j99e3

$\cancel{\frac{1}{2} I \omega(t)^2 - E_{EM} = E_{tot}}$

$I\omega(t)\dot{\omega}(t) - P_{rad} = 0$

$P_{rad} = \frac{\mu_0 m_0^2 \omega^4}{12\pi c^3}$

have: mass, radius, $\dot{\omega}$, ω roughly → solve for m

then suppose uniform M, solve for B - sure ✓.

$I_{sphere} = \int dm\, (r\sin\theta)^2 = \frac{M}{V}\int r^4 \sin^3\theta \, d\theta \, dr \, d\phi$

$= \frac{2\pi R^5 M}{5V}\int \sin\theta - \sin\theta\cos^2\theta$

$-\cos\theta \Big|_0^\pi + \frac{1}{3}\cos^3\theta \Big|_0^\pi$

$+2 \quad - \frac{2}{3}($

$= \frac{2}{5} R^2 \cancel{\frac{4\pi R^3}{3}} \cancel{\frac{M}{V}}$

so $m_0^2 = \frac{2}{5} M R^2 \dot{\omega} \left(\frac{12\pi c^3}{\mu_0 \omega^3}\right)$

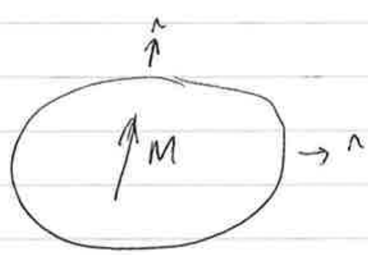
so $M_0 = m_0 V$

$J_b = \nabla\times M = 0$.

$K_b = M\times n$

$= M\hat{z}\times\hat{r}$

$= M\sin\theta\,\hat{\phi}$



~~$r\times\theta$~~

$r\times\phi = z$

outside, exact dipole field. $\vec{B} = \frac{\mu_0 M_0}{4\pi r^3}\left(3(\hat{m}\cdot\hat{r})\hat{r} - \hat{m}\right)$

so max on surface is $\frac{2\mu_0 M_0}{4\pi R^3} = B$. ($B_\perp$ continuous over surface)

$B_{max} = \frac{2\mu_0}{4\pi R^3}\left(\frac{4\pi R^3}{3}\right)\sqrt{\frac{2}{5} M R^2 \dot{\omega}\left(\frac{12\pi c^3}{\mu_0 \omega^3}\right)}$