DAΦNE TECHNICAL NOTE

INFN - LNF, Accelerator Division

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Note: **I-16**

LATTICE OF THE DAΦNE TRANSFER LINES AT THE 2003 STARTUP

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Abstract

The transfer lines of the DAΦNE complex have been slightly modified during machine commissioning, in different shut-down periods. The optical model of the transfer lines, developed in the project phase [1], has been updated to all the changes. Recently even the Transfer Lines model has been reorganized in order to have a more suitable tool to be used to develop automatic optimization procedures. Using the updated MAD model the optical function along the beam lines have been evaluated for the datasets relative to December 2002 and February 1999 with the aim, as a first, to debug the model and then to review the Transfer Lines evolution during three years of the DAΦNE complex operations. The optical functions along the beam lines are presented here, for the last December 2002 and for the February 1999 datasets. Using the updated MAD model a comparison of the changes occurred during three years of machine operation is discussed in the following. Beam envelopes are plotted with respect to the vacuum chamber aperture, to analyse the simulated beams transportation efficiency. The four transfer lines have been matched to the present initial and final values, minimizing the beta and dispersion functions. The matched lattices are presented in the last section. The note gives the starting point and the tool to optimise the beam lines for the next machine start-up.

1 TRANSFER LINES LAYOUT

All the quadrupole magnets positions have been measured again in March 2003 [2] and corrected in the model. The updated parameter list containing the magnetic elements at their present position can be found in the appendix and in:

/afs/lnf.infn.it/project/macchina/user/optics/mad8/DAFNEmodel/TL

The main variation in the accumulator extraction line concerns the electron line TE, where the two quadrupoles QUATE104 and QUATE105 have been added in 1999.

The transfer lines of the DAΦNE complex have changed mostly in the accumulator injection line (TM line). The QUATM006 quadrupole has been removed from the TM section and added in the Accumulator-DAΦNE beam line as QUATT011. As a consequence the lattice of the accumulator injection section has changed quite strongly since the last studies (February 1999), as shown in section 3.

The updated MAD model has been used with the February '99 datasets [2]-[5]. This has been useful both to check the model and to compare the optical functions calculated with the last period of DAΦNE operation, in December 2002.

2 ACCUMULATOR EXTRACTION LINES

In both the electrons and positrons lines the changes occurred to the lattice do not affect significantly the beam envelopes; therefore a good efficiency in the beams transportation is calculated also for the last period of DAΦNE runs, but the beam focusing has improved.

The beam envelope has been calculated using the parameter values reported in table 1. The phase plane distribution is nearly Gaussian; the beam envelope containing 99.7% of the beam is computed as in [1]:

$$3\cdot\sqrt{\varepsilon\beta+\left((D\cdot\frac{\Delta p}{p})\right)^2}$$

We just mention here that the beam transportation efficiency is the calculated one from the β and dipersion functions and does not take into account the possible misalignments nor the corrector magnets.

Table 1. Nominal optical functions for the beam at the accumulator extraction point.

	Positrons	**Electrons**
ε_x[m rad]	$2.8*10^{-7}$	$2.8*10^{-7}$
ε_y[m rad]	$1.4*10^{-7}$	$1.4*10^{-7}$
Δp/p [%]	0.1	0.1
β_x[m]	3.07	3.07
α_x	1.017	1.017
β_y[m]	4.041	4.041
α_y	0.458	0.458

2.1 Electrons

Figure1 shows the β-functions on the left and the dispersion functions on the right side, for the February 1999 dataset and for the December 2002 one (upper and lower plots). It appears that the lattice has changed especially in the region where the quadrupoles QUATT011 (at 50.675m), QUATE104 and QUATE105 (at 79.344m) have been installed.

The relevant parameter is the beam envelope, which has to be compared to the vacuum aperture dimensions. As appears from Fig. 2 and Fig. 3 the radial and vertical envelopes are largely within the pipe for both configurations.

Nevertheless, the radial envelope is at the vacuum chamber limit at two points: close to DHPTT01 (s=36.07m) and close to QUATE07 (91.47m). For the last set these points result more critical.

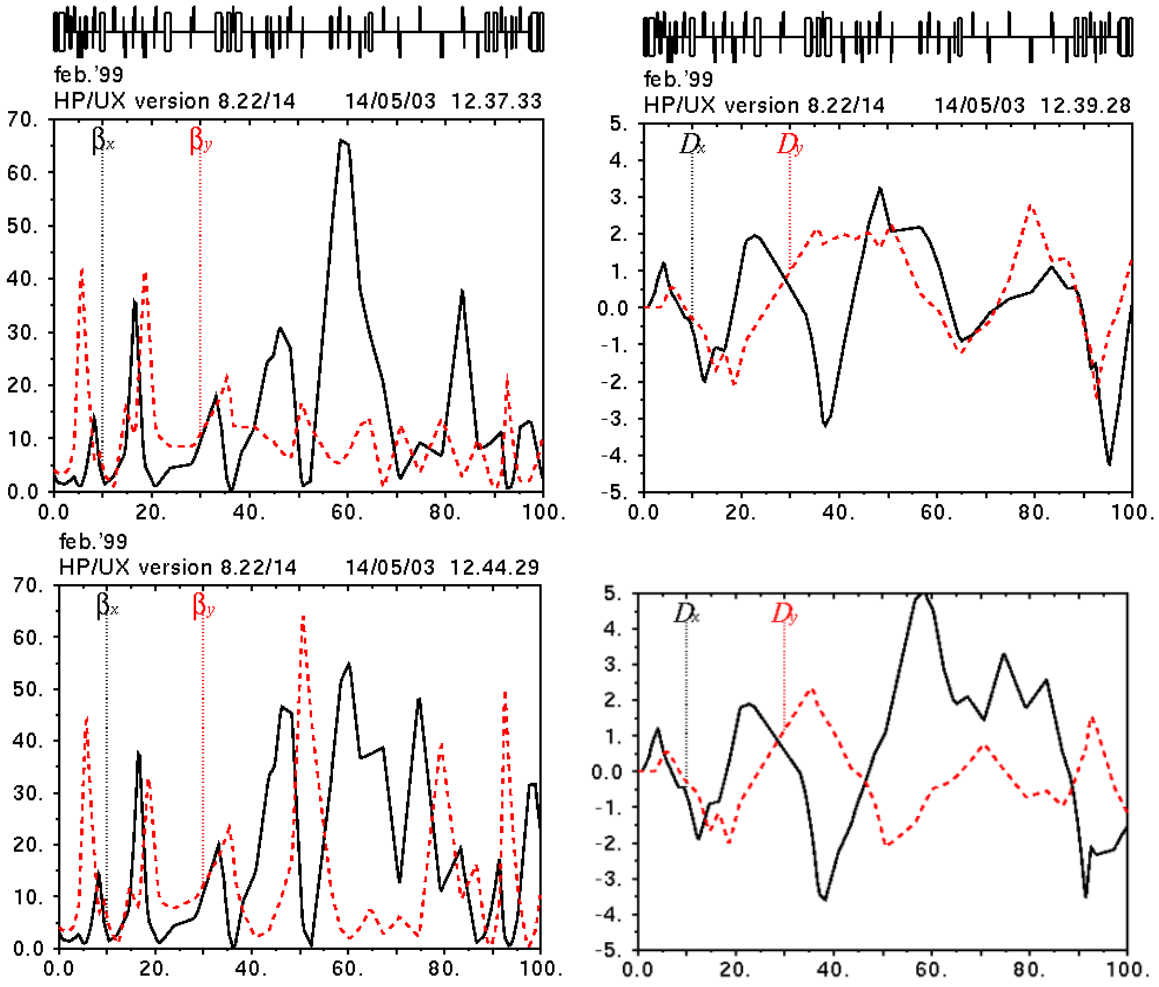

Figure 1: Comparison of optical functions for the February 1999 dataset (*upper plots*) with the 17th December 2002 dataset (*lower plots*) using the updated MAD model for the electrons beam line.

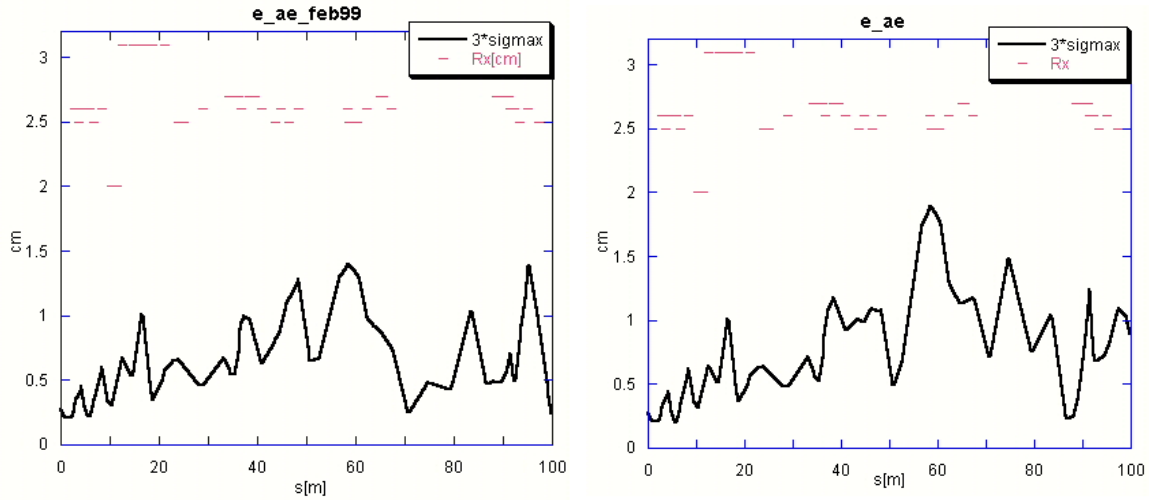

Figure 2: Electrons beam envelope in the radial plane with respect to the vacuum chamber aperture (pink markers) for the February 1999 dataset (*left plot*) and for the 17th December 2002 configuration (*right plot*). The envelope is well within the pipe in both cases.

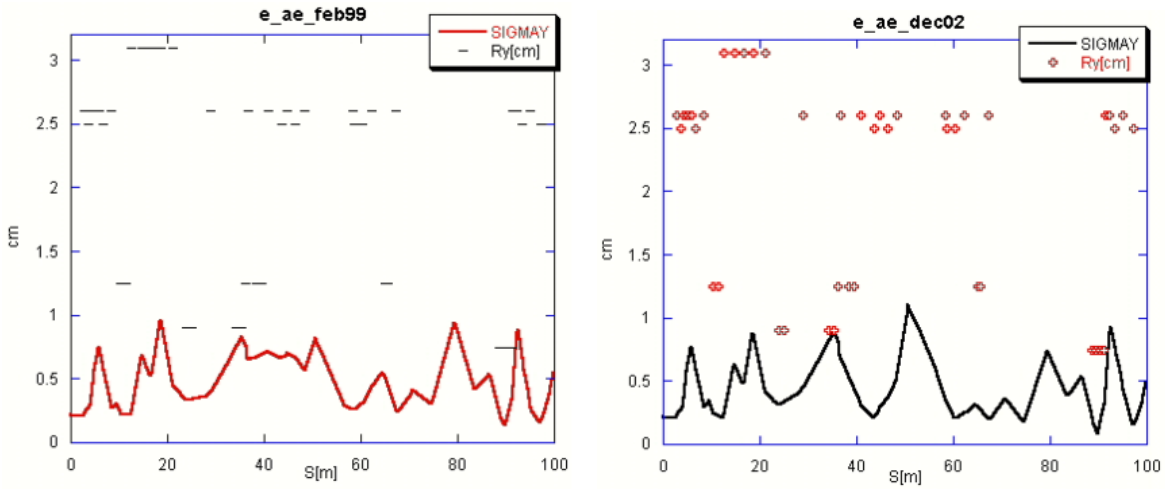

Figure 3: Electrons beam envelope in the vertical plane with respect to the vacuum chamber aperture for the February 1999 dataset (*left plot*) and for the 17th December 2002 dataset (*right plot*). For both configurations the critical points are: close to DHPTT01 (S=36.07m) and close to QUATE007 (s=91.47m). The envelope on the right is at the limit at those positions, the one on the left is always within the pipe.

