The magnetic vector potential is

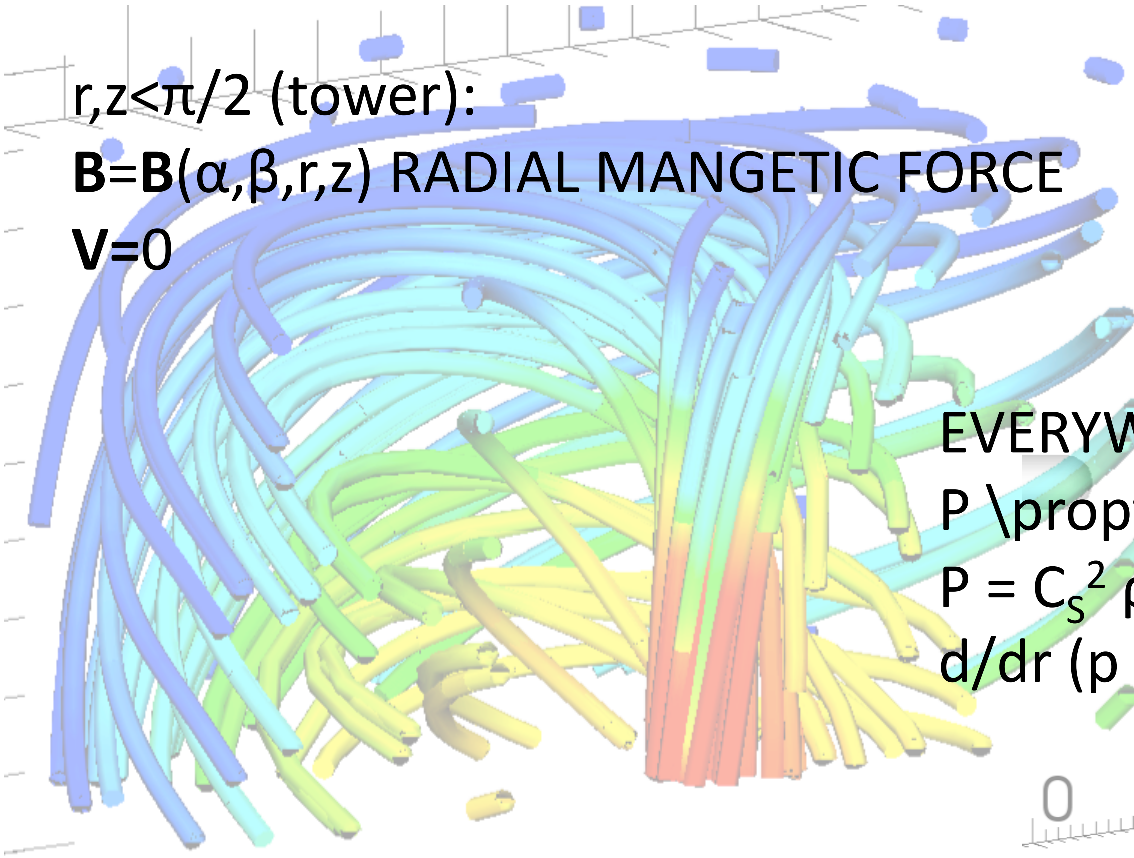
$$\mathbf{A}(r,z) = \begin{cases} \frac{r}{4}(cos(2\,r)+1)(cos(2\,z)+1)\hat{\phi} + \frac{\alpha}{8}(cos(2\,r)+1)(cos(2\,z)+1)\hat{k}, & \text{for } r,z < \pi/2; \\ 0, & \text{for } r,z \geq \pi/2, \end{cases} \tag{1}$$

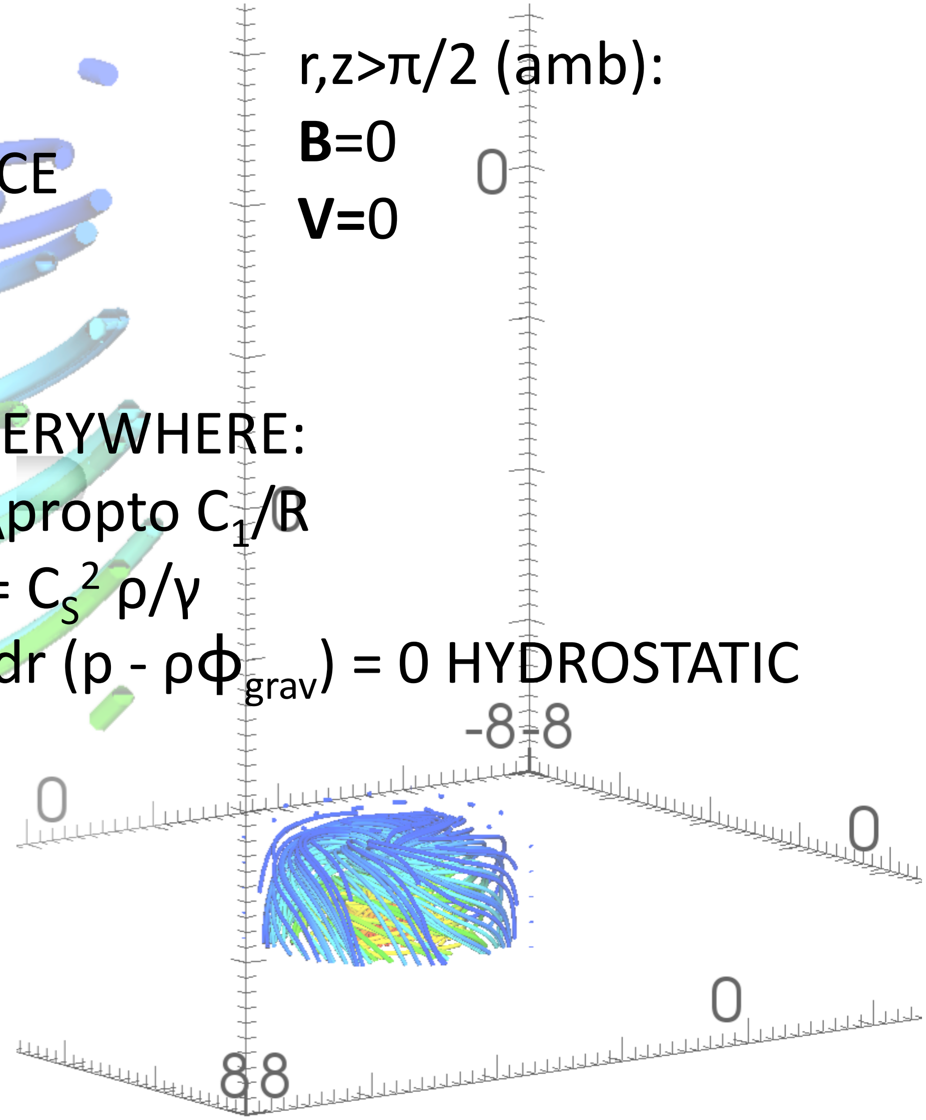
in cylindrical coordinates. The parameter α is an integer with units of length. Inside the initial cylinder $\mathbf{A}$ can also be written as

