40.0
79.62
sr3_40A_0mm
Z(cm)
-200
-150
-100
-50
0

Excitation curves (LSKLIS)





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Magnet SRHMF

File : sr3e04r.lsk
Date : 17.06.11

Pre-cycle : off-->200-->-200 A (5 A/s)

#Curr: 21 (nPaths=2)
Z-dir: from -1770.00 mm, steps of 2.00 mm
X-dir: at 0.00 mm

 linear_<1:Ilin> and cubic_<Ilin:Imax> approximation of Bc:
 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
       ======     ======       ====       ====       ====       ====      =====
 /       36.8      199.9       -3.7      381.4       -3.1       -4.8        0.1
 \       88.2      199.9        3.9      379.2       -5.7       -5.8        0.4
 ¯       26.9      199.9        0.0      381.2       -0.1      -10.1        0.2

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

constLeff (straight) = 1201.0 mm

   I_Amp        Bdz_Gmm      Bc_G     err_G
   =====        =======      ====     =====
    0.00*       -4356.4      -3.6       0.0
   20.00/       41394.1      34.5       0.0
   39.99/       87261.4      72.7       0.0
   59.98/      132888.2     110.6       0.0
   79.97/      178399.9     148.5      -0.1
   99.96/      223783.6     186.3       0.0
  119.95/      268795.0     223.8       0.1
  139.94/      313306.4     260.9       0.0
  159.94/      357506.3     297.7       0.0
  179.93/      400919.9     333.8      -0.2
  199.92*      444580.4     370.2      -0.5 (average of 2 fits)
  179.93\      407087.6     339.0       0.8
  159.94\      364414.7     303.4       0.1
  139.94\      320754.4     267.1      -0.4
  119.95\      276495.0     230.2      -0.6
   99.96\      231778.4     193.0      -0.4
   79.97\      186657.4     155.4      -0.1
   59.98\      141400.8     117.7       0.1
   39.99\       95846.1      79.8       0.1
   19.99\       50187.3      41.8       0.0
    0.00*        4356.4       3.6      -0.2

   Bc = Bdz / constLeff
   err = Bc - Bfit
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Magnet SRHMF

File : sr4e04r.lsk
Date : 01.07.11

Pre-cycle : off-->200-->-200 A (5 A/s)

#Curr: 20 (nPaths=2)
Z-dir: from -1770.00 mm, steps of 2.00 mm
X-dir: at 0.00 mm

 linear_<1:Ilin> and cubic_<Ilin:Imax> approximation of Bc:
 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
       ======     ======       ====       ====       ====       ====      =====
 /       48.8      199.9       -3.6      381.1       -4.9       -2.9        0.1
 \       65.8      199.9        3.7      380.4       -5.4       -7.3        0.4
 ¯       49.3      199.9        0.1      381.0       -4.2       -6.2        0.2

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

constLeff (straight) = 1198.0 mm

   I_Amp        Bdz_Gmm      Bc_G     err_G
   =====        =======      ====     =====
    0.00*       -4359.2      -3.6      -0.1
   19.99/       41445.2      34.6       0.0
   39.99/       87038.2      72.7       0.0
   59.98/      132581.6     110.7      -0.1
   79.97/      178010.0     148.6      -0.1
   99.96/      223167.2     186.3       0.0
  119.95/      267954.9     223.7       0.0
  159.94/      356499.9     297.6       0.1
  179.93/      399835.0     333.8      -0.1
  199.92*      443167.7     369.9      -0.7 (average of 2 fits)
  179.93\      405526.7     338.5       0.8
  159.94\      363190.0     303.2       0.3
  139.94\      319820.4     267.0      -0.2
  119.95\      275712.8     230.1      -0.5
   99.96\      231167.6     193.0      -0.5
   79.97\      186329.0     155.5      -0.3
   59.98\      141132.5     117.8      -0.1
   39.99\       95721.3      79.9       0.1
   19.99\       50085.4      41.8       0.0
    0.00*        4359.2       3.6      -0.1

   Bc = Bdz / constLeff
   err = Bc - Bfit
```