DAΦNE TECHNICAL NOTE

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NUMERICAL CONSTANTS AND INITIAL SET POINTS FOR THE FIRST PART OF THE DAΦNE INJECTOR COMMISSIONING

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1. Introduction

With this Technical Note we intend to provide a link between the magnetic measurements performed at Ansaldo and at LNF and the Real Time and Off-line Databases of the Control System. Here we take into account all the magnets used for injection into (not extraction from) the Accumulator, namely the section of Transfer Line from the end of the Linac to the Accumulator and the Accumulator itself. For each magnet (or kind of magnets) we indicate the mathematical relations between the excitation current, the magnetic properties of the magnet and the physical quantities related to the beam motion. We recall the nominal values of the ideal lattice, in order to start machine commissioning from a calculated set of parameters.

Almost all the informations contained in this Note can partially be extracted from other DAΦNE Technical Notes. However, it is clear that it will be useful for the Group responsible of setting up the initial software package to have such a compact collection of data. For more details on the magnets referred to in the following, we quote wherever possible the corresponding reference.

2. Definition of physical quantities, units and magnetic parameters

For all dipoles we indicate:

(a) The nominal bending radius ρ (m);
(b) The nominal bending angle α (rad);
(c) The nominal length of the trajectory L_{nom} (m) [equal to (a)*(b)];
(d) The magnetic length L_{mag} (m) defined as the field integral divided by the field at the magnet center (m);
(e) The maximum excitation current I_{max} (A);
(f) The field at magnet center B_o (T) as a function of the excitation current I (A) in the rectangular model with the nominal magnetic length;
(g) The field integral $\int Bdy = B_o L_{nom}$ (Tm) obtained from the magnetic measurements on the nominal trajectory as a function of the excitation current I (A), which takes into account both saturation and magnet shortening at high current;
(h) The beam energy E (GeV) as a function of the excitation current I (A) at the nominal bending angle α;
(i) The excitation current I (A) as a function of beam energy E (GeV) at the nominal bending angle α (of course this is only the inverted relation (h));
(l) The initial setting of the excitation current I_{set} (A) at the nominal energy (0.51 GeV).

For the quadrupoles:

(a) The nominal magnetic length L_{nom} (m);
(b) The measured magnetic length L_{mag} (m);
(c) The maximum excitation current I_{max} (A);
(d) The gradient at magnet center G (T/m) as a function of the excitation current I (A);
(e) The integrated gradient $\int Gdy$ (T) as a function of the excitation current I (A);
(f) The lattice parameter $K = G/B\rho$ (m^{-2}) as a function of the excitation current I (A) and beam energy E (GeV): it is the integrated gradient, divided by the nominal length and the magnetic rigidity $B\rho$;
(g) The excitation current I (A) as a function of K (m^{-2}) and beam energy E (GeV) (comes from the inversion of relation (f));
(h) The initial setting of the lattice parameter K_{set} (m^{-2});
(i) The initial setting of the excitation current I_{set} (A) at the nominal energy (0.51 GeV);

For the sextupoles:

(a) The nominal magnetic length L_{nom} (m);
(b) The measured magnetic length L_{mag} (m);
(c) The maximum excitation current I_{max} (A);
(d) The gradient at magnet center S (T/m^2), defined as the second derivative $\partial^2B/\partial x^2$ with respect to the horizontal distance from the magnet axis, as a function of the excitation current I (A);
(e) The integrated gradient $\int Sdy$ (T/m) as a function of the excitation current I (A);
(f) The lattice parameter K (m^{-2}) as a function of the excitation current I (A) and beam energy E (GeV): it is the integrated gradient divided by the magnetic rigidity (sextupoles are represented as thin lenses in almost all lattice codes;
(g) The excitation current I (A) as a function of K (m^{-2}) and beam energy E (GeV) (comes from the inversion of relation (f));
(h) the initial setting of the lattice parameter K_{set} (m^{-2}).

