Chapter 40

Quantum Mechanics I: Wave Functions

40.1 The Wave Equation

8/24:

- **Quantum wave**: The wave-like nature of an electron.
- But waves must satisfy a wave equation.
  - The classical one didn't work.
  - In 1925, Schrödinger determined that in one dimension, an electron moving in a potential V (the nucleus-electron Coulombic attraction) satisfies

$$-\frac{\hbar^2}{2m}\frac{\partial^2\Psi(x,t)}{\partial x^2}+V\Psi=i\hbar\frac{\partial\Psi}{\partial t}$$

    - This wave equation wasn't derived in an analogous method to Figure 15.2, but rather was constructed from conservation of energy.
  - This wave function has both real and imaginary parts with the inclusion of $i=\sqrt{-1}$.

40.2 Electrons in the Double Slit Experiment

- Electrons exhibit both diffraction and interference in the double slit experiment.
  - $d\sin\theta=m\lambda$ applies when λ is the deBroglie wavelength.
  - Even with only one electron being emitted at a time, you get interference (further confirms wave-like nature of electrons): $\Psi_{\text{electron}}=\Psi_{\text{slit 1}}+\Psi_{\text{slit 2}}$.
  - Observing which slit an electron goes through removes the interference pattern.
- $P\propto\Psi^2$ is independent of time, so you have static charge distributions.