2.2 Positrons

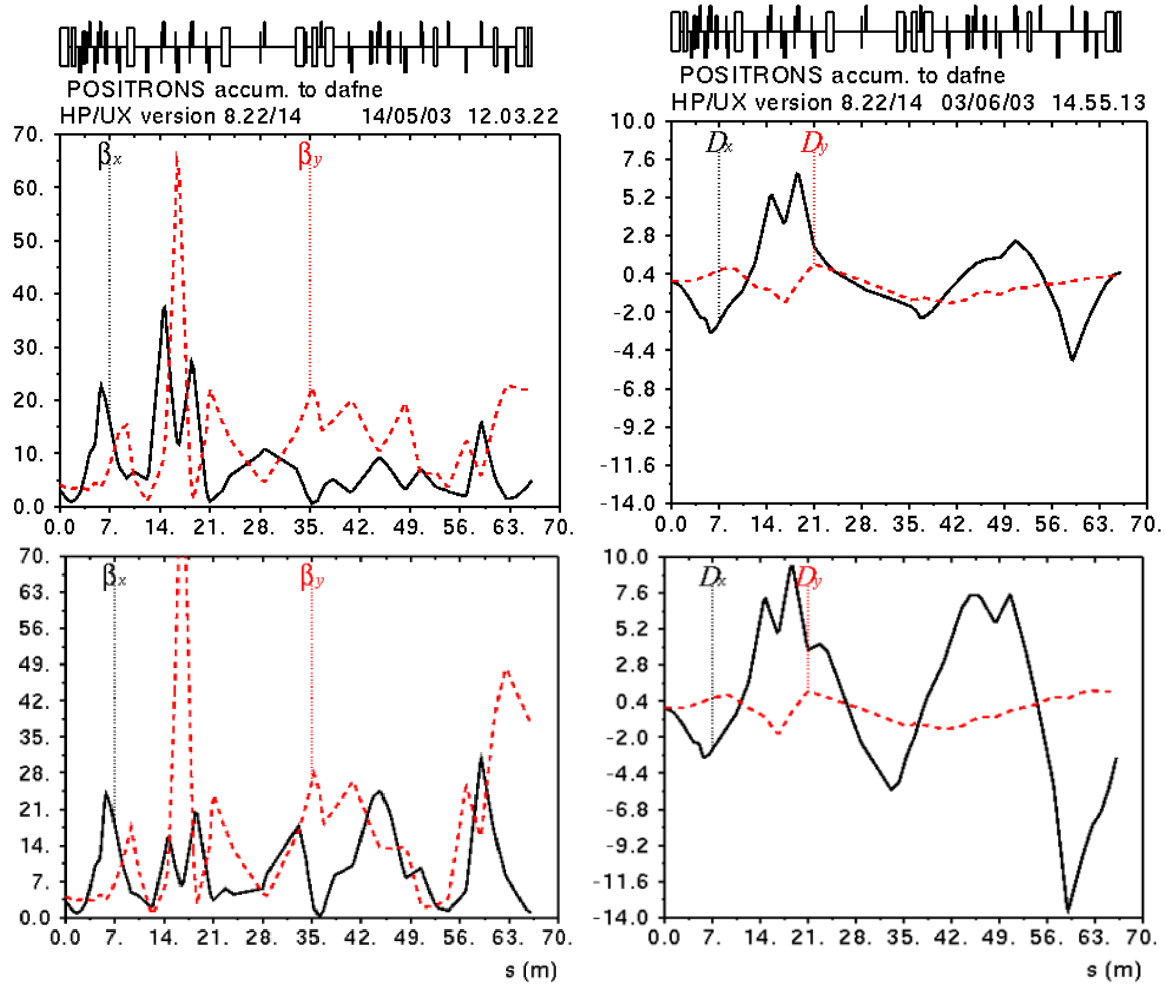

Figure 4: Comparison of optical functions for the February 1999 dataset (*upper plots*) with the 17th December 2002 dataset (*lower plots*) using the updated MAD model for the positrons beam line.

Figure 4 shows the β-functions on the left and the dispersion functions on the right side, for the February 1999 and for the December 2002 datasets (upper and lower plots, respectively).

The values of the two quadrupoles QUATP002 and QUATP004 are close to the values: QUATP002=-27.4A and QUATP004=–6.7A, but they are not exactly these. This can explain the high values of β_y , D_x and consequently the large radial envelope after s=60m. As shown in the right upper plots of Fig. 5, the horizontal beam envelope is within the pipe everywhere, but at the quadrupole QUATP002. The left side plots shows instead a small sigmax all along the line. The February '99 has been rematched to this line, a good dataset is shown in the last section.

The vertical beam envelope is well confined inside the vacuum pipe for both configurations (see lower plots of Fig. 5).

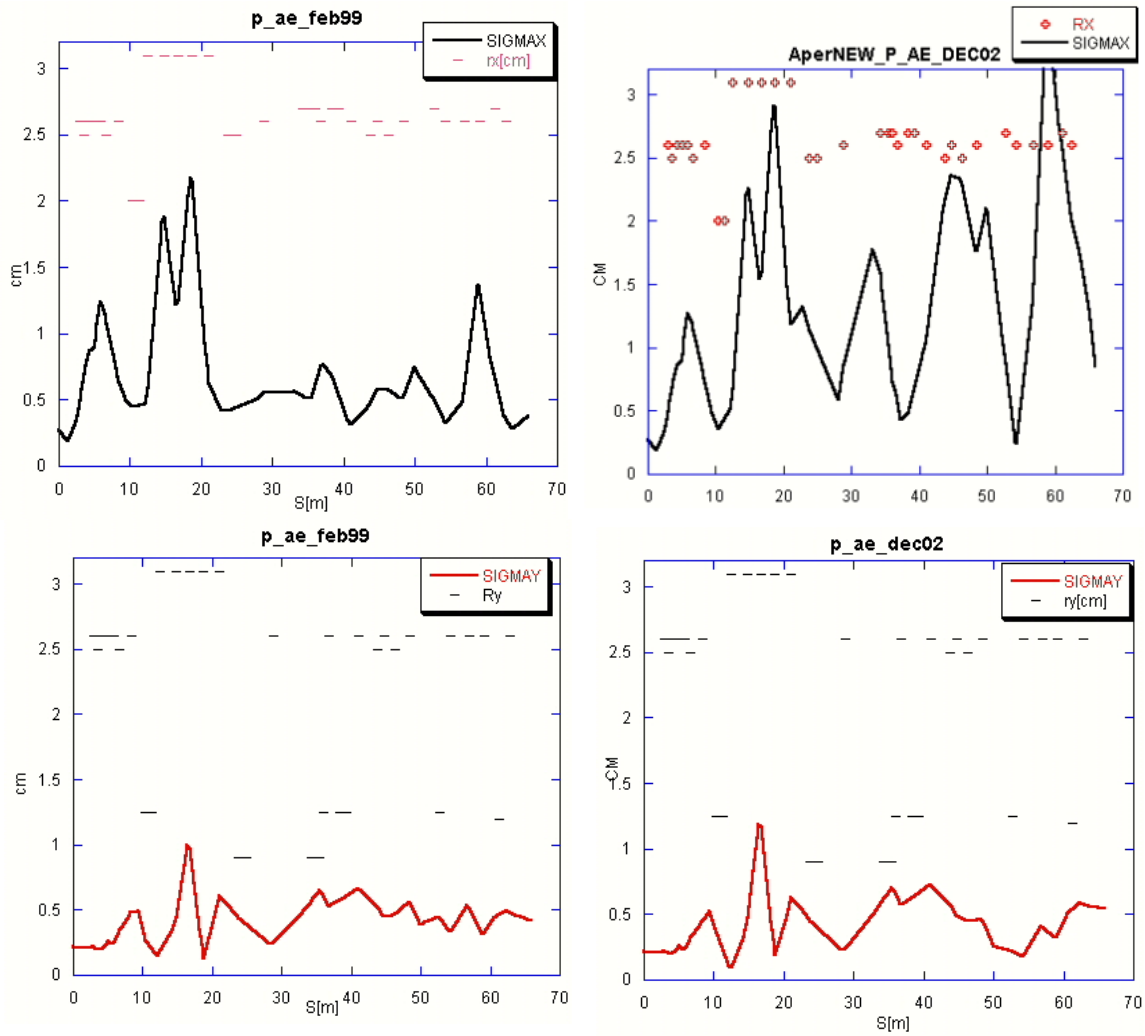

Figure 5: *Upper plot:* Positrons beam envelope in the radial plane with respect to the vacuum chamber aperture (red markers) for the February 1999 dataset (*upper left plot*) and for the 17th December 2002 dataset (*upper right plot*). The envelope is well inside the pipe for the two configurations, but for the Dec'02 case the horizontal envelope is larger than the aperture at the QUATP002 (s=56.775m). The value for this quadrupole, as for QUATP004 is not known exactly, so it is plausible that the real configuration is better than this; *Lower plots*: Positrons beam envelope in the vertical plane with respect to the vacuum chamber aperture (black markers) for the February 1999 dataset (*lower left plot*) and for the 17th December 2002 dataset (*lower right plot*). The envelope is well within the pipe in both cases.

3 ACCUMULATOR INJECTION LINES

The beam line from the linac exit to the accumulator is shared for positrons and the electrons one up to DHYTT01 magnet. Of course, the hardware modifications done on the TM line affect both beams.

If we compare the β-functions of the Dec'02 set to the ones of February '99 set, we find that the β_x-function has changed substantially for the electron beam, while the β_y-function has changed a lot for the positron beam.

Moreover, as the positron emittance is larger by a factor 10 and the energy spread is larger by a factor 3 with respect to the electron one, the variations to the positron lattice have as a direct consequence a worse efficiency in the beam transportation, as the beam envelope gets greater than the vacuum chamber at some critical points.

So while the electron beam envelopes keep within the vacuum chamber, the positron case look a bit worse, as both in the radial and in the vertical plane there are some critical points where the envelope exceeds the aperture. In particular, horizontally the most critical points are at the quadrupole QUATT04 (s=38.478m) and at the DHYTT01 (s=47.52m) as shown in Fig. 10 Vertically, the beam envelope is larger than the aperture at QUATM04 (s=11.21), at QUATT06 (28.32m) and at DHYTT01, as shown in Fig. 11.

The beam envelope has been calculated using the parameter values reported in Table 2. The beam size is defined as:

$$\sqrt{\varepsilon\beta + \left((D \cdot \frac{\Delta p}{p})\right)^2}$$

The beam distribution at the linac exit is nearly uniform, in this case the emittance is the area containing 95% of all the particles.

As initial conditions we assumed those used for the February '99 configuration. In fact, small variations to the last linac quadrupoles have occurred since then. In Fig. 1 of [6] the β-values are plotted versus the last linac quadrupole current. The current of the last linac quadrupole is reported for the two configurations in Table 3.

Table 2. Nominal optical functions for the beam at the linac exit.

	Positrons	**Electrons**
ε_x[m rad]	10^{-5}	10^{-6}
ε_y[m rad]	10^{-5}	10^{-6}
Δp/p [%]	1.5	0.5
β_x[m]	3	8.5
α_x	0	0
β_y[m]	6	5.5
α_y	0	0

Table 3. Last Linac quadrupole current for the two periods into account.

dataset	**Positrons**	**Electrons**
February 1999	18A	8A
December 2002	17.8A	12A

3.1 Electrons

Figure 6 shows the β-functions on the left and the dispersion functions on the right side, for the February 1999 and for the December 2002 dataset (upper and lower plots). It appears that lattice has changed all over the line. Nevertheless, as appears from Fig. 7 and Fig. 8 the radial and vertical envelopes are well within the pipe, for both configurations. A 100% efficiency in beam transportation is expected for this electron accumulator injection beam line.

