FIELDS OF A MOVING MAGNETIC MONOPOLE

Link to: physicspages home page.

To leave a comment or report an error, please use the auxiliary blog.

References: Griffiths, David J. (2007), Introduction to Electrodynamics, 3rd Edition; Pearson Education - Chapter 11, Post 26.

We can use the duality transformations to find the analog of the Larmor formula for a point magnetic monopole. The transformations are

$$\mathbf{E}' = \mathbf{E}\cos\alpha + c\mathbf{B}\sin\alpha \tag{1}$$

$$c\mathbf{B}' = c\mathbf{B}\cos\alpha - \mathbf{E}\sin\alpha \tag{2}$$

$$cq_e' = cq_e\cos\alpha + q_m\sin\alpha \tag{3}$$

$$q_m' = q_m\cos\alpha - cq_e\sin\alpha \tag{4}$$

The fields for a moving point electric charge are

$$\mathbf{E}(\mathbf{r},t) = \frac{q_e\mathfrak{r}}{4\pi\epsilon_0(\mathfrak{r}\cdot\mathbf{u})^3}\left[\left(c^2-v^2\right)\mathbf{u}+\mathfrak{r}\times(\mathbf{u}\times\mathbf{a})\right] \tag{5}$$

$$\mathbf{B}(\mathbf{r},t) = \frac{1}{c}\hat{\mathfrak{r}}\times\mathbf{E}(\mathbf{r},t) \tag{6}$$

Applying the transformations with $\alpha = \frac{\pi}{2}$ we get

$$-c\mathbf{B}_m = -\frac{q_m\mathfrak{r}}{4\pi c\epsilon_0(\mathfrak{r}\cdot\mathbf{u})^3}\left[\left(c^2-v^2\right)\mathbf{u}+\mathfrak{r}\times(\mathbf{u}\times\mathbf{a})\right] \tag{7}$$

$$\mathbf{B}_m = \frac{q_m\mathfrak{r}}{4\pi c^2\epsilon_0(\mathfrak{r}\cdot\mathbf{u})^3}\left[\left(c^2-v^2\right)\mathbf{u}+\mathfrak{r}\times(\mathbf{u}\times\mathbf{a})\right] \tag{8}$$

$$\frac{1}{c}\mathbf{E}_m = -\frac{1}{c}\hat{\mathfrak{r}}\times c\mathbf{B}_m(\mathbf{r},t) \tag{9}$$

$$\mathbf{E}_m = -c\hat{\mathfrak{r}}\times\mathbf{B}_m(\mathbf{r},t) \tag{10}$$

The Larmor formula for electric charge is

$$P_e = \frac{\mu_0 q_e^2 a^2}{6\pi c} \tag{11}$$

so for magnetic charge it becomes

$$P_m = \frac{\mu_0 q_m^2 a^2}{6\pi c^3} \tag{12}$$