

Electric dipole radiation : From potentials to fields

(2)

$$\begin{aligned}
 \phi(\vec{x}, t) &\approx \frac{1}{4\pi\epsilon_0} \int_{\vec{x}'} d\vec{x}' \frac{1}{R} [\rho(\vec{x}', t')] \\
 &\approx \frac{1}{4\pi\epsilon_0} \left\{ \frac{q_0 \cos(\omega t')}{r_+} - \frac{q_0 \cos(\omega t')}{r_-} \right\} \\
 &= \frac{1}{4\pi\epsilon_0} \left\{ \frac{q_0 \cos\left(\omega\left(t + \frac{r_+}{c}\right)\right)}{r_+} - \frac{q_0 \cos\left(\omega\left(t + \frac{r_-}{c}\right)\right)}{r_-} \right\}
 \end{aligned}$$

Scalar Potential

Find $\phi = \phi(r, \Theta, t)$

$$\begin{aligned}
 t'_+ &= t + \frac{r_+}{c} \\
 t'_- &= t + \frac{r_-}{c}
 \end{aligned}$$

