Radiation exploration

Topics: Lienard Wiechert potential and radiation formulas

Summary: This activity presents formulas and lets students simply explore and extract their own insights into what these (complicated) results imply

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Comments: Not used or observed by SJP yet. May need some work!

Radiation exploration

1) Scavenger hunt: List everything interesting you can spot about the electric and magnetic fields produced by a moving charge q:

$$\vec{\mathbf{E}}(\vec{\mathbf{r}},t) = \frac{q}{4\pi\varepsilon_0}\frac{\mathfrak{R}}{(\vec{\mathfrak{R}}\cdot\mathbf{u})^3}\left[(c^2 - v^2)\vec{\mathbf{u}} + \vec{\mathfrak{R}}\times(\vec{\mathbf{u}}\times\vec{\mathbf{a}})\right]$$

$$\vec{\mathbf{B}}(\vec{\mathbf{r}},t) = \frac{1}{c}\hat{\mathfrak{R}}\times\vec{\mathbf{E}}$$

Where $\vec{\mathbf{u}} = c\hat{\mathfrak{R}} - \vec{\mathbf{v}}$, **v** is the velocity, and **a** acceleration. <u>Everything</u> on the right hand side is evaluated at the retarded time t_r.

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2) Scavenger hunt: List everything interesting you can spot about the electric and magnetic fields produced by a nonrelativistic oscillating charge q near the origin:

$$\vec{\mathbf{E}}(\vec{\mathbf{r}},t) = \frac{q\hat{r}}{4\pi\varepsilon_0 r^2} - \frac{\mu_0 p\omega^2 \sin(\theta)\cos(\omega(t-r/c))\hat{\theta}}{4\pi r}$$

$$\vec{\mathbf{B}}(\vec{\mathbf{r}},t) = \frac{-\mu_0 p\omega \sin(\theta)\sin(\omega(t-r/c))\hat{\phi}}{4\pi r^2} - \frac{\mu_0 p\omega^2 \sin(\theta)\cos(\omega(t-r/c))\hat{\phi}}{4\pi rc}$$