# THE ELECTRON WAVE

**The Dilemma of the Atom:**

- Electrons outside the nucleus are attached to the protons in the nucleus.
- Charged particles moving in curved paths lose energy.
- What keeps the atom from collapsing?
- It is because the energy is "quantized". The electron's energy can't have any value, it can only have a multiple of the elementary energy.

**Wave-Particle Duality:**

- JJ Thomson won the Nobel Prize for describing the electron as a particle.
- His son, George Thomson won the Nobel prize for describing the wave-like nature of the electron.

**The Wave-like Electron:**

- Louis deBroglie said "The electron propagates through space as an energy wave. To understand the atom, one must understand the behavior of electromagnetic waves.
- Electromagnetic radiation propagates through space as a wave moving at the speed of light.
- $C=VL$
  - C= speed of light, a constant ($3.00 \times 10^8$ m/s)
  - V= frequency, in units of hertz (hz, $sec^{-1}$)
  - L= wavelength, in meters
- The energy (E) of electromagnetic radiation is directly proportional to the frequency (v) of the radiation.
- $E= hv$
  - E= Energy, in the units of Joules ($kg.m^2/s^2$)
  - h= Planck's constant (6.626 x 10-34 J.s)
  - v= frequency, in units of hertz (hz, $sec^{-1}$)
- Long Wavelength=Low Frequency=Low Energy
- Shorth Wavelength=High Frequency=High Energy

**Answering the Dilemma of the Atom:**

- Treat electrons as waves
- As the electron moves toward the nucleus, the wave length shortens
- Shorter wavelength=higher energy
- Higher energy=greater distance from the nucleus

**Electron Transitions:**

- Electron transitions involve jumps of definite amounts of energy.
- This produces bands of light with definite wavelengths.
- Spectroscopic analysis of hydrogen spectrum produces a "bright line" spectrum.

**Flame Tests:**

- Many elements give off characteristic light which can be used to help identify