CONSTANT PHASE TUNABLE INSERTION

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General Description

Low-beta insertions have been used in many storage rings to get high luminosity optics where beta-functions are very small at beam colliding points. The smaller become beta-functions at collision points, the higher reaches luminosity of colliding rings. On the other hand, smaller beta-function requires larger aperture in quadrupole magnets near to collision points, causes larger closed orbit distortions by same magnet errors and makes sextupoles stronger to correct chromaticity. At the energy of physics experiments, beta-functions are chosen so small that same values may produce serious difficulties in correcting closed orbit distortions, accumulating particles and accelerating beams.

The tunable insertion was introduced to make injection optics where beta-functions around collision points are rather smooth during the injection and acceleration periods. By adjusting four quadrupoles in each side of collision points, $\beta^*(H)$ and $\beta^*(V)$ are changed from the injection values to the luminosity ones continuously, while $\alpha^*(H)$ and $\alpha^*(V)$ are kept constant. Nevertheless, in this scheme, betatron phase advances in the insertin do not remain constant and should be compensated by a change of beta-functions in the other parts of a ring.

Owing to the invention of a constant phase tunable insertion, it has become possible to keep a change of beta-functions within an insertion itself. Six quadrupoles in each side of collision points are used to control six parameters, namely $\beta^*(H)$, $\beta^*(V)$, $\alpha^*(H)$, $\alpha^*(V)$, horizontal and vertical phase advances. Constant phase tunable insertions were developed for the first time for the LEP lattice Version 10 by the present auther.1) In the followings, the scheme that was applied to TRISTAN electron-positron collider is presented.2)

Results

Figure 1 shows the lattice parameters of TRISTAN electron-positron collider in the luminosity optics. The arrengement of quadrupole magnets are shown with their name and bending magnets are described only with their position. Here, $\beta^*(H)$ and $\beta^*(V)$ are reduced to 1.12 m and 0.07 m, respectively and $\beta(H)$ rises upto 270.m in QC2 and $\beta(V)$ rises upto 212.m in QC1. The lattice parameters in the injection optics are shown in Figure 2 where $\beta^*(H)$ and $\beta^*(v)$ are increased to 5.6m and 0.35m, respectively then maximum values of $\beta(H)$ and $\beta(V)$ are reduced to 107.m and 43.m, respectively. Figure 3 shows the continuous tuning path of six quadrupoles between the luminosity optics and the injection optics.

Sextupoles strengths which are neccesary to compensate chromatic tune shifts by two sextupole families are -1.08/m*m and 0.679/m*m in the luminosity optics and -0.606/m*m and 0.395/m*m in the injection optics.

Acknowledgement

The author owes basic idea of the present scheme to Dr. A.Hutton.

Refferences

1) LEP Note 283 compiled by A.Hutton
2) S.Kamada et al TRISTAN Note 82-009

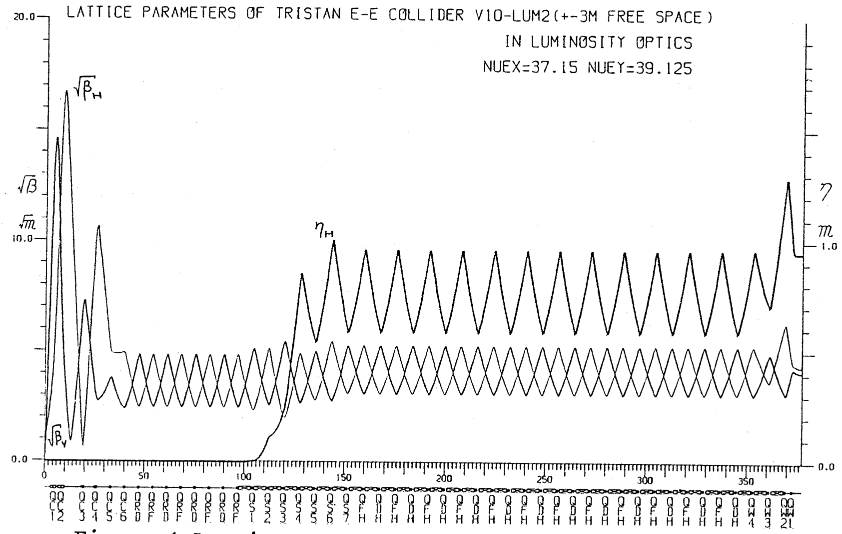

Figure 1 Lattice parameters in luminosity optics

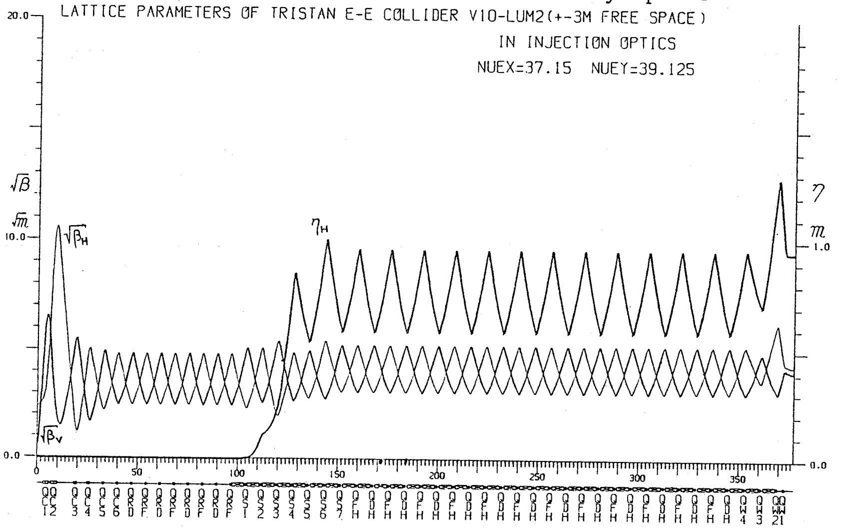

Figure 2 Lattice parameters in injection optics

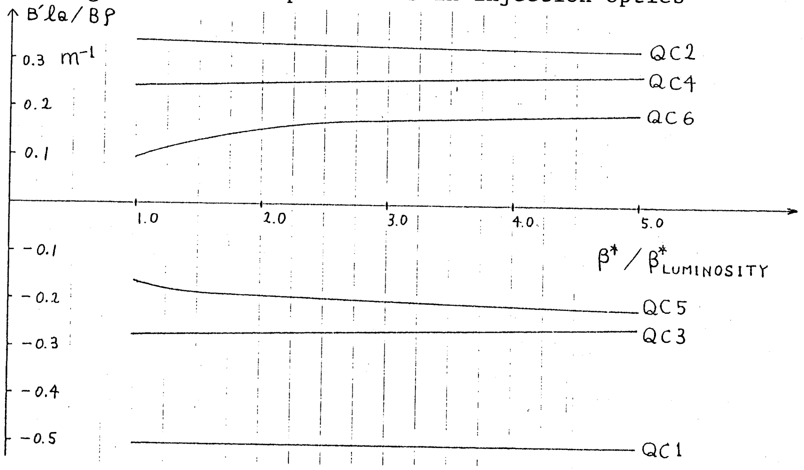

Figure 3 Tuning path of six qudrupoles