For the correctors:

(a) The magnetic length L_{max} (m) defined as the field integral divided by the field at the magnet center (m);
(b) The maximum excitation current I_{max} (A);
(c) The field at magnet center B_o (T) as a function of the excitation current I (A);
(d) The field integral $\int Bdy$ (Tm) on the magnet axis as a function of the excitation current I (A), which takes into account both saturation and magnet shortening at high current;
(e) The bending angle α (rad) as a function of the excitation current I (A) and beam energy E (GeV);
(f) The excitation current I (A) as a function of bending angle α (rad) and beam energy E (GeV) (of course this is only the inverted relation (e)).

For the Accumulator kickers:

(a) The magnetic length L_{mag} (m) defined as the field integral divided by the field at the magnet center (m);
(b) The maximum voltage V_{max} (kV) of the high voltage power supply;
(c) The linear relation between the power supply setting voltage (kV) and the maximum pulse current I (A);
(d) The field at magnet center B_o (T) as a function of the maximum pulse current I (A);

(e) The field integral $\int Bdy$ (Tm) on the magnet axis as a function of the maximum pulse current I(A);
(f) The bending angle α (rad) as a function of the maximum pulse current I (A) and beam energy E (GeV);
(g) The maximum pulse current I (A) as a function of bending angle α (rad) and beam energy E (GeV) (of course this is only the inverted relation (f)).

For practical purposes, we use the exponential notation for the powers of ten (as an example e-3 = 10^{-3}), and omit the units, already defined in this section, in the following.

3. Transfer Line from the end of the Linac to the Accumulator

3.1 Dipoles

Starting from the end of the Linac the first dipole is DHPTS001; it is a pulsed magnet which deflects the beam, at a rate set by the timing system, towards the energy analyzing system of the hodoscope spectrometer. In this line the necessary energy dispersion is created by the DHSTS001 dipole. We have then the 45° bend towards the Accumulator, accomplished by the pulsed magnet DHPTT001, which changes rapidly its polarity for the injected and extracted beam. For the Accumulator commissioning, both DHPTS001 and DHPTT001 will be powered by a D.C. power supply: the constants indicated for these two magnets, however, hold also for the pulsed operation if the excitation current is intended as the maximum current in the pulse, in time coincidence with the passage of the beam. All these magnets change polarity between electron and positron operation.

There is then the "Y" magnet DHYTT01, which splits the injection line into the left branch for electrons and the right one for positrons. Into each of these two branches we find two vertical dipoles (DVRTL002 and DVRTL001 for electrons, DVRTR002 and DVRTR001 for positrons): the first ones deflect the beam up by 11°, the second ones bring the beam back parallel to the Accumulator horizontal plane. Finally we have in each branch the two septum magnets SPTTL001 and SPTA1001 for electrons, SPTTR001 and SPTA2001 for positrons).

<u>DHPTS001</u>

This magnet (and the following one, DHSTS001) have been designed for a maximum energy of 0.8 GeV. The measured magnetic lengths at different currents differ by less than 0.5 mm (<0.1%) and therefore we have taken L_{mag} as constant.

(a) $\rho = 6$
(b) $\alpha = 0.113833$ (6.52216°)
(c) $L_{nom} = 0.683$
(d) $I_{max} = 230$
(e) $L_{mag} = 0.685$
(f) $B_o = 2.4018e-3*I$
(g) $\int Bdy = 1.6404e-3*I$
(h) $E = 4.3202e-3*I$
(i) $I = 2.3147e2*E$
(l) $I_{set} = 185.18$ @ 0.80 GeV
$I_{set} = 118.05$ @ 0.51 GeV

