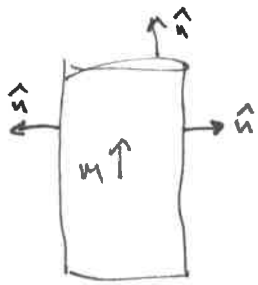
phys 341 – class 28 – ch 9: 1 & 8

1)



$J_M = \nabla \times M = 0$ (M is constant)

$j_M = \vec{M} \times \hat{n} = M\, \hat{k} \times \hat{r} = M\, \hat{\varphi}$ (sides)

top: $\vec{M}$ & $\hat{n}$ in $\hat{k}$ so cross = zero

so .. exactly like solenoid with surface current = M

this means, eg, that at center $B = \mu_0 K = \mu_0 M$

as you move away from center B falls to $\mu_0 \frac{M}{2}$ at faces.

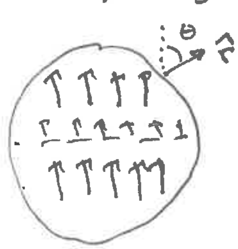
8) current view: $J_M = \nabla \times M$ & $j_M = \vec{M} \times \hat{n}$

monopole view: $\rho_M = -\nabla \cdot M$ & $\sigma_M = \vec{M} \cdot \hat{n}$

I'm going to rotate the text x-axis to z-axis

so $\vec{M} = (az^2 + b)\,\hat{k}$ (if a & b positive this means M grows away from equatorial plane)

current



$\hat{k} \times \hat{r} = \hat{\varphi} \sin\theta$ so $j_M = M \sin\theta\, \hat{\varphi}$ ← goes around

$M = (a(r\cos\theta)^2 + b)$

$= aR^2 \cos^2\theta + b$

$b\sin\theta$ term large at equator

$aR^2\cos^2\theta \sin\theta$ term large at "mid latitudes"

I'm going to do curl in xyz:

$$\nabla \times M = \begin{vmatrix} i & j & k \\ \partial_x & \partial_y & \partial_z \\ 0 & 0 & az^2+b \end{vmatrix} = 0$$

(nothing "curlish" about const direction that strengthens along that direction)

monopole

$\rho_M = -\nabla \cdot M = -\partial_z (az^2 + b) = -2az$ ((−) poles above equator, (+) below)

$\sigma_M = M\,\hat{k} \cdot \hat{n} = M \cos\theta = (aR^2\cos^2\theta + b)\cos\theta$ ← odd about equator