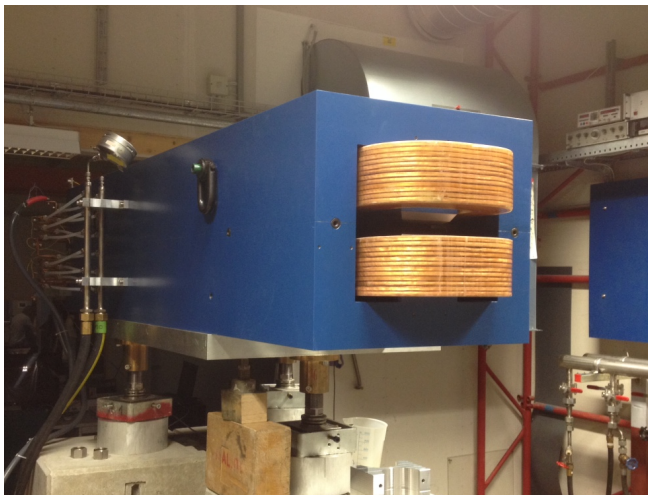
AFBC3 Dipole (SwissFEL, Linac Section)



AFBC3 dipole (#12 of 12)
measured from the beam entrance end

gap = 22 mm

L500 x W550 x H430 mm

conductor 8 x 8, D 5 mm
57 turns/coil, I_{MAX} = 150 A

wire 2.5 mm
15 turns/coil, I_{MAX} = 10 A

MEASUREMENT DATE:
11.Aug–3.Oct.2014

MEASUREMENT ARM:
brass cylinder interface Ø 40 mm
aluminum pipe Ø 28 mm, 1 m
carbon pipes Ø 10/8/6 mm, 1.5 m

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

INTEGRATION TIME:
20 msec

DVM-1 (1 V RANGE):
Hall probe sbv175 (150 mA)
powered in series with the other 2

DVM-2 (1, 10 V RANGE):
50 V / 200 A (MSG-2.1), 5 A/s
20 V / 10 A (MSG-2.3), 1 A/s

AIR CONDITIONING:
ON (T_{SET} = 24.5°)

OPERATORS:
Roland Deckardt
Vjeran Vranković (#7,9,12)

DATA DIRECTORY:
afs: group/magnet/meas/
SwissFEL/Linac/afbc3

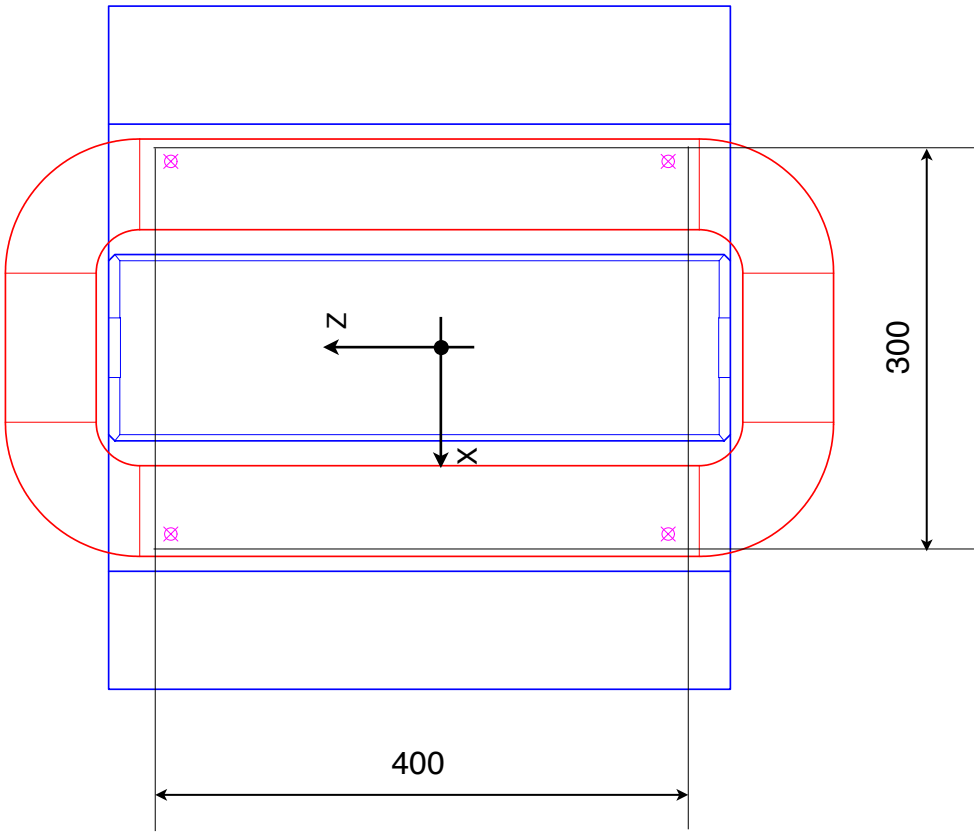
Alignment and positioning

The AFBC3 magnets were placed on adjustable base plate. The base plate was levelled by adjusting its feet heights. To reduce time for aligning 12 AFBC3 magnets to the measurement bench, a support has been made with position limiters defined from alignment of the first measured magnet. This significantly eased the positioning of successive magnets.

In the measurements coordinate system the magnet axis is the Z-axis, vertical axis is the Y-axis (see the sketch).

The probe was levelled with a spirit level built into the measuring arm.

The aligning of the first magnet and positioning of all magnets was done magnetically by measuring horizontal field maps of the double reference pin that was inserted in provided four reference holes on the magnet top plate (see the sketch below).



brueno						
AFBC3_01	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
21 Aug 17:44	-149.83	259.03	199.84	-574.0	-0.90	4.4
21 Aug 16:55	150.23	258.95	199.79	-574.9	-0.89	4.6
21 Aug 16:27	150.04	258.92	-200.16	-574.8	-0.90	4.3
21 Aug 16:06	-149.94	258.99	-200.22	-574.5	-0.90	4.3
mean	0.13	43.97	-0.19			
hr	-149.95	215.06	200.02		**v-300**	-0.02
hl	150.10	214.98	199.98		**h-300**	0.05
vl	149.91	214.95	-199.97		**r-400**	0.06
vr	-150.07	215.02	-200.03		**l-400**	-0.05
	0.00	215.00	0.00			
					yaw	**0.38**
					roll	**-0.25**
					pitch	**0.09**
Scanditronix						
hr (41-43)	-150.035	214.961	200.025		**v-300**	0.00
hl (47-49)	149.981	214.946	200.047		**h-300**	0.02
vl (53-55)	150.000	214.944	-199.987		**r-400**	0.04
vr (59-61)	-150.004	214.955	-200.013		**l-400**	0.03
	-0.01	214.95	0.02			
					yaw	-0.06
					roll	-0.04
					pitch	0.01

brueno						
AFBC3_02	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
16 Sep 16:35	-150.17	259.05	200.27	-573.6	-0.90	4.6
16 Sep 15:51	149.83	258.99	200.29	-573.4	-0.90	4.7
16 Sep 15:13	149.84	259.11	-199.77	-572.7	-0.89	5.2
16 Sep 16:55	-150.14	259.18	-199.77	-572.8	-0.90	4.8
mean	-0.16	44.08	0.26			
hr	-150.01	214.97	200.02		**v-300**	-0.02
hl	149.99	214.91	200.04		**h-300**	-0.01
vl	150.00	215.03	-200.03		**r-400**	0.04
vr	-149.98	215.10	-200.02		**l-400**	0.06
	0.00	215.00	0.00			
check (vr02)					**yaw**	**-0.05**
18 Sep 11:28	-149.94	259.09	-200.05		**roll**	**-0.22**
	0.04	-0.01	-0.03		**pitch**	**-0.31**
Scanditronix						
hr (41-43)	-150.130	215.005	200.000		**v-300**	0.01
hl (47-49)	149.870	215.000	200.000		**h-300**	0.00
vl (53-55)	149.859	214.991	-200.024		**r-400**	0.02
vr (59-61)	-150.155	214.992	-200.016		**l-400**	0.02
	-0.14	215.00	-0.01			
					yaw	0.04
					roll	-0.01
					pitch	0.03

