NEW METHOD OF DISPERSION CORRECTION IN THE PEP-II LOW ENERGY RING*

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Abstract

The sextupole magnets in the Low Energy Ring (LER) of PEP-II are grouped in pairs with a phase advance of 180 degrees. Displacing the magnets or moving the orbit to displace the beam in the magnets in an antisymmetric way creates a dispersion wave around the ring. This can be used to correct the vertical dispersion in LER without changing the local coupling. Results from simulations are shown.

1 INTRODUCTION

The luminosity of PEP-II is currently mainly determined by the vertical beam size at the interaction point (IP). In the Low Energy Ring (LER) the vertical beam size at the IP is, to some extent, caused by the residual vertical dispersion in the ring. It is hoped that by lowering the dispersion in the ring, the vertical beam size at the IP can be decreased and the luminosity therefore increased.

The sextupoles to correct the chromaticity in LER are grouped in non-interleaved pairs of the same strength. Therefore moving one of the sextupoles of a pair up (or moving the beam in the sextupole using a closed orbit bump) and the other one of the pair down creates a dispersion wave around the ring without affecting the coupling or the orbit outside the region. We want to use one or more of these dispersion waves to try to cancel some of the residual vertical dispersion in the ring in order to minimize the vertical beam size at the IP.

2 SIMULATION

2.1 LEGO

The simulations are done using LEGO [1]. Five different seeds are used for the misalignment. All five seeds give RMS dispersions and orbits of the size that is observed in the real machine. Orbit and dispersion are corrected using the same algorithms that are used in the control room. The coupling is minimized using the closest tune approach in a way similar to the procedure used in the control room on the real ring.

2.2 Effects of Sextupole Alignment

For a vertical alignment error of 0.5 mm for the sextupoles (this is assumed to be the error in the machine), the residual vertical dispersions for these seeds are between 5 and 6 cm. Using an error of 1 mm, the dispersions are only slightly larger for four seeds and grow from 6 to almost 7.2 cm for one seed. Figure 1 shows the dependence of the dispersion on the average error. average.

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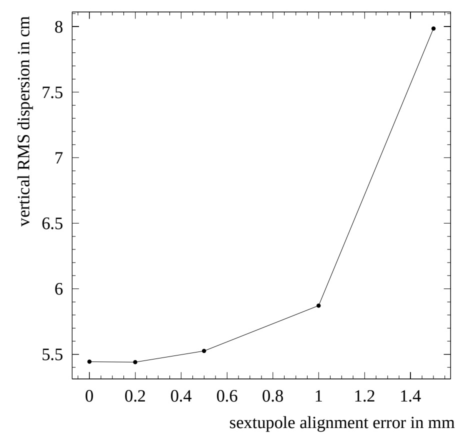

Figure 1: Dependence of the residual vertical dispersion on the vertical sextupole alignment (average over five seeds).

2.3 Moving Sextupole Pairs

In the simulations we currently move the sextupoles by changing their alignment. This is easier and ”cleaner” than a closed orbit bump.

A sextupole pair is chosen. The simulation program then loops over position changes from -5 to $+5$ mm in steps of one mm. One of the two magnets is moved up by the appropriate amount, the other one down (taking into account the original (mis-)alignment of the magnet).

At each step the dispersion and the vertical beam size at the IP are calculated. The vertical beam size is calculated using the algorithm described in [2].

The correction algorithm was studied for vertical sextupole misalignments of 0.5 and 1.0 mm, where the average dispersion for the five seeds is 5.5 and 5.9 cm respectively. The average beam sizes at the IP are 3.52 and 4.11 μm. For each calculation two different sextupole pairs and the same five different seeds as before are used.

3 RESULTS

Figure 2 shows the results of a typical simulation run. The dispersion and vertical beam size at the IP are plotted versus the alignment change of the sextupole pair. One can

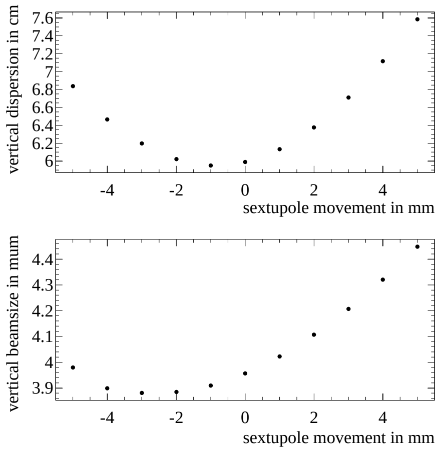

Figure 2: Simulation result for one sextupole pair and one seed.

see that the two parameters have their minimum not at the same misalignment.

From each the dispersion and the beam size one can obtain an optimal position for the respective sextupole pair (see Fig. 2). However, the results of the two don't always agree with each other.

Moving one sextupole pair such that the minimum dispersion is obtained, the vertical beam size on average shrinks slightly to 3.51 and $4.07\,\mu$m respectively (to be compared to 3.52 and $4.11\,\mu$m). In this case the sextupoles have to be moved on average by 0.8 and 1.2 mm respectively.

Using the minimum of the vertical beam size one can obtain slightly better results: 3.50 and $4.06\,\mu$m respectively.

4 CONCLUSION

Unfortunately for this method, the general steering algorithm in PEP-II is good enough to obtain small dispersions and small vertical beam sizes. Moving sextupole pairs can decrease the vertical beam size only by about $0.1\,\mu$m, which is of the order of two to three percent. Using this method on the real machine is made complicated by two things: In the machine closed orbit bumps have to be used instead of moving the magnets themselves and it is not very easy to optimize on the vertical beam size at the IP itself which seems to be the method to be used giving the difference in location of the minima.

Nevertheless the method might be useful on the real machine as the dispersion correction in the steering package currently works not very well. This method might be faster and more efficient. This will be studied.

REFERENCES

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[2] Y. Cai: Simulation of Synchrotron Radiation in an Electron Storage Ring, Proceedings of the 15th Advanced ICFA Beam Dynamics Workshop on Quantum Aspects in Beam Physics, 1998. SLAC-PUB-7793