Homework 6

February 13, 2020

Problem 1. (15 pts)

'3-bump' method is commonly used in accelerator for local orbit correction. Let's consider three short corrector dipoles in a storage ring, each provide kicking angle θ_i ($i = 1, 2, 3$). The dipoles locate at location s_i ($s_1 < s_2 < s_3$), where the beta functions are β_i and phase advance are ψ_i ($\psi_1 < \psi_2 < \psi_3$), measured from some reference point s_0. We aim on a set of parameters for an 'three-bump' setting, which as nonzero closed orbit between the correctors ($s_1 < s < s_3$), while zero outside the region.

Please calculate the angle θ_2 and θ_3 as function of other quantities.

Problem 2. (10 pts)

Particle is extracted from a ring at locations with dispersion function (D, D'). After the extraction point, the transport line starts with a drift space l_d, followed by a thin length quad with focal length f, then a long dipole of length l_b and bending angle θ. Could you find right combination of these parameters to suppress the dispersion at the extraction (D, D')?

Problem 3. (25 pts)

For a FODO cell with dipole and quads (QF/2, B, QD, B, QF/2), we found the optics at the middle plane of the focusing quad are β_F and d_F, from the periodic boundary condition. The bending angle of each dipole is θ. The phase advance of the cell is Φ.

1. Please find the 3-by-3 matrix $\mathcal{M}$ for the cell.
2. To match the cell's dispersion function to zero, we need attach a dispersion suppressor to its end. Please show that using n same FODO cells with zero bending angle will not do the job.
3. To design a proper suppressor, we can use another two same FODO cell with reduced bending angle. The cell 1 has bending angle θ_1 in each dipole, while cell 2 has bending angle θ_2 in each dipole. Please find θ_1 and θ_2.

Problem 4. (Optional)

Show that in a straight section, $\mathcal{H}$ function is constant.