brueno						
AFBC3_03	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
26 Sep 15:13	-149.75	258.88	200.18	-573.0	-0.90	4.3
26 Sep 15:43	150.23	258.77	200.58	-572.9	-0.90	4.5
26 Sep 16:10	150.70	258.84	-199.47	-572.3	-0.89	5.2
26 Sep 14:50	-149.30	258.88	-199.82	-572.2	-0.89	4.8
mean	0.47	43.84	0.37			
hr	-150.22	215.04	199.82		**v-300**	0.00
hl	149.76	214.93	200.21		**h-300**	-0.02
vl	150.23	215.00	-199.84		**r-400**	0.01
vr	-149.77	215.04	-200.19		**l-400**	0.05
	0.00	215.00	0.00			
check (vr2)					**yaw**	**-1.16**
29 Sep 13:34	-149.75	259.11	-200.21		**roll**	**-0.25**
	0.02	0.07	-0.02		**pitch**	**-0.09**
Scanditronix						
hr (41-43)	-150.009	214.989	200.052		**v-300**	-0.02
hl (47-49)	149.988	214.983	200.064		**h-300**	-0.00
vl (53-55)	149.994	215.008	-199.953		**r-400**	0.03
vr (59-61)	-149.986	215.005	-199.975		**l-400**	0.02
	-0.00	215.00	0.05			
					yaw	-0.04
					roll	-0.01
					pitch	-0.05

brueno						
AFBC3_04	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
22 Sep 16:17	-149.79	258.79	199.67	-572.7	-0.90	4.4
22 Sep 16:48	150.22	258.69	200.02	-573.9	-0.90	4.0
22 Sep 17:27	150.63	258.67	-200.02	-572.7	-0.89	5.2
22 Sep 15:58	-149.34	258.75	-200.33	-572.4	-0.90	4.4
mean	0.43	43.73	-0.17			
hr	-150.22	215.07	199.83		**v-300**	-0.03
hl	149.79	214.97	200.18		**h-300**	0.01
vl	150.20	214.95	-199.85		**r-400**	-0.00
vr	-149.77	215.03	-200.16		**l-400**	0.03
	0.00	215.00	0.00			
check (vr2)					**yaw**	**-1.08**
24 Sep 10:22	-149.80	259.03	-200.22		**roll**	**-0.30**
	-0.03	0.00	-0.06		**pitch**	**0.07**
Scanditronix						
hr (41-43)	-149.983	214.984	200.048		**v-300**	-0.02
hl (47-49)	150.018	214.985	200.033		**h-300**	0.00
vl (53-55)	149.996	215.010	-199.977		**r-400**	0.02
vr (59-61)	-149.987	215.005	-199.969		**l-400**	0.01
	0.01	215.00	0.03			
					yaw	0.03
					roll	0.01
					pitch	-0.06

brueno						
AFBC3_05	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
3 Sep 11:42	-150.32	259.23	199.93	-573.4	-0.90	4.4
3 Sep 15:15	149.62	259.17	199.86	-573.7	-0.90	4.0
3 Sep 14:41	149.74	259.16	-200.07	-572.5	-0.90	4.3
3 Sep 14:11	-150.34	259.22	-170.13	-572.3	-0.91	3.4
mean	-0.33	44.20	7.40			
hr	-150.00	215.04	192.53		**v-300**	1.58
hl	149.95	214.98	192.46		**h-300**	-0.06
vl	150.07	214.97	-207.47		**r-400**	-29.94
vr	-150.02	215.03	-177.53		**l-400**	-0.07
	0.00	215.00	-0.00			
					yaw	**-0.14**
					roll	**-0.20**
					pitch	**0.03**
Scanditronix						
hr (41-43)	-149.989	215.004	200.019		**v-300**	0.00
hl (47-49)	150.021	215.001	200.032		**h-300**	0.01
vl (53-55)	150.029	215.007	-200.004		**r-400**	0.03
vr (59-61)	-149.974	215.003	-200.008		**l-400**	0.04
	0.02	215.00	0.01			
					yaw	-0.03
					roll	0.00
					pitch	-0.01

Note: Reference hole “vr” has a wrong position. *Scanditronix* drilled the hole.
No indication in their position measurement protocol: BEMA-070002, 07-05-2014 09:20:15

brueno						
AFBC3_06	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
29 Aug 13:57	-149.34	258.87	200.31	-573.8	-0.89	4.4
29 Aug 13:34	150.58	258.78	200.32	-573.9	-0.89	4.8
29 Aug 13:13	150.73	258.74	-199.72	-573.1	-0.90	4.5
29 Aug 14:43	-149.30	258.82	-199.71	-573.2	-0.89	4.8
mean	0.67	43.80	0.30			
hr	-150.01	215.07	200.01		**v-300**	0.03
hl	149.91	214.98	200.02		**h-300**	-0.08
vl	150.06	214.94	-200.02		**r-400**	0.02
vr	-149.97	215.02	-200.01		**l-400**	0.04
	0.00	215.00	0.00			
					yaw	**-0.23**
					roll	**-0.28**
					pitch	**0.11**
Scanditronix						
hr (41-43)	-149.988	214.970	200.038		**v-300**	-0.01
hl (47-49)	150.005	214.968	200.052		**h-300**	-0.01
vl (53-55)	150.024	214.994	-199.958		**r-400**	0.01
vr (59-61)	-149.970	214.986	-199.972		**l-400**	0.01
	0.02	214.98	0.04			
					yaw	-0.05
					roll	0.01
					pitch	-0.05

brueno						
AFBC3_07	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
18 Sep 15:26	-149.85	258.97	199.92	-572.9	-0.90	4.0
18 Sep 16:23	150.03	258.89	200.17	-572.8	-0.90	4.3
18 Sep 16:49	150.15	259.09	-199.93	-572.3	-0.91	4.1
18 Sep 15:03	-149.85	259.15	-200.01	-572.0	-0.89	5.0
mean	0.12	44.03	0.04			
hr	-149.97	214.95	199.88		**v-300**	-0.00
hl	149.91	214.87	200.13		**h-300**	-0.12
vl	150.03	215.07	-199.96		**r-400**	-0.08
vr	-149.97	215.13	-200.05		**l-400**	0.09
	-0.00	215.00	0.00			
check (vr2)					**yaw**	**-0.17**
22 Sep 11:21	-149.95	259.10	-200.01		**roll**	**-0.23**
	0.02	-0.02	0.04		**pitch**	**-0.47**
Scanditronix						
hr (41-43)	-149.985	214.972	200.009		**v-300**	-0.03
hl (47-49)	150.008	214.978	199.980		**h-300**	-0.01
vl (53-55)	149.954	215.006	-200.024		**r-400**	0.01
vr (59-61)	-150.018	214.989	-199.996		**l-400**	0.00
	-0.01	214.99	-0.01			
					yaw	0.11
					roll	0.04
					pitch	-0.06