DHSTS001

(a) ρ = 1.7227
(b) α = 1.0472 (60°)
(c) L_{nom} = 1.804
(d) I_{max} = 280
(e) L_{mag} = 1.8193 I<150
L_{mag} = 1.8406 - 1.4201e-4∗I I>150
(f) B_o = 2.21e-4 + 7.3337e-3∗I I<150
B_o = -7.0283e-12∗I^4 + 9.7012e-8∗I^3 - 7.8636e-5∗I^2 + 2.4844e-2∗I - 1.1808 I>150
(g) ∫Bdy = 4.0e-4 + 1.3234e-2∗I I<150
∫Bdy = -1.2679e-11∗I^4+ 1.7501e-7∗I^3 - 1.4186e-4∗I^2 + 4.4819e-2∗I - 2.1299 I>150
(h) E = 5.2083e-5 + 3.7886e-3*I I<150
E = -3.6297e-12∗I^4 + 5.0102e-8∗I^3 - 4.0611e-5∗I^2 + 1.2831e-2∗I - 0.6098 I>150
(i) I = 263.95*E - 1.375e-2 I<150
I = 941.04*E^3 - 1329*E^2 + 846.83*E - 74.76 I>150
(l) I_{set} = 136.3 @ 0.51 GeV
I_{set} = 234.0 @ 0.80 GeV

DHPTT001

(a) ρ = 1.417
(b) α = 0.7854 (45°)
(c) L_{nom} = 1.113
(d) I_{max} = 650
(e) L_{mag} = 1.124 I<300
L_{mag} = 1.1373 - 4.4444e-5∗I I>300
(f) B_o = 1.2129e-4 + 2.419e-3∗I I<300
B_o = -1.3699e-13∗I^4 + 3.7969e-9∗I^3 - 7.7012e-6∗I^2 + 6.2805e-3∗I - 0.56665 I>300
(g) ∫Bdy = 1.35e-4 + 2.6924e-3∗I I<300
∫Bdy = -1.5247e-13∗I^4 + 4.2260e-9∗I^3 - 8.5714e-6∗I^2 + 6.9902e-3∗I - 0.63068 I>300
(h) E = 5.153e-5 + 1.0277e-3∗I I<300
E = -5.8198e-14∗I^4 + 1.6131e-9∗I^3 - 3.2717e-6∗I^2 + 2.6682e-3∗I - 0.24072 I>300
(i) I = 973.05∗E - 0.05 E<.30836
I = 9193.5∗E^3 - 8315.6∗E^2 + 3437∗E - 238.7 E>.30836
(l) I_{set} = 570.81

DHYTT001

This magnet has two channels (right and left). The magnetic length and the excitation curve have been averaged over the two channels (they differ by less than 0.1%). Being the variation of L_{mag} with the current less than 0.1%, it has been neglected and its value at the nominal current taken.

(a) ρ = 1.5915
(b) α = 0.62832 (36°)
(c) L_{nom} = 1.000
(d) I_{max} = 120

(e) L_{mag} = 1.002
(f) B_o = 3.8349e-3 + 1.1171e-2∗I
(g) ∫Bdy = 3.8349e-3 + 1.1171e-2∗I
(h) E = 1.8297e-3 + 5.3300e-3∗I
(i) I = -0.343 + 187.62*E
(l) I_{set} = 95.34

<u>DVRTL001, DVRTL002, DVRTR001, DVRTR002</u>

We have averaged the measurements over the 10 magnets measured at Ansaldo. The data are available from the Magnetic Measurements Group (C. Sanelli, M. Preger). The field is linear up to 60A.

(a) ρ = 1.823
(b) α = 0.192 (11°)
(c) L_{nom} = 0.35
(d) I_{max} = 120
(e) L_{mag} = 0.3525 — 0<I< 60
L_{mag} = 0.3569 - 7.4792e-5∗I — 60<I<120
(f) B_o = 1.0514e-3 + 1.1010e-2∗I — 0<I< 60
B_o = -1.7718e-10*I^4 + 9.0349e-7∗I^3 - 2.8357e-4∗I^2 + 3.4797e-2∗I - 0.59817 — 60<I<120
(g) ∫Bdy = 3.68e-4 + 3.8536e-3∗I — 0<I< 60
∫Bdy = -6.2013e-11∗I^4 + 3.1622e-7∗I^3 - 9.9251e-5∗I^2 + 1.2179e-2∗I - 0.20936 — 60<I<120
(h) E = 5.7464e-4 + 6.0175e-3∗I — 0<I< 60
E = -9.6834e-11∗I^4 + 4.9378e-7∗I^3 - 1.5498e-4∗I^2 + 1.9018e-2∗I - 0.32692 — 60<I<120
(i) I = 166.182∗E - 0.0955 — 0<E< 0.3616
I = 805.46∗E^2 - 431.26∗E + 110.63
0.3616<E<0.5567
(l) I_{set} = 100.19

