Lecture 21 (2-5), Oct 31, 2022

X-Ray Diffraction

- X-rays are reflected from atoms in the crystalline structure of solids
- Reflected x-rays from different layers can interfere constructively or destructively, leading to a diffraction pattern
- Bragg's Law: $n\lambda = 2d\sin\theta$ leads to constructive interference, where d is the spacing between layers of atoms
  - We can orient the crystal in different ways and get different values of d to figure out the arrangement of atoms
  - This can also be used to determine λ given known θ and d
- Powder diffraction: doing an effective average of all the d distances by having tiny particles of the crystal as a powder, which lets us do all orientations at once

Matter Waves

- de Broglie: if photons can behave like both a particle and a wave, can electrons?
- $\lambda = \dfrac{h}{p}$ for photons, so can other matter act like waves?
- What if electrons around a Bohr model acted like standing waves?
  - From this assumption we can derive Bohr's quantization idea that $mvr = L = n\hbar$
- $\lambda = \dfrac{h}{\sqrt{2mE}}$ because $E = \dfrac{1}{2}mv^2 = \dfrac{p^2}{2m}$, for an electron this is about 1.23Å
- This idea was proven by doing diffraction on electrons