brueno						
AFBC3_08	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
30 Sep 16:49	-150.26	259.13	200.08	-573.5	-0.90	4.2
30 Sep 17:44	149.68	259.05	200.38	-573.5	-0.90	4.1
30 Sep 18:37	150.03	259.14	-199.64	-572.4	-0.88	5.7
30 Sep 16:15	-149.95	259.20	-199.94	-572.8	-0.90	4.2
mean	-0.13	44.13	0.22			
hr	-150.13	215.00	199.86		**v-300**	-0.02
hl	149.81	214.92	200.16		**h-300**	-0.06
vl	150.15	215.01	-199.86		**r-400**	0.01
vr	-149.83	215.07	-200.16		**l-400**	0.02
	-0.00	215.00	-0.00			
check (vr2)					**yaw**	**-0.81**
29 Sep 13:34	-149.75	259.11	-200.21		**roll**	**-0.23**
	0.08	0.04	-0.05		**pitch**	**-0.20**
Scanditronix						
hr (41-43)	-149.983	214.947	200.048		**v-300**	-0.02
hl (47-49)	150.013	214.946	200.035		**h-300**	-0.00
vl (53-55)	149.992	214.966	-199.974		**r-400**	0.00
vr (59-61)	-149.992	214.959	-199.952		**l-400**	0.01
	0.01	214.95	0.04			
					yaw	0.04
					roll	0.01
					pitch	-0.04

brueno						
AFBC3_09	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
16 Sep 9:48	-150.01	259.04	200.07	-573.5	-0.90	3.9
16 Sep 10:17	149.95	258.99	199.98	-573.9	-0.90	4.1
16 Sep 11:44	149.84	258.98	-200.03	-572.4	-0.90	3.8
16 Sep 9:14	-150.12	259.02	-199.95	-572.9	-0.90	4.3
mean	-0.08	44.01	0.02			
hr	-149.92	215.03	200.05		**v-300**	-0.04
hl	150.03	214.98	199.96		**h-300**	-0.04
vl	149.93	214.97	-200.04		**r-400**	0.01
vr	-150.04	215.01	-199.96		**l-400**	0.01
	0.00	215.00	-0.00			
					yaw	**0.28**
					roll	**-0.15**
					pitch	**0.04**
Scanditronix						
hr (41-43)	-149.963	215.029	200.063		**v-300**	-0.00
hl (47-49)	150.053	215.026	200.005		**h-300**	0.02
vl (53-55)	149.955	215.034	-200.018		**r-400**	0.02
vr (59-61)	-150.040	215.027	-199.961		**l-400**	0.02
	0.00	215.03	0.02			
					yaw	0.22
					roll	0.01
					pitch	-0.01

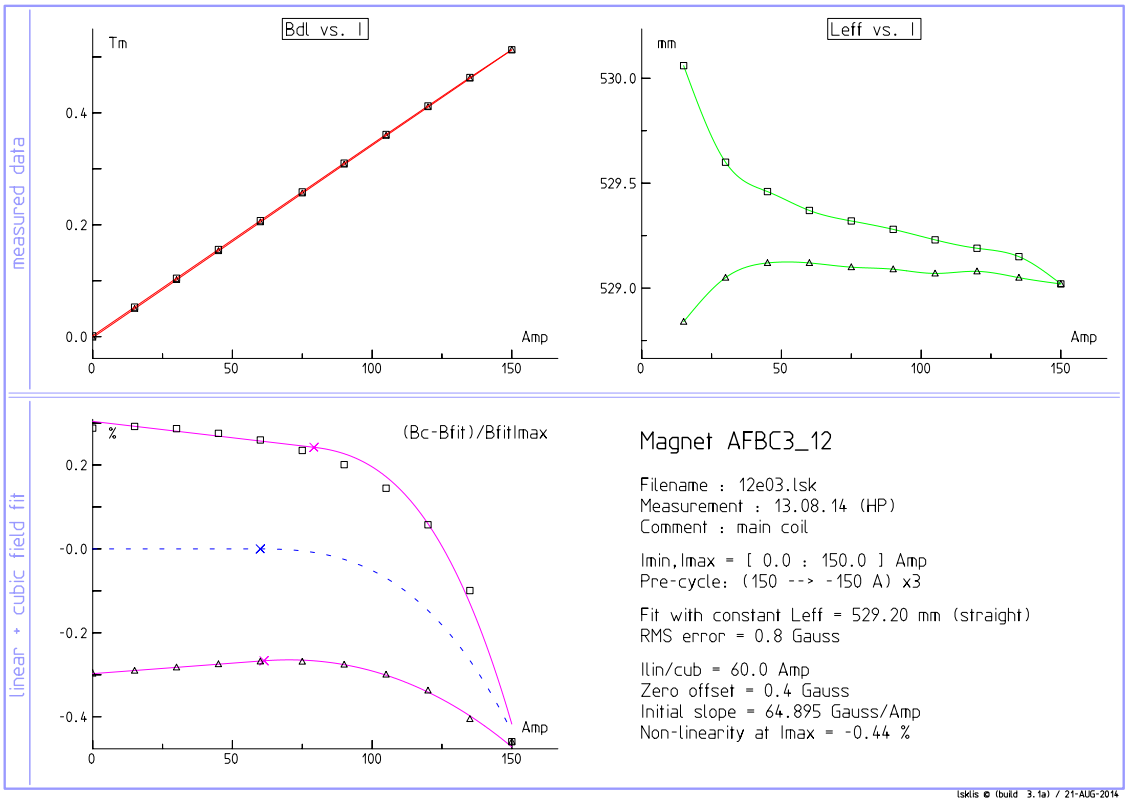
brueno						
AFBC3_10	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
24 Sep 15:09	-150.34	259.25	199.78	-572.6	-0.90	4.0
24 Sep 15:51	149.61	259.15	199.53	-572.8	-0.90	4.1
24 Sep 16:14	149.24	259.16	-200.53	-572.3	-0.90	4.8
24 Sep 14:33	-150.69	259.22	-200.28	-572.0	-0.90	4.2
mean	-0.54	44.20	-0.37			
hr	-149.79	215.06	200.16		**v-300**	-0.06
hl	150.16	214.96	199.91		**h-300**	-0.05
vl	149.79	214.97	-200.16		**r-400**	0.06
vr	-150.15	215.03	-199.90		**l-400**	0.07
	-0.00	215.00	0.00			
no check					**yaw**	**0.90**
					roll	**-0.27**
					pitch	**0.02**
Scanditronix						
hr (41-43)	-150.002	214.991	200.085		**v-300**	-0.01
hl (47-49)	149.999	214.985	200.041		**h-300**	0.00
vl (53-55)	149.942	215.019	-200.007		**r-400**	0.03
vr (59-61)	-150.051	215.013	-199.945		**l-400**	0.05
	-0.03	215.00	0.04			
					yaw	0.13
					roll	0.00
					pitch	-0.07

brueno						
AFBC3_11	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
not measured						
not measured						
26 Aug 16:42	149.12	257.92	-200.43	-573.1	-0.90	4.4
26 Aug 17:03	-150.83	257.98	-200.34	-572.9	-0.90	4.4
mean	-0.85	42.95	-200.39			
hr					**v-300**	-0.05
hl					**h-300**	
vl	149.97	214.97	-0.04		**r-400**	
vr	-149.97	215.03	0.04		**l-400**	
	0.00	215.00	-0.00			
					yaw	
					roll	**-0.20**
					pitch	
Scanditronix						
hr (41-43)	-150.046	215.007	200.020		**v-300**	0.00
hl (47-49)	149.962	215.001	200.017		**h-300**	0.01
vl (53-55)	149.953	215.017	-200.011		**r-400**	0.03
vr (59-61)	-150.050	215.025	-200.006		**l-400**	0.03
	-0.05	215.01	0.01			
					yaw	0.02
					roll	-0.02
					pitch	-0.04

brueno						
AFBC3_12	**X [mm]**	**Y [mm]**	**Z [mm]**	**B_{FIT} [Gauss]**	**hom [%]**	**ovality [%]**
11 Aug 14:06	-150.09	259.05	199.88	-574.4	-0.90	4.1
11 Aug 13:29	149.94	258.96	199.82	-574.4	-0.90	4.6
11 Aug 11:24	149.89	258.89	-200.12	-574.3	-0.91	3.6
12 Aug 10:49	-150.03	258.91	-200.17	-573.9	-0.90	4.6
mean	-0.07	43.95	-0.15			
hr	-150.02	215.10	200.03		**v-300**	-0.07
hl	150.01	215.01	199.97		**h-300**	0.03
vl	149.97	214.94	-199.97		**r-400**	0.05
vr	-149.96	214.96	-200.03		**l-400**	-0.06
	0.00	215.00	-0.00			
					yaw	**-0.01**
					roll	**-0.18**
					pitch	**0.26**
Scanditronix						
hr (41-43)	-150.005	215.029	200.030		**v-300**	0.00
hl (47-49)	149.999	215.031	200.021		**h-300**	0.00
vl (53-55)	149.957	215.044	-200.017		**r-400**	0.04
vr (59-61)	-150.045	215.031	-200.005		**l-400**	0.04
	-0.02	215.03	0.01			
					yaw	0.10
					roll	0.02
					pitch	-0.02

Excitation curve – main coil

Before measurements the magnet was cycled 3 times from –150 A to 150 A.
The fields are measured at 21 currents on the line X = Y = 0, Z = ±1000 mm.



