

18. Force balance equation in cylindrical coordinates:

Assume $\partial/\partial\theta = \partial/\partial z = 0$ and $B_r = 0$ and show that the force balance equation in cylindrical coordinates (r, θ, z) takes the form

$$\frac{\partial}{\partial r} \left(p + \frac{B_\theta^2 + B_z^2}{2\mu_0} \right) + \frac{B_\theta^2}{\mu_0 r} = 0$$

19. Z pinch:

Assume a constant current j_0 in the z direction in a cylindrical coordinate system.

- Compute the magnetic field $B_\theta(r)$ and integrate the force balance equation to obtain $p(r)$. The pressure at $r = 0$ is p_0 .
- Determine the critical radius for which the pressure decreases to 0.
- Show that the equilibrium condition for the θ pinch

$$\frac{dp_0}{dr} = \frac{B_0}{\mu_0 r} \frac{d(rB_0)}{dr}$$

can be expressed as

$$\frac{d \ln B_0}{d \ln r} = \frac{\beta}{2} \frac{d \ln p_0}{d \ln r} - 1$$

20. Project:

Provide a report on your progress with the class project. Take some time to list all items in your project which you do not yet understand or where you felt difficulties in your progress.

Please turn in the solutions to the homework on Thursday day, 4/19/2012