

FUNDAMENTALS OF NANO ELECTRONICS

Basic Concepts

1. The New Perspective

Energy Band Model

3. What and Where

is the Voltage?

4. Heat & Electricity:

Second Law & Information

2.1. Introduction

2.2. $E(p)$ or $E(k)$ relation

2.3. Counting States

2.4. Density of states

2.5. Number of modes

2.6. Ballistic Conductance vs n

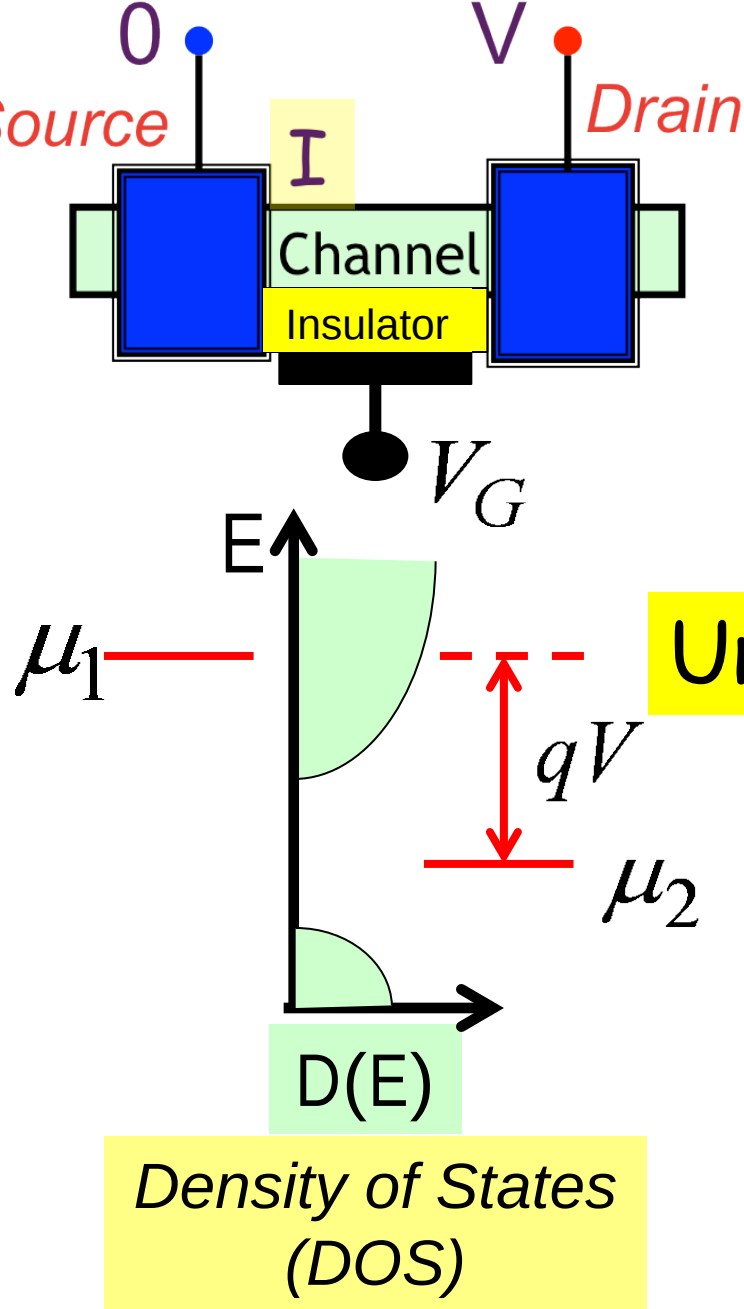
2.7. Conductivity vs n

2.8. Quantum Capacitance

2.9. The Nanotransistor

2.10. Summing up ..

2.10a Summing up ..