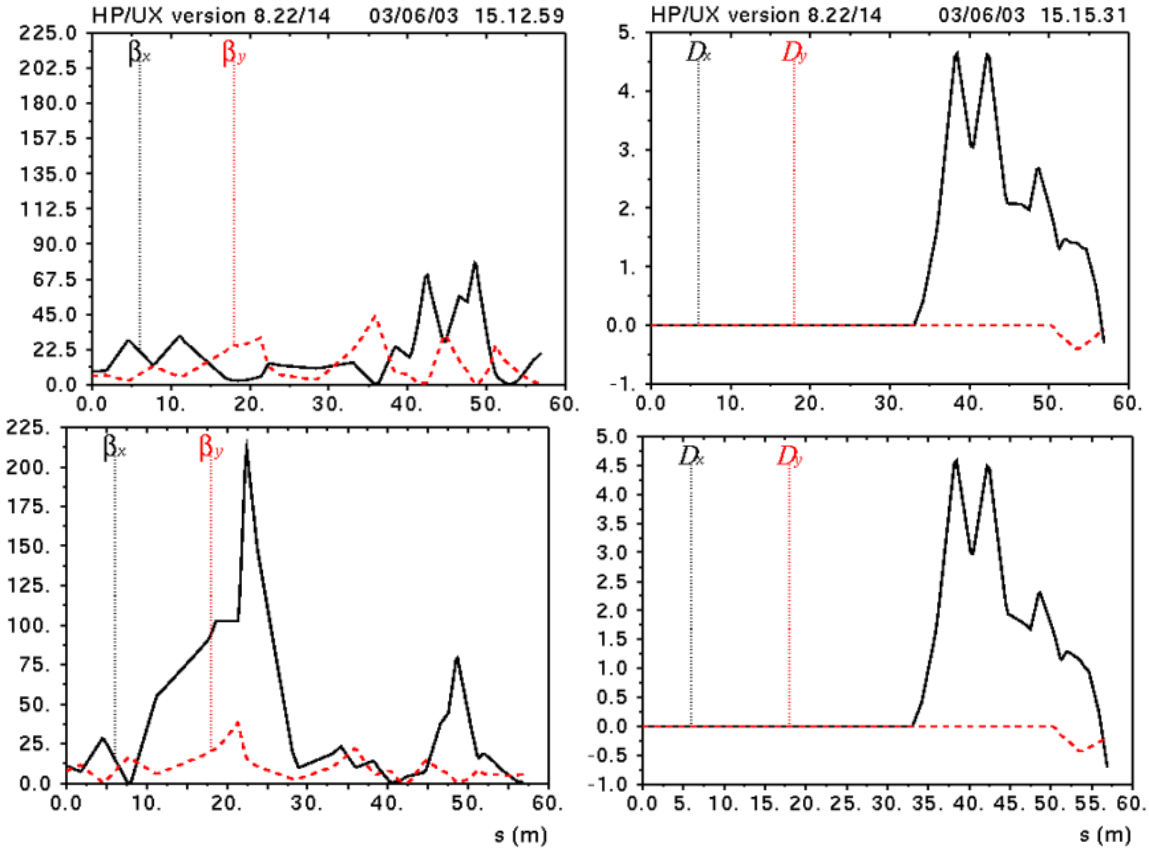

Figure 6: Comparison of optical functions for the February 1999 dataset (*upper plots*) with the 17th December 2002 dataset (*lower plots*) using the updated MAD model for the electrons linac to accumulator beam line.

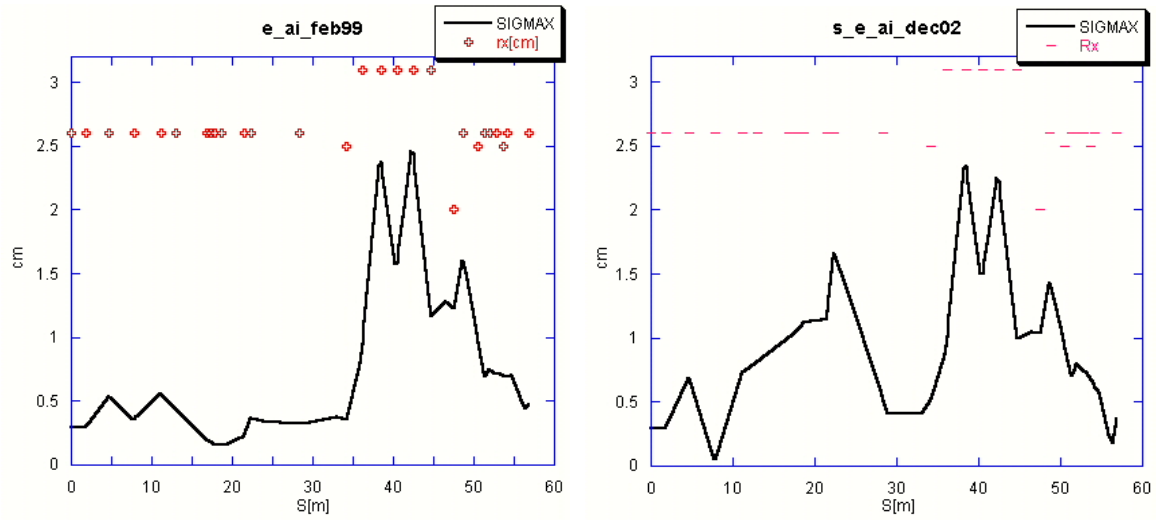

Figure 7: Electrons beam envelope in the radial plane (black curve) with respect to the vacuum chamber aperture (red markers) for the February 1999 dataset (*left plot*) and for the 17th December 2002 dataset (*right plot*). For both configurations the envelope is within the pipe.

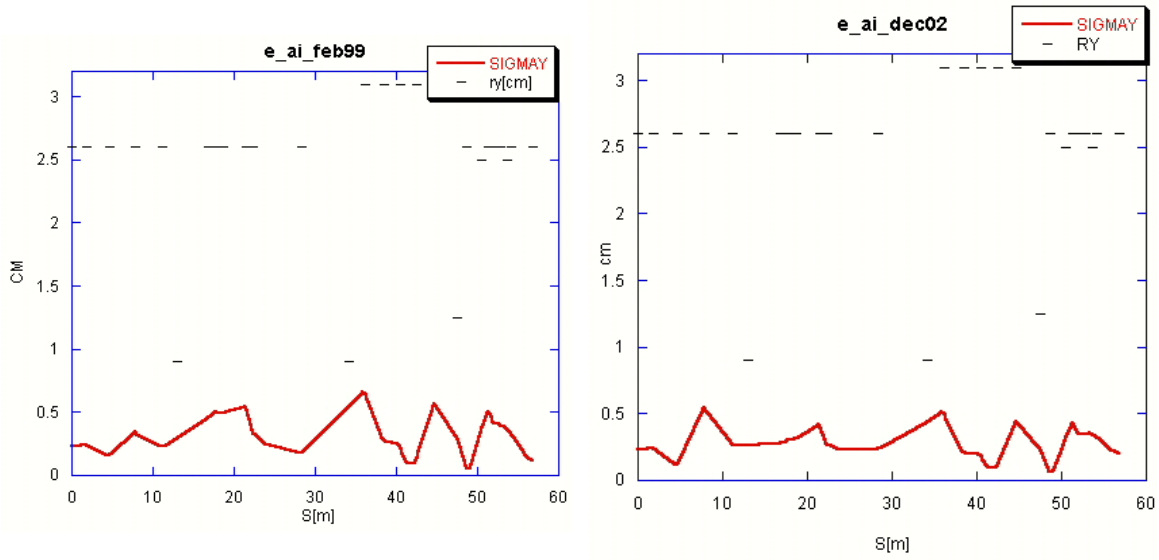

Figure 8: Electrons beam envelope in the vertical plane (red curve) with respect to the vacuum chamber aperture (black markers) for the February 1999 dataset (*left plot*) and for the 17th December 2002 dataset (*right plot*). For both configurations the envelope is within the pipe.

3.2 Positrons

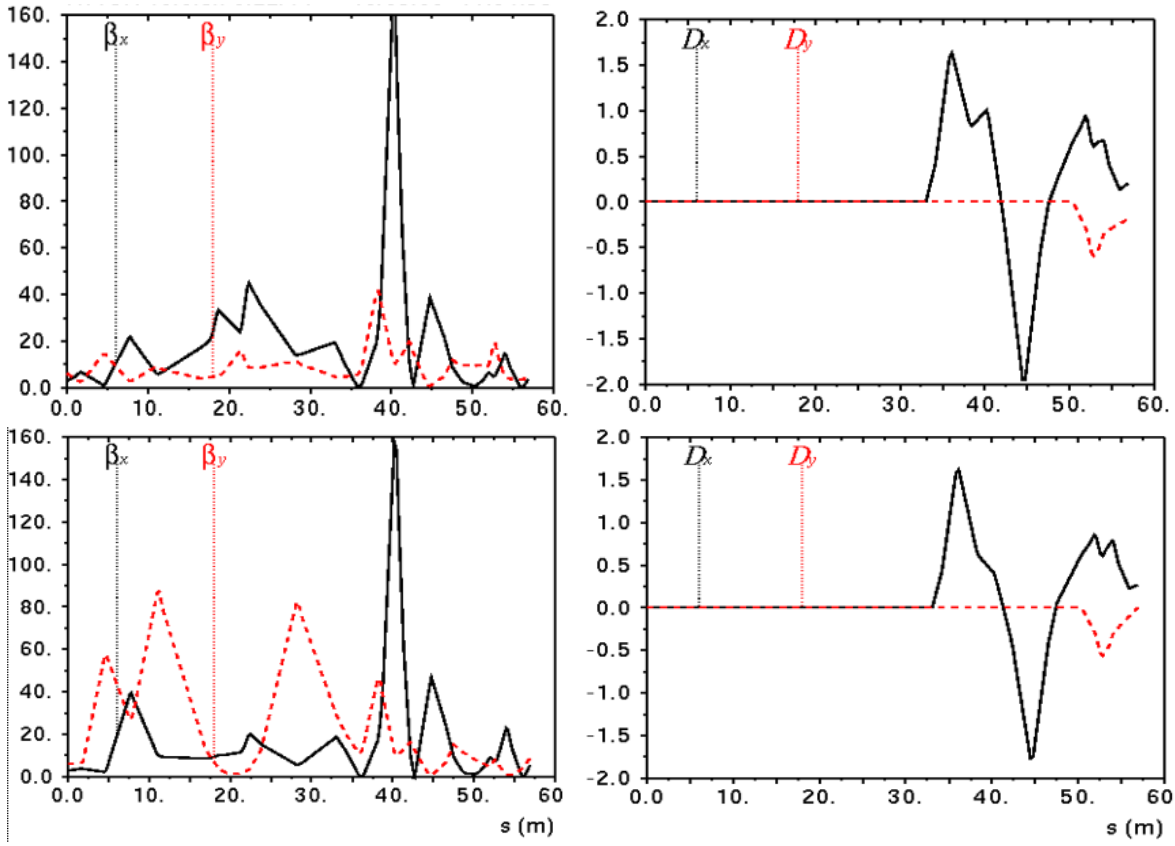

Figure 9: Comparison of the optical functions for the February 1999 dataset (*upper plots*) with the 17th December 2002 dataset (*lower plots*) using the same updated MAD model for the positrons linac to accumulator beam line.

The lattice of the positrons transfer line from the linac exit to the accumulator is not changed substantially since the February '99 set, as shown in Fig. 9. But as the beam emittance and the energy spread are quite large (see table 2), such lattice variations induce quite a large increase in the beam envelope. It exceeds the aperture in different positions along the line (Fig. 10 and Fig. 11).