<u>SPTTL001, SPTTR001</u>

The data, available from the Magnetic Measurements Group (C. Sanelli, M. Preger) are averaged over the two magnets measured at LNF. The field is linear up to the maximum current.

(a) ρ = 2.0778
(b) α = 0.5934 (34°)
(c) L_{nom} = 1.233
(d) I_{max} = 2300
(e) L_{mag} = 1.2522
(f) B_o = 3.9324e-4∗I
(g) ∫Bdy = 4.8486e-4∗I
(h) E = 2.4495e-4∗I
(i) I = 4.0825e3∗E
(l) I_{set} = 2082.1

SPTA1001, SPTA2001

The data are averaged over the two magnets measured at LNF (DAΦNE Technical Note MM-7). The field is linear up to the maximum current.

(a) ρ = 16.395
(b) α = 0.038 (2.177°)
(c) L_{nom} = 0.623
(d) I_{max} = 2300
(e) L_{mag} = 0.6327
(f) B_o = 5.7289e-5∗I
(g) ∫Bdy = 3.5691e-5∗I
(h) E = 2.8157e-4∗I
(i) I = 3.5515e3∗E
(l) I_{set} = 1811.2

3.2 Quadrupoles

There are two types of quadrupoles, the first with a nominal length of 30 cm (Type A) and the second (Type B) with 20 cm. The long quads are used in the straight section between the 45° pulsed magnet DHPTT001 and the "Y" magnet DHYTT001. All the other are Type B ones.

QUATM001÷008, QUATT006, QUATL001÷004, QUATR001÷004 (Type B)

These magnets have been measured by Ansaldo, and the data are averaged over the whole set of 37 magnets built for the DAΦNE Transfer Lines.The data are available from the Magnetic Measurements Group (C. Sanelli, M. Preger). The field is linear over the operational range.

(a) L_{nom} = 0.200
(b) L_{mag} = 0.1966
(c) I_{max} = 100
(d) G = 0.11214∗I + 5.7675e-2
(e) ∫Gdy = 2.2427e-2∗I + 1.1536e-2
(f) K = (1/E) [3.3617e-2∗I + 1.7292e-2]
(g) I = 29.7469∗K∗E - 0.514

Table I shows the nominal values of K and I for all the quadrupoles, both in the electron and positron injection modes, computed with the nominal beam parameters of the Linac (see DAΦNE Technical Note I-14). A positive value for K indicates a horizontally focusing quadrupole, both for electrons and positrons. We indicate here only the absolute value of the current, and therefore the power supply does <u>not</u> change polarity between electron and positron injection when the two values of K have the opposite sign.

Table I - K values and power supply current set values @ 0.51 GeV for Type B quadrupoles

Quadrupole	K positrons	I positrons	K electrons	I electrons
QUATM001	3.4060	51.157	-1.8189	28.108
QUATM002	-2.2505	34.655	1.3200	19.512
QUATM003	2.1491	32.090	-1.7183	26.582
QUATM004	-1.3160	20.479	1.4991	22.228
QUATM005	2.6572	39.799	-0.4701	7.646
QUATM006	1.3951	20.651	0.4587	6.445
QUATM007	-2.5721	39.535	-0.6356	10.157
QUATM008	-1.5173	23.533	3.0615	45.931
QUATM009	2.8347	42.491	-2.6024	39.995
QUATT006	-0.8955	14.100	0.9300	13.595
QUATR005	1.1509	16.947		
QUATR004	0.0809	0.713		
QUATR003	2.7883	41.787		
QUATR002	-4.1458	63.410		
QUATR001	2.9782	44.668		
QUATL005			0.1620	1.943
QUATL004			-3.1904	48.916
QUATL003			4.9908	75.201
QUATL002			-2.4455	37.614
QUATL001			-1.3094	20.378

