2nd International Accelerator School for Linear Colliders
Erice, Sicily, 1-10 October, 2007

Damping Rings

Homework Problems

Useful physical constants:

$c = 2.998\times10^{8}$ m/s
$C_\gamma = 8.846\times10^{-5}$ m/GeV^3
$C_q = 3.832\times10^{-13}$ m

Some of the parameter specifications for the damping rings are as follows:

Circumference	6.6 km
Energy	5 GeV
Injected emittance (x and y)	1 μm
Extracted horizontal geometric emittance	0.8 nm
Extracted vertical geometric emittance	2 pm
Equilibrium vertical geometric emittance	1.4 pm
Maximum extracted energy spread	0.13%
Beam store time	200 ms
Lattice type	TME
Number of dipoles	120
Dipole length	6 m

In these questions, you will work towards specifications for the parameters for the damping wiggler (peak field, total length, and period), given the above parameters for the damping rings.

1. Calculate the transverse damping times required to achieve the extracted emittances starting with the specified injected emittances, in the given store time.
2. Estimate (i) the damping times, and (ii) the natural emittance that would be achieved in the lattice without any damping wiggler (i.e. with the only synchrotron radiation energy loss provided by the dipoles). Assume that the lattice is properly tuned for the minimum possible natural emittance.
3. Estimate the maximum wiggler peak field allowed by the specified extracted energy spread. (Assume that the energy spread reaches equilibrium during the damping cycle).
4. Assuming the wiggler peak field is the maximum allowed by the energy spread, estimate the length of damping wiggler needed to achieve the required damping times.
5. Assuming an average horizontal beta function in the wiggler of 20 m, estimate the maximum wiggler period in order to achieve the specified extracted horizontal emittance.