Homework PHY 554 #5. **Due October 15th, 2025**

HW 1 (3 points):

Consider an electron storage ring at an energy of 3.8 GeV, a circulating current of 650 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):
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 3 (5 points): For 2.5 GeV storage ring with circulating current of 400 mA and a bending radius of ρ=15 meters, consider an undulator with 120 periods and with K=0.85 installed in the straight section. Assume horizontal geometrical emittance of 2 nm.rad (2e-9 m.rad), vertical emittance of 25 pm.rad (25e-12 m.rad) at the radiation point βx=βy=1.5 m.

(a) Find undulator period that fundamental wavelength will be 0.3 nm (3 Å)
(b) What will be spectral brightness at the fundamental wavelength?