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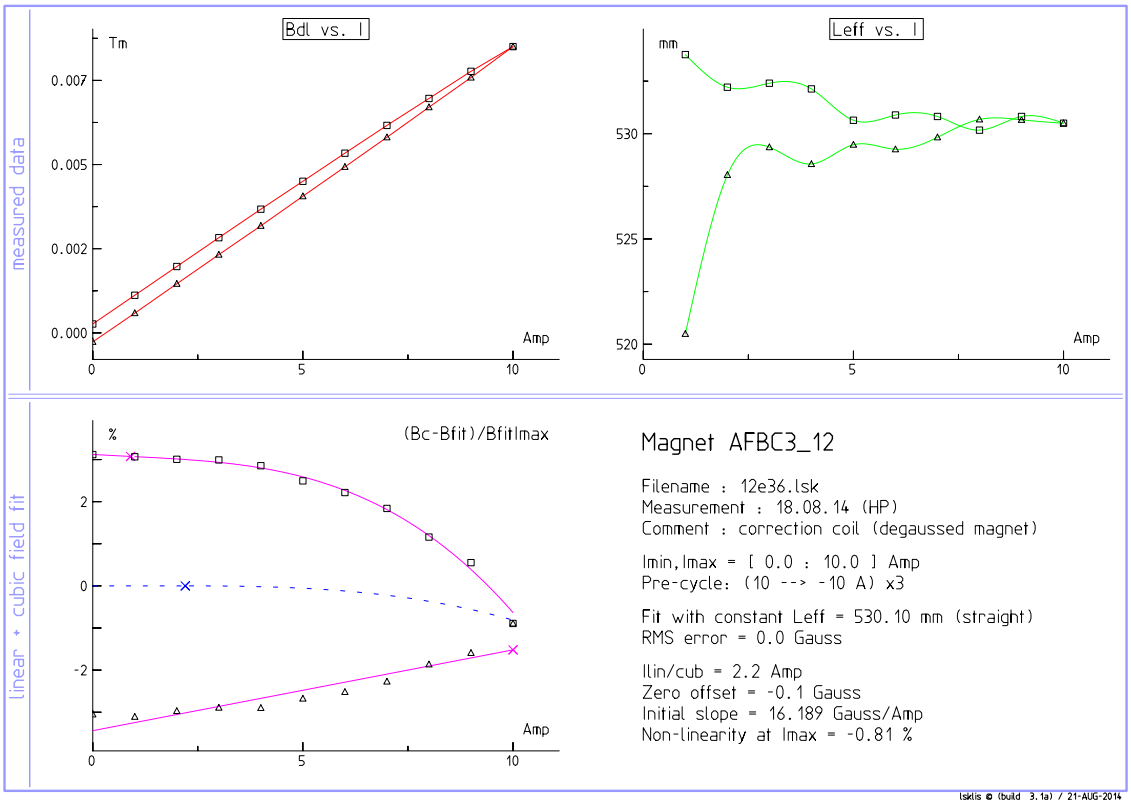
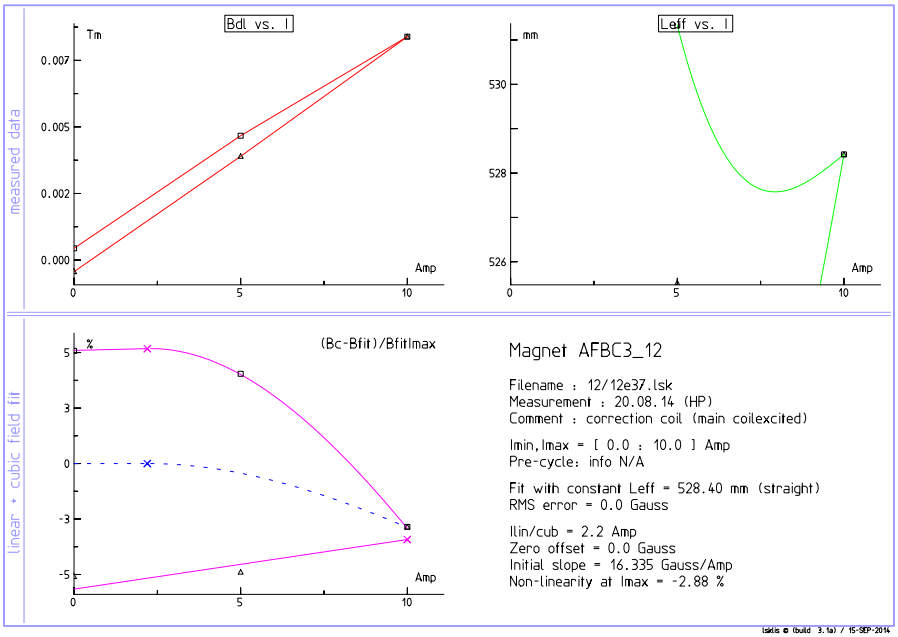
AFBC3	B·dz(150A) [T·m]		L_{SEFF} [mm]		I_{LIN} [A]	B_{OFFSET}(0A) [Gauss]	B_{SLOPE} [Gauss/A]	NL(I_{MAX}) [%]
01e12 22 Aug	0.51204	-0.12%	529.5	0.04%	56.7	0.6	64.812	-0.47
02e11 17 Sep	0.51218	-0.09%	529.3	0.00%	55.7	0.3	64.866	-0.47
03e11 27 Sep	0.51225	-0.08%	529.3	0.00%	53.6	0.4	64.841	-0.43
04e11 23 Sep	0.51264	-0.00%	529.4	0.02%	53.4	0.4	64.873	-0.43
05e01 5 Sep	0.51272	0.01%	529.2	-0.01%	55.4	0.2	64.919	-0.43
06e06 1 Sep	0.51251	-0.03%	529.3	0.00%	68.6	0.6	64.870	-0.42
07e11 19 Sep	0.51278	0.03%	529.2	-0.01%	59.2	0.5	64.924	-0.44
08e11 2 Oct	0.51290	0.05%	529.2	-0.01%	56.8	0.6	64.935	-0.44
09e11 15 Sep	0.51295	0.06%	529.3	0.00%	58.1	0.2	64.930	-0.43
10e11 25 Sep	0.51299	0.07%	529.2	-0.01%	55.8	0.4	64.939	-0.42
11e12 27 Aug	0.51298	0.07%	529.2	-0.01%	54.9	0.5	64.939	-0.42
12e03 13 Aug	0.51280	0.03%	529.2	-0.01%	60.0	0.4	64.895	-0.44
mean	**0.51265**		**529.3**		**57.4**	**0.4**	**64.895**	**-0.44**

Excitation curve – correction coil

Before measurements the magnet was cycled 3 times from –10 A to 10 A.
The fields are measured at 21 currents on the line X = Y = 0, Z = ±1000 mm.





main coil excited with I_{MAX}

Main coils are switched OFF.

