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with the cyclotron frequency

$$\omega = qB/\gamma m \tag{1.2}$$

where

$$\gamma = [1 - (v^2/c^2)]^{-1/2} \tag{1.3}$$

$$\mathbf{B} = \nabla \times \mathbf{A} \tag{1.4}$$

$$\mathbf{A} = \hat{\phi}\mathfrak{M}\rho r^{-3} \tag{1.5}$$

$$B = \frac{\mathfrak{M}}{r^3}(1 + 3\sin^2\lambda)^{1/2} \tag{1.6}$$

In addition, the particle will move along the line of force, making its actual orbit resemble a spiral. As it moves into regions of stronger field at higher latitudes, it will be reflected back toward the equator by converging lines of force. The result is a bouncing motion back and forth across the equatorial plane. Finally, the line of force about which the particle spirals will slowly drift in longitude.

In the following sections these intuitive conclusions are made more precise. Section 2 contains a discussion of the equations of motion in several different coordinate systems and their few known exact solutions.

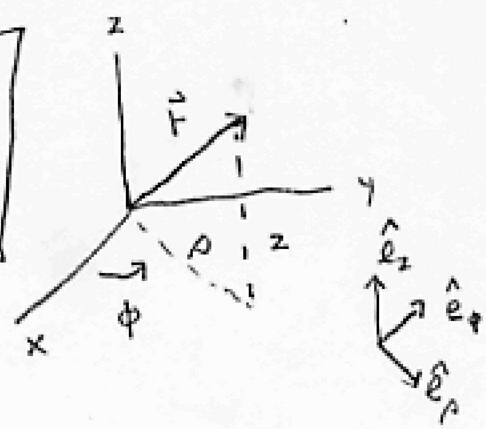
a) In cylindrical coordinates

$$\vec{r} = \rho\,\hat{e}_\rho + z\,\hat{e}_z, \quad \dot{\vec{r}} = \vec{v} = \dot{\rho}\,\hat{e}_\rho + \rho\dot{\phi}\,\hat{e}_\phi + \dot{z}\,\hat{e}_z.$$

For $\vec{\mu} = \mu\,\hat{e}_z$ we get

$$\vec{A} = \frac{\vec{\mu}\times\vec{r}}{r^3} = \frac{\mu\,\hat{e}_z \times (\rho\,\hat{e}_\rho + z\,\hat{e}_z)}{[\rho^2+z^2]^{3/2}} \Rightarrow$$

$$\boxed{\vec{A} = \frac{\mu\rho\,\hat{e}_\phi}{[\rho^2+z^2]^{3/2}} = A_\phi\,\hat{e}_\phi}$$



with $\boxed{A_\phi = \mu\rho/[\rho^2+z^2]^{3/2}}$