Mar. 11. Lewis Conley

Fusion

more energy out than in
- → Balance against leakage
- → instability

Area A

$\text{leakage plasma} = \int_A \gamma_\perp \, dA \quad + P_{Rad}$

$\frac{\partial n}{\partial t} - D_\perp \nabla^2 n = S$

$\gamma_\perp = -D_\perp \nabla n$

$\times \langle E \rangle$ = (energy leakage)

$\nu_{collision} \to 0$

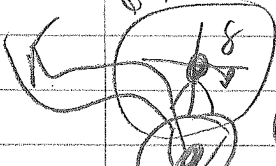
nice time to erase!

$\nabla \times B = \frac{4\pi}{e} \gamma$

$\nabla \cdot B = 4\pi \nu$

$\nabla \cdot B = e$

elliptical



1. find equil
2. peturb the equil

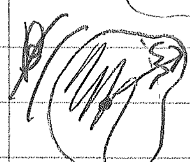
$0 = -\nabla p_0 + \frac{1}{e}(\gamma_0 \times B_0)$

use linear part

i.e. $p \to p_0 + p'$ $\quad \frac{p'}{p_0} \ll 1$

$\frac{\partial \xi}{\partial t} = v$ or $\xi = \int v \, dt$

ξ: displacement parameter



$\xi \to e^{+\Gamma t}$ — Γ: growth rate constant for the instability

$p \frac{\partial^2 \xi}{\partial t^2} = \nabla [\gamma p_0 \nabla \cdot \xi + \xi \cdot \nabla p_0] +$
$+ \frac{1}{4\pi} [\nabla \times \nabla \times (\xi \times B_0) \times B_0 + \nabla \times B_0 \times \nabla \times (\xi \times B_0)]$

THE FORCE!

$p \frac{\partial^2 \xi}{\partial t^2} = F(\xi, P_0, B_0, \gamma_0)$ (bacon)

Two soln method to get insight

① variational principle

② Fourier Analysis → "normal mode"

~~$B_0 \Omega$~~

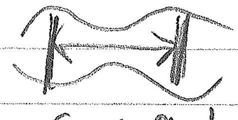
$$\Omega^2 \int \rho\, (\xi \cdot \xi)\, d^n x = \int \xi \cdot F \xi\, d^n x$$

$$\Omega^2 = \delta W / \int \rho (\xi \cdot \xi)\, d^n x$$

$$-F \cdot \nabla \times Q \times B_0 = -Q^2 + \nabla \cdot [Q \times B_0]$$

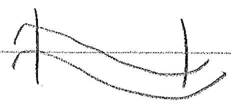
$$\xi = \xi(r) \exp(im\theta + ikz)$$

$m = 0$

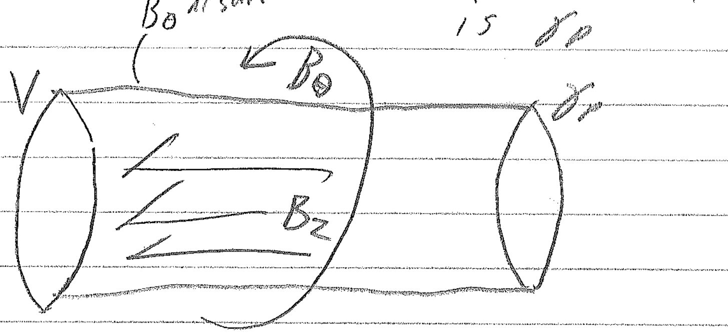


sausage!

$m = 1$



kink



GAME OVER!

unless we add B_z

$\frac{B_z}{B_\theta}$ strong enough