

Accelerator Physics for an ERL x-Ray Source

Homework 3

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Exercise 1 (Radiation power in a transfer line)

Imagine you have to design a transfer line that bends a 5GeV electron beam of 100mA by 180°

- (a) How many 4m long bending magnets do you need if the magnetic field should be smaller than 1T?
- (b) How much synchrotron power will be produced per meter of magnet length?
- (c) Approximately how much power per area hits the wall of a vacuum chamber of 2.5cm diameter?
- (d) Approximately how many photons are radiated per meter of magnet length?
- (e) How much energy does each electron lose in that transfer line?

Exercise 2 (Undulator radiation)

An electron beam of 5GeV is sent through a long bending magnet of 2T field strength and an undulator with 5T pole field and 5mm gap and 25mm period. (a) What is the characteristic wavelength and photon energy of the bending magnet radiation.

- (b) What photon energies can be produced by the undulator in forward direction?
- (c) At angles away from the forward direction, photon energies are reduced. How large is the energy spread within the $1/\gamma$ angle of the undulator radiation?

