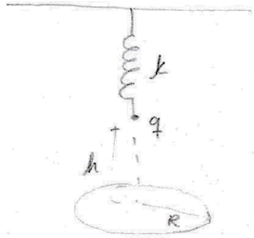
EM-2 September 2018



particle mass m
charge q

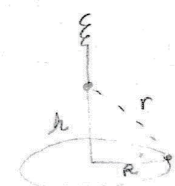
At $t=0$, pulled down distance d below equilibrium

a. Calculate intensity of radiation as function of R.

$$\langle \vec{S} \rangle = \left(\frac{\mu_0 p_0^2 \omega^4}{32\pi^2 c} \right) \frac{\sin^2\theta}{r^2} \hat{r}$$

→ we only care about radiation hitting floor ($\vec{z}$ direction)

$$I = \langle \vec{S} \rangle \cdot \hat{z} = \left(\frac{\mu_0 p_0^2 \omega^4}{32\pi^2 c} \right) \frac{\sin^2\theta}{r^2} \underbrace{(\hat{r}\cdot\hat{z})}_{|\hat{r}||\hat{z}|\cos\theta}$$



$r^2 = h^2 + R^2$

$\sin\theta = \frac{R}{r}$ & $\cos\theta = \frac{h}{r}$.

$$I = \frac{\mu_0 p_0^2 \omega^4}{32\pi^2 c} \frac{R^2}{r^4} \frac{h}{r} = \frac{\mu_0 p_0^2 \omega^4}{32\pi^2 c} \frac{R^2 h}{(h^2+R^2)^{5/2}}$$

b. At what R is the intensity max?

$$\frac{dI}{dR} = 0 \Rightarrow \frac{d}{dR}\left[\frac{\mu_0 p^2 \omega^4}{32\pi^2 c} \frac{R^2 h}{(h^2+R^2)^{5/2}} \right] = \frac{\mu_0 p^2 \omega^4 h}{32\pi^2 c} \left[2R(h^2+R^2)^{-5/2} + -\frac{5}{2} R^2 (h^2+R^2)^{-7/2}(2R) \right]$$

$$\rightarrow 0 = \frac{R(h^2+R^2)}{(h^2+R^2)^{7/2}} - \frac{5}{2}\frac{R^3}{(h^2+R^2)^{7/2}} \Rightarrow 0 = 2(h^2+R^2) - 5R^2$$

$$\rightarrow 0 = 2h^2 - 3R^2 \qquad \rightarrow R^2 = \frac{2}{3} h^2$$

At $R = \sqrt{\frac{2}{3}}\, h$, the intensity will be maximum.