CBN 13-6
May 31, 2013

L0 HARDBEND LATTICE AND LAYOUT ALTERNATIVES

D. RUBIN

Alternative configurations for the L0 hard bend optics are presented. The four solutions share the layout of dipoles defined in CBN13-2 that preserves the circumference of the storage ring. The first, see Figure 1, included for reference is the solution as in CBN13-2 where each of the four zero dispersion straights is split by a horizontally focusing quadrupole leaving four pairs of 3.6m drifts in which wigglers or undulators could be installed. The second (Figure 2), is a re-optimization that attempts to reduce horizontal and vertical β-functions in the straights, and relaxes the zero dispersion requirement, by simply varying the gradients of the bends and the quadrupoles.

To further tame the β in the straights we consider a modified quadrupole layout. Rather than a single horizontally focusing quad at the center of the straight, we place horizontal quads at the ends of the straight so that now there is a β waist at the midpoint. The result is four 5.9 m drifts. We show a solution suitable for x-ray operation, with small β and nonzero dispersion (Figure 3) and another for wiggler dominated low emittance operation with zero dispersion (Figure 4). We refer to the layout with a single quad splitting the drift as layout A and the layout with quads at each end of the straight as B. Note that the gradient in the bend magnet is the same for both.

The magnet count for layout A and strengths for the two solutions are summarized in Table 1.

Table 1. Constituents of the A-layout cell and focusing for the zero dispersion solution (Fig.1) and the finite dispersion solution with smaller β (Fig. 2)

Magnet	High Gradient Quad	Standard Quad	Combined function
Number	1	1	2
Gradient [m^{-2}]	1.2873/0.9686	0.38244/0.38364	-0.10562/-0.1206
Bend radius [m]	0	0	35.97
Length [m]	0.38	0.38	3.2379

The components of the B-layout are summarized in Table 2. Layout-B has the advantage of a longer straight and in the x-ray solution with β minimuma ($\beta_x = 9.8$m and $\beta_y = 4.8$m).

Date: May 31, 2013.

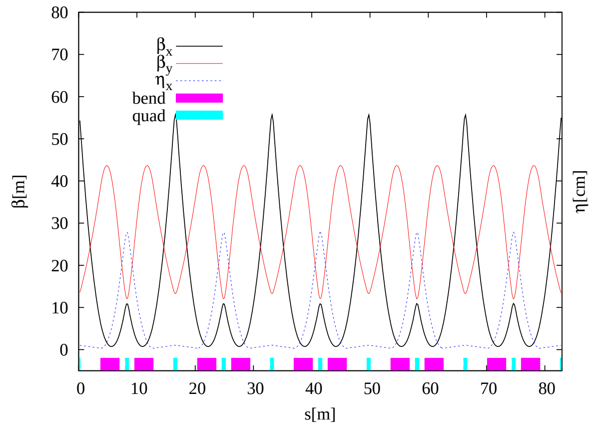

FIGURE 1. Layout A. Single quad centered in zero dispersion straight. As in CBN13-2.

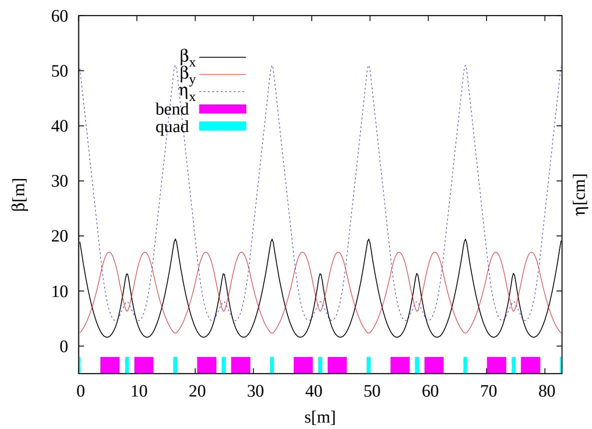

FIGURE 2. Layout A. Single quad centered in long drift. Focusing strengths optimized to reduce β in straight and allow nonzero dispersion.

The dispersion at the midpoint of the straight is small, $\eta = 0.154$m. The 5.9m long drift can accommodate a long undulator, a pair of canted undulators or three superconducting damping wigglers. The disadvantage is that an additional quadrupole is required and the gradient in the bend magnet is somewhat higher than in the A-layout.

Matching into the CESR arcs remains to be demonstrated.

TABLE 2. Constituents of the B-layout cell and focusing strengths for the x-ray solution (Fig.3) and the wiggler dominated low emittance solution zero dispersion (Fig. 4)

Magnet	High Gradient Quad	Standard Quad	Combined function
Number	1	2	2
Gradient [m^{-2}]	1.0948/1.2676	0.7281/0.38477	-0.1783/-0.1783
Bend radius [m]	0	0	35.97
Length [m]	0.38	0.38	3.2379

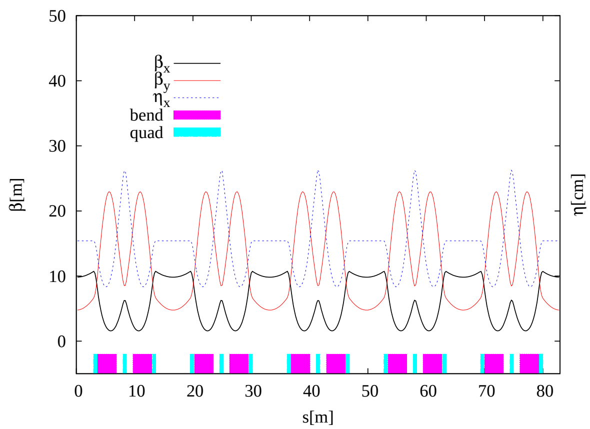

FIGURE 3. Layout B - horizontal quad at each end of long drift. Focusing strengths chosen to minimize β in straight. Dispersion is not constrained.

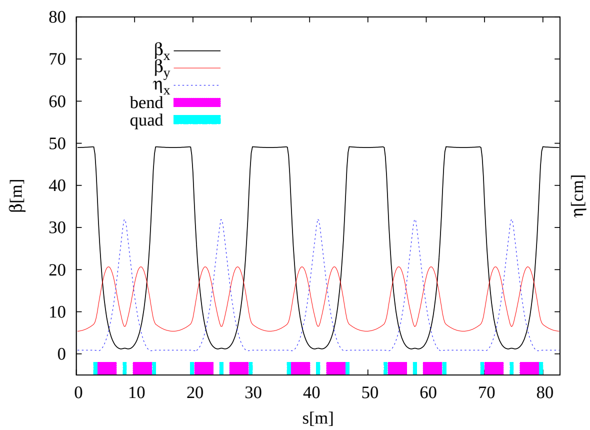

FIGURE 4. Layout B - horizontal quad at each end of long straight with zero dispersion as required for wiggler dominated low emittance configuration

Reference

1. D. Rubin, A. Mikhailchenko, S.T.Wang, Y.Li, CBN13-2