Modern Physics

Louis de Broglie, Erwin Schrodinger and Werner Heisenberg

Louis de Broglie (1923)

- Nature has symmetry.
- If light sometimes behaves like a wave and sometimes like a particle, then electrons and other matter also has wave properties.
- The wavelength of a matter is related to its momentum in the same way as for a photon:
- p = h/(wavelength)
- Wavelength = h/m v

Example

- Calculate the de Broglie wavelength of a ball with mass = 0.20 kg moving with a speed of 15 m/s.

- Wavelength = h/m v
- = (6.63 x 10^(-34))/(0.20)(15)
- = 2.2 x 10^(-34) m

Calculate your wavelength !!!

Given your mass in kg and given you are walking

In East Bottom at 1.5 m/s. What is your de Broglie wavelength?

Wavelength = h/m v

Example of my wavelength

- Wavelength = h/m v
- (6.63 x 10^(-34))/(80) (1.5) = 5/5 x 10^(-36) m

Example

- Calculate the wavelength of an electron traveling at 5.9 x 10^6 m/s.

- Wavelength = h/m v

  = (6.63 x 10^(-34))/(9.1 x 10^(-31))(5.9 x 10^6)

  = 1.2 x 10^(-10) m

Electron

- Electron orbits the nucleus. These orbits correspond to CIRCULAR STANDING WAVES.
- n = 1 has one wavelength
- n = 2 has two wavelengths
- n = 3 has three wavelengths

- Also, electrons diffract through single slit and double slit like WAVES.

No one has actually ever seen an electron !!!!

- The particle model and the wave model are mere pictures that we use to address the reality of an electron.
- We use a wave or a particle model (whichever works best in a situation) so that we can talk about what is happening.
- An electron is just a “logical construction.”

Erwin Schrodinger

- The amplitude of an electron wave is called the wave function (“psi”). “Psi” is the amplitude at any point in space/time of a matter wave. “Psi”^2 at a certain point in space and time represents the probability of finding an electron at the given position.
- We cannot predict or even follow the path of an electron precisely through space/time.

Werner Heisenberg (1927)

- Heisenberg Uncertainty Principle.
- The act of observing produces an uncertainty in position or momentum of an electron.
- (When a photon strikes a small object such as electron, it can transfer momentum to the object and thus change the object's motion and position in an unpredictable way).
- We cannot measure both the position and the momentum of an object precisely at the same time.