clsk.py 21 "I"								
AFBC3	**B·dz(10A) [mT·m]**		**L_{SEFF} [mm]**		**I_{LIN} [A]**	**B_{OFFSET}(0A) [Gauss]**	**B_{SLOPE} [Gauss/A]**	**NL(I_{MAX}) [%]**
01e19 25 Aug	8.514	-0.05%	531.0	0.09%	3.9	0.1	16.263	-1.37
05e06 5 Sep	8.519	0.00%	530.4	-0.03%	3.1	0.0	16.159	-0.64
06e07 1 Sep	8.539	0.24%	530.6	0.01%	4.3	0.0	16.327	-1.41
09e16 15 Sep	8.518	-0.01%	530.2	-0.06%	6.2	0.0	16.192	-0.71
11e13 28 Aug	8.520	0.02%	530.9	0.07%	6.7	0.1	16.152	-0.68
12e36 18 Aug	8.502	-0.20%	530.1	-0.08%	2.2	-0.1	16.189	-0.81
mean	**8.519**		**530.5**		**4.4**	**0.0**	**16.214**	**-0.94**

clsk.py 21 "I"								
AFBC3	**B·dz(10A) [mT·m]**		**L_{SEFF} [mm]**		**I_{LIN} [A]**	**B_{OFFSET}(0A) [Gauss]**	**B_{SLOPE} [Gauss/A]**	**NL(I_{MAX}) [%]**
02e12 17 Sep	8.406	-0.04%	530.7	0.00%	5.0	0.0	16.007	-1.07
03e13 27 Sep	8.419	0.11%	530.4	-0.05%	5.4	0.0	16.030	-1.04
04e13 24 Sep	8.416	0.08%	530.8	0.02%	2.0	0.0	16.042	-1.14
07e13 20 Sep	8.407	-0.03%	530.8	0.02%	4.9	0.1	15.981	-1.03
08e13 3 Oct	8.401	-0.10%	531.1	0.08%	2.2	0.1	16.011	-1.21
10e13 25 Sep	8.409	-0.01%	530.3	-0.07%	1.6	0.0	16.057	-1.20
mean	**8.410**		**530.7**		**3.5**	**0.0**	**16.021**	**-1.12**

Note: Magnets # 1, 5, 6, 9, 11 and 12 were not pre-cycled.

Main coils are switched ON with the maximal current I_{MAX} = 150 A.

clsk.py 5 "I"

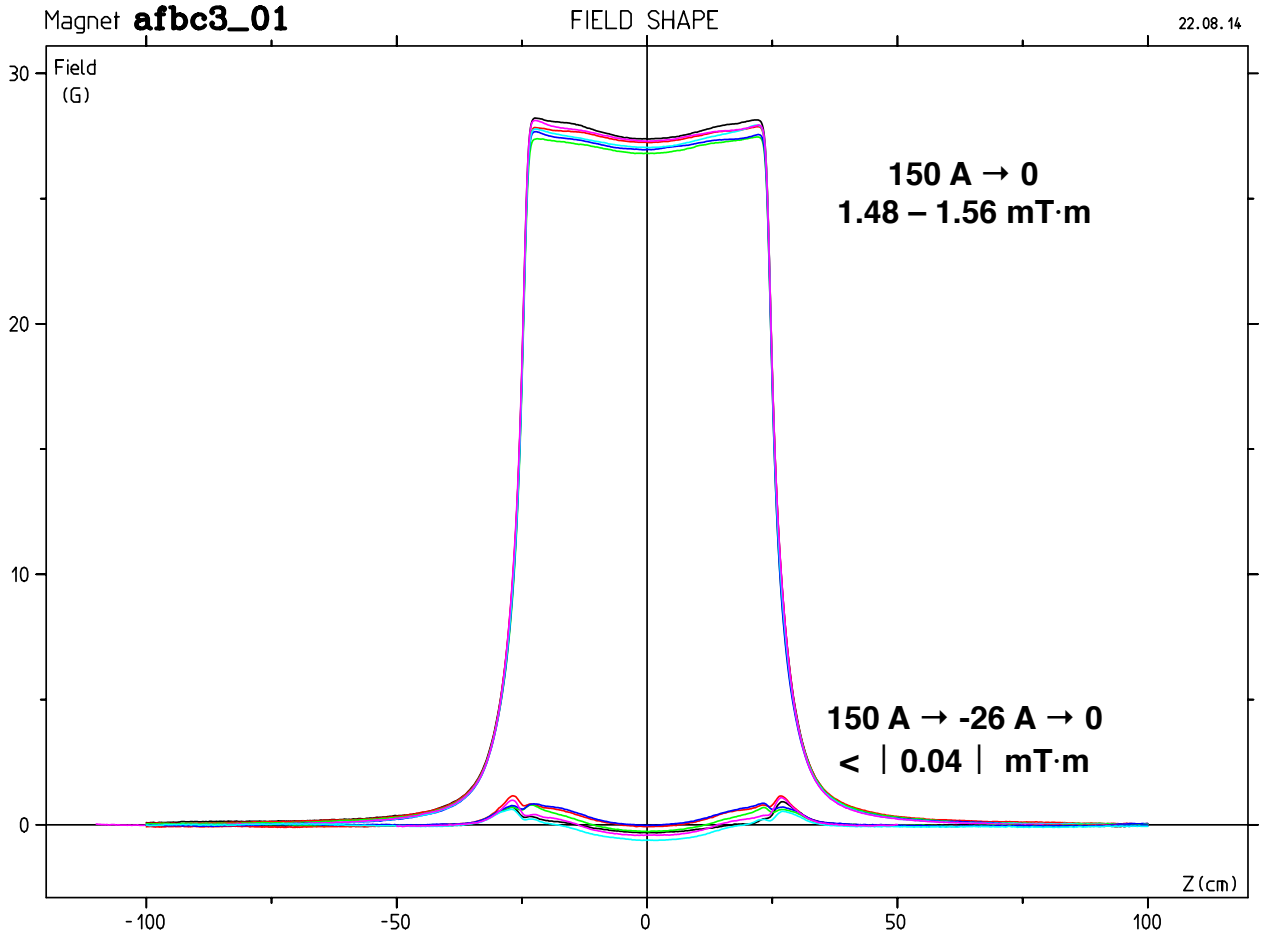
AFBC3	B·dz(10A) [mT·m]		L_{SEFF} [mm]		I_{LIN} [A]	B_{OFFSET}(0A) [Gauss]	B_{SLOPE} [Gauss/A]	NL(I_{MAX}) [%]
01e20 25 Aug	8.372	-0.45%	529.3	0.07%	2.2	0.0	16.249	-2.69
05e07 5 Sep	8.423	0.16%	528.8	-0.02%	2.2	0.0	16.472	-3.34
06e05 29 Aug	8.412	0.03%	529.5	0.11%	2.2	0.0	16.441	-3.41
09e17 15 Sep	8.439	0.35%	529.1	0.03%	2.2	0.0	16.448	-3.07
11e21 28 Aug	8.426	0.19%	528.4	-0.10%	2.2	0.0	16.455	-3.12
12e37 20 Aug	8.386	-0.28%	528.4	-0.10%	2.2	0.0	16.335	-2.88
mean	**8.410**		**528.9**		**2.2**	**0.0**	**16.400**	**-3.09**

clsk.py 5 "I"

AFBC3	B·dz(10A) [mT·m]		L_{SEFF} [mm]		I_{LIN} [A]	B_{OFFSET}(0A) [Gauss]	B_{SLOPE} [Gauss/A]	NL(I_{MAX}) [%]
02e13 17 Sep	8.038	-0.27%	527.5	0.01%	2.2	0.0	15.373	-0.89
03e12 27 Sep	8.071	0.14%	527.1	-0.07%	2.2	0.0	15.440	-0.83
04e12 23 Sep	8.094	0.42%	527.6	0.03%	2.2	0.0	15.433	-0.61
07e12 20 Sep	8.022	-0.47%	527.7	0.04%	2.2	0.0	15.356	-1.02
08e12 3 Oct	8.071	0.14%	527.4	-0.01%	2.2	0.0	15.427	-0.81
10e12 25 Sep	8.064	0.05%	527.5	0.01%	2.2	0.0	15.433	-0.96
mean	**8.060**		**527.5**		**2.2**	**0.0**	**15.410**	**-0.85**

Note: Magnets # 1, 5, 6, 9, 11 and 12 were not pre-cycled.

