DAΦNE TECHNICAL NOTE

INFN - LNF, Accelerator Division

Frascati, October 27, 1994

Note: **I-13**

STRENGTHS OF THE INJECTION KICKERS (UPDATE I-12)

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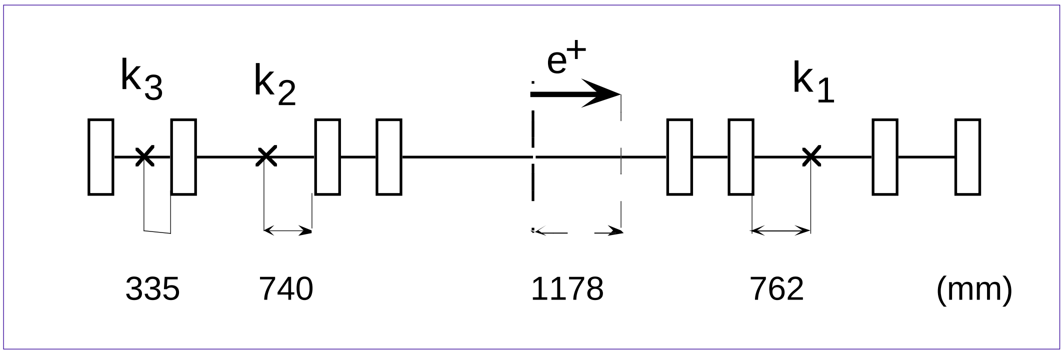
The strengths of the injection kickers have been calculated for the final configuration of the kickers in the injection straight section and the updated version of the DAΦNE lattice.

The injection configuration has been described in [1], the position of the three kickers in the LONG straight section is shown below.



The septum position with respect to the DAΦNE central orbit x_{septum} is larger than the vacuum chamber half aperture A_x required for the stored beam (for good beam lifetime A_x is $10\sigma_x$ plus closed orbit allowance[2]).

With the new lattice configuration and Q_x=5.18 it is:

$$A_x = (24.8+2.5)\ \text{mm} = 27.3\ \text{mm}$$

and

$$x_{septum} = 32\ \text{mm}.$$

The injection parameters are listed in **Table I**.

Table I

x_{septum}	32 mm	ε	1.0 10^{-6}
Δx_s	4.2 mm	β_{septum}	6.13 m
Q_x	5.18	ε_{inj}	2.5 10^{-7}
Q_y	6.15	β_{inj}	6 m

The kickers strengths calculated assuming:

$$x_{bump} = x_{septum} - 4\ \sigma_x$$

are shown in Table II for different Q_x values.

$\mathbf{x_{res}^{inj}}\ /\sigma_\mathbf{x}$ is the residual oscillation amplitude of the injected beam after the kicker, in units of σ_x, for an initial amplitude x_0.

$$x_0 = x_{septum} + \Delta x_s + 4\ \sigma_{xinj} = 41 \text{ mm}$$

$\mathbf{x_{res}^{acc}}\ /\sigma_\mathbf{x}$ is the residual oscillation of the stored beam, in units of σ_x, when the orbit bump is not exactly closed.

Table II

$\mathbf{Q_x}$	δ_1 (mrad)	δ_2 (mrad)	δ_3 (mrad)	$\mathbf{x_{res}^{acc}}\ /\sigma_\mathbf{x}$	$\mathbf{x_{res}^{inj}}\ /\sigma_\mathbf{x}$	$\mathbf{x_{bump}}$ (mm)	$\mathbf{x'_{bump}}$ (mrad)
5.24	8.73	9.50	_	1.24	7.11	20.36	-.223
5.18	9.47	9.74	_	0.30	7.61	22.10	-.089
5.12	9.58	7.39	2.54	0.	7.64	22.67	.475
5.09	9.51	5.55	4.36	0.	7.64	22.72	.840

In Table III the same quantities are calculated for:

$$x_{bump} = x_{septum} - 5\ \sigma_x.$$

Table III

Q_x	δ_1 (mrad)	δ_2 (mrad)	δ_3 (mrad)	x_{res}^{acc}/σ_x	x_{res}^{inj}/σ_x	x_{bump} (mm)	x'_{bump} (mrad)
5.24	7.48	8.15	_	1.06	8.12	17.44	-.191
5.18	8.41	8.65	_	.26	8.65	19.62	-.079
5.12	8.60	6.63	2.27	0.	8.69	20.33	.426
5.09	8.54	4.98	3.92	0.	8.66	20.40	.754

In both cases the kickers strengths are higher than those presented in [1].

In order to reduce them the central orbit can be displaced towards the septum by means of the corrector dipoles. The maximum orbit displacement allowed by the aperture is:

$$x_{corr} = 32 \text{ mm} - 10\ \sigma_x$$

correspondingly the kickers strengths listed in Table I are reduced by the factor

$$f = (x_{bump} - x_{corr})/x_{bump}$$

as shown in Table IV.

An orbit displacement of ~ 3 mm is sufficient to reduce the kickers strengths to the previous design values.

Table IV

Q_x	δ_1 (mrad)	δ_2 (mrad)	δ_3 (mrad)	f	x_{bump} (mm)	$x_{corr.}$ (mm)
5.24	7.49	8.15	_	.86	20.36	2.89
5.18	6.34	6.53	_	.67	22.10	7.25
5.12	5.94	4.58	1.57	.62	22.67	8.67
5.09	5.80	3.39	2.66	.61	22.72	8.80

Tolerances on the kickers strengths

The residual oscillation amplitude of the stored beam, in units of σ_x, obtained by varying the angle δ_2 by ± 5% is shown in Table V compared with that for the nominal value.

Table V

Q_x	δ_2 (mrad)	x_{res}^{acc} / σ_x	x_{res}^{acc} / σ_x $\delta_2 = \delta_2$*1.05	x_{res}^{acc} / σ_x $\delta_2 = \delta_2$*.95
5.24	8.15	1.24	1.26	.94
5.18	8.65	.30	.61	.32
5.12	6.63	0.	.35	.35
5.09	4.98	0.	.28	.28

The same quantity is shown in Table VI for a variation of the angle δ_3 by ±10%.

In both cases the effect on the stored beam is smaller than one standard deviation of the beam size.

Table VI

Q_x	δ_3 (mrad)	x_{res}^{acc} / σ_x $\delta_3 = \delta_3 \pm \delta_3$*.10
5.12	2.27	.28
5.09	3.92	.48

References

[1] S. Guiducci: "Injection configuration in DAΦNE ", Technical note I-12.

[2] C. Biscari: "DAΦNE stay-clear apertures", Technical note L-6.