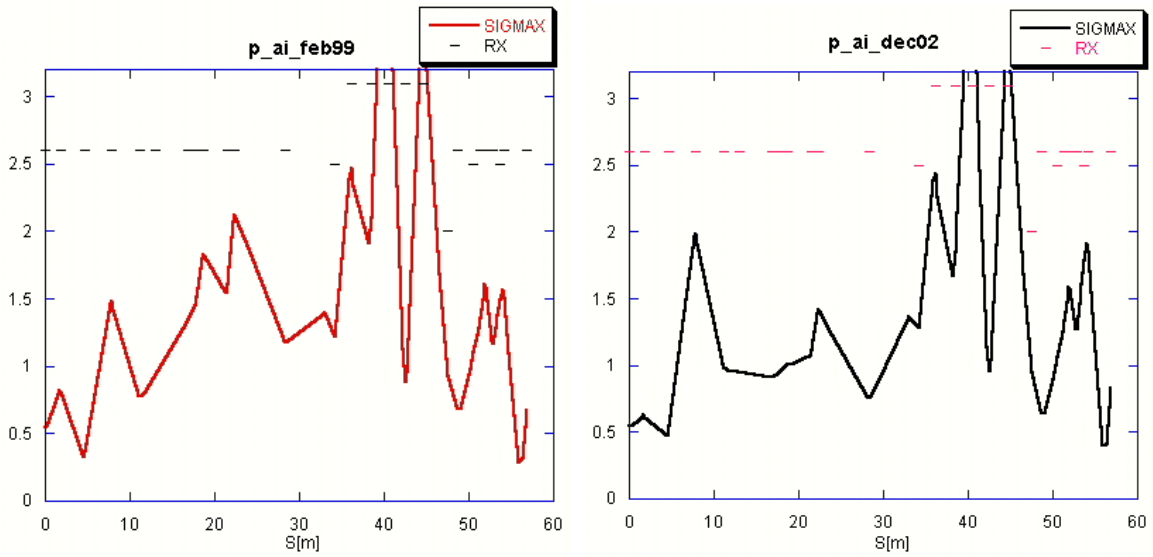

Figure 10: Positrons beam envelope in the radial plane with respect to the vacuum chamber aperture for the February 1999 dataset (*left plot*) and for the 17th December 2002 dataset (*right plot*). On both configurations the model predicts the beam to exceeds the vacuum chamber close to QUATT04 (s=38.478m) and to DHYTT01 (47.52m).

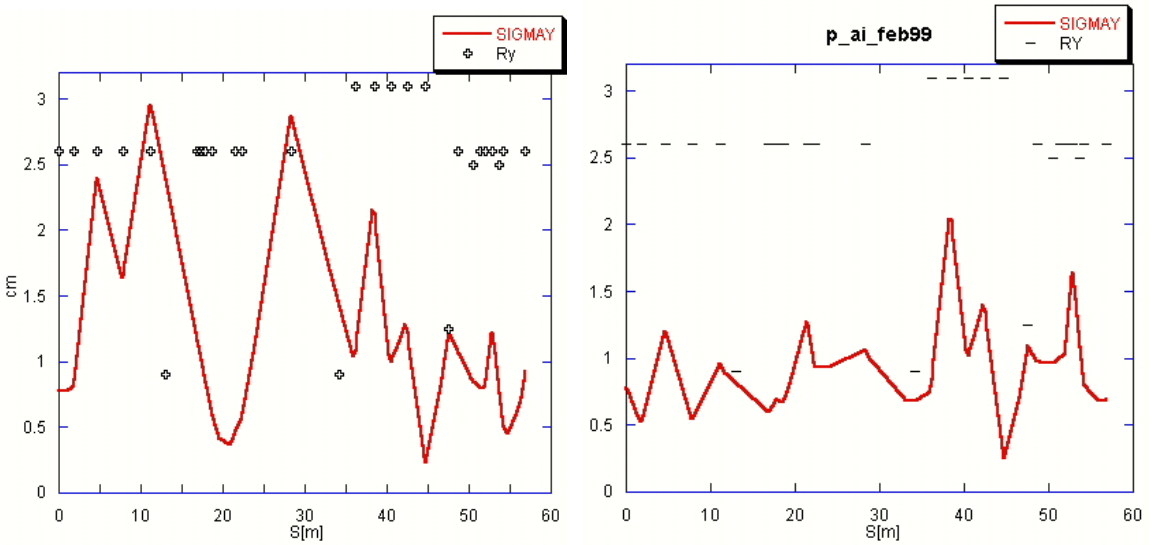

Fig.11 Positrons beam envelope in the vertical plane with respect to the vacuum chamber aperture (black markers) for the February 1999 set (*left plot*) and for the 17th December 2002 dataset (*right plot*). On the left side plot the envelope is within the pipe, on the right side it exceeds the aperture at QUATM04 (11.21m), at QUATT06 (28.32m).

Actually, the result should not be due to the initial conditions at the linac exit which have been used. In fact, the β_x and β_y values should not have changed much since February '99, as reported in Table 3. Nevertheless, even if the last quadrupole has not changed, the whole dataset of the linac has changed a lot.

The β_x and β_y values at the beginning of this line could be measured at the DAΦNE start-up, in order verify the initial conditions. The magnets positions should be measured once again to verify the model description. In any case, assuming that the model is correct a suitable dataset that corrects the high βy value has been found, and it is given in Section 5.

4 MATCHING OF THE 4 TRANSFER LINES

The lattice of the 4 transfer lines has been optimised using the new model and imposing the new conditions at the DAΦNE main rings injection point. The matched lattice minimizes the β and dispersions functions along the lines, optimising the beam transportation.

The datasets have to be applied on the machine, to test and prove the reliability of the model.

4.1 Matching of electrons accumulator extraction line

QUADRUPOLES DATASET:

CTR001 = -0.987	CTT001 = +36.687	CTE001 = -2.176
CTR002 = -77.652	CTT002 = -31.563	CTE002 = 0.000
CTR003 = +32.626	CTT003 = +41.754	CTE003 = -14.543
CTR004 = +32.044	CTT004 = -31.736	CTE004 = +44.797
CTR005 = -55.192	CTT005 = +20.801	CTE104 = -59.432
	CTT006 = +3.438	CTE105 = +61.587
	CTT007 = -22.084	CTE005 = -28.160
	CTT008 = +3.588	CTE006 = +22.736
	CTT009 = +11.598	CTE007 = -59.498
	CTT010 = -23.691	CTE008 = +55.137
	CTT011 = +24.525	CTE009 = -7.081

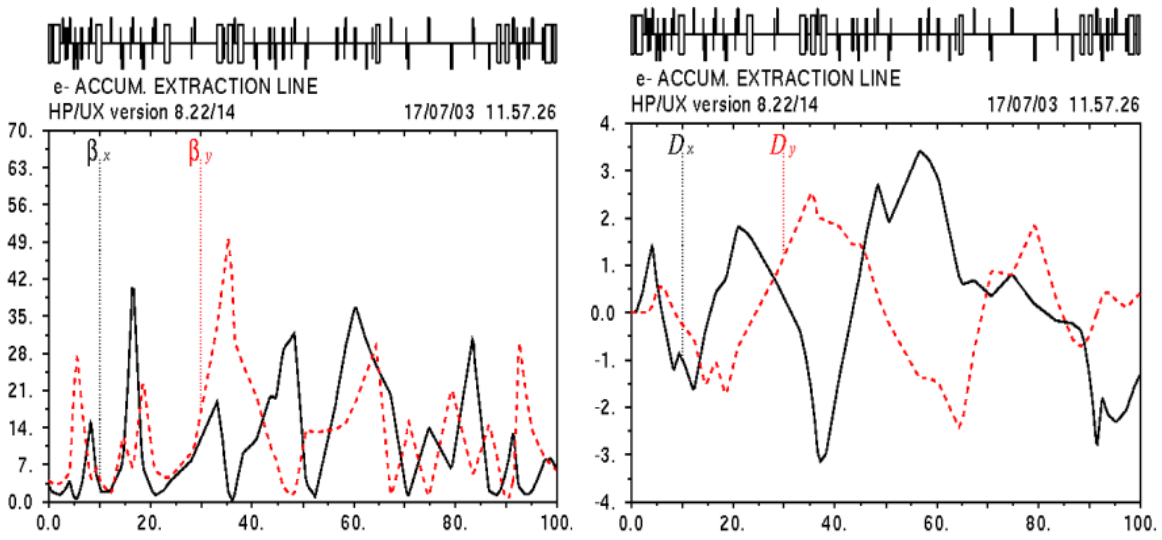

Figure 13: At DAΦNE entrance: β_x=6m; β_y=6m; α_x=0.5; α_y=-0.1; D_x=-1m; D_{xp}=0.2; D_y=0.4m; D_{yp}=0.1

4.2 Matching of electrons accumulator injection line

QUADRUPOLES DATASET:

KLE0 = +0.111	CTM001 = +12.206	CTT001 = +36.687	CTL001 = +44.410
	CTM002 = -24.939	CTT002 = -31.563	CTL002 = -0.609
	CTM003 = +27.137	CTT003 = +41.754	CTL003 = -34.104
	CTM004 = -18.717	CTT004 = -31.736	CTL004 = +60.409
	CTM005 = +0.594	CTT005 = +20.801	CTL005 = -29.860
	CTM007 = -8.093	CTT006 = +3.438	
	CTM008 = +40.868		
	CTM009 = -38.503		

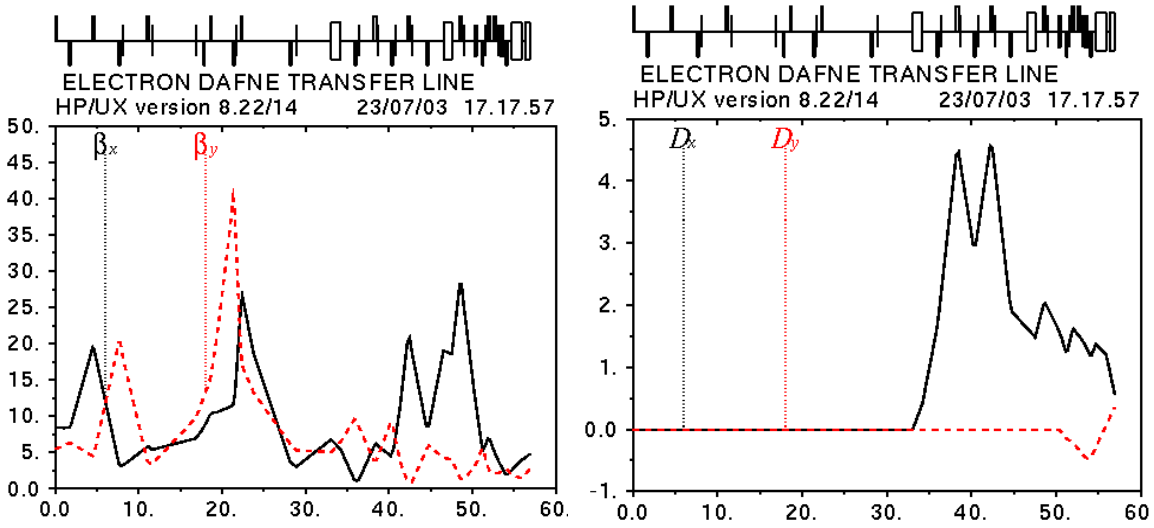

Figure 14: At ACCUMULATOR entrance: β_x=4.8m; β_y=2.8m; α_x=-0.6; α_y=-1.0; D_x=0.56m; D_{xp}=-0.66; D_y=0.36m; D_{yp}=0.29

4.3 Matching of positrons accumulator extraction line

QUADRUPOLES DATASET:

CTL001 = +5.780	CTT001 = +44.047	CTP001 = +23.991
CTL002 = -30.604	CTT002 = -35.318	CTP002 = -29.996
CTL003 = +52.820	CTT003 = +49.597	CTP003 = +36.136
CTL004 = -40.612	CTT004 = -37.493	CTP004 = -12.278
CTL005 = +15.542	CTT005 = +44.295	
	CTT006 = -3.612	
	CTT007 = +27.0346	
	CTT008 = -11.155	
	CTT009 = +13.159	
	CTT010 = -23.950	
	CTT011 = +27.213	

