

## Development of Modern Atomic Theory -- A Summary

### J.J. Thomson

- discovered sub-atomic particles common to all elements in cathode ray tube experiments
- named negatively charged particles with very little mass **electrons**
- positively charged particles with much greater mass called **protons**

**MODEL: "plum pudding"** : positive charge of protons distributed throughout atom, electrons embedded like raisins or nuts in pudding

### Ernest Rutherford et. al.

- designed **alpha-particle scattering experiment** using radioactive source and gold foil
- observed that most particles passed through foil undeflected, some slightly deflected and a very few *reflected*
- concluded that Thomson's model was incorrect

**MODEL: "nuclear" atom** : positive, very small center of atom is *nucleus* containing protons; electrons move around nucleus like planets around sun; atom is mostly empty space

### Niels Bohr

- worked out mathematical model of hydrogen atom which explained emission line spectrum of only certain wavelengths using Planck's quantum concept,  $E = h\nu$
- showed that calculations matched observed behavior of electrons as existing on only certain energy levels in the atom, "quantization"

**MODEL: Bohr atom** : similar to Rutherford in structure but electron energy levels fixed at certain amounts or distances from nucleus; electron transitions from higher to lower levels result in discrete wavelengths of emitted light

### Erwin Schrödinger

- combined some particle behavior with wave behavior as suggested by deBroglie and formulated mathematical model for hydrogen atom
- derived equation which gives the *probability* of finding the electron at some point in a 3-dimensional space at any given instant; gives no information about the path the electron follows
- solutions from equation yield information about probability maps or shapes on different energy levels

**MODEL: "wave/mechanical"** : basic layout of atom similar to Bohr and Rutherford, but electrons do not follow simple orbits; their position can only be predicted in terms of probability