Degaussing


Magnet afbc3_01
FIELD SHAPE
22.08.14
Field
(G)
30
20
10
0
150 A → 0
1.48 – 1.56 mT·m
150 A → -26 A → 0
< | 0.04 | mT·m
Z(cm)
-100
-50
0
50
100

```
printf "/\n\n" | xmes -l ../orig_files/01/afbc3_01l13 l13
… (same for all the other fieldmaps)

printf "l15\n-l14\n/2\n\ndg1\ny\n" | combi
… (same for all the other fieldmaps)
```

AFBC3	I [A]	B·dz(0A) [mT·m]	I [A]	B·dz(0A) [mT·m]	I [A]	B·dz(0A) [mT·m]	I [A]	B·dz(0A) [mT·m]
01 25 Aug	**26** (l14-l13)	**0.022** -0.1, 1.0	**26** (l16-l15)	**0.033** -0.1, 1.1	**25** (l18-l17)	**0.002** -0.3, 0.9		
02 18 Sep	**26** (l15-l14)	**-0.042** -1.3, 0.5	**27** (l17-l16)	**0.012** -0.2, 0.8	**27** (l19-l18)	**0.046** -0.1, 1.0		
03 27 Sep	**25** (l15-l14)	**-0.010** -0.7, 0.5	**26** (l17-l16)	**0.012** -0.3, 0.7	**27** (l19-l18)	**0.042** -0.0, 1.2	**26** (l21-l20)	**0.000** -0.4, 0.7
04 24 Sep	**25** (l15-l14)	**-0.020** -0.9, 0.9	**26** (l17-l16)	**0.001** -0.5, 1.0	**27** (l19-l18)	**0.026** -0.1, 1.1	**26** (l21-l20)	**-0.007** -0.6, 0.9
05 5 Sep	**26** (l03-l02)	**-0.027** -1.1, 0.9	**27** (l05-l04)	**0.023** -0.1, 1.2				
06 29 Aug	**25** (l02-l01)	**-0.064** -1.8, 0.4	**26** (l04-l03)	**0.014** -0.3, 0.8				
07 22 Sep	**27** (l15-l14)	**-0.009** -0.9, 1.1	**26** (l17-l16)	**0.033** -0.1, 1.3	**26** (l19-l18)	**0.011** -0.3, 1.2		
08 3 Oct	**25** (l15-l14)	**-0.002** -0.5, 1.0	**26** (l17-l16)	**0.018** -0.1, 1.2	**27** (l19-l18)	**0.049** -0.0, 1.4	**26** (l21-l20)	**0.016** -0.1, 1.1
09 15 Sep	**26** (l13-l12)	**-0.026** -1.1, 0.5	**27** (l15-l14)	**0.026** -0.1, 0.9				
10 25 Sep	**25** (l15-l14)	**0.005** -0.5, 0.7	**26** (l17-l16)	**0.036** -0.0, 0.9	**27** (l19-l18)	**0.054** -0.0, 1.4	**26** (l21-l20)	**0.021** -0.1, 0.9
11 28 Aug	**26** (l14-l13)	**0.018** -0.3, 0.8	**27** (l16-l15)	**0.027** -0.1, 0.9	**25** (l18-l17)	**-0.022** -0.9, 0.6	**25** (l20-l19)	**-0.012** -0.6, 0.6
12 18 Aug	**27** (l29-l28)	**0.043** -0.0, 1.3	**27** (l31-l30)	**0.028** -0.1, 1.3	**25** (l33-l32)	**-0.010** -0.8, 1.0	**26** (l35-l34)	**0.007** -0.4, 1.1

Field maps

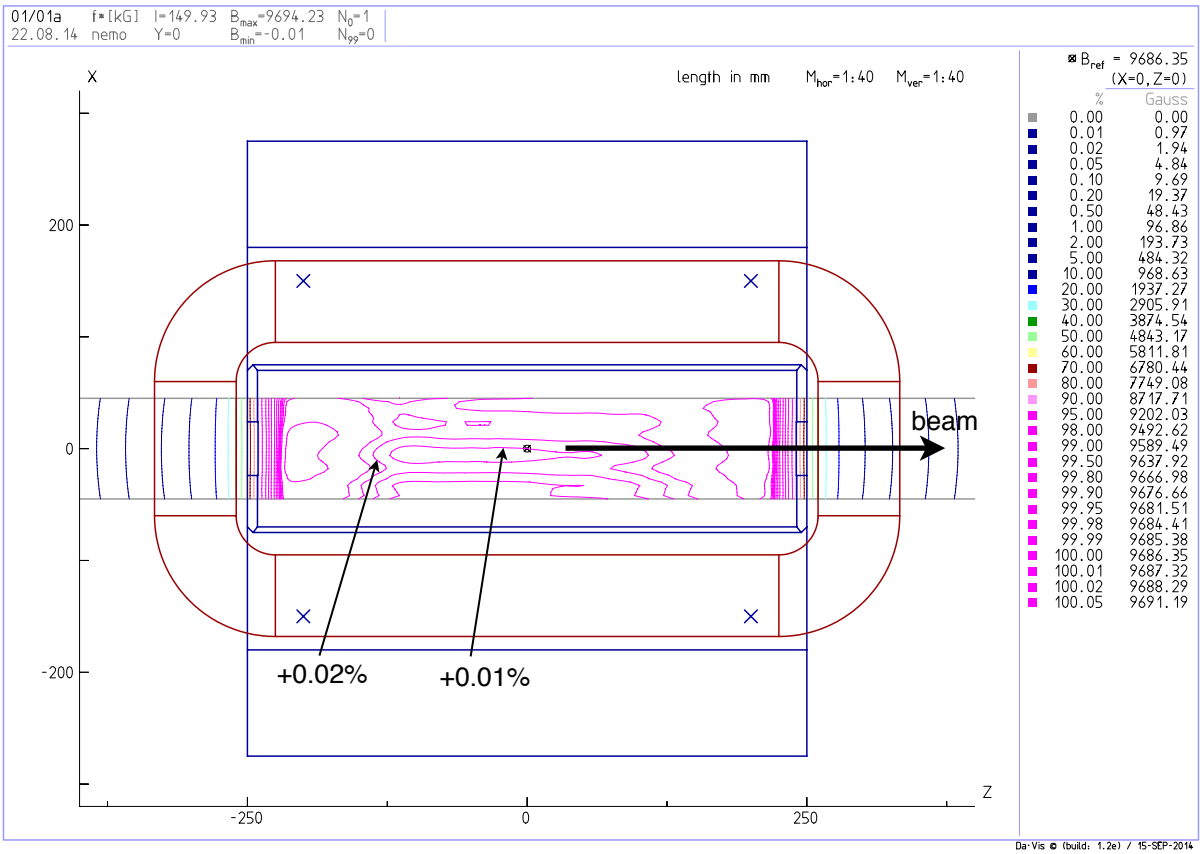
The field maps were measured at different Y position in order to be able to create full 3D field volume by integrating the measured main field component into potential and then differentiating and interpolating between these potentials.

