

FIELDS OF A MOVING MAGNETIC MONOPOLE

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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

$$\mathbf{E}' = \mathbf{E} \cos \alpha + c\mathbf{B} \sin \alpha \quad (1)$$

$$c\mathbf{B}' = c\mathbf{B} \cos \alpha - \mathbf{E} \sin \alpha \quad (2)$$

$$cq'_e = cq_e \cos \alpha + q_m \sin \alpha \quad (3)$$

$$q'_m = q_m \cos \alpha - cq_e \sin \alpha \quad (4)$$

The fields for a moving point electric charge are

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

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

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

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

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

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

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

The Larmor formula for electric charge is

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

so for magnetic charge it becomes

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