$$\mathbf{A}(r,z) = rcos^2(r)cos^2(z)\hat{\phi} + \frac{\alpha}{2}cos^2(r)cos^2(z)\hat{k}. \tag{2}$$

From $\mathbf{B} = \nabla \times \mathbf{A}$,

$$\begin{aligned} B_r &= -\tfrac{\partial}{\partial z}(A_\phi) = 2rcos^2(r)cos(z)sin(z), \\ B_\phi &= -\tfrac{\partial}{\partial r}(A_z) = \alpha cos^2(z)cos(r)sin(r), \\ B_z &= \tfrac{1}{r}\tfrac{\partial}{\partial r}(rA_\phi) = 2cos^2(z)(cos^2(r) - rcos(r)sin(r)). \end{aligned} \tag{3}$$





$r,z<\pi/2$ (tower):

$\mathbf{B}=\mathbf{B}(\alpha,\beta,r,z)$ RADIAL MANGETIC FORCE

$\mathbf{V}=0$

$r,z>\pi/2$ (amb):

$\mathbf{B}=0$

$\mathbf{V}=0$

EVERYWHERE:

P \propto C_1/R

$P = C_S^2\, \rho/\gamma$

$d/dr\,(p - \rho\phi_{grav}) = 0$ HYDROSTATIC

BASE ($z<0$):

$R<\pi/2$:$\mathbf{B}=\mathbf{B}(\alpha,\beta,r,z)$

$V_\phi = c_2/(r^{1/2})$) *{mom balance}* OR $(V_{A\phi})M_{A\phi} = |\mathbf{B}|^2/(\sqrt{\rho})\ M_{A\phi}$

$R>\pi/2$:$\mathbf{B}=0$

$V_\phi = c_2/(\pi/2)^{1/2}$ OR $[V_{A\phi}(R,Z=\pi/2,0)]M_{A\phi}$

r,z<π/2 (tower):
B=**B**(α,β,r,z) RADIAL MAGNETIC FORCE
V=0

r,z>π/2 (amb):
B=0
V=0

WE USE:

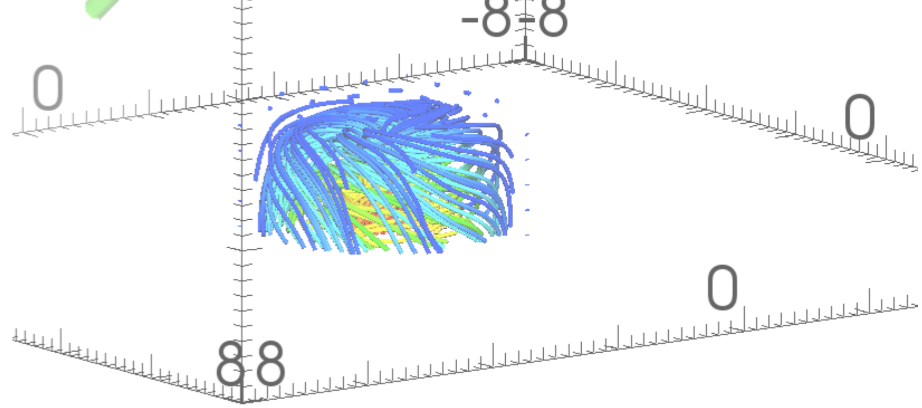
α \propto F_{tor}/F_{pol} = .1,1,10

β ~ .05

$M_{A\phi}$= 0, .5, 1

OR V_{ϕ}=(0, .1, 1) V_{KEPLER}

EVERYWHERE:
P \propto C_1/R
P = C_S^2 ρ/γ
d/dr (p - $\rho\phi_{grav}$) = 0 HYDROSTATIC



BASE (z<0):
R<π/2 :**B**=**B**(α,β,r,z)
V_{ϕ}= $c_2/(r^{1/2})$ *{mom balance}* OR $(V_{A\phi})M_{A\phi} = |\mathbf{B}|^2/(\sqrt{\rho})\, M_{A\phi}$
R>π/2 :**B**=0
V_{ϕ}= $c_2/(\pi/2)^{1/2}$ OR $[V_{A\phi}(R,Z=\pi/2,0)]M_{A\phi}$