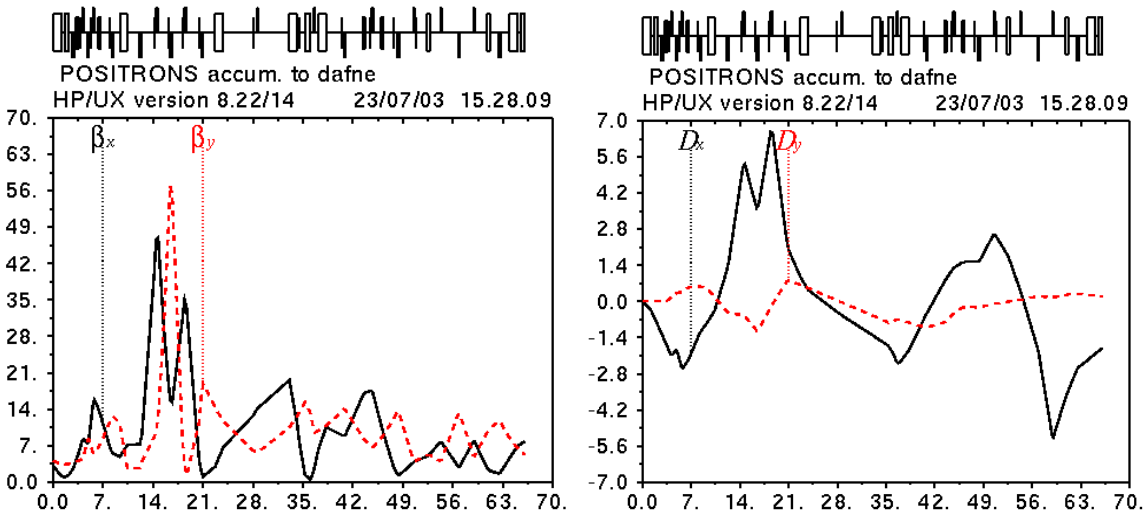

Figure 15: At DAΦNE entrance: β_x=7.8m; β_y=5.2m; α_x=-0.49; α_y=0.49; D_x=-1.8m; D_{xp}=0.2; D_y=0.19m; D_{yp}=-0.03.

4.4 Matching of positrons accumulator injection line

QUADRUPOLES DATASET:

KLE0 = -1.350	CTM001 = +33.964	CTT001 = +44.047	CTR001 = +42.000
	CTM002 = -32.344	CTT002 = -35.318	CTR002 = +0.236
	CTM003 = +35.290	CTT003 = +49.597	CTR003 = -17.216
	CTM004 = -28.955	CTT004 = -37.493	CTR004 = +0.01
	CTM005 = +5.600	CTT005 = +44.295	CTR005 = -0.210
	CTM007 = +12.659	CTT006 = -3.612	
	CTM008 = -38.294		
	CTM009 = +27.786		

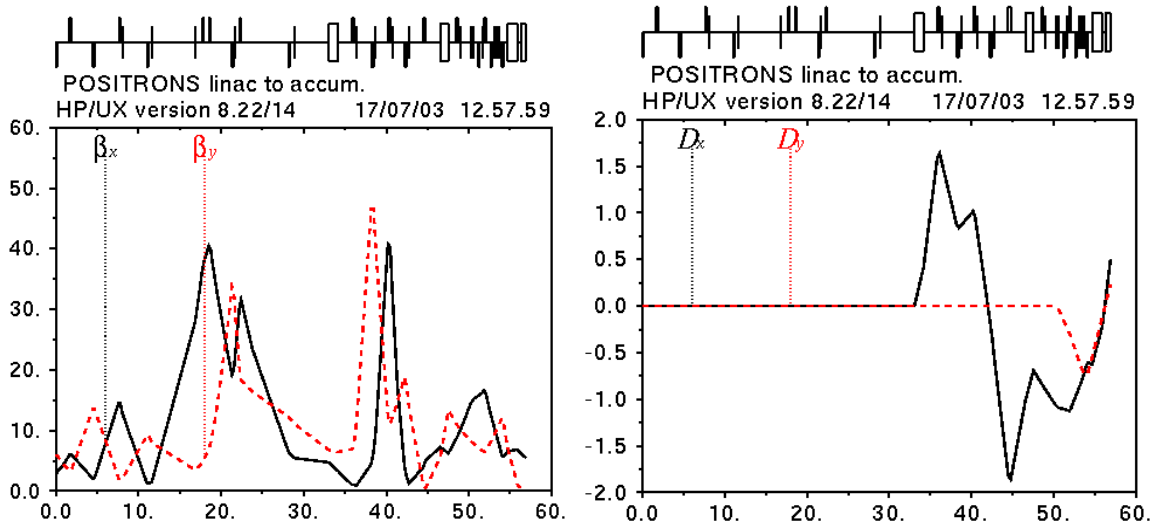

Figure 16: At Accumulator entrance: β_x=5.5m; β_y=0.96m; α_x=-0.56; α_y=-1.0; D_x=0.5m; D_{xp}=0.7; D_y=0.3m; D_{yp}=0.3.

5 CONCLUSIONS

The DAΦNE transfer line model has been updated and reorganized. In the appendix is the updated paramter list for the four beam lines.

The intent of this note is to give the starting point and the tool to optimize the beam lines according to the rings optics modifications that have occurred during the last DAΦNE shut-down.

Moreover, the model has been used to analyze the lattice configuration of the last December 2002 runs and compared to the February 1999 situation.

The work presented in this note becomes even more significant if the developed model will be implemented on the control system for a fast off-line analysis, like it is done for the DAΦNE main rings. This could easily give the beam envelopes and calculate the critical points and correction bumps.

A new matched lattice for the 4 lines has been calculated. It minimizes the β and dispersion functions, fulfilling also the new conditions at the DAΦNE injection points. These datasets are the starting point for the next machine start-up.

6 REFERENCES

[1] C.Biscari, "Transfer Lines Update", DAΦNE Technical Note I-14, Frascati, April 1996.

[2] C. Milardi, F.Sgamma, private communications, March-April 2003.

[2] TL Logbook, pag.46 (e- AE).

[3] TL Logbook, pag. 41 (e+ AE).

[4] TL Logbook, pag. 45 (e- AI).

[5] TL Logbook, pag. 40 (e+ AI).

[6] C.Biscari, "About e^- Transfer Lines", DAΦNE Technical Note I-15, Frascati, September 1997.

A-1 APPENDIX

Parameter List for electron extraction from the Accumulator into DAΦNE

I	IDENT	TYPE	NAME	LENGTH (m)	IN.POS (m)	K1 (m-2)	ANGLE (rad)	E1 (rad)	E2 (rad)	RO (m)	Ax (mm)	Ay (mm)
1		1	D0	0.0000	0.0000	0.00000						
2		7	SPTA2001	0.6230	0.6230	0.00000	0.0380	0.0000	0.0000	16.3947		
3		1	D1	0.3900	1.0130	0.00000						
4		7	SPTA2002	1.2330	2.2460	0.00000	0.5934	0.0000	0.0000	2.0779		
5		80	VALTR001	0.0000	2.2460	0.00000						
6		99	FL2TR001	0.0000	2.2460	0.00000						
7		1	D2	0.4754	2.7214	0.00000						
8		2	QUATR001	0.2000	2.9214	3.21864					52	52
9		1	D3	0.2770	3.1984	0.00000						
10		44	DVRTR001	0.3500	3.5484	0.00000	0.1920	0.0960	0.0960	1.8230	50	50
11		1	D4	0.2310	3.7794	0.00000						
12		56	CHVTR001	0.0000	3.7794	0.00000						
13		50	BPSTR001	0.0000	3.7794	0.00000						
14		1	D4	0.3180	4.0974	0.00000						
15		2	QUATR002	0.2000	4.2974	-4.48004					52	52
16		1	D5	0.5430	4.8404	0.00000						
17		80	SIPTR001	0.0000	4.8404	0.00000						
18		2	QUATR003	0.2000	5.0404	3.26418					52	52
19		1	D6	0.2560	5.2964	0.00000						
20		56	CHVTR002	0.0000	5.2964	0.00000						
21		1	D6	0.2940	5.5904	0.00000						
22		2	QUATR004	0.2000	5.7904	-0.04281					52	52
23		1	D7	0.5500	6.3404	0.00000						
24		44	DVRTR002	0.3500	6.6904	0.00000	-0.1920	-0.0960	-0.0960	1.8230	50	50
25		1	D8	1.2670	7.9574	0.00000						
26		99	FL2TR002	0.0000	7.9574	0.00000						
27		56	CHVTR003	0.0000	7.9574	0.00000						
28		1	D8	0.2560	8.2134	0.00000						
29		2	QUATR005	0.2000	8.4134	2.52385					52	52
30		1	D9	0.9630	9.3764	0.00000						
31		99	WCMTR001	0.0000	9.3764	0.00000						
32		50	BPSTR002	0.0000	9.3764	0.00000						
33		4	DHYTT001	1.0000	10.3764	0.00000	-0.6283	-0.6283	0.0000	1.5915	40	25
34		50	BPSTT001	0.0000	10.3764	0.00000						
35		80	VALTT001	0.0000	10.3764	0.00000						
36		1	D10	1.7720	12.1484	0.00000						
37		2	QUATT001	0.3000	12.4484	1.23000					62	62
38		1	D11	1.7140	14.1624	0.00000						
39		56	CHVTT001	0.0000	14.1624	0.00000						
40		1	D11	0.2560	14.4184	0.00000						
41		2	QUATT002	0.3000	14.7184	-1.56500					62	62

42	80	SIPTT001	0.0000	14.7184	0.00000						
43	1	D12A	0.8500	15.5684	0.00000						
44	50	BPSTT002	0.0000	15.5684	0.00000						
45	1	D12B	0.5940	16.1624	0.00000						
46	56	CHVTT002	0.0000	16.1624	0.00000						
47	1	D12B	0.2560	16.4184	0.00000						
48	2	QUATT003	0.3000	16.7184	2.08000					62	62
49	1	D13	1.4440	18.1624	0.00000						
50	56	CHVTT003	0.0000	18.1624	0.00000						
51	1	D13	0.2560	18.4184	0.00000						
52	2	QUATT004	0.3000	18.7184	-1.77000					62	62
53	99	WCMTT001	0.0000	18.7184	0.00000						
54	99	SLTTT001	0.0000	18.7184	0.00000						
55	1	D14	1.7890	20.5074	0.00000						
56	56	CHVTT004	0.0000	20.5074	0.00000						
57	1	D14	0.2560	20.7634	0.00000						
58	2	QUATT005	0.3000	21.0634	0.73800					62	62
59	1	D15	1.6500	22.7134	0.00000						
60	80	SIPTT002	0.0000	22.7134	0.00000						
61	99	FL2TT001	0.0000	22.7134	0.00000						
62	50	BPSTT003	0.0000	22.7134	0.00000						
63	4	DHPTT001	1.1130	23.8264	0.00000	0.7854	0.0000	0.0000	1.4171	50	18
64	1	D16	4.1890	28.0154	0.00000						
65	56	CHVTT005	0.0000	28.0154	0.00000						
66	1	D16	0.5610	28.5764	0.00000						
67	50	BPSTT004	0.0000	28.5764	0.00000						
68	2	QUATT006	0.2000	28.7764	-0.93000					52	52
69	99	FL2TT002	0.0000	28.7764	0.00000						
70	1	D17	4.3490	33.1254	0.00000						
71	4	DHPTT002	1.1130	34.2384	0.00000	-0.7854	0.0000	0.0000	1.4171	54	18
72	1	D18	0.2470	34.4854	0.00000						
73	56	CHVTT006	0.0000	34.4854	0.00000						
74	50	BPSTT005	0.0000	34.4854	0.00000						
75	1	D18	0.8340	35.3194	0.00000						
76	50	BSTTT001	0.0000	35.3194	0.00000						
77	99	FL1TT001	0.0000	35.3194	0.00000						
78	4	DHRTT001	0.7570	36.0764	0.00000	-0.5236	-0.2618	-0.2618	1.4458	54	25
79	1	D19	0.4240	36.5004	0.00000						
80	2	QUATT007	0.2000	36.7004	2.12028					52	52
81	1	D20	0.4570	37.1574	0.00000						
82	99	SLTTT002	0.0000	37.1574	0.00000						
83	4	DHSTT001	1.1130	38.2704	0.00000	-0.7854	0.0000	0.0000	1.4171	54	25
84	80	VALTT001	0.0000	38.2704	0.00000						
85	99	FL1TT002	0.0000	38.2704	0.00000						
86	80	SIPTT001	0.0000	38.2704	0.00000						
87	1	D21A	2.2440	40.5144	0.00000						
88	56	CHVTT007	0.0000	40.5144	0.00000						
89	1	D21B	0.2560	40.7704	0.00000						
90	2	QUATT008	0.2000	40.9704	0.64346					52	52

