CESR IV TRANSFER LINE DESIGN

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Introduction

In the CESR IV design [1], the present storage ring and the new one - which will be on top of the synchrotron, will share the synchrotron ring as injector. When designing the new transfer line for CESR IV the following requirements should be considered:

- It will share the input point (coming from the synchrotron) with that of the existing transfer line [2] and will split after $QT02$.
- It will have the same beam pipe radius of 1.27 cm as that of the present transfer line.
- The beam should be guided up to the level of CESR IV, which is 0.43 m above the synchrotron, and then curved back connecting tangentially to CESR IV.
- TWISS parameters at the input of the transfer line should match those of the synchrotron at S133 and the TWISS parameters at the output of the transfer line should match those of CESR IV at Q051.
- Vertical dispersion should be minimized which requires small bending angles in the vertical direction.
- The new transfer line should fit together with the present one in the available space.

1 *Transfer Line Design*

CESR IV transfer line will share the present transfer line up to $QT02$ and then will split off with an angle of 9°. The splitting dipole will be located in the drift line $F146$ (2.4 m). The 9° angle is needed in order to put a straight beam pipe which will stay clear of the Synchrotron ring. BEND 1 of the exsiting transfer line will have to be moved slightly or be modified to accommodate the new beam pipe.

The trajectory is determined by Horizontal and Vertical bending magnets and tangential drift lines. It was geometrically constructed to connect point $(x, y, z)_{sync} = 113.3467, 166.3434, 0\, m$, $\theta_{synch} =$ 109.184 with $(x, y, z)_{CESR\ IV} = 95.609, 197.1394, 0.430\ m$, $\theta_{CESR\ IV} = 127.329^\circ$ [3]. See drawing # 6059-900. The bending magnets angles and their desired fields are summarized in Table 1.

At the input of the transfer line the TWISS parameters are identical to those of the synchrotron ring at S133, while the TWISS parameter at the output of the transfer line are matched to those of

Bending magnet	*Length (m)*	*Bending angle*	*Magnetic field (Testa)*	*Total current (Amp-turn)*
HSWT	1.53	9.042	1.82156184	18409.3212
V100	1.53	-2.5403	0.51224722	5176.94405
V300	1.53	2.5403	0.51224722	5176.94405
HB10	1.53	8.37	1.68643418	17043.6754
HB20	1.53	4.336	0.87421008	8835.06336
DC SEPTUM	1.6511	-1.3608	0.25429178	2569.95892
PULSE SEPTUM	1.4987	-2.244	0.46195747	4668.69877

Table 1: Summary of the bending magnets needed for CESR IV transfer line

Quadrupole	*Length (m)*	*Optimized strength*
Q306	0.8	0.58375171409400E+00
Q100	0.8	-0.35847930758951E+00
Q200	0.8	-0.25387193764661E+00
Q304	0.8	0.49262645061570E+00
Q300	0.8	-0.16804210883850E+00
Q303	0.8	0.72075067008473E-01
Q305	0.8	-0.24233794799489E+00

Table 2: Qudropoles strengths optimized to match input to CESR IV

CESR IV at $Q051$ by optimizing the strength of the quadrupoles using the program $DIMAT$ [4]. In addition the quadrupoles were also moved along the drift lines in order to minimize their strength. The variations of the TWISS parameters along the transfer line are seen in $Figures\ 1-5$ with the corresponding quadrupole strengths in Table 2. Note, the strength and location of $QT01$ and $QT02$ which are shared by the two transfer lines were set for the present CESR and have not been changed.

2 *Conclusion*

The total length of the transfer line will be 35.765 m. The obtained TWISS parameters at the output of the transfer line match those of CESR IV well except those of η'. Diagnostic components have not been included yet.

Acknowledgment

I would like to thank Scot Chapman for supplying the the survey measurements of the synchrotron and the present transfer line.

References

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[2] J. T. Seeman, "Injection Process of the Cornell electron Storage Ring CESR," thesis 1979.

[3] S. Chapman, "Survey Measurments of the Synchrotron-private communication".

[4] R. V. Servranckx, K.L. Brown,"DIMAT", SLAC report 270 UC-28 (A) 1984.