QUATT001÷005 (Type A)

Also these magnets have been measured by Ansaldo, and the data are averaged over the whole set of 9 magnets built for the DAΦNE Transfer Lines.The data are available from the Magnetic Measurements Group (C. Sanelli, M. Preger). The field is linear over the operational range. Table II shows the nominal set points.

(a) $L_{nom} = 0.300$
(b) $L_{mag} = 0.2951$
(c) $I_{max} = 100$
(d) $G = 8.372e\text{-}2 * I + 2.3767e\text{-}2$
(e) $\int G dy = 2.5116e\text{-}2 * I + 7.13e\text{-}3$
(f) $K = (1/E) [2.5100e\text{-}2 * I + 7.13e\text{-}3]$
(g) $I = 39.8406 * K * E - 0.28$

Table II - K values and power supply current set values @ 0.51 GeV for Type A quadrupoles

Quadrupole	K positrons	I positrons	K electrons	I electrons
QUATT005	2.3976	48.437	-0.7380	15.275
QUATT004	-1.7392	35.619	1.7700	35.684
QUATT003	2.4992	50.500	-2.0800	42.543
QUATT002	-1.8618	38.110	1.5650	31.519
QUATT001	2.9483	59.626	-1.2300	25.272

3.3 Horizontal/Vertical correctors

CHVTM001÷004, CHVTT001÷004, CHV, CHVTL001÷003, CHVTR001÷003

All these correctors, each one with two independent power supplies, are of the same kind. A prototype has been measured at LNF, and the results are in agreement with those performed by Ansaldo on the 31 magnets built for the DAΦNE Transfer Lines. Since the field integral has been measured only at LNF, we take therefore our measurements for the calibration of the magnets. The correctors are linear on the whole operating range.

(a) $L_{mag} = 0.2242$
(b) $I_{max} = 10$
(c) $B_o = 1.8561e\text{-}3*I + 1.5042e\text{-}4$
(d) $\int Bdy = 4.1613e\text{-}4*I + 3.3725e\text{-}5$
(e) $X = \alpha*E = 1.2475e\text{-}5*I + 1.011e\text{-}6$
(e) $I = 8.016e3*X - 8.1e\text{-}2$

4. Accumulator

4.1 Dipoles

The 8 dipoles of the DAΦNE Accumulator are powered in series. They have been all measured at LNF and the results are given in the DAΦNE Technical Note MM-9. Since the Accumulator is planned to run mainly at the energy of the Φ-resonance (0.51 GeV), the measurements have been performed only at a fixed current corresponding to the nominal field at the magnet center, and the energy corresponding to the nominal 45° deflection has been found by integrating the field on the particle trajectory calculated from the field maps. We give therefore here, as a rough estimate, the dependence of the beam energy on the excitation current only by scaling the field integral calculated in this way with the same law as the field measured at the magnet center. The field at the magnet center is linear up to 350A.