91	50	BPSTT006	0.0000	40.9704	0.00000						
92	1	D22	2.3870	43.3574	0.00000						
93	99	WCMTT002	0.0000	43.3574	0.00000						
94	44	DVRTT001	0.3500	43.7074	0.00000	0.1920	0.0960	0.0960	1.8230	50	50
95	1	D23	0.6510	44.3584	0.00000						
96	56	CHVTT008	0.0000	44.3584	0.00000						
97	1	D23	0.2560	44.6144	0.00000						
98	2	QUATT009	0.2000	44.8144	-1.39087					52	52
99	50	BPSTT007	0.0000	44.8144	0.00000						
100	1	D24	1.1090	45.9234	0.00000						
101	44	DVRTT002	0.3500	46.2734	0.00000	-0.1920	-0.0960	-0.0960	1.8230	50	50
102	1	D25	1.4180	47.6914	0.00000						
103	56	CHVTT009	0.0000	47.6914	0.00000						
104	1	D25	0.3400	48.0314	0.00000						
105	50	BPSTT008	0.0000	48.0314	0.00000						
106	1	D25	0.2490	48.2804	0.00000						
107	2	QUATT010	0.2000	48.4804	0.28676					52	52
108	99	FL1TT003	0.0000	48.4804	0.00000						
109	1	D26A1	2.1400	50.4750	0.00000						
110	2	QUATT011	0.2000	50.6750						52	52
111	1	D26A2		50.9390							
112	56	CHVTT010	0.0000	50.9390	0.00000						
113	1	D26B	1.5560	52.3760	0.00000						
114	50	BPSTE001	0.0000	52.3760	0.00000						
115	80	VALTE001	0.0000	52.3760	0.00000						
116	80	SIPTE001	0.0000	52.3760	0.00000						
117	1	D51	4.0690	56.4450	0.00000						
118	44	DVRTE001	0.3500	56.7950	0.00000	0.1920	0.0960	0.0960	1.8230	50	50
119	1	D52	1.3020	58.0970	0.00000						
120	56	CHVTE001	0.0000	58.0970	0.00000						
121	1	D52	0.2560	58.3530	0.00000						
122	2	QUATE001	0.2000	58.5530	0.44624					52	52
123	1	D53	1.5600	60.1130	0.00000						
124	44	DVRTE002	0.3500	60.4630	0.00000	-0.1920	-0.0960	-0.0960	1.8230	50	50
125	1	D54	1.8888	62.3518	0.00000						
126	2	QUATE002	0.2000	62.5518	1.30420					52	52
127	1	D55	1.0550	63.6068	0.00000						
128	56	CHVTE002	0.0000	63.6068	0.00000						
129	1	D55	0.7200	64.3268	0.00000						
130	50	BPSTE002	0.0000	64.3268	0.00000						
131	4	DHRTE001	0.7570	65.0838	0.00000	0.5236	0.2618	0.2618	1.4458	54	25
132	80	SIPTE002	0.0000	65.0838	0.00000						
133	1	D56	2.1050	67.1888	0.00000						
134	2	QUATE003	0.2000	67.3888	0.78166					52	52
135	1	D57	2.9440	70.3328	0.00000						
136	56	CHVTE003	0.0000	70.3328	0.00000						
137	1	D57	0.2560	70.5888	0.00000						
138	2	QUATE004	0.2000	70.7888	0.64326					52	52

139	50	BPSTE003	0.0000	70.7888	0.00000						
140	1	D158	5.8000	74.5340	0.00000						
141	2	QUATE104	0.3000	74.8340						52	52
142	1	D58		74.8340							
143	99	FL1TE001	0.0000	74.8340	0.00000						
144	1	D59	6.7277	79.0440	0.00000						
145	2	QUATE105	0.3000	79.3440						52	52
146	1	D159		83.3170							
147	2	QUATE005	0.2000	83.5170	-1.23192					52	52
148	1	D60A	0.2560	83.7730	0.00000						
149	56	CHVTE004	0.0000	83.7730	0.00000						
150	1	D60B		86.5170	0.00000						
151	1	D60B	0.0000	86.5170	0.00000						
152	1	D60	1.5000	88.0170	0.00000						
153	2	QUATE006	0.2000	86.7170	1.67383					52	52
154	1	D61	1.4510	88.1620	0.00000						
155	50	BPSTE004	0.0000	88.1620	0.00000						
156	4	DHRTE002	0.7570	88.9190	0.00000	-0.5411	-0.2705	-0.2705	1.3990	54	15
157	1	D62	0.8226	89.7416	0.00000						
158	4	DHRTE003	0.7570	90.4986	0.00000	-0.5411	-0.2705	-0.2705	1.3990	54	15
159	99	FL1TE002	0.0000	90.4986	0.00000						
160	80	VALTE002	0.0000	90.4986	0.00000						
161	1	D63	0.7730	91.2716	0.00000						
162	2	QUATE007	0.2000	91.4716	-3.48714					52	52
163	80	SIPTE004	0.0000	91.4716	0.00000						
164	1	D64	0.6140	92.0856	0.00000						
165	56	CHVTE005	0.0000	92.0856	0.00000						
166	1	D64	0.2560	92.3416	0.00000						
167	2	QUATE008	0.2000	92.5416	2.53616					52	52
168	50	BPSTE005	0.0000	92.5416	0.00000						
169	1	D65	0.7860	93.3276	0.00000						
170	44	DVRTE003	0.3500	93.6776	0.00000	-0.1920	-0.0960	-0.0960	1.8230	50	50
171	1	D66	1.3580	95.0356	0.00000						
172	50	BPSTE006	0.0000	95.0356	0.00000						
173	2	QUATE009	0.2000	95.2356	-2.30714					52	52
174	80	SIPTE005	0.0000	95.2356	0.00000						
175	1	D67	0.5950	95.8306	0.00000						
176	56	CHVTE006	0.0000	95.8306	0.00000						
177	99	FL1TE003	0.0000	95.8306	0.00000						
178	80	FVLTE001	0.0000	95.8306	0.00000						
179	80	VALTE003	0.0000	95.8306	0.00000						
180	99	WCMTE001	0.0000	95.8306	0.00000						
181	1	D67	1.1650	96.9956	0.00000						
182	44	DVRTE004	0.3500	97.3456	0.00000	0.1920	0.0960	0.0960	1.8230	50	50
183	1	D68	0.2130	97.5586	0.00000						
184	7	SPTEL101	1.2330	98.7916	0.00000	-0.5934	0.0000	0.0000	2.0779		
185	1	D69	0.3905	99.1822	0.00000						
186	7	SPTEL102	0.6230	99.8052	0.00000	-0.0380	0.0000	0.0000	16.3947		

A-2 APPENDIX

Parameter List for positron extraction from the Accumulator into DAΦNE

I	IDENT	TYPE	NAME	LENGTH (m)	IN.POS (m)	K1 (m-2)	TETA (rad)	E1 (rad)	E2 (rad)	RO (m)	Ax (mm)	Ay (mm)
1		1	D0	0.0000	0.0000	0.00000						
2		7	SPTA1002	0.6230	0.6230	0.00000	-0.038	0	0	16.3947		
3		1	D1	0.3900	1.0130	0.00000						
4		7	SPTA1001	1.2330	2.2460	0.00000	-0.5934	0	0	2.077856		
5		80	VALTL001	0.0000	2.2460	0.00000						
6		99	FL2TL001	0.0000	2.2460	0.00000						
7		1	D2	0.4754	2.7214	0.00000						
8		2	QUATL001	0.2000	2.9214	2.40402					52	52
9		1	D3	0.2770	3.1984	0.00000						
10		44	DVRTL001	0.3500	3.5484	0.00000	0.192	0.096	0.096	1.8230475	50	50
11		1	D4	0.2310	3.7794	0.00000						
12		56	CHVTL001	0.0000	3.7794	0.00000						
13		50	BPSTL001	0.0000	3.7794	0.00000						
14		1	D4	0.3180	4.0974	0.00000						
15		2	QUATL002	0.2000	4.2974	-0.84961					52	52
16		1	D5	0.5430	4.8404	0.00000						
17		80	SIPTL001	0.0000	4.8404	0.00000						
18		2	QUATL003	0.2000	5.0404	-2.97461					52	52
19		1	D6	0.2560	5.2964	0.00000						
20		56	CHVTL002	0.0000	5.2964	0.00000						
21		1	D6	0.2940	5.5904	0.00000						
22		2	QUATL004	0.2000	5.7904	2.99991					52	52
23		1	D7	0.5500	6.3404	0.00000						
24		44	DVRTL002	0.3500	6.6904	0.00000	-0.192	-0.096	-0.096	1.8230475	50	50
25		1	D8	1.2670	7.9574	0.00000						
26		DIAG	FL2TL002	0.0000	7.9574	0.00000						
27		56	CHVTL003	0.0000	7.9574	0.00000						
28		1	D8	0.2560	8.2134	0.00000						
29		2	QUATL005	0.2000	8.4134	0.14693					52	52
30		1	D9	0.9630	9.3764	0.00000						
31		DIAG	WCMTL001	0.0000	9.3764	0.00000						
32		DIAG	BPSTL002	0.0000	9.3764	0.00000						
33		4	DHYTT001	1.0000	10.3764	0.00000	0.6283	0.6283	0	1.591549	40	25
34		DIAG	BPSTT001	0.0000	10.3764	0.00000						
35		80	VALTT001	0.0000	10.3764	0.00000						
36		1	D10	1.7720	12.1484	0.00000						
37		2	QUATT001	0.3000	12.4484	-2.94830					62	62
38		1	D11	1.7140	14.1624	0.00000						
39		56	CHVTT001	0.0000	14.1624	0.00000						
40		1	D11	0.2560	14.4184	0.00000						
41		2	QUATT002	0.3000	14.7184	1.86182					62	62