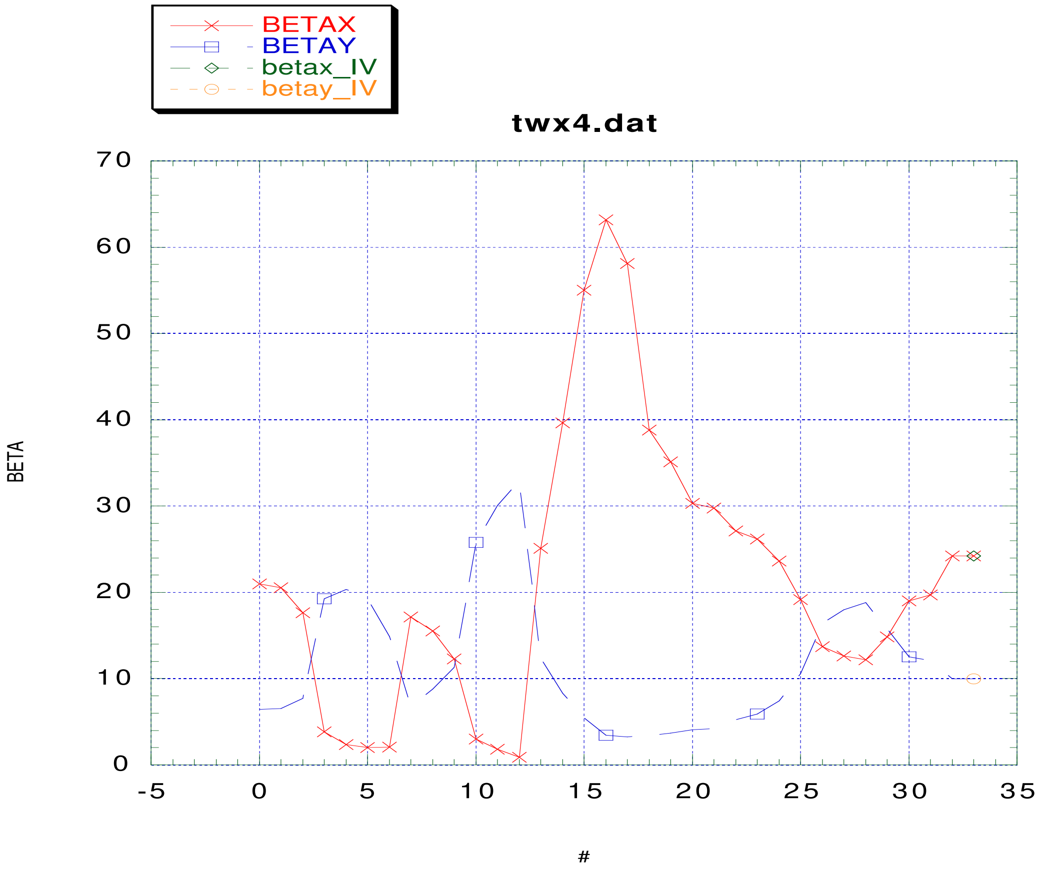

Figure 1: Variations of β along CESR IV transfer line. The vertical section is constructed by elements $10 - 18$

