FUNDAMENTALS OF NANOELECTRONICS

Basic Concepts

The New Perspective

2. Energy Band Model

3. What and Where

   is the Voltage?

4. Heat & Electricity:

   Second Law & Information

1.1. Introduction

1.2. Two Key Concepts

1.3. Why Electrons Flow

1.4. Conductance Formula

1.5. Ballistic(B) Conductance

1.6. Diffusive(D) Conductance

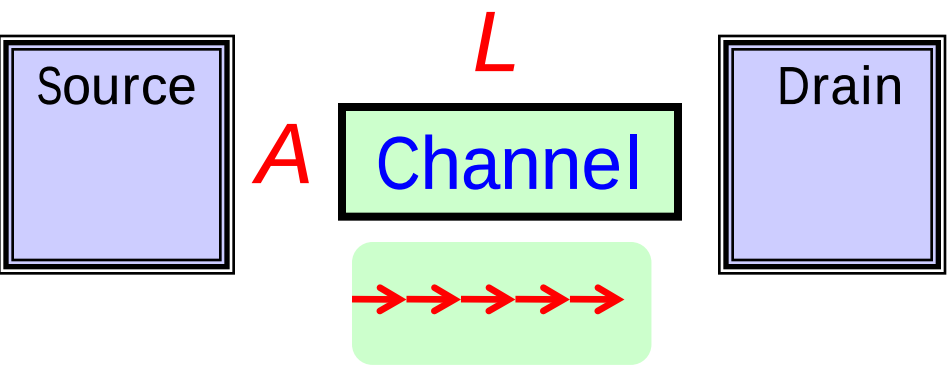
1.7. Connecting B to D

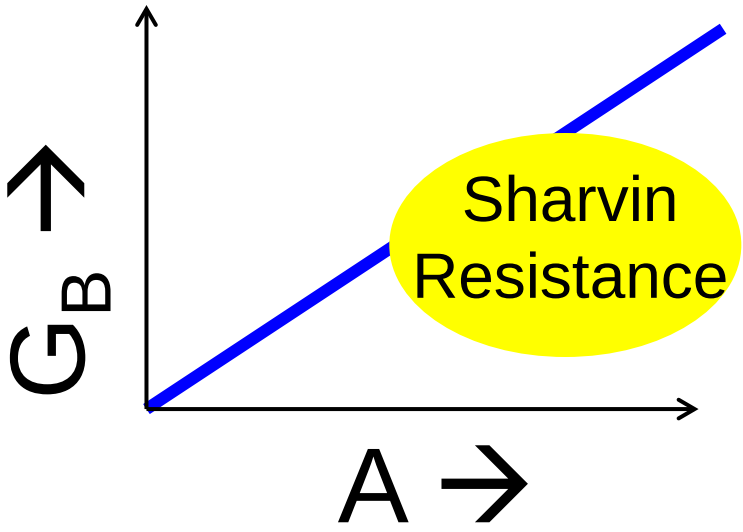
1.8. Angular Averaging

1.9. Drude Formula

1.10. Summing up ..

1.5a Ballistic Conductance





D ~ AL

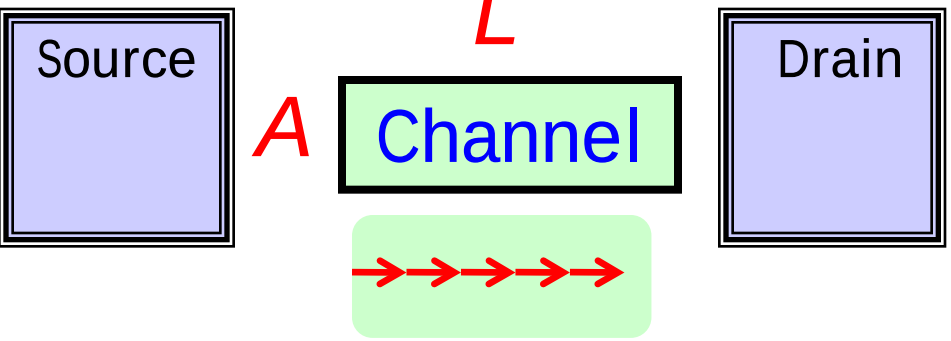
$$t_B = \frac{L}{\bar{v}}$$

$$G = \frac{q^2 D}{2t}$$