42	80	SIPTT001	0.0000	14.7184	0.00000						
43	1	D12A	0.8500	15.5684	0.00000						
44	50	BPSTT002	0.0000	15.5684	0.00000						
45	1	D12B	0.5940	16.1624	0.00000						
46	56	CHVTT002	0.0000	16.1624	0.00000						
47	1	D12B	0.2560	16.4184	0.00000						
48	2	QUATT003	0.3000	16.7184	-2.49919					62	62
49	1	D13	1.4440	18.1624	0.00000						
50	56	CHVTT003	0.0000	18.1624	0.00000						
51	1	D13	0.2560	18.4184	0.00000						
52	2	QUATT004	0.3000	18.7184	1.73924					62	62
53	99	WCMTT001	0.0000	18.7184	0.00000						
54	99	SLTT0T01	0.0000	18.7184	0.00000						
55	1	D14	1.7890	20.5074	0.00000						
56	56	CHVTT004	0.0000	20.5074	0.00000						
57	1	D14	0.2560	20.7634	0.00000						
58	2	QUATT005	0.3000	21.0634	-2.39763					62	62
59	1	D15	1.6500	22.7134	0.00000						
60	80	SIPTT002	0.0000	22.7134	0.00000						
61	99	FL2TT001	0.0000	22.7134	0.00000						
62	50	BPSTT003	0.0000	22.7134	0.00000						
63	4	DHPTT001	1.1130	23.8264	0.00000	0.7854	0	0	1.417116	50	18
64	1	D16	4.1890	28.0154	0.00000						
65	56	CHVTT005	0.0000	28.0154	0.00000						
66	1	D16	0.5610	28.5764	0.00000						
67	50	BPSTT004	0.0000	28.5764	0.00000						
68	2	QUATT006	0.2000	28.7764	0.89551					52	52
69	99	FL2TT002	0.0000	28.7764	0.00000						
70	1	D17	4.3490	33.1254	0.00000						
71	4	DHPTT002	1.1130	34.2384	0.00000	-0.7854	0	0	1.417116	54	18
72	1	D18	0.2470	34.4854	0.00000						
73	56	CHVTT006	0.0000	34.4854	0.00000						
74	50	BPSTT005	0.0000	34.4854	0.00000						
75	1	D18	0.8340	35.3194	0.00000						
76	99	BSTTT001	0.0000	35.3194	0.00000						
77	99	FL1TT001	0.0000	35.3194	0.00000						
78	4	DHRTT001	0.7570	36.0764	0.00000	-0.5236	-0.2618	-0.2618	1.4457635	54	25
79	1	D19	0.4240	36.5004	0.00000						
80	2	QUATT007	0.2000	36.7004	0.14233					52	52
81	1	D20	0.4570	37.1574	0.00000						
82	99	SLTTT002	0.0000	37.1574	0.00000						
83	4	DHSTT001	1.1130	38.2704	0.00000	-0.7854	0	0	1.417116	54	25
84	80	VALTT001	0.0000	38.2704	0.00000						
85	99	FL1TT002	0.0000	38.2704	0.00000						
86	80	SIPTT001	0.0000	38.2704	0.00000						
87	1	D21A	2.2440	40.5144	0.00000						
88	56	CHVTT007	0.0000	40.5144	0.00000						
89	1	D21B	0.2560	40.7704	0.00000						
90	2	QUATT008	0.2000	40.9704	0.21524					52	52

91	50	BPSTT006	0.0000	40.9704	0.00000						
92	1	D22	2.3870	43.3574	0.00000						
93	99	WCMTT002	0.0000	43.3574	0.00000						
94	44	DVRTT001	0.3500	43.7074	0.00000	0.192	0.096	0.096	1.823048	50	50
95	1	D23	0.6510	44.3584	0.00000						
96	56	CHVTT008	0.0000	44.3584	0.00000						
97	1	D23	0.2560	44.6144	0.00000						
98	2	QUATT009	0.2000	44.8144	-1.83103					52	52
99	50	BPSTT007	0.0000	44.8144	0.00000						
100	1	D24	1.1090	45.9234	0.00000						
101	44	DVRTT002	0.3500	46.2734	0.00000	-0.192	-0.096	-0.096	1.823048	50	50
102	80	SIPTT002	0.0000	46.2734	0.00000						
103	1	D25	1.4180	47.6914	0.00000						
104	56	CHVTT009	0.0000	47.6914	0.00000						
105	1	D24	0.3400	48.0314	0.00000						
106	50	BPSTT008	0.0000	48.0314	0.00000						
107	1	D24	0.2490	48.2804	0.00000						
108	2	QUATT010	0.2000	48.4804	1.63825					52	52
109	99	FL1TT003	0.0000	48.4804	0.00000						
110	1	D26A1	2.1400	50.4750	0.00000						
111	2	QUATT011	0.2000	50.6750						52	52
112	1	D26A2		50.9390							
113	56	CHVTT010	0.0000	50.9390	0.00000						
114	1	D26B	1.5560	52.1760	0.00000						
115	4	DHRTP001	0.4510	52.6280	0.00000	-0.3188	-0.1594	-0.1594	1.41468	54	25
116	1	D27	1.4130	54.0410	0.00000						
117	50	BPSTP001	0.0000	54.0410	0.00000						
118	80	VALTP001	0.0000	54.0410	0.00000						
119	80	SIPTP001	0.0000	54.0410	0.00000						
120	1	D27		54.0410							
121	2	QUATP001	0.2000	54.2410	4.79746					52	52
122	1	D28	2.3340	56.5750	0.00000						
123	56	CHVTP001	0.0000	56.5750	0.00000						
124	2	QUATP002	0.2000	56.7750	-3.14205					52	52
125	99	FL1TP001	0.0000	56.7750	0.00000						
126	1	D29	1.6280	58.4030	0.00000						
127	56	CHVTP002	0.0000	58.4030	0.00000						
128	1	D28	0.2560	58.6590	0.00000						
129	2	QUATP003	0.2000	58.8590	2.91252					52	52
130	1	D30	1.7084	60.5680	0.00000						
131	4	DHRTP002	0.4520	61.0190	0.00000	-0.2365	-0.1182	-0.1182	1.911205	54	24
132	1	D31	0.9710	62.2460	0.00000						
133	80	SIPTP002	0.0000	62.2460	0.00000						
134	56	CHVTP003	0.0000	62.2460	0.00000						
135	1	D31	0.2560	62.2460	0.00000						
136	2	QUATP004	0.2000	62.4460	-3.18593					52	52
137	50	BPSTP002	0.0000	62.4460	0.00000						
138	1	D32	1.2120	63.6580	0.00000						
139	99	FL1TP002	0.0000	63.6580	0.00000						
140	99	FVLTP001	0.0000	63.6580	0.00000						
141	80	VALTP002	0.0000	63.6580	0.00000						
142	99	WCMTP001	0.0000	63.6580	0.00000						
143	7	SPTPL101	1.2330	64.8910	0.00000	-0.5934	0	0	2.077856		
144	1	D33	0.3905	65.2820	0.00000						
145	7	SPTPL102	0.6230	65.9050	0.00000	-0.038	0	0	16.3947		

A-3 APPENDIX

Parameter List for electron injection from the Linac into the Accumulator

I	IDENT	TYPE	NAME	LENGTH (m)	IN.POS (m)	K1 (m-2)	TETA (rad)	E1 (rad)	E2 (rad)	RO (m)	Ax (mm)	Ay (mm)
1		1	D0	0.0000	0.0000	0.00000						
2		2	QUALIXX	0.1250	0.1250	2.30000						
3		1	DL0	1.0000	1.1250	0.00000						
4			Interface Poin	0.0000	1.1250	0.00000						
5		1	DL1	0.5300	1.6700	0.00000						
6		2	QUATM001	0.2000	1.8700	-1.81888					52	52
7		80	SIPTM001	0.0000	1.8700	0.00000						
8		1	DL2	2.6200	4.4900	0.00000						
9		2	QUATM002	0.2000	4.6900	1.32001					52	52
10		50	BPSTM001	0.0000	4.6900	0.00000						
11		1	DL3	2.9200	7.6100	0.00000						
12		2	QUATM003	0.2000	7.8100	-1.71832					52	52
13		1	DL4	0.2560	8.0660	0.00000						
14		56	CHVTM001	0.0000	8.0660	0.00000						
15		1	DL4	2.9440	11.0100	0.00000						
16		99	WCMTM001	0.0000	11.0100	0.00000						
17		99	BPFTM001	0.0000	11.0100	0.00000						
18		2	QUATM004	0.2000	11.2100	1.49907					52	52
19		1	DL5	0.4280	11.6380	0.00000						
20		56	CHVTM002	0.0000	11.6380	0.00000						
21		1	DL5	0.1890	11.8270	0.00000						
22		1	DL5	1.1850	13.0120	0.00000						18
23		1	DL5	3.8520	16.8640	0.00000						
24		80	SIPTM002	0.0000	16.8640	0.00000					52	52
25		56	CHVTM003	0.0000	16.8640	0.00000						
26		1	DLTM9	0.2560	17.1200	0.00000						
27		99	TGTTM001	0.0000	17.5200	0.00000						
28		1	DLTM9	0.4000	17.7200	0.00000						
29		2	QUATM005	0.2000	17.9200	0.45871					52	52
30		50	BPSTM002	0.0000	17.9200	0.00000						
31		1	DLTM10	0.6000	18.5200	0.00000						
32		2	QUATM007	0.2000	18.7200	-0.63559					52	52
33		1	DLTM11	0.7570	18.9950	0.00000						

34	99	SLTTM001	0.0000	18.9950	0.00000						
35	99	after BTF	0.0000	18.9950	0.00000						
36	99	BSTTM001	0.0000	18.9950	0.00000						
37	80	VALTM001	0.0000	18.9950	0.00000						
38	1	DL7B	1.8430	21.3200	0.00000						
39	2	QUATM008	0.2000	21.5200	3.06146					52	52
40	1	DL8	0.1900	21.7100	0.00000						
41	56	CHVTM004	0.0000	21.7100	0.00000						
42	1	DL8	0.5100	22.2200	0.00000						
43	2	QUATM009	0.2000	22.4200	-2.60239					52	52
44	50	BPSTM003	0.0000	22.4200	0.00000						
45	1	DL9	1.3510	23.7710	0.00000						
46	1	D17	4.3490	28.1200	0.00000						
47	99	FL2TT002	0.0000	28.1200	0.00000						
48	2	QUATT006	0.2000	28.3200	0.93000					52	52
49	50	BPSTT004	0.0000	28.3200	0.00000						
50	1	D16	0.5610	28.8810	0.00000						
51	56	CHVTT005	0.0000	28.8810	0.00000						
52	1	D16	4.1890	33.0700	0.00000						
53	4	DHPTT001	1.1130	34.1830	0.00000	0.7854	0	0	1.417116	50	18
54	50	BPSTT003	0.0000	34.1830	0.00000						
55	99	FL2TT001	0.0000	34.1830	0.00000						
56	80	SIPTT002	0.0000	34.1830	0.00000						
57	1	D15	1.6500	35.8330	0.00000						
58	2	QUATT005	0.3000	36.1330	-0.73800					62	62
59	1	D14	0.2560	36.3890	0.00000						
60	56	CHVTT004	0.0000	36.3890	0.00000						
61	1	D14	1.7890	38.1780	0.00000						
62	99	SLTTT001	0.0000	38.1780	0.00000						
63	99	WCMTT001	0.0000	38.1780	0.00000						
64	2	QUATT004	0.3000	38.4780	1.77000					62	62
65	1	D13	0.2560	38.7340	0.00000						
66	56	CHVTT003	0.0000	38.7340	0.00000						
67	1	D13	1.4440	40.1780	0.00000						
68	2	QUATT003	0.3000	40.4780	-2.08000					62	62
69	1	D12B	0.2560	40.7340	0.00000						
70	56	CHVTT002	0.0000	40.7340	0.00000						
71	1	D12B	0.5940	41.3280	0.00000						
72	50	BPSTT002	0.0000	41.3280	0.00000						
73	1	D12A	0.8500	42.1780	0.00000						
74	80	SIPTT001	0.0000	42.1780	0.00000						
75	2	QUATT002	0.3000	42.4780	1.56500					62	62