To cancel out errors coming from the probe roll angle the field maps off the magnet mid-plane were measured at two positions ±Y and then the fields were averaged:

$$\frac{measurement(+Y\ position) + measurement(-Y\ position)}{2}$$

The earth and the background fields are removed from the measured fields by:

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



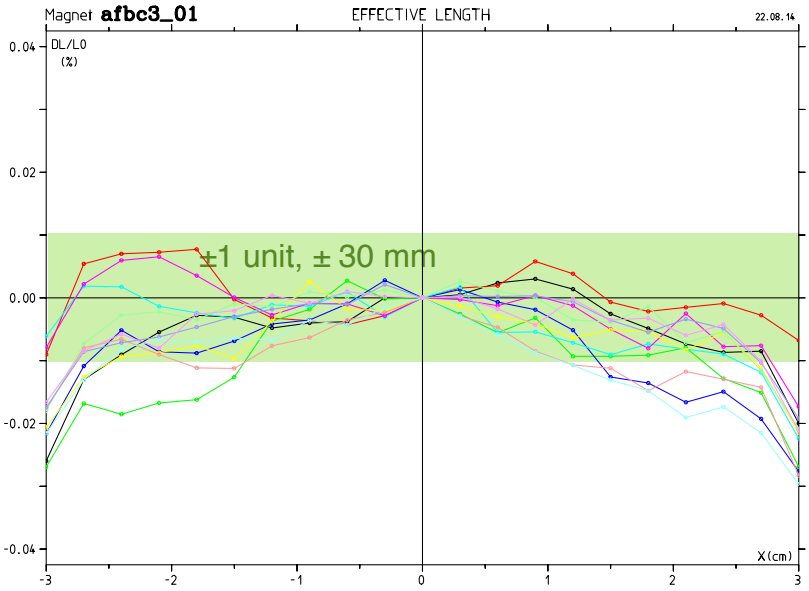
```
printf "/\n\n" | xmes 01/afbc3_01f02 f02
… (same for all the other fieldmaps)

printf "f06\n-f01\n+f10\n-f05\n/4\n\n02c\ny\n" | combi
printf "f07\n-f02\n+f09\n-f04\n/4\n\n02b\ny\n" | combi
printf "f08\n-f03\n/2\n\n02a\ny\n" | combi
```

AFBC3	I [A]	Y = -4 mm	Y = -3 mm	Y = 0	Y = 3 mm	Y = 4 mm
01 22 Aug	-150 150	f02 f07	f03 f08	f04 f09	f05 f10	f06 f11
02 17 Sep	-150 150	f01 f06	f02 f07	f03 f08	f04 f09	f05 f10
03 27 Sep	-150 150	f01 f06	f02 f07	f03 f08	f04 f09	f05 f10
04 23 Sep	-150 150	f01 f06	f02 f07	f03 f08	f04 f09	f05 f10
05 9 Sep	-150 150	f08 f13	f09 f14	f10 f15	f11 f16	f12 f17
06 2 Sep	-150 150	f08 f13	f09 f14	f10 f15	f11 f16	f12 f17
07 19 Sep	-150 150	f01 f06	f02 f07	f03 f08	f04 f09	f05 f10
08 2 Oct	-150 150	f01 f06	f02 f07	f03 f08	f04 f09	f05 f10
09 12 Sep	-150 150	f01 f06	f02 f07	f03 f08	f04 f09	f05 f10
10 25 Sep	-150 150	f01 f06	f02 f07	f03 f08	f04 f09	f05 f10
11 27 Aug	-150 150	f02 f07	f03 f08	f04 f09	f05 f10	f06 f11
12 14 Aug	-90 90	f04 f09	f05 f10	f06 f11	f07 f12	f08 f13
12 15-16 Aug	-150 150	f14 f19	f15 f20	f16 f21	f17 f22	f18 f23

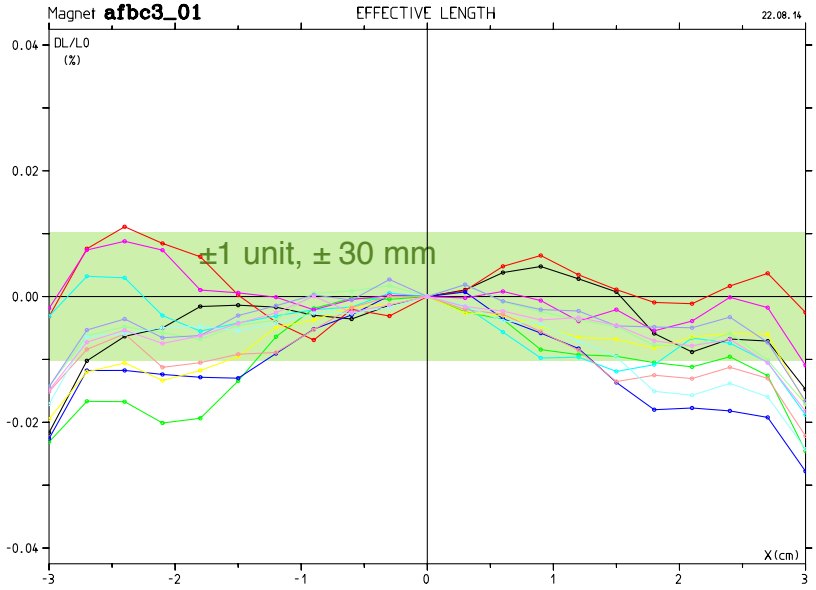
The table summarises central field, straight effective magnetic length (differences in L_{SEFF} between the beam entrance and exit side are given) and field integrals of all 12 AFBC3 magnets.

printf “01a\n<v16,16\n<u1,501\n\n\n\n” I combi
printf “01a\n<v16,16\n<u501,1001\n\n\n\n” I combi
printf “01a\n<v16,16\n<u1,1001\n\n\n\n” I combi