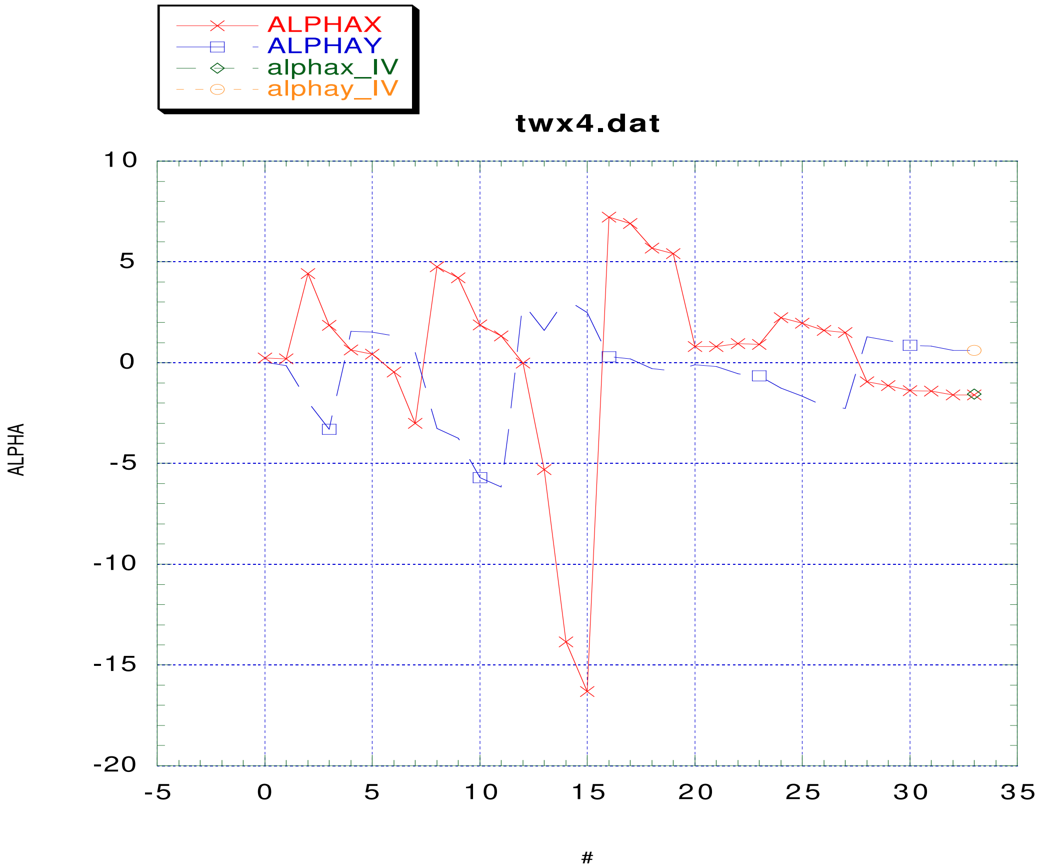

Figure 2: Variations of α along CESR IV transfer line. The vertical section is constructed by elements $10 - 18$

