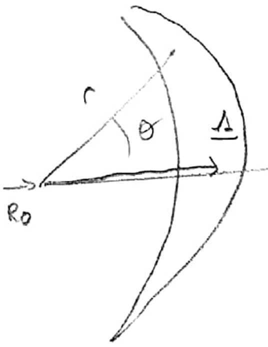
2015 II : Q6 Transport

(a.) $P_\zeta = mRV_\zeta + \frac{e}{c}\psi$



At $\theta = 0$: $P_\zeta = m(R_0 + r + \Delta)V_\zeta + \frac{e}{c}\psi(r + \Delta)$

At turning point : $P_\zeta = \frac{e}{c}\psi(r)$

$$\psi(r+\Delta) \approx \psi(r) + \Delta \frac{d\psi(r)}{dr} = \psi(r) + \Delta (R_0 + r) B_p$$

momentum conservation $\Rightarrow m(R_0 + r + \Delta)V_\zeta + \frac{e}{c}\Delta(R_0+r)B_p = 0$

$$\Rightarrow \Delta \sim \frac{mc}{eB_p}\frac{(R_0 + r + \Delta)}{(R_0 + R)} V_{th}\,\varepsilon^{1/2} \qquad q = \frac{\varepsilon B_T}{B_p}$$

$$\Rightarrow \Delta \sim \frac{mc}{eB_T} V_{th} \frac{\varepsilon^{1/2}}{\varepsilon} q \quad \Rightarrow \boxed{\Delta \sim \rho q \varepsilon^{-1/2}}$$

(b.) $\nu_{eff} \sim \frac{\nu_{ei}^{90^\circ}}{\varepsilon}$ $\qquad \langle f \rangle \sim \varepsilon^{1/2}$

$$D_{banana} \sim \frac{(\Delta x)^2}{(\Delta t)} \sim \Delta^2 \langle f \rangle \nu_{eff} \sim \rho^2 q^2 \varepsilon^{-3/2} \nu_{ei}^{90^\circ}$$