Recall $J_{boot} \sim$ #-passing $\cdot\, eV_{th}$
$(\Delta\ \nabla R)\, eV_{th}$

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a. $\nu^{*} = \dfrac{\nu_{eff}}{\omega_B} < 1$ still complete bounce orbits.

To estimate ω_B, $\tau_B \sim \dfrac{2\pi}{\omega_B} \sim 2\displaystyle\int_{-\theta_0}^{\theta_0} \frac{ds}{V_{\parallel}} \sim \frac{R_0 q}{V_{th}\epsilon^{1/2}}$

$$\nu^{*} = \frac{\nu_{ei} R_0 q}{V_{th}} \frac{1}{\epsilon^{3/2}} < 1$$

b. $\begin{pmatrix} \Gamma_e \\ J_{Ace} \end{pmatrix} \sim \begin{pmatrix} \frac{1}{T} D_{ban} & \text{Ware} \\ \text{Boot} & \sigma_{\parallel}\epsilon^{1/2} \end{pmatrix} \cdot \begin{pmatrix} -\nabla P \\ -n_0 E_{\parallel} \end{pmatrix}$

so need to get Boot coeff $\Leftrightarrow$ Ware coeff.

$V_W \sim V_{D,R}\,\Delta\theta \sim V_{D,R} \dfrac{\Delta V_{\parallel}}{V_{\parallel}}$ due to E_φ

$V_{D_r} \sim \dfrac{1}{\Omega}\hat{n} \times \left(\mu\nabla B + W_{\parallel}\,\hat{n}\cdot\nabla\hat{n}\right)_r$ $\qquad V_{\parallel} \sim \epsilon^{1/2} V_{th}$

$\sim \dfrac{\mu}{\Omega}\left(\hat{n}\times\nabla B\right)_r \sim \dfrac{V_{th}^2 \cancel{B_0}}{\Omega \cancel{B_0} R_0} \sim \dfrac{\rho V_{th}}{R_0}$

Since $\hat{n} \sim \hat{\varphi} + \dfrac{B_P}{B_T}\hat{\theta}$, $B \sim B_0(1-\epsilon\cos\theta)$, $\epsilon = \dfrac{r}{R_0}$.

$\dfrac{\Delta V_{\parallel}}{\Delta t} \sim \dfrac{e}{m} E_\varphi \rightarrow \Delta V_{\parallel} \sim \dfrac{e}{m}\dfrac{E_\varphi}{\omega_B}$ $\qquad \dfrac{mv^2}{r} = \dfrac{qvB}{c}$

$V_W \sim \left(\dfrac{\rho V_{th}}{\cancel{R_0}}\right)\left(\dfrac{e}{m}E_\phi\right)\left(\dfrac{\cancel{R_0} q}{V_{th}\epsilon^{1/2}}\right)\dfrac{1}{V_{th}\epsilon^{1/2}}$ $\qquad r \sim \dfrac{mvc}{qB}$

$\sim \dfrac{e}{m}\dfrac{\rho}{V_{th}} E_\phi \dfrac{q}{\epsilon} \sim \dfrac{e}{m}\dfrac{\rho}{V_{th}} E_\phi \dfrac{B_T}{B_P}$ $\qquad \Omega \sim \dfrac{v}{r} \sim \dfrac{qB}{mc}$

$\sim \left(\dfrac{eB_0}{mc\,\cancel{V_{th}}}\right) c\, \dfrac{E_\phi \cdot \rho}{B_P V_{th}} \sim \dfrac{c\,E_\phi}{B_P}$

Ware coeff $\sim \dfrac{\epsilon^{1/2} V_{ware}}{E_\phi}$ (only trapped contribute to flux)

$$J_{Ace} = \langle J_{\parallel} - J_S\rangle \sim \frac{\epsilon^{1/2} c}{B_P}\nabla P + \sigma_{\parallel}\epsilon^{1/2} n_0 E_{\parallel}$$

c. use steady state drift-kinetic equation $(\hat{n}V_{\parallel} + V_D)\cdot\nabla f + \frac{e}{m}E_{\parallel}V_{\parallel}\frac{\partial}{\partial \mathcal{E}} f = Cf$

d. $J_{boot} \sim$ collisional trapping and detrapping of banana particles

e. steady state current to generate B_P, and does not require input power ("free")

2. a. $1 - \frac{\omega_{*e}}{\omega} + b_s \theta - \frac{k_\parallel^2 c_s^2}{2\omega^2}\left(1 - \frac{\omega_{*pi}}{\omega}\right) = 0$

$\omega_{*pi} = \omega_{*i}(1 + \eta_i)$

$\omega_* = k_y v_*$, $v_* = \frac{\rho v_{th}}{L_n}$ of that species

$\eta_i = \frac{\cancel{\delta_T}}{\eta} \frac{L_{in}}{L_{iT}}$

$\eta_i \gg 1$, $\omega_{*pi} \sim \eta_i \omega_{*i}$

$1 - \frac{\omega_{*e}}{\omega} + b_s - \frac{k_\parallel^2 c_s^2}{2\omega^2}\left(1 - \frac{\omega_{*i}\eta_i}{\omega}\right) = 0$

$v_{th,i} < \frac{\omega}{k_\parallel} < v_{th,e}$

$\rightarrow 1 + \frac{k_\parallel^2 c_s^2 \omega_{*i}\eta_i}{2\omega^3} = 0$ has two complex ω roots, one unstable.