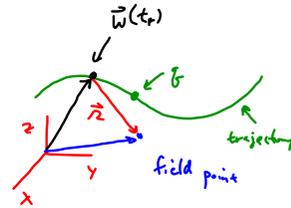


Reading For Tomorrow
 Chapter 11 up to pg. 460

Lienard-Wiechart Potentials

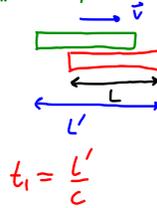
$\vec{w}(t) \equiv$ position of q at time t
 $\vec{r} \equiv \vec{r} - \vec{w}(t_r)$
 retarded position



$$V(\vec{r}, t) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho(\vec{r}', t_r)}{r} d\tau'$$

We want to write $\rho(\vec{r}', t_r)$ as a δ -function.
 But it's to make this difficult

Idea of why this is:



$$t_1 = \frac{L'}{c}$$

Call t_1 , the time it takes for the light to "catch up" with the front of the line change.
 Red travels a distance $L' - L = vt_1$
 $t_1 = \frac{L' - L}{v} = \frac{L'}{c}$
 $L' - L = \frac{v}{c} L'$
 $L'(1 - \frac{v}{c}) = L$
 $L' = \frac{L}{1 - v/c}$

Generalize this result to find

$$\tau' = \frac{\tau}{1 - \hat{r} \cdot \vec{v}/c}$$

$$V(\vec{r}, t) = \frac{1}{4\pi\epsilon_0} \frac{q}{r \sqrt{1 - \hat{r} \cdot \vec{v}/c}}$$

$$= \frac{1}{4\pi\epsilon_0} \frac{cq}{rc - \hat{r} \cdot \vec{v}}$$

$$\vec{A}(\vec{r}, t) = \frac{\mu_0}{4\pi} \int \frac{\vec{J}(\vec{r}', t_r)}{r} d\tau'$$

$\vec{J} = \rho \vec{v}$

$$\vec{A}(\vec{r}, t) = \frac{\vec{v}}{c^2} V(\vec{r}, t)$$

Lienard-Wiechart Potentials
 \vec{v} 's are evaluated at t_r

Liénard-Wiechert Fields

$$\vec{E} = -\vec{\nabla}V - \frac{\partial \vec{A}}{\partial t}$$

$$\vec{E}(\vec{r}, t) = \frac{q}{4\pi\epsilon_0} \frac{r}{(\vec{r} \cdot \vec{u})^3} \left[(c^2 - v^2) \vec{u} + \vec{r} \times (\vec{u} \times \vec{a}) \right]$$

↑ acceleration @
the retarded time

$$\vec{B} = \vec{\nabla} \times \vec{A} = \frac{1}{c} \hat{n} \times \vec{E}(\vec{r}, t)$$

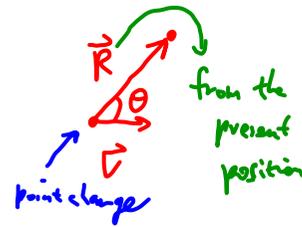
$$\vec{u} = c\hat{n} - \vec{v}$$

10.18 Point charge q constrained to move along the x -axis
Show that the fields for points to the right of the
charge are:

$$\vec{E} = \frac{q}{4\pi\epsilon_0} \frac{1}{r^2} \frac{c+v}{c-v} \hat{x} \quad \vec{B} = 0$$

Point Charge moving at constant velocity

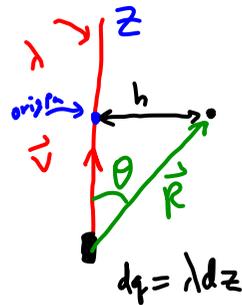
$$\vec{E}(\vec{r}, t) = \frac{q}{4\pi\epsilon_0} \frac{1 - v^2/c^2}{[1 - \frac{v^2}{c^2} \sin^2\theta]^{3/2}} \frac{\hat{R}}{R^2}$$



10.19

Uniform line charge λ moves with speed v .

Find the electric field a distance h above the line charge.



Write integral in terms of θ .

$$\int_0^{\pi} \frac{\sin\theta}{[1 - \beta^2 \sin^2\theta]^{3/2}} = \frac{2}{1 - \beta^2}$$

$$\text{or } \int_0^{\pi/2} \frac{\sin\theta}{[1 - \beta^2 \sin^2\theta]^{3/2}} = \frac{1}{1 - \beta^2}$$

Should get same as for line charge at rest:

$$\vec{E} = \frac{1}{2\pi\epsilon_0} \frac{\lambda}{h} \hat{s}$$

$$\vec{B} = \frac{\mu_0 I}{2\pi h} \hat{\phi} \quad (\text{Infinite wire})$$

get this from $\vec{B} = \frac{1}{c} (\hat{r} \times \vec{E})$ for each dq .