Homework for Synchrotron Light Source, due Apr. 21, 2014

1. Let us calculate the synchrotron radiation related problem in NSLS II. NSLS II adopts DBA lattice (separate function magnets). Here are the parameters:

Table 1: NSLS II parameters

Parameters	Values
Energy [GeV]	3.0
Circumference [m]	780
Number of dipoles	60
Dipole field [T]	0.4
Beam current [A]	0.5
RF frequency [MHz]	499.68
Harmonic number	1320

From the design parameters, we can calculated the following parameters:

- The energy loss due to the dipole field.

- If the accelerating phase of the RF cavity is $\pi/6$, at least how much voltage is required? How much is the power needed?

- Actually the RF voltage is about 3MV. Find the longitudinal tune of NSLS II

- What is the critical radiation frequency of the dipole radiation.

- In DBA lattice, dispersion D and dispersion slope D' are zero at one end of dipoles and non-zero at the other end of the dipole. Find dispersion function inside the dipole magnet.

- Find the partition number $\bar{D}$ due to synchrotron radiation in dipole.

- Find the longitudinal damping rate α_E and compare with the period of longitudinal oscillation.

- Find the equilibrium energy spread of NSLS II.