New perspective

Drude formula

$$\sigma = \frac{G_B}{A} \lambda$$

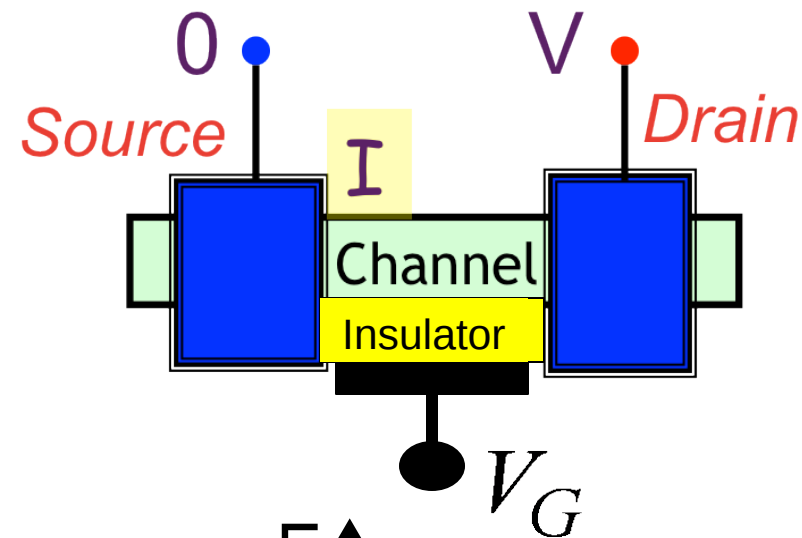
$$\sigma = q^2 \frac{n}{m} \tau$$

$$I = \frac{1}{q} \int_{-\infty}^{+\infty} dE G(E) (f_1(E) - f_2(E))$$

$$I/V = \int_{-\infty}^{+\infty} dE \left(-\frac{\partial f_0}{\partial E} \right) G(E)$$

$$G = \frac{q^2 D}{2t} = \frac{G_B \lambda}{L + \lambda} \rightarrow \frac{\sigma A}{L + \lambda}$$

2.10b Summing up ..

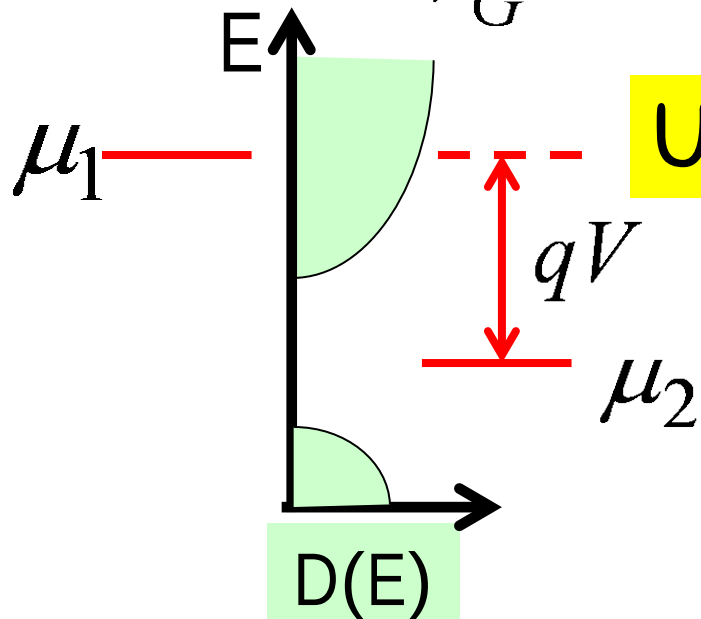


New perspective

Drude formula

$$\sigma = \frac{G_B}{A} \lambda$$

$$\sigma = q^2 \frac{n}{m} \tau$$



Unit 2

Density of States (DOS)

2.2 E(p)

2.3 N(p)

2.4 D(E)

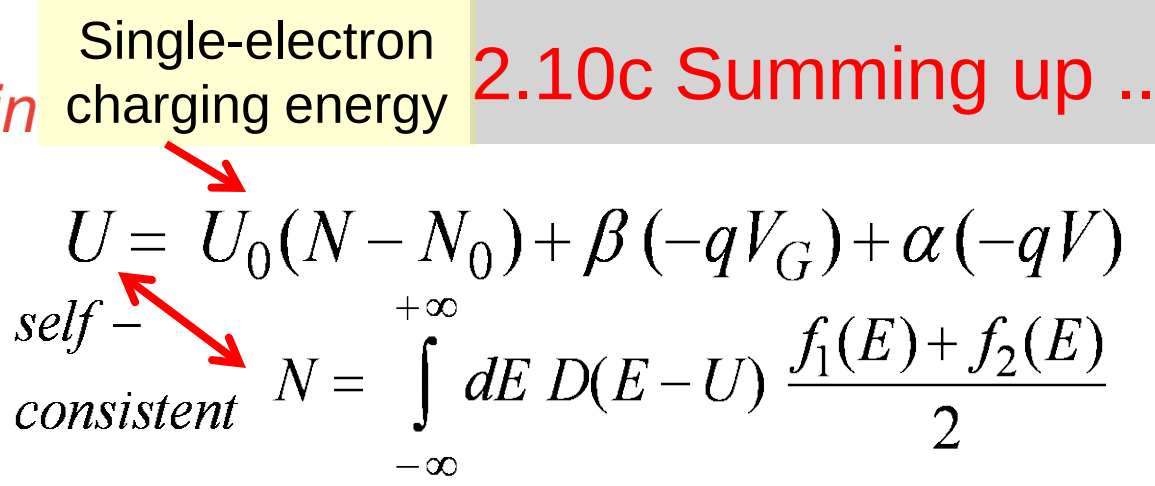
2.5 M(E)

