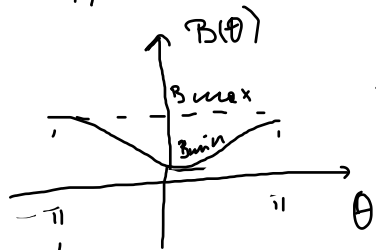
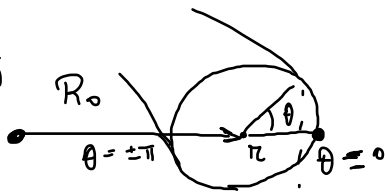


{ Passing particles  
 { Trapped particles



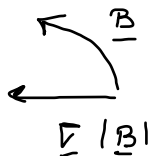
Orbit of a passing particle



$$R \frac{v_{\perp 0}}{v_{\parallel 0}} < \sqrt{2E}$$

$$E = \frac{v_{\perp 0}^2}{2}$$

$$i \approx 2\pi R_0 \frac{B_p}{B_T}$$



$$\begin{cases}
 R - R_0 = r \cos(\omega t) \\
 z = r \sin(\omega t)
 \end{cases}$$

$$T \approx \frac{2\pi R_0}{v_{\parallel}}$$

$$\omega = \frac{i}{T} \approx \frac{i}{2\pi R_0} v_{\parallel} \approx \frac{2\pi R_0 B_p}{r B_T} \frac{v_{\parallel}}{2\pi R_0}$$

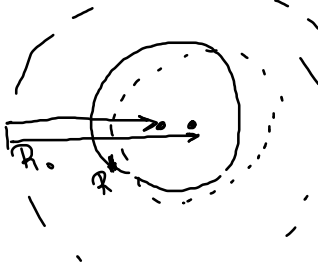
$$\approx \frac{B_p}{B_T} \frac{v_{\parallel}}{r}$$

$$\begin{cases} \dot{R} = -\pi w \sin(\omega t) \\ \dot{z} = \pi w \cos(\omega t) \\ = \omega(R - R_0) \end{cases}$$

particle strictly follows the field line  
 → circle around  $R_0$

By Adding drift

$$\begin{cases} \dot{R} = -\pi w \sin(\omega t) \\ \dot{z} = v_D + \pi w \cos(\omega t) = \omega(R - R') \end{cases} \left. \begin{array}{l} \text{circle around} \\ R' \end{array} \right\}$$



if  $R' - R_0$  is small  $\Rightarrow$  passing particle is well confined  
 = = is large  $\Rightarrow$  = = is not well confined

$$\sigma_D + \omega(R - R_0) = \omega(R - R')$$

$$\sigma_D + \cancel{\omega R} - \omega R_0 = \cancel{\omega R} - \omega R';$$

$$R' = R_0 - \frac{\sigma_D}{\omega}$$

$$\Delta = R_0 - R' = \frac{\sigma_D}{\omega}$$

$$\omega \approx \frac{B_T \sigma_{\parallel}}{B_T R}$$

$$\sigma_{\parallel} \approx \frac{m \sigma_{\perp}^2}{2B} \frac{B^2}{R} \frac{1}{qB} \approx \frac{m \sigma_{\perp}^2}{2qBR}$$

$$\sigma_D = \sigma_{\parallel} + \sigma_{F_c}$$

$$\sigma_{\parallel} = \frac{-\mu \nabla B / \lambda B}{qB^2}$$

$$\sigma_{F_c} = \frac{m \sigma_{\perp}^2 \times B}{R qB^2}$$

$$\sigma_{F_c} \approx \frac{m \sigma_{\perp}^2}{R qB}$$

$$\sigma_D \approx \underbrace{\left( \frac{\sigma_{\parallel}^2 + \sigma_{F_c}^2}{2} \right)}_{\approx \sigma^2} \frac{m}{qBR}$$

$$\frac{\Delta}{W} = \frac{v_D}{W} \approx \frac{m v^2}{9 \frac{B_T}{R} B_p v_{||}} \approx \frac{(m v)^2}{9 R B_p} \approx \pi_{L,p} \cdot \epsilon$$

$\pi_{L,p}$  If  $B_T$  is large enough  
 then

passing particles are well confined