76	1	D11	0.2560	42.7340	0.00000						
77	56	CHVTT001	0.0000	42.7340	0.00000						
78	1	D11	1.7140	44.4480	0.00000						
79	2	QUATT001	0.3000	44.7480	-1.23000					62	62
80	1	D10	1.7720	46.5200							
81	80	VALTT001	0.0000	46.5200	0.00000						
82	50	BPSTT001	0.0000	46.5200	0.00000						
83	4	DHYTT001	1.0000	47.5200	0.00000	0.6283	0	0.6283	1.591549	40	25
84	50	BPSTL002	0.0000	47.5200	0.00000						
85	99	WCMTL001	0.0000	47.5200	0.00000						
86	1	D9	0.9630	48.4830	0.00000						
87	2	QUATL005	0.2000	48.6830	0.16196					52	52
88	1	D9	0.2560	48.9390	0.00000						
89	56	CHVTL003	0.0000	48.9390	0.00000						
90	99	FL2TL001	0.0000	48.9390	0.00000						
91	1	D8	1.2670	50.2060	0.00000						
92	44	DVRTL002	0.3500	50.5560	0.00000	-0.192	-0.096	-0.096	1.823048	50	50
93	1	D7	0.5500	51.1060	0.00000						
94	2	QUATL004	0.2000	51.3060	-3.19042					52	52
95	1	D6	0.2940	51.6000	0.00000						
96	56	CHVTL002	0.0000	51.6000	0.00000						
97	1	D6	0.2560	51.8560	0.00000						
98	2	QUATL003	0.2000	52.0560	4.99080					52	52
99	80	SIPTL001	0.0000	52.0560	0.00000						
100	1	D5	0.5430	52.5990	0.00000						
101	2	QUATL002	0.2000	52.7990	-2.44547					52	52
102	1	D4	0.3180	53.1170	0.00000						
103	50	BPSTL001	0.0000	53.1170	0.00000						
104	56	CHVTL001	0.0000	53.1170	0.00000						
105	1	D4	0.2310	53.3480	0.00000						
106	44	DVRTL001	0.3500	53.6980	0.00000	0.192	0.096	0.096	1.823048	50	50
107	1	D3	0.2770	53.9750	0.00000						
108	2	QUATL001	0.2000	54.1750	-1.30936					52	52
109	1	D2	0.4754	54.6504	0.00000						
110	99	FL2TL001	0.0000	54.6504	0.00000						
111	80	VALTL001	0.0000	54.6504	0.00000						
112	7	SPTA1001	1.2330	55.8834	0.00000	-0.5934	0	0	2.077856		
113	1	D1	0.3900	56.2734	0.00000						
114	7	SPTA1002	0.6230	56.8964	0.00000	-0.038	0	0	16.3947		

A-4 APPENDIX

Parameter List for positron injection from the Linac into the Accumulator

I	IDENT	TYPE	NAME	LENGTH (m)	IN.POS (m)	K1 (m-2)	TETA (rad)	E1 (rad)	E2 (rad)	RO (m)	Ax (mm)	Ay (mm)
1		1	D0	0.0000	0.0000	0.00000						
2		7	SPTA1002	0.6230	0.6230	0.00000	-0.038	0	0	16.3947		
3		1	D1	0.3900	1.0130	0.00000						
4		7	SPTA1001	1.2330	2.2460	0.00000	-0.5934	0	0	2.077856		
5		80	VALTL001	0.0000	2.2460	0.00000						
6		99	FL2TL001	0.0000	2.2460	0.00000						
7		1	D2	0.4754	2.7214	0.00000						
8		2	QUATL001	0.2000	2.9214	2.40402					52	52
9		1	D3	0.2770	3.1984	0.00000						
10		44	DVRTL001	0.3500	3.5484	0.00000	0.192	0.096	0.096	1.8230475	50	50
11		1	D4	0.2310	3.7794	0.00000						
12		56	CHVTL001	0.0000	3.7794	0.00000						
13		50	BPSTL001	0.0000	3.7794	0.00000						
14		1	D4	0.3180	4.0974	0.00000						
15		2	QUATL002	0.2000	4.2974	-0.84961					52	52
16		1	D5	0.5430	4.8404	0.00000						
17		80	SIPTL001	0.0000	4.8404	0.00000						
18		2	QUATL003	0.2000	5.0404	-2.97461					52	52
19		1	D6	0.2560	5.2964	0.00000						
20		56	CHVTL002	0.0000	5.2964	0.00000						
21		1	D6	0.2940	5.5904	0.00000						
22		2	QUATL004	0.2000	5.7904	2.99991					52	52
23		1	D7	0.5500	6.3404	0.00000						
24		44	DVRTL002	0.3500	6.6904	0.00000	-0.192	-0.096	-0.096	1.8230475	50	50
25		1	D8	1.2670	7.9574	0.00000						
26		DIAG	FL2TL002	0.0000	7.9574	0.00000						
27		56	CHVTL003	0.0000	7.9574	0.00000						
28		1	D8	0.2560	8.2134	0.00000						
29		2	QUATL005	0.2000	8.4134	0.14693					52	52
30		1	D9	0.9630	9.3764	0.00000						
31		DIAG	WCMTL001	0.0000	9.3764	0.00000						
32		DIAG	BPSTL002	0.0000	9.3764	0.00000						
33		4	DHYTT001	1.0000	10.3764	0.00000	0.6283	0.6283	0	1.591549	40	25
34		DIAG	BPSTT001	0.0000	10.3764	0.00000						

35	80	VALTT001	0.0000	10.3764	0.00000						
36	1	D10	1.7720	12.1484	0.00000						
37	2	QUATT001	0.3000	12.4484	-2.94830					62	62
38	1	D11	1.7140	14.1624	0.00000						
39	56	CHVTT001	0.0000	14.1624	0.00000						
40	1	D11	0.2560	14.4184	0.00000						
41	2	QUATT002	0.3000	14.7184	1.86182					62	62
42	80	SIPTT001	0.0000	14.7184	0.00000						
43	1	D12A	0.8500	15.5684	0.00000						
44	50	BPSTT002	0.0000	15.5684	0.00000						
45	1	D12B	0.5940	16.1624	0.00000						
46	56	CHVTT002	0.0000	16.1624	0.00000						
47	1	D12B	0.2560	16.4184	0.00000						
48	2	QUATT003	0.3000	16.7184	-2.49919					62	62
49	1	D13	1.4440	18.1624	0.00000						
50	56	CHVTT003	0.0000	18.1624	0.00000						
51	1	D13	0.2560	18.4184	0.00000						
52	2	QUATT004	0.3000	18.7184	1.73924					62	62
53	99	WCMTT001	0.0000	18.7184	0.00000						
54	99	SLTT0T01	0.0000	18.7184	0.00000						
55	1	D14	1.7890	20.5074	0.00000						
56	56	CHVTT004	0.0000	20.5074	0.00000						
57	1	D14	0.2560	20.7634	0.00000						
58	2	QUATT005	0.3000	21.0634	-2.39763					62	62
59	1	D15	1.6500	22.7134	0.00000						
60	80	SIPTT002	0.0000	22.7134	0.00000						
61	99	FL2TT001	0.0000	22.7134	0.00000						
62	50	BPSTT003	0.0000	22.7134	0.00000						
63	4	DHPTT001	1.1130	23.8264	0.00000	0.7854	0	0	1.417116	50	18
64	1	D16	4.1890	28.0154	0.00000						
65	56	CHVTT005	0.0000	28.0154	0.00000						
66	1	D16	0.5610	28.5764	0.00000						
67	50	BPSTT004	0.0000	28.5764	0.00000						
68	2	QUATT006	0.2000	28.7764	0.89551					52	52
69	99	FL2TT002	0.0000	28.7764	0.00000						
70	1	D17	4.3490	33.1254	0.00000						
71	4	DHPTT002	1.1130	34.2384	0.00000	-0.7854	0	0	1.417116	54	18
72	1	D18	0.2470	34.4854	0.00000						
73	56	CHVTT006	0.0000	34.4854	0.00000						
74	50	BPSTT005	0.0000	34.4854	0.00000						
75	1	D18	0.8340	35.3194	0.00000						
76	99	BSTTT001	0.0000	35.3194	0.00000						

77	99	FL1TT001	0.0000	35.3194	0.00000						
78	4	DHRTT001	0.7570	36.0764	0.00000	-0.5236	-0.2618	-0.2618	1.4457635	54	25
79	1	D19	0.4240	36.5004	0.00000						
80	2	QUATT007	0.2000	36.7004	0.14233					52	52
81	1	D20	0.4570	37.1574	0.00000						
82	99	SLTTT002	0.0000	37.1574	0.00000						
83	4	DHSTT001	1.1130	38.2704	0.00000	-0.7854	0	0	1.417116	54	25
84	80	VALTT001	0.0000	38.2704	0.00000						
85	99	FL1TT002	0.0000	38.2704	0.00000						
86	80	SIPTT001	0.0000	38.2704	0.00000						
87	1	D21A	2.2440	40.5144	0.00000						
88	56	CHVTT007	0.0000	40.5144	0.00000						
89	1	D21B	0.2560	40.7704	0.00000						
90	2	QUATT008	0.2000	40.9704	0.21524					52	52
91	50	BPSTT006	0.0000	40.9704	0.00000						
92	1	D22	2.3870	43.3574	0.00000						
93	99	WCMTT002	0.0000	43.3574	0.00000						
94	44	DVRTT001	0.3500	43.7074	0.00000	0.192	0.096	0.096	1.823048	50	50
95	1	D23	0.6510	44.3584	0.00000						
96	56	CHVTT008	0.0000	44.3584	0.00000						
97	1	D23	0.2560	44.6144	0.00000						
98	2	QUATT009	0.2000	44.8144	-1.83103					52	52
99	50	BPSTT007	0.0000	44.8144	0.00000						
100	1	D24	1.1090	45.9234	0.00000						
101	44	DVRTT002	0.3500	46.2734	0.00000	-0.192	-0.096	-0.096	1.823048	50	50
102	80	SIPTT002	0.0000	46.2734	0.00000						
103	1	D25	1.4180	47.6914	0.00000						
104	56	CHVTT009	0.0000	47.6914	0.00000						
105	1	D24	0.3400	48.0314	0.00000						
106	50	BPSTT008	0.0000	48.0314	0.00000						
107	1	D24	0.2490	48.2804	0.00000						
108	2	QUATT010	0.2000	48.4804	1.63825					52	52
109	99	FL1TT003	0.0000	48.4804	0.00000						
110	1	D26A1	2.1400	50.4750	0.00000						
111	2	QUATT011	0.2000	50.6750						52	52
112	1	D26A2		50.9390							
113	56	CHVTT010	0.0000	50.9390	0.00000						
114	1	D26B	1.5560	52.1760	0.00000						
115	4	DHRTP001	0.4510	52.6280	0.00000	-0.3188	-0.1594	-0.1594	1.41468	54	25
116	1	D27	1.4130	54.0410	0.00000						
117	50	BPSTP001	0.0000	54.0410	0.00000						
118	80	VALTP001	0.0000	54.0410	0.00000						

119	80	SIPTP001	0.0000	54.0410	0.00000						
120	1	D27		54.0410							
121	2	QUATP001	0.2000	54.2410	4.79746					52	52
122	1	D28	2.3340	56.5750	0.00000						
123	56	CHVTP001	0.0000	56.5750	0.00000						
124	2	QUATP002	0.2000	56.7750	-3.14205					52	52
125	99	FL1TP001	0.0000	56.7750	0.00000						
126	1	D29	1.6280	58.4030	0.00000						
127	56	CHVTP002	0.0000	58.4030	0.00000						
128	1	D28	0.2560	58.6590	0.00000						
129	2	QUATP003	0.2000	58.8590	2.91252					52	52
130	1	D30	1.7084	60.5680	0.00000						
131	4	DHRTP002	0.4520	61.0190	0.00000	-0.2365	-0.1182	-0.1182	1.911205	54	24
132	1	D31	0.9710	62.2460	0.00000						
133	80	SIPTP002	0.0000	62.2460	0.00000						
134	56	CHVTP003	0.0000	62.2460	0.00000						
135	1	D31	0.2560	62.2460	0.00000						
136	2	QUATP004	0.2000	62.4460	-3.18593					52	52
137	50	BPSTP002	0.0000	62.4460	0.00000						
138	1	D32	1.2120	63.6580	0.00000						
139	99	FL1TP002	0.0000	63.6580	0.00000						
140	99	FVLTP001	0.0000	63.6580	0.00000						
141	80	VALTP002	0.0000	63.6580	0.00000						
142	99	WCMTP001	0.0000	63.6580	0.00000						
143	7	SPTPL101	1.2330	64.8910	0.00000	-0.5934	0	0	2.077856		
144	1	D33	0.3905	65.2820	0.00000						
145	7	SPTPL102	0.6230	65.9050	0.00000	-0.038	0	0	16.3947		