$$G_B = \frac{q^2 D \bar{v}}{2L} \sim A$$

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

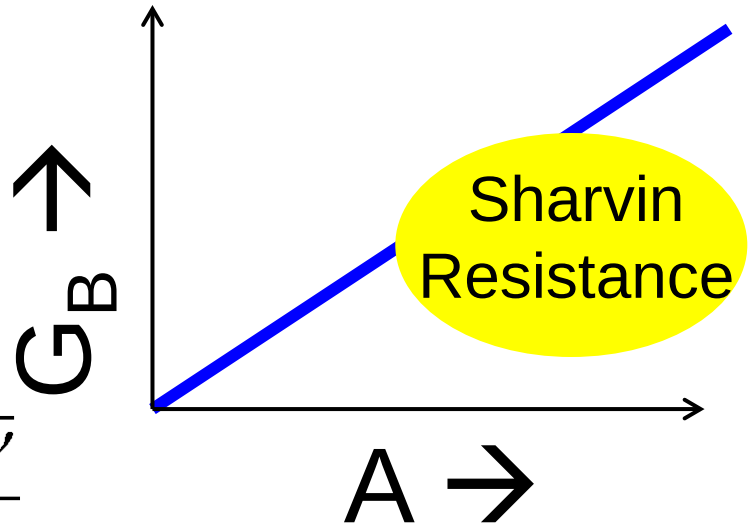
1.5b Ballistic Conductance



$$t_B = \frac{L}{\bar{\nu}}$$

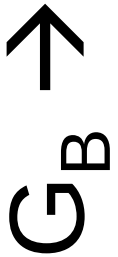
$$G = \frac{q^2 D}{2t}$$

$$G_B = \frac{q^2 D \bar{\nu}}{2L}$$

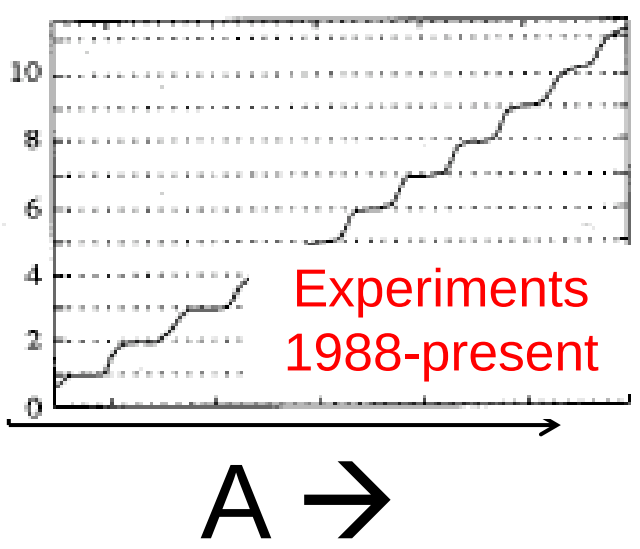


$$\frac{2t}{D} = h$$

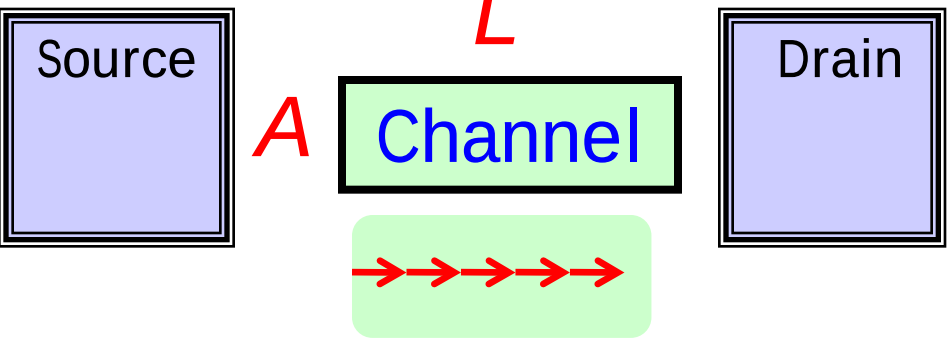
$$G_B = \frac{q^2}{h} \times M$$



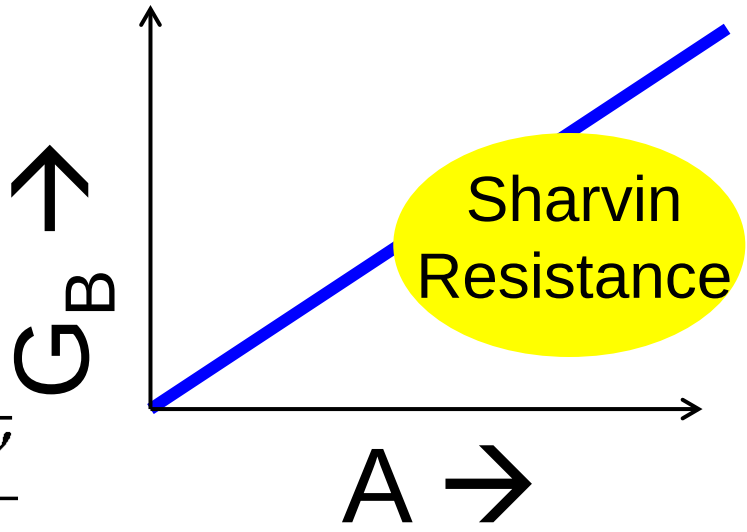
$$\Delta E \sim \frac{h}{t}$$



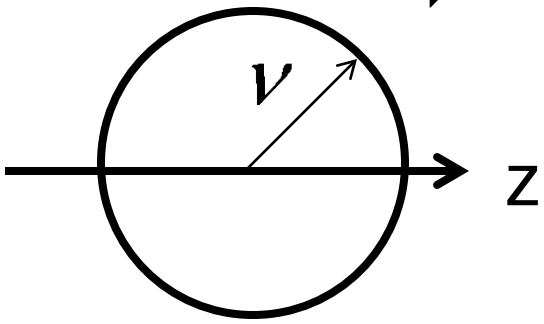
1.5c Ballistic Conductance

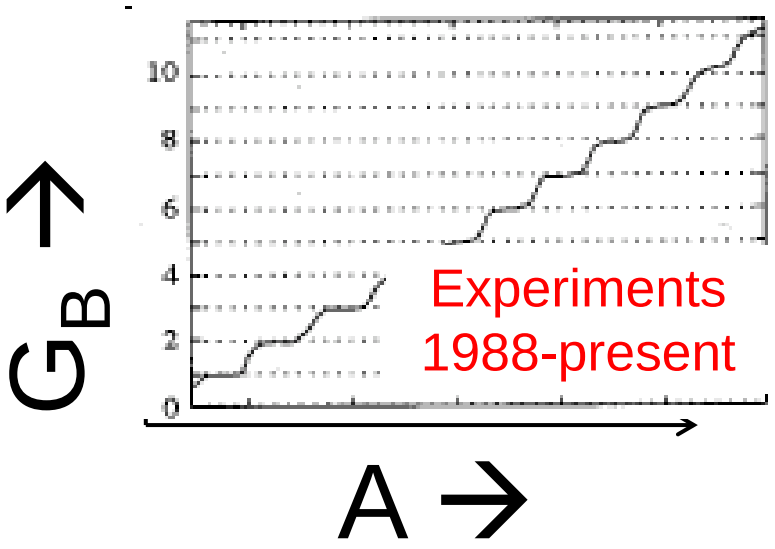


$$t_B = \frac{L}{\bar{\nu}} \qquad G = \frac{q^2 D}{2t} \qquad G_B = \frac{q^2 D \bar{\nu}}{2L}$$



$$\bar{\nu} = \left\langle \left| \nu_z \right| \right\rangle$$





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

$$G(E) = \frac{q^2 D}{2t}$$

$$G_B = q^2 \frac{D\bar{\nu}}{2L}$$ Ballistic

$$\bar{\nu} \equiv \langle |\nu_z| \rangle$$

Conductivity

$$\sigma = q^2 \bar{D} \frac{D}{AL}$$ Diffusive

Coming up next ..

1.1. Introduction

1.2. Two Key Concepts

1.3. Why Electrons Flow

1.4. Conductance Formula

1.5. Ballistic(B) Conductance

1.6. Diffusive(D) Conductance

1.7. Connecting B to D

1.8. Angular Averaging

1.9. Drude Formula

1.10. Summing up ..