(a) $\rho = 1.1$
(b) $\alpha = 0.7854$ (45°)
(c) $L_{nom} = 0.864$
(d) $I_{max} = 700$
(e) $L_{mag} = 0.8671$
(f) $B_o = 2.8361e\text{-}3*I + 1.8171e\text{-}3$ $\quad 0<I< 350$
$B_o = -2.5431e\text{-}6*I^2 + 4.6794e\text{-}3*I - 0.3318$ $\quad 350<I<700$
(g) $\int Bdy = 2.4504e\text{-}3*I + 1.57e\text{-}3$ $\quad 0<I< 350$
$\int Bdy = -2.1971e\text{-}6*I^2 + 4.0429e\text{-}3*I - 0.28666$ $\quad 350<I<700$
(h) $E = 9.3533e\text{-}4*I + 6.1e\text{-}4$ $\quad 0<I< 350$
$E = -8.3865e\text{-}7*I^2 + 1.5432e\text{-}3*I - 0.10942$ $\quad 350<I<700$
(i) $I = 1.0692e3*E - 0.66$ $\quad 0<E< 0.328$
$I = 5.3019e4*E^4 - 8.368e4*E^3 + 5.0775e4*E^2 - 1.2794e4*E + 1.4231e3$ $\quad 0.328<E<0.560$
(l) $I_{set} = 591.3$

4.2 Quadrupoles

The 12 Accumulator quadrupoles have been measured at LNF, and the results are given in the DAΦNE Technical Note MM-8. As explained in the Note, since there is a common power supplies for the 4 quads of each family, the position of the magnets in the ring has been decided following the criterion of minimising the spread in integrated gradient between the magnets of each family. We have therefore different calibrations for the three families. The values are averaged over the magnets of each family. The quadrupoles are all linear up to the maximum current delivered by the power supply

QUAA1001, QUAA2003, QUAA3001, QUAA4003

These quadrupoles are horizontally focusing.

(a) $L_{nom} = 0.300$
(b) $L_{mag} = 0.2959$
(c) $I_{max} = 315$
(d) $G = 3.0450e\text{-}2 * I$
(e) $Gdy = 9.1350e\text{-}3 * I$
(f) $K = 9.1286e\text{-}3 * I/E$
(g) $I = 109.55 * K * E$
(h) $K_{set} = 4.71289$
(i) $I_{set} = 263.312$

QUAA1002, QUAA2002, QUAA3002, QUAA4002

These quadrupoles are horizontally defocusing.

(a) $L_{nom} = 0.300$
(b) $L_{mag} = 0.2959$
(c) $I_{max} = 315$
(d) $G = 3.0498e\text{-}2 * I$
(e) $\int Gdy = 9.1494e\text{-}3 * I$
(f) $K = 9.1430e\text{-}3 * I/E$
(g) $I = 109.37 * K * E$
(h) $K_{set} = -4.73852$
(i) $I_{set} = 264.308$

QUAA1003, QUAA2001, QUAA3003, QUAA4001

These quadrupoles are horizontally focusing.

(a) $L_{nom} = 0.300$
(b) $L_{mag} = 0.2959$
(c) $I_{max} = 315$
(d) $G = 3.051e\text{-}2 * I$
(e) $\int Gdy = 9.1530e\text{-}3 * I$
(f) $K = 9.1466e\text{-}3 * I/E$
(g) $I = 109.33 * K * E$
(h) $K_{set} = 4.49090$
(i) $I_{set} = 250.405$

4.3 Sextupoles

There are two families of chromaticity correcting sextupoles, each powered by a single power supply. All magnets have been measured at LNF and results collected into the DAΦNE Technical Note MM-6. For the place of the magnets into the ring, the same criterion as for the quads has been adopted. We have therefore different calibrations for the two families. The initial set values are those which set both chromaticities to zero, taking into account the sextupole contribution of the dipoles to the overall ring chromaticity (see the DAΦNE Technical Note MM-9). The magnets are linear over the operating range.

<u>SXPA1001, SXPA2002, SXPA3001, SXPA4002</u>

This is a family of horizontally focusing sextupoles.

(a) $L_{nom} = 0.100$
(b) $L_{mag} = 0.105$
(c) $I_{max} = 336$
(d) $S = 0.6772*I$
(e) $\int Sdy = 6.772e\text{-}2*I$
(f) $K = 2.0302e\text{-}2*I/E$
(g) $I = 49.256*K*E$
(h) $K_{set} = 7.29$
(i) $I_{set} = 183.13$

<u>SXPA1002, SXPA2001, SXPA3002, SXPA4001</u>

This is a family of horizontally defocusing sextupoles.

