Today	**Ch 28 - 30**	The Atomic Picture	**HW28Redo; HW30**
Friday	**Ch 31**	The Nuclear Atom	**HW29Redo; HW31**

Wave Mechanics: Special Relativity to the Atomic Spectrum

- **Outline**
- **Development of Wave vs. Quantum Mechanics**
  - **Quantum Mechanics**
  - **Wave Mechanics**
- **Useful Background**
  - **Special Relativity**
  - **De Broglie Wavelength**
- **Wave Packet – particle vs. wave compromise**
  - **Light**
  - **Matter**
  - **Test the concept and the prediction**
    - **Doesn't disagree with classical physics in every day situations**
    - **Ex. Diffraction**

Example1: De Broglie Wavelength. Say you're running like a jaguar, 50 mph = 22m/s. If you have a mass of 68 kg then A) what's you're De Broglie Wavelength? B) What's your diffraction angle through a 1m wide doorway?

29.6 Heisenberg Uncertainty Principle

Audio Example

- **Position vs. wavelength**
  - **Limiting Examples**
    - **A single, pure-tone wave**
    - **A beat**
    - **Super Beat**.
  - **Mathematically**
- **Time vs. Frequency.**
- **Momentum and Energy**

Example2: Uncertainty Principle. An electron, described by a wave-packet, is confined in what is known as a 'quantum corral' that measures 2nm long and 2nm wide. Just considering the width, A) plane waves of what minimum range of momenta comprise the wave-packet? B) what range of (the component of) velocity?

- **Atomic Structure**
  - **Nuclear Atom.**
  - **Analogy: Shooting into a Dark Room.**
  - **What are the electrons *doing*??**
    - **Particle Picture Possibilities and Problems**
      - **Orbiting the nucleus**.
      - **Just sitting out there**.
    - **Wave Picture Solution and Features**
      - **Standing wave Refresher: Harmonic Series**

- **Linear Quantization Example: Laser Cavity**
- **Atomic Electron Energy Levels (circular quantization)**
  - r_n =
  - E_n =

Example3: Electronic Orbital Radii and Energy. A doubly-ionized lithium atom has just one electron. **A)** What is the second smallest allowed orbital radius for that electron and **B)** What is the associated energy?

- **Multi-electron Atoms**

- **Atomic Spectra**

Demo: Atomic Spectrum of H, He, and Hg.

- **Application: Neon signs & Florescent lights.**

Example4: Atomic Spectra . The spectral lines of light emitted when an excited electron falls from a higher orbital down to n = 5 make up the 'Pfund series' of lines. A) What is the shortest wavelength of light in this series? B) What is the longest?

HW31

Ch29

33. Consider a line that is 2.5 m long. A moving object is somewhere along this line, but its position is not known. (a) Find the minimum uncertainty in the momentum of the object. Find the minimum uncertainty in the object's velocity, assuming that the object is (b) a golf ball (mass = 0.045 kg) and (c) an electron.

Ch 30

Terminology:

Ground state = lowest energy state for the electron / atom. For H and He, that's when $n = n_{ground} = 1$.

Excited state = state above the ground state. The 1st Excited state is $n = n_{ground} + 1$, the 2nd Excited state is $n = n_{ground} + 2$, etc.

8. Concept Simulation 30.1 at www.Wiley.com/college/cutnell (6th edition) reviews the concepts on which the solution to this problem depends. The electron in a hydrogen atom is in the first excited state, when the electron acquires an additional 2.86 eV of energy. What is the quantum number n_{final} of the state into which the electron moves?

10. A singly ionized helium atom (He^+) has only one electron. What is the radius of the electron's orbital when it is in the second excited state?

14. A hydrogen atom is in the ground state. It absorbs energy and makes a transition to the $n = 3$ excited state. The atom returns to the ground state by first dropping into the 1st excited state and then into the ground state. What are the wavelengths of the two photons emitted?