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.

40.3 Office Hours (Gazes)

- Quantifying optical roughness?
- What are C_V and C_p? Are they specific to certain gasses?
- What is an adiabatic process? Is it a straight conversion from temperature (internal) energy to work? I find this highly unintuitive.

  - Heat flow is held constant, so we have the process happening in an insulating container.
  - Temperature, pressure, and volume are all changing, hence the isotherm-crossing curve in Figures 20.1 and 20.3.
  - Running a fire piston backwards does cause the interior to get colder.
  - Releasing air from a compressed air can is also an adiabatic process (pressure decreases, volume effectively gets much bigger as it enters the room, and can gets cold).

- Additive entropies derivation.