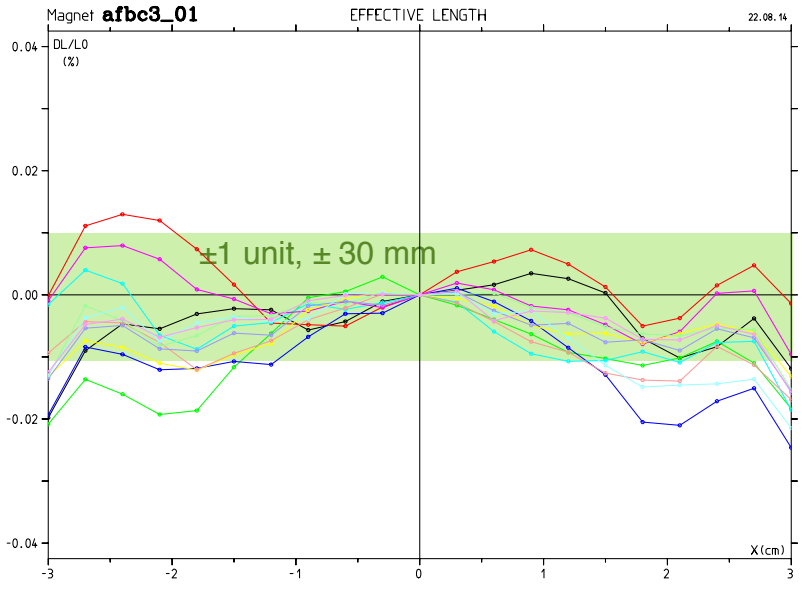
AFBC3	Y [mm]	B_0 [Gauss]	L_{SEFF_IN+OUT} [mm]	B·dz [T·m]
01 22 Aug	**0** 3.0 4.0	**9686.4** 9686.2 9686.3	**264.67 + 264.66 = 529.33** 264.67 + 264.67 = 529.34 264.67 + 264.67 = 529.34	**0.51273** 0.51273 0.51274
02 17 Sep	**0** 3.0 4.0	**9695.9** 9695.9 9695.9	**264.66 + 264.47 = 529.14** 264.66 + 264.47 = 529.13 264.67 + 264.47 = 529.14	**0.51305** 0.51304 0.51305
03 27 Sep	**0** 3.0 4.0	**9693.6** 9693.6 9693.5	**264.58 + 264.52 = 529.10** 264.58 + 264.52 = 529.10 264.58 + 264.54 = 529.12	**0.51289** 0.51289 0.51290
04 23 Sep	**0** 3.0 4.0	**9698.5** 9698.7 9698.6	**264.61 + 264.62 = 529.23** 264.62 + 264.61 = 529.23 264.62 + 264.61 = 529.23	**0.51328** 0.51328 0.51328
05 9 Sep	**0** 3.0 4.0	**9701.7** 9701.7 9701.8	**264.52 + 264.54 = 529.07** 264.52 + 264.56 = 529.08 264.51 + 264.57 = 529.08	**0.51329** 0.51330 0.51330
06 2 Sep	**0** 3.0 4.0	**9698.8** 9698.6 9698.7	**264.53 + 264.57 = 529.10** 264.53 + 264.57 = 529.11 264.54 + 264.57 = 529.11	**0.51317** 0.51316 0.51316
07 19 Sep	**0** 3.0 4.0	**9705.4** 9705.5 9705.4	**264.71 + 264.33 = 529.04** 264.73 + 264.32 = 529.05 264.72 + 264.33 = 529.04	**0.51346** 0.51347 0.51346
08 2 Oct	**0** 3.0 4.0	**9707.0** 9706.9 9706.9	**264.64 + 264.43 = 529.07** 264.64 + 264.43 = 529.07 264.65 + 264.42 = 529.07	**0.51356** 0.51356 0.51356
09 12 Sep	**0** 3.0 4.0	**9705.8** 9705.9 9705.7	**264.78 + 264.34 = 529.12** 264.79 + 264.34 = 529.13 264.79 + 264.34 = 529.13	**0.51356** 0.51356 0.51356
10 25 Sep	**0** 3.0 4.0	**9707.3** 9707.3 9707.3	**264.61 + 264.47 = 529.08** 264.61 + 264.47 = 529.08 264.62 + 264.47 = 529.09	**0.51359** 0.51359 0.51360
11 27 Aug	**0** 3.0 4.0	**9709.2** 9709.1 9709.1	**264.40 + 264.65 = 529.05** 264.39 + 264.65 = 529.04 264.39 + 264.65 = 529.04	**0.51367** 0.51365 0.51365
12 15-16 Aug	**0** 3.0 4.0	**9704.8** 9704.5 9704.7	**264.63 + 264.40 = 529.03** 264.64 + 264.41 = 529.04 264.64 + 264.40 = 529.04	**0.51341** 0.51341 0.51342



relative deviations of field integrals at Y = 0 mm



relative deviation of field integrals at Y = 3 mm



relative deviation of field integrals at Y = 4 mm

For the bunch compressor 2 the following four magnets #8, #9, #10 and #11 have been chosen.
The integral difference comes from the current overshoot which is higher for the bigger current change, 150 A (field maps) compared to 10 A (excitation curve).

AFBC3	B·dz(150A) [T·m]		L_{SEFF} [mm]		AFBC3	B·dz [T·m]		L_{SEFF} [mm]	
01e12 22 Aug	0.51204	-0.12%	529.5	0.04%	**01** 22 Aug	0.51273	-0.11%	529.33	0.04%
02e11 17 Sep	0.51218	-0.09%	529.3	0.00%	**02** 17 Sep	0.51305	-0.05%	529.14	0.01%
03e11 27 Sep	0.51225	-0.08%	529.3	0.00%	**03** 27 Sep	0.51289	-0.08%	529.10	-0.00%
04e11 23 Sep	0.51264	-0.00%	529.4	0.02%	**04** 23 Sep	0.51328	-0.00%	529.23	0.02%
05e01 5 Sep	0.51272	0.01%	529.2	-0.01%	**05** 9 Sep	0.51329	-0.00%	529.07	-0.01%
06e06 1 Sep	0.51251	-0.03%	529.3	0.00%	**06** 2 Sep	0.51317	-0.03%	529.10	-0.00%
07e11 19 Sep	0.51278	0.03%	529.2	-0.01%	**07** 19 Sep	0.51346	0.03%	529.04	-0.01%
08e11 2 Oct	0.51290	0.05%	529.2	-0.01%	**08** 2 Oct	0.51356	0.05%	529.07	-0.01%
09e11 15 Sep	0.51295	0.06%	529.3	0.00%	**09** 12 Sep	0.51356	0.05%	529.12	0.00%
10e11 25 Sep	0.51299	0.07%	529.2	-0.01%	**10** 25 Sep	0.51359	0.06%	529.08	-0.01%
11e12 27 Aug	0.51298	0.07%	529.2	-0.01%	**11** 27 Aug	0.51367	0.07%	529.05	-0.01%
12e03 13 Aug	0.51280	0.03%	529.2	-0.01%	**12** 15-16 Aug	0.51341	0.02%	529.03	-0.02%
mean	**0.51265**		**529.3**			**0.51331**		**529.11**	

	1		3		8	
1_01	-0.51259	529.25	-0.51273	529.01	-0.51337	528.98
1_21	0.51184	529.41	0.51215	529.19	0.51282	529.16
2_01	0.51186	529.43	0.51216	529.19	0.51282	529.15
2_21	-0.51188	529.20	-0.51195	528.95	-0.51259	528.92
f03	-0.51265	529.24	-0.51275	529.00	-0.51342	528.97
f08	0.51281	529.42	0.51302	529.20	0.51371	529.16

The cubic fit for every integral is evaluated in the X range of ±30 mm (±20 mm over 3.8° bend, which sagitta is 17.6 mm). The field errors B_{Nerr} = (B_N - B_0) / B_0 are shown in ppm and are calculated at X=30 mm.
Except of the magnets #2, #5 and #6 all others have sextupole error of around 0.02%.

printf “01a\n<v6,26\n\n\n\n” I combi
printf “01b\n<v6,26\n\n\n\n” I combi
printf “01c\n<v6,26\n\n\n\n” I combi

AFBC3	Y [mm]	fit_{RMS} [ppm]	B_{1err} [ppm]	B_{2err} [ppm]	B_{3err} [ppm]
01 22 Aug	**0** 3.0 4.0	**29** 30 32	**19** 11 05	**-192** -163 -131	**-1** 5 14
02 17 Sep	**0** 3.0 4.0	**44** 44 51	**-6** 14 -5	**-26** 25 41	**-23** -46 -41
03 27 Sep	**0** 3.0 4.0	**33** 37 41	**21** 37 15	**-228** -192 -166	**-4** -21 14
04 23 Sep	**0** 3.0 4.0	**28** 32 42	**-41** -20 -25	**-215** -204 -167	**-2** -17 -16
05 9 Sep	**0** 3.0 4.0	**26** 32 35	**-46** -58 -34	**-83** -39 -28	**-34** -14 -40
06 2 Sep	**0** 3.0 4.0	**34** 31 33	**-48** -41 -38	**-67** -5 11	**-14** -14 -12
07 19 Sep	**0** 3.0 4.0	**27** 25 28	**3** 20 31	**-162** -127 -92	**3** 6 -25
08 2 Oct	**0** 3.0 4.0	**33** 31 34	**-12** -13 -28	**-141** -130 -80	**-37** -20 -9
09 12 Sep	**0** 3.0 4.0	**26** 20 24	**-14** -11 6	**-165** -133 -99	**-6** -4 -21
10 25 Sep	**0** 3.0 4.0	**19** 23 25	**15** 0 2	**-157** -122 -95	**-22** -8 -11
11 27 Aug	**0** 3.0 4.0	**21** 22 27	**-81** -66 -66	**-195** -154 -133	**37** 21 15
12 15-16 Aug	**0** 3.0 4.0	**25** 17 21	**-2** -7 -4	**-154** -125 -100	**-10** -9 -8