Home Work PHY 554 #5. **Due October 25th, 2023**

HW 1 (3 points):

Consider an electron storage ring at an energy of 5 GeV, a circulating current of 200 mA and a bending radius of ρ=7 meters. Calculate the energy loss per turn, the critical photon energy, and the total synchrotron radiation power.

HW 2 (2 points): Make a short argument about why the trajectory of a charged particle can not intersect with light cone more than once (see slide #9 from the lecture 13)

HW 3 (2 points):
As shown in slide #17, the angular distribution of radiation power is given by

$$\frac{dP(t_r)}{d\Omega} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{4\pi c}\frac{\dot{\beta}^2}{(1-\beta\cos)^3}\left[1-\frac{\sin^2\theta\cos^2\phi}{\gamma^2(1-\beta\cos\theta)^2}\right]$$

Show that for $\gamma^{-4} << \theta << 1$ and $\gamma >> 1$, the angular spread of the radiation power is in the order of γ^{-1}.

HW 4 (3 points): For 2.5 GeV storage ring with circulating current of 500 mA and a bending radius of ρ=9 meters, consider an undulator with 50 periods and with K=1 installed in the straight section. Assume horizontal geometrical emittance of 1 nm rad (1e-9 m rad), vertical emittance of 20 pm rad (20e-12 m.rad) at the radiation point βx=βy=3 m.

(a) Find undulator period that fundamental wavelength will be 0.4 nm (4 Å)
(b) What will be spectral brightness at the fundamental wavelength?