USPAS June 2013

Design of Electron Storage and Damping Rings

Homework Problems 2

Lecture 3 Problem

1. Consider a simple FODO storage ring.

   a. Show that, neglecting the focusing effects of the dipoles, the phase advance μ per cell is related to the quadrupole focal length *f* and the distance *L* between quadrupoles by:

   $$\cos(\mu) = 1 - \frac{L^2}{2f^2}.$$

   Hint: multiply the matrices for thin quads and drift spaces to construct the transfer matrix for a single cell; then use the fact that the trace of the transfer matrix is $2\cos(\mu)$.

   b. Using the result from part (a), find an expression for the natural chromaticity of the lattice in terms of the phase advance μ.

   c. Sketch a plot showing the natural chromaticity as a function of phase advance per cell.

Lecture 4 Problem

2. A damping ring for a linear collider is designed with 3 km circumference, and for 5 GeV beam energy. The required transverse damping time is 25 ms. The natural (rms) energy spread should be below 1.5×10^{-3}, and the natural normalised emittance should be below 0.8 μm.

   Given that the average beta function in the wiggler is approximately 10 m, find appropriate values for:

   a. the peak field in the wiggler;

   b. the wiggler period;

   c. the total length of the wiggler.

   Discuss the possible advantages and disadvantages for the wiggler of using a higher beam energy in the damping ring.