(a) $L_{nom} = 0.100$
(b) $L_{mag} = 0.105$
(c) $I_{max} = 336$
(d) $S = 0.6772*I$
(e) $\int Gdy = 6.735e\text{-}2*I$
(f) $K = 2.0191e\text{-}2*I/E$
(g) $I = 49.527*K*E$
(h) $K_{set} = -5.87$
(i) $I_{set} = 148.27$

4.4 Correctors

There are two kinds of orbit correctors in the Accumulator, both measured at LNF. Both have a square shape with two independent coils for correction in the horizontal and vertical planes. Six of them, referred to as "Type A" correctors have a 150x150 mm^2 gap. The other two are placed in the kicker and RF sections, and are larger, in order to cope with the larger size of the vacuum chamber; they are "Type B" correctors and the gap is 260x260 mm2. The measurements, available from the Magnetic Measurements Group (C. Sanelli, M. Preger), have been performed separately on the two coils, and the mutual interference has not been checked.

CHVA1001, CHVA2001, CHVA3001, CHVA3002, CHVA4002, CHVA4003 (Type A)

Each field component is linear up to the maximum excitation current.

(a) $L_{mag} = 0.223$
(b) $I_{max} = 10$
(c) $B_o = 1.455e\text{-}3*I$
(d) $\int Bdy = 3.244e\text{-}4*I$
(e) $X = \alpha*E = 9.73e\text{-}5*I$
(e) $I = 1.028e4*X$

CHVA1002, CHVA4001 (Type B)

Each field component is linear up to 6A

(a) $L_{mag} = 0.336$
(b) $I_{max} = 10$
(c) $B_o = 2.2117e\text{-}3*I + 7.0e\text{-}5$ — $0<I<6$
$B_o = -1.7428e\text{-}4*I^2 + 4.5308e\text{-}3*I - 7.571e\text{-}3$ — $6<I<10$
(d) $\int Bdy = 7.43e\text{-}4*I + 2.40e\text{-}5$ — $0<I<6$
$\int Bdy = -5.855e\text{-}5*I^2 + 1.52207e\text{-}3*I - 2.543e\text{-}3$ — $6<I<10$
(e) $X = \alpha*E = 2.2274e\text{-}4*I + 7.195e\text{-}6$ — $0<I<6$
$X = \alpha*E = -1.7553e\text{-}5*I^2 + 4.563e\text{-}4*I - 7.6237e\text{-}4$ — $6<I<10$
(f) $I = 4.4895e3*X - 3.21e\text{-}2$ — $0<X<1.3436e\text{-}3$
$I = 3.8063e9*X^3 - 1.6178e7*X^2 + 2.726e4*X - 10.6534$ — $1.3436e\text{-}3<X<2.04$

4.5 Kickers

Two "short" kickers are placed in the RF straight section, one on each side of the cavity. The two "long" ones are on the opposite side of the ring. The field has been measured at LNF by the Pulsed Magnets Group (S. De Simone, A. Ghigo), and the results are given in the DAΦNE Technical Note MM-2.

KCKA1001, KCKA2001 ("long")

(a) $L_{mag} = 0.845$
(b) $V_{max} = 35$
(c) $I = 84.75*V$
(d) $B_o = 6.62e\text{-}6*I$
(e) $\int Bdy = 5.60e\text{-}6*I$
(f) $\alpha = 1.68e\text{-}6*I/E$
(g) $I = 5.95e5*\alpha*E$

KCKA3001, KCKA4001 ("short")

(a) $L_{mag} = 0.550$
(b) $V_{max} = 35$
(c) $I = 84.75*V$
(d) $B_o = 6.62e\text{-}6*I$
(e) $\int Bdy = 3.64e\text{-}6*I$
(f) $\alpha = 1.09e\text{-}6*I/E$
(g) $I = 9.16e5*\alpha*E$