KFLn Dipole (SwissFEL, Resonant Linac Kicker)



KFL3 (one of 3 dipoles)

MEASUREMENT DATE: 9 - 20 Nov. 2017

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 (10 V RANGE): 24 V / 10 A (MSG-2.3), 1 A/s

AIR CONDITIONING: ON $(T_{SET} = 24.5^{\circ})$

OPERATORS: Roland Deckardt Vjeran Vranković

DATA DIRECTORY: afs: group/magnet/meas/ SwissFEL/kfl

gap = 25 mm L180 x W250 x H270 mm (without the base)

conductor Ø 3.08 mm 90 turns/coil, I_{MAX} = 10 A

Overview

PS MAXIMUM CURRENT: 10 A

PS CURRENT RAMP: 1 A/s

PRE-CYCLING: unnecessary

FIELD SETTLING TIME: 5 s

CURRENT SETTING: $I_{OLD} \rightarrow I_{NEW}$

DEGAUSSING: $I_{ANY} \rightarrow 10 \text{ A} \rightarrow -3 \text{ A} \rightarrow \text{OFF}$

CONSTANT EFFECTIVE LENGTH: straight 112.9-113.2 mm

EXCITATION INITIAL SLOPE: 88.973-89.179 Gauss/Amp

STRAIGHT FIELD INTEGRALS: 10.0283 – 10.0507 mT·m (10 A)

FIELD HOMOGENEITY OVER ±10 MM: B₁: 887.85 to 888.78 Gauss B₂: -0.011 to 0.182 Gauss/mm B₃: -0.0545 to -0.0590 Gauss/mm²

CURRENT VS. BEAM ENERGY:

Magnets alignment and positioning

The SwissFEL standard magnet support (girder mock-up) was placed on a plate with 3 feet and was put in water and aligned with the Hall probe measuring machine. Our standard double reference pin "Brüno" was glued to the support side and positioned with the help of the FARO-Arm. The Hall probe arm was rotated around its axis by 90° for horizontal field measurements.

Positioning with the FARO-Arm is in general accurate to 0.025 mm, The error coming from the magnetic positioning of Hall probes is around ±0.01 mm. Therefore, the magnet positioning error was within 0.05 mm.

A control of the support position was carried out each time when a magnet was put on the support.

MAGNET					
alias	name	measurements			
KFL1	S20SY02-MKDC010	10–14 Nov 2017			
KFL2	S20SY02-MKDC030	14–16 Nov 2017			
KFL3	S20SY02-MKDC050	17–20 Nov 2017			

file	date	x	Y	z	Bfit
		mm	mm	mm	Gauss
rp3 (set)	13 Nov 2017	-286.295	-230.216	-150.150	-752.13
rp4	14 Nov 2017	-286.28	-230.215	-150.134	-752.13
rp5	16 Nov 2017	-286.25	-230.196	-150.121	-752.04
	MAX DIFFERENCE	0.05	0.02	0.03	

Excitation curves

Before measurements the magnet was pre-cycled 2 times from 10 A to -10 A. The fields were measured at 21 currents on the line X = Y = 0, Z = -500:500 mm.



clsk.py 21 "l"						
	B·dz (10A) [mT·m]	L _{SEFF} [mm]	І _{LIN} [A]	B _{OFFSET} (0A) [Gauss]	B _{SLOPE} [Gauss/A]	NL(I _{MAX}) [%]
KFL1 (e03) 13 Nov 2017	10.0283	112.9	2.3	0.2	89.179	-0.37
KFL2 (e01) 14 Nov 2017	10.0507	113.2	5.6	0.1	89.023	-0.30
KFL3 (e01) 17 Nov 2017	10.0425	113.2	2.8	0.1	88.973	-0.28
MAX DIFFERENCE	0.0224	0.3	3.3	0.1	0.206	0.09

Page 1/1 Printed for: Vjeran Vranković

/Users/vrankovic/Desktop/kfl1e03.lsklis Saved: 27/11/2017, 16:08:35

Magnet KFL1

File : kfl1e03.lsk Date : 13.11.17 Meas-type : HP Comment : HHL Pre-cycle : 2x (-10 A --> 10 A) #Curr: 21 (nPaths=2) Z-dir: from -500.00 to 500.00 mm, steps of 2.00 mm X-dir: at -135.000 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) b2_G RMS_G Ilin_A Imax_A b0_G b1_G b3_G ____ ____ ____ _____ _____ ____ ____ 891.9 -1.8 -5.4 0.1 / 5.5 10.0 3.5 \mathbf{n} 10.0 891.0 0.3 1.1 1.5 1.8 -5.5 891.8 2.3 10.0 -0.2 -0.8 -2.5 0.2 / = increasing current branch \land = decreasing current branch - = average constLeff (straight) = 112.90 mm I_Amp Bdz_Gmm Bc_G err_G _____ ____ ____ ____ 0.00* -164.9 -1.5 0.4 1.00/ 9832.2 87.1 -0.3 2.00/ 19968.7 176.9 0.3 3.00/ 29993.8 265.7 -0.1 4.00/ 40052.1 354.8 -0.2 5.00/ 50154.7 444.2 0.1 6.00/ 60204.7 533.3 0.0 7.00/ 70221.4 622.0 -0.1 8.00/ 80239.3 710.7 0.1 9.00/ 90232.1 799.2 -0.1 -0.2 (average of 2 fits) 10.00* 100282.8 888.2 9.00\ 90454.0 0.2 801.2 8.00\ 80514.6 713.1 0.3 -0.4 7.00\ 70442.8 623.9 6.00\ 60508.6 535.9 0.2 5.00\ 50422.6 446.6 -0.3 4.00\ -0.3 357.6 40371.1 3.00\ 30419.0 269.4 0.6 -0.1 2.00\ 20273.6 179.6 90.6 -0.0 1.00\ 10226.0 0.00* 164.9 1.5 -0.0

Bc = Bdz / constLeff
err = Bc - Bfit

Field maps (I = 10 A)



Field maps (I = 10 A)



printf "file\n <v4,8\n\n\n\n" combi<="" i="" th=""></v4,8\n\n\n\n">						
		cubic fit				
file	B·dz (0,0,z) [mT·m]	L _{SEFF} [mm]	B ₁ [Gauss]	B₂ [Gauss/mm]	B ₃ [Gauss/mm²]	fit error [%]
kfl1_x0 13 Nov 2017	10.0378	112.95	888.70	0.120	-0.0590	0.0024
kfl2_x0 16 Nov 2017	10.0476	113.10	888.78	0.182	-0.0585	0.0305
kfl3_x0 17 Nov 2017	10.0481	113.19	887.85	-0.011	-0.0545	0.0134
MAX DIFFERENCE	0.0103	0.24	0.93	0.19	0.0045	

Degaussing (I = -3 A)



The magnet KFL3 has been measured, dismantled, reassembled and measured again. The difference between two measurements is shown and amounts to $0.0007 \text{ mT}\cdot\text{m}$.

