3.10a Summing Up …

- Follow the voltage $IR$ NOT the heat $I^2R$

Voltage drop corresponds to intuition even on atomic scale

$$J = - \frac{\sigma_0}{q} \frac{d\mu}{dz}$$

- Electrochemical NOT Electrostatic Potential

ESP is smeared out

ESP is NOT constant even in equilibrium
3.10b Summing Up …

- Follow the voltage $\text{IR}$, NOT the heat $I^2R$.
- Electrochemical NOT Electrostatic Potential.

**Benchmark:**
- Boltzmann equation
- NEGF: Quantum Transport

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NEGF-based Calculation
3.10c Summing Up …

- Follow the voltage $\mathbf{V}$
- NOT the heat $I^2R$
- Electrochemical NOT
- Electrostatic Potential

\[
\mu(E) = \frac{1}{1 + \exp\left(\frac{E - \mu(E)}{kT}\right)}
\]

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3.10d Summing Up …

- Follow the voltage $IR$
  - NOT the heat $I^2R$

- Electrochemical NOT
  - Electrostatic Potential

- Boltzmann equation
  - NEGF: Quantum Transport

- Quasi-Fermi Levels (QFL’s)
3.10e Summing Up …

- Follow the voltage $IR$
  - NOT the heat $I^2R$

- Electrochemical NOT
  - Electrostatic Potential

- Boltzmann equation
  - NEGF: Quantum Transport

- Quasi-Fermi Levels (QFL’s)

- Spin Potentials

$J = \sigma F \sim -d\phi/ dx$

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Basic Concepts

1. The New Ohm’s Law
2. Quantum of Resistance
3. What & Where is the “Voltage”?

4. Heat & Electricity:
   Second Law & Information

FUNDAMENTALS OF NANOELECTRONICS

Coming up next ..

Source
Channel
Drain

Thermodynamics: Entropy driven
Mechanics: Force driven

Usually all mixed up !!

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