ECE 659 Quantum Transport: Atom to Transistor

Lecture 6: Hall Effect

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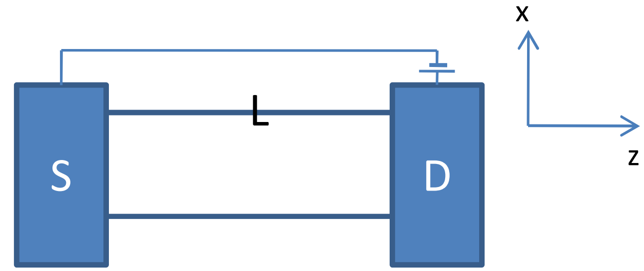
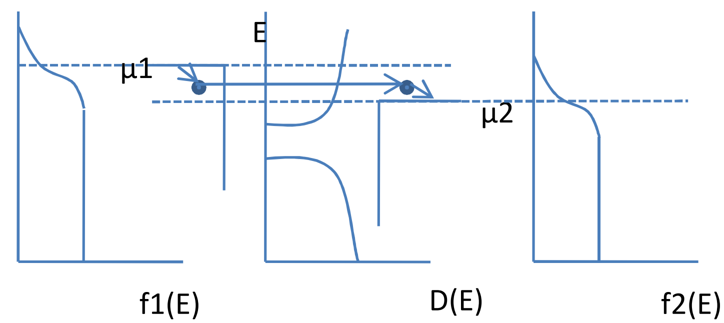
Notes prepared by Samiran Ganguly

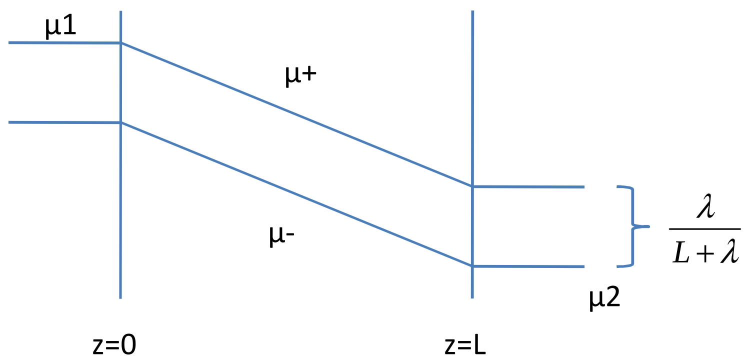
$$G = \sigma \frac{A}{L+\lambda}$$

$$R = \frac{\rho}{A}(L+\lambda)$$

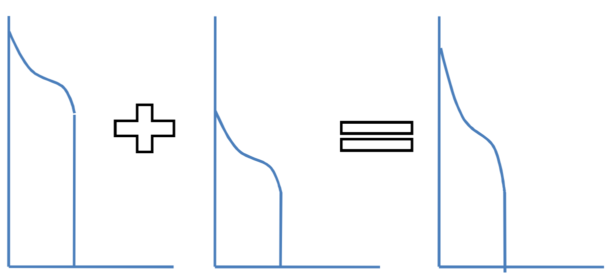
$$I = q\int dE \frac{Dv_z}{2L}\left(f^{+} - f^{-}\right)$$





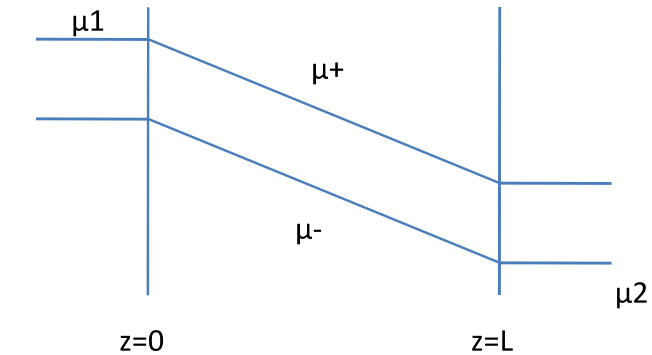


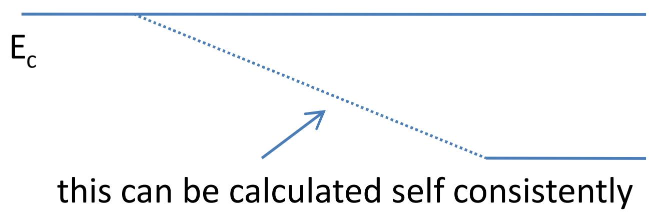
(at large T)