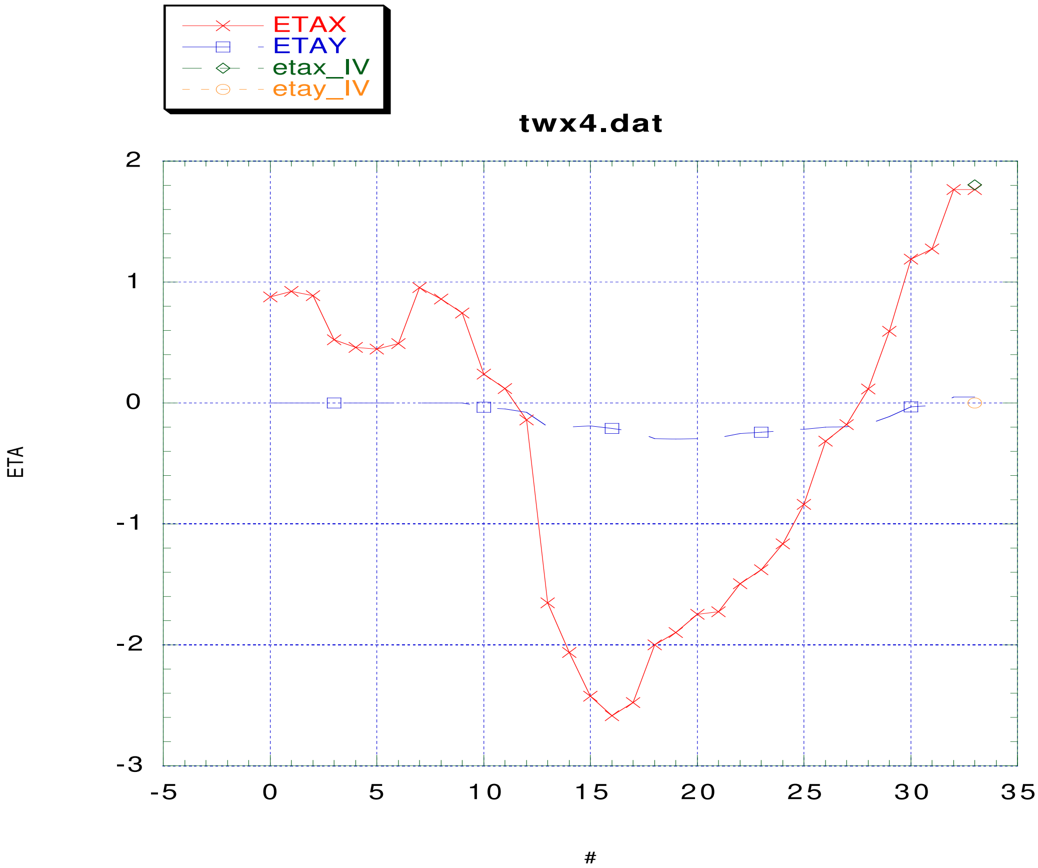

Figure 3: Variations of η along CESR IV transfer line. The vertical section is constructed by elements $10-18$

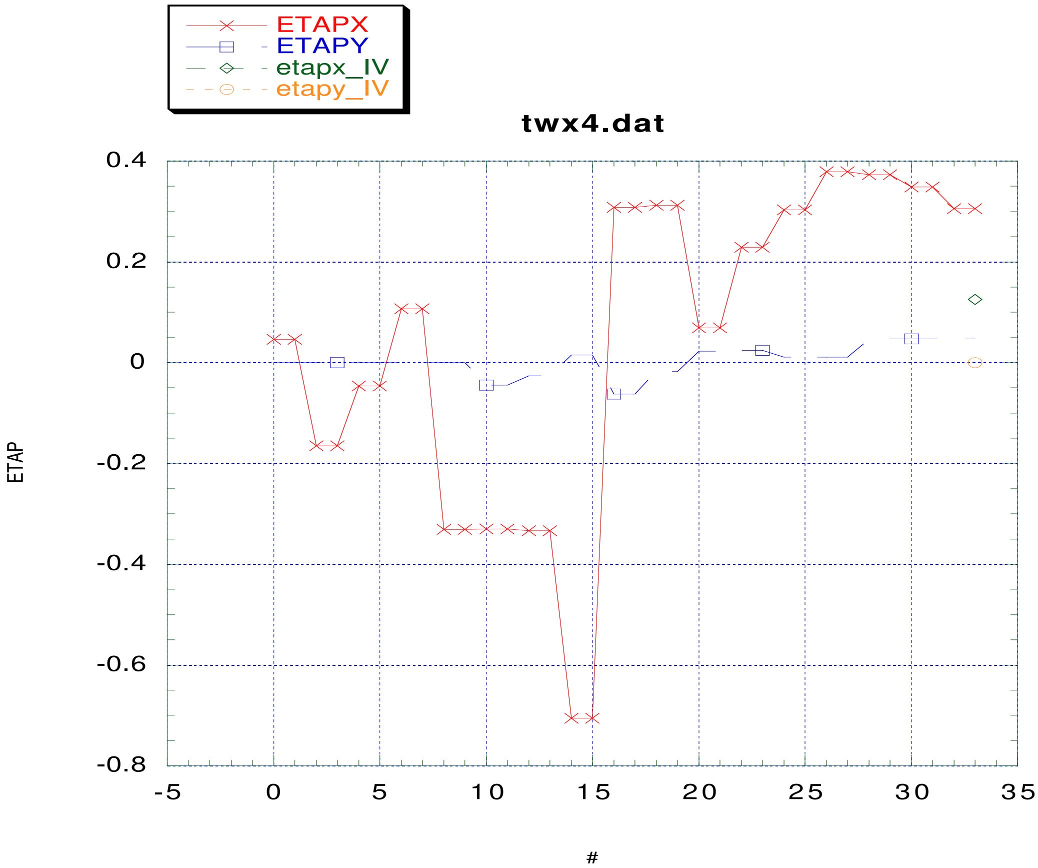

Figure 4: Variations of η' along CESR IV transfer line. The vertical section is constructed by elements $10-18$