Electron drift waves

Contents

- Adiabatic (Boltzmann) response
- "Universal" drift wave instability in slab

$$\underset{\sim}{E} + \underset{\sim}{v}_e \times \underline{B} = \frac{-\nabla p_e}{en} + \frac{m_e}{ne^2}\frac{dJ}{dt} \quad \rightarrow m_e = 0$$

Take parallel component (along B)

$$\underset{\sim}{b}\cdot\underset{\sim}{E} = E_{\parallel} = -\frac{\underset{\sim}{b}\cdot\nabla p_e}{en} \qquad \underset{\sim}{b}\cdot\nabla = \partial_{\parallel}$$

$$\begin{cases} \delta p_e \simeq eT\,\delta n \\ \delta E_{\parallel} \simeq -\partial_{\parallel}\delta\phi \end{cases}$$

$\underset{\sim}{E} \simeq -\nabla\phi$ electrostatic

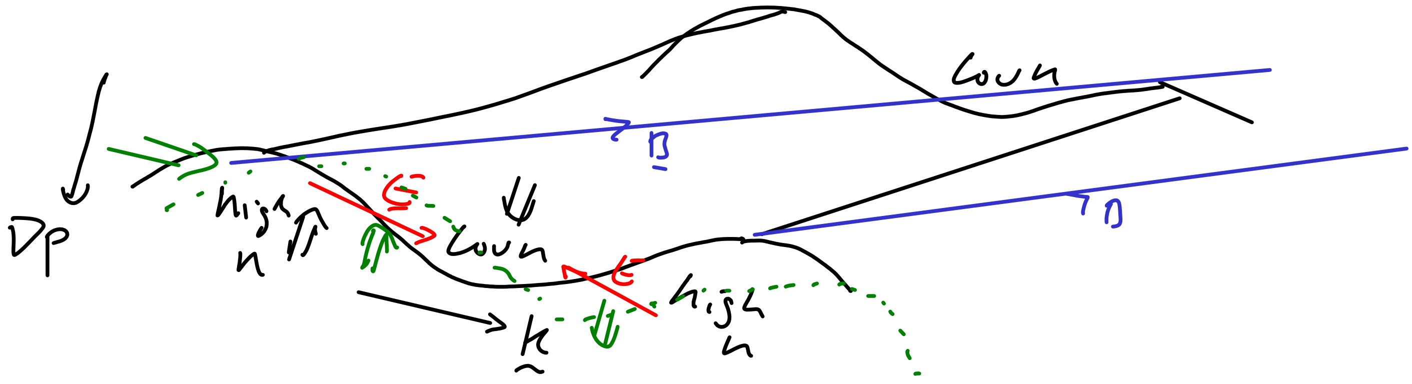
$$E_{\parallel} \simeq -\underset{\sim}{b}\cdot\nabla\phi = -\partial_{\parallel}\phi$$

$$-\partial_{\parallel}\delta\phi \simeq -\frac{eT\,\partial_{\parallel}\delta n}{en} \qquad \partial_{\parallel}\left(-\delta\phi + \frac{T}{n}\delta n\right) = 0$$

$$\boxed{\frac{\delta\phi}{T} \simeq \frac{\delta n}{n}}$$

adiabatic response
- on timescales long compared to electron response

Electron drift waves



$$\delta n / n \simeq \frac{\delta \phi}{T}$$

Density

$$\underbrace{\frac{\partial}{\partial t}}_{-i\omega} \delta n = \underbrace{- \nabla \cdot (n \, \delta \underline{u})}_{\simeq V_{E\times B} \cdot \underbrace{\nabla n}_{\frac{dn}{dr}}}$$

$$\delta \underline{u} = \underline{V}_{E\times B} = \frac{1}{B} \underline{b} \times \nabla \phi = \frac{-i k_\theta}{B} \delta \phi$$

$$i\omega \, \delta n \simeq V_{E\times B} \frac{dn}{dr} = \frac{-i k_\theta}{B} \delta\phi \frac{dn}{dr}$$

adiabatic

$$\delta n = \frac{\delta \phi}{T} n$$

$$\omega = -k_\theta \frac{T}{nB} \frac{dn}{dr} = k_\theta V_* = \omega_*$$

diamagnetic frequency.

$$V_* = \frac{-1}{enB} \frac{dP}{dr}$$

form of particle drift / diamagnetic drift

but has different source