Electron Source

(a) Calculate the space charge limit according to Child-Langmuir law with parameters

- V=120kV,
- S:1cm diameter
- d:5cm

(b) In this limit, what is the bunch length, to extract 3.2nC charge for ILC?

(c) Compare this bunch length to 1.3 Ghz RF period. Calculate energy spread due to RF curvature with 1/10, 1/100, 1/300, and 1/1000 of this bunch length.

Hint: Energy spread due to RF curvature is

$$\frac{\Delta E}{E} = 1 - \cos\left(\omega \frac{\delta t}{2}\right), \tag{1}$$

where δt is bunch length.

Positron Source

(d) How much beam energy, E, is neccesary to obtain 10 MeV photons from undulator? Undulator strength parameter, K, is given as

$$K = 93.4 B \lambda_p, \tag{2}$$

where B is the peak magnetic flux density (T) and λ_p is undulator period (m). Please assume following parameters

- λ_p, 0.01m
- n: harmonic number,1
- B: Peak magnetic flux desity, 1.0 T

(e) How much beam energy, E, is neccesary to obtain 10 MeV photons from Laser Compton? Assume $1\mu\mathrm{m}$ wave length for laser.

- Planck constant: 6.63E-34 Js
- Speed of light : 3.00E+8 m/s

Bunch Compressor

(f) Calculate the expected final bunch length after BC section assuming $\sigma_0 = 0.15(\%)$ and $R_{56} = -0.2(m)$.

(g) How much voltage (V_{RF}) is required to compose this BC section?

Spin Rotator

(h) Derive Precession angle by solenoid rotator from Thomas-BMT equation.

(i) Calculate the bending magnetic filed integral (T.m) to rotate the spin vector with 90 degree.

Physics constatns

- Electronic charge e : $1.60 \times 10^{-19} C$.
- Planck constant h : 6.63×10^{-34}Js.
- Speed of light c : $3.00 \times 10^{8}\mathrm{m/s}$.
- electron mass m : $9.1 \times 10^{-31} kg$