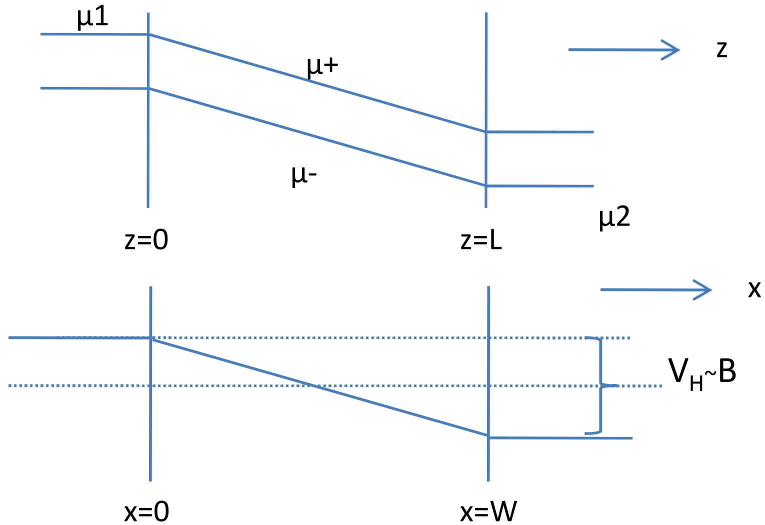


We can do Taylor series expansion of fermi function at large T

$$\left(f^{+} - f^{-}\right) \sim \left(-\frac{df}{dE}\right)(\mu_1 - \mu_2)$$

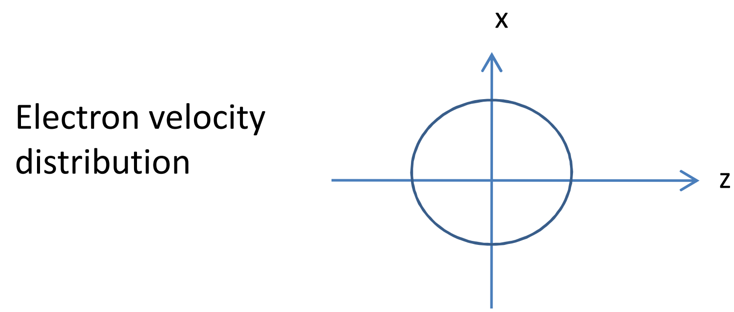


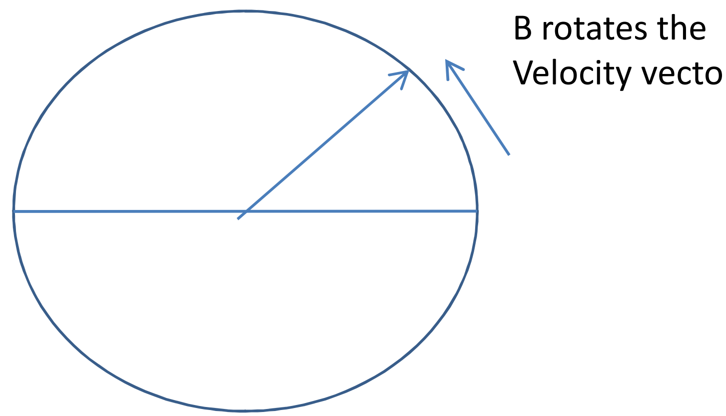




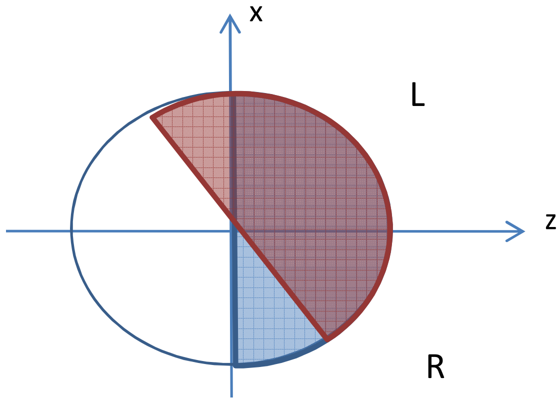
$$\frac{V_H}{I} = \frac{B}{qn}$$

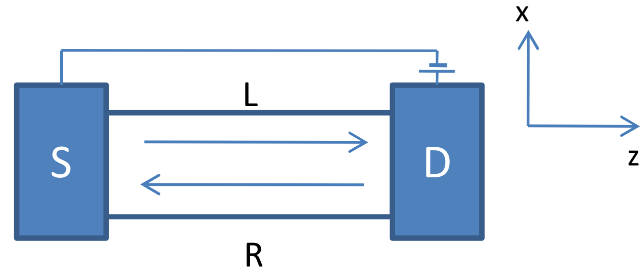
$$\sigma = qn\mu_n$$



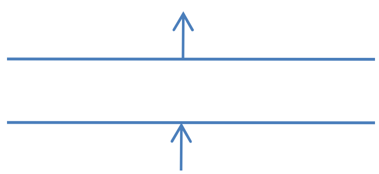


Cyclotron frequency $\omega_c = \frac{qB}{m}$





$$\frac{df^L}{dx} = \frac{df^R}{dx} = -\frac{\left(f^L - f^R\right)}{\lambda} + (\ )B$$



$$\Delta f_L = \frac{\omega_c}{\pi/2}\left(\frac{\Delta x}{v}\right) f^+$$

$$\frac{\Delta f_L}{\Delta x} = \frac{\omega_c}{\pi/2}\frac{f^+}{v}$$

$$\frac{df_L}{dx} = \frac{df_R}{dx} = \frac{\omega_c}{\pi/2}\left(f^+ - f^-\right)$$

$$f_{L,R}(x=0) - f_{L,R}(x=W) = \frac{qBW}{(\pi/2)mv}\left(f^+ - f^-\right)$$

$$V_H = \frac{qBW}{(\pi/2)mv}\frac{\mu^+ - \mu^-}{q}$$

$$I = q^2\frac{Dv_z}{2L}\frac{\mu^+ - \mu^-}{q}$$