2.6 n(E)

2.7 Drude

2.8 Gate

2.9 I - V



$$U = U_0(N - N_0) + \beta(-qV_G) + \alpha(-qV)$$

self-consistent  $N = \int_{-\infty}^{+\infty} dE D(E - U) \frac{f_1(E) + f_2(E)}{2}$

$$I = \frac{1}{q} \int_{-\infty}^{+\infty} dE G(E - U) (f_1(E) - f_2(E))$$



2.2 $E(p)$

2.3 $N(p)$

2.4 D(E)

2.5 M(E)

2.6 $n(E)$

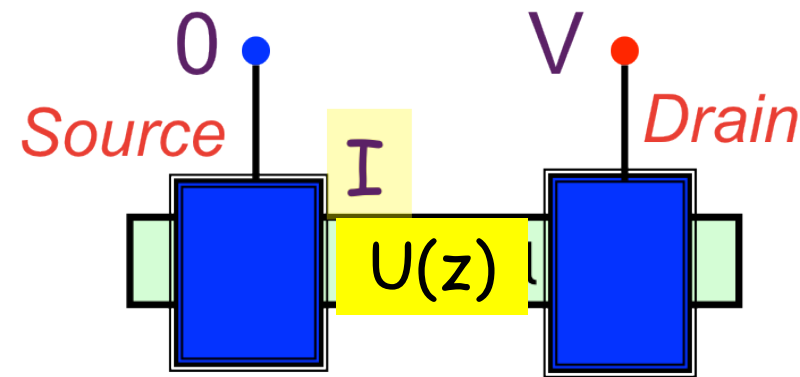
2.7 Drude

Density of States (DOS)

2.8 Gate

2.9 I - V

2.10d Summing up ..



$$I = \frac{1}{q} \int_{-\infty}^{+\infty} dE G(E - U) (f_1(E) - f_2(E))$$

$$N = \int_{-\infty}^{+\infty} dE D(E - U) \frac{f_1(E) + f_2(E)}{2}$$

Boltzmann Transport Equation (BTE)

$$\frac{R_B}{2} \quad R_B \quad \frac{L}{\lambda} \quad \frac{R_B}{2}$$

$$R = R_B \left(\frac{L + \lambda}{\lambda} \right) = R_B \frac{L}{\lambda} + R_B$$

self-consistent

Drift Diffusion Equation

$$I = - \frac{\sigma(z)}{q} \frac{d\mu}{dz}$$

$$\frac{dI}{dz} = 0$$

Poisson Equation

$$\frac{d}{dz} \left(\epsilon \frac{dU}{dz} \right) = q^2 (n - n_0)$$

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

$$U = U_0 (N - N_0) + \beta (-qV_G) + \alpha (-qV)$$

Coming up next ..

Basic Concepts

1. The New Perspective

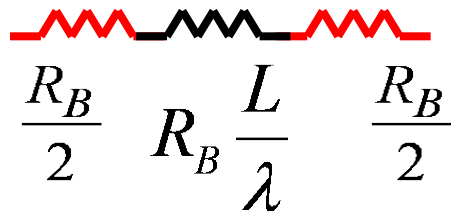
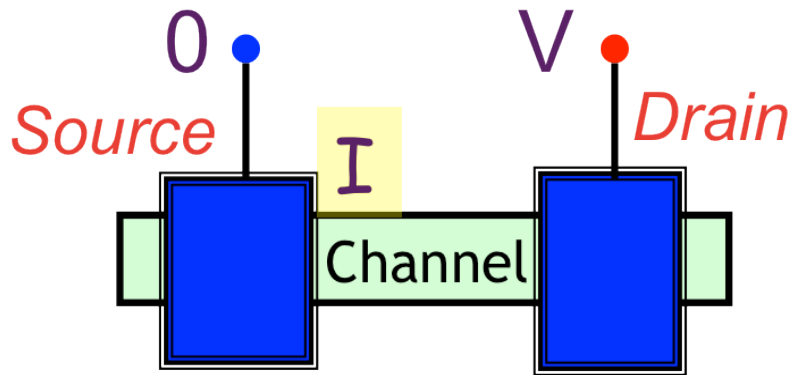
2. Energy Band Model

3. What and Where

is the Voltage?

4. Heat & Electricity:

Second Law & Information



$$R = R_B \left(\frac{L + \lambda}{\lambda} \right) = R_B \frac{L}{\lambda} + R_B$$