Quick Quiz

Water is heated slowly until it reaches its boiling point. As the hot stove delivers additional energy to the container of water, the temperature of the water remains constant. This is because

a) energy travels straight through the water—in the bottom, out the top.
b) the additional energy is being stored in the walls of the container.
c) the additional energy is becoming internal electrical potential energy in the water and vapor rather than changing the temperature.
d) The additional energy is becoming internal kinetic energy in the water and vapor rather than changing the temperature.

Quick Quiz

Imagine you are observing a demonstration of “Brownian motion”. According to the molecular model, which statements are true?

a. You see tiny, individual molecules jiggling about.
b. The particles spontaneously break into segments due to internal forces—looks like vibratory motion.
c. Ordinary laws of force and motion cannot account for the observed accelerations of the particles.
d. all of the above are true.
e. none of the above are true.

Main Ideas

• Atomic Properties
  – size, mass
  – constituent parts
  – mass distribution
  – energy levels

• Hierarchy of Models
  – molecular model
  – Thomson model
  – Rutherford model (Solar System Model)
  – Bohr model
  – wave model (next time)
Gas Discharge Tube

- negative particles are identical
  - small mass; electrons
- positive particles differ depending on gas
  - large mass
  - even small differences with same gas

Thomson Model of Atom (Plum Pudding Model)

- Atoms consist of a thin positive fluid or cloud containing point-like negative electrons

Rutherford’s Experiment

- most particles went straight through
- some were scattered at large angles
Rutherford Model of Atom

- Most atomic mass in small positively charged nucleus
  - radius of nucleus is 1/100,000 that of atom
  - density of nuclear matter about 1,000,000,000 times that of normal matter (like mass of battleship in size of pin)
- Electrons orbit nucleus like planets in elliptical orbits

Problems at the start!

- Accelerating (orbiting) electrons should continually radiate, loose energy, and spiral into the nucleus
- However if electrons are stationary they would fall into the nucleus too.
- Why are discrete spectra seen from gas discharge tubes rather than continuous spectra?
- There was no fix for these. The model was created with flaws and soon died.

Discrete Spectra

- Gas discharge tubes
  - excited atoms only radiate lines with discrete frequencies
  - the frequencies are characteristic of the types of atoms in the gas
- Absorption cells
  - black lines corresponding to discrete spectral absorption
  - valuable astronomy tool
Bohr Model of Atom

- electrons can only have certain angular momenta and therefore occupy certain stable orbits with characteristic energies
- discrete emission and absorption lines are from electrons jumping between these allowed orbits

Bohr Spectra

Matched Rydberg’s trial and error formula!

Models of Matter so far:

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<th>Does NOT explain</th>
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Problems with the “Bohr Model”

1. Why are only certain orbits possible (not like a solar system!)
2. Why doesn’t the undisturbed atom radiate? (Why don’t the electrons fall into the nucleus?)
   ‘Because Bohr says so’ is not a good answer

Chapters 15 and 16 hold the answers to these questions.