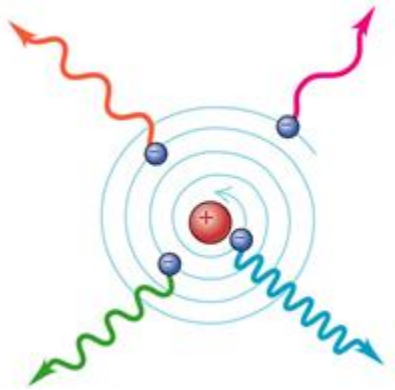
# De-Broglie Waves



Classical physics predicts electron should “spiral in” to the nucleus emitting continuous spectrum of radiation as the atom “collapses”. Classical physics can’t give us stable atoms.

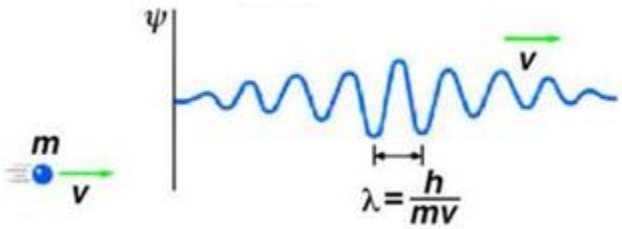
In 1924, the French physicist Louis de Broglie proposed that moving objects behave like waves; these are called **Matter Waves**.

De Broglie waves represent the set of waves which establish or reveal the nature and conduct of some atoms, molecules or some elementary particles under certain circumstances.

The de Broglie Wavelength is denoted by λ and is written as,

$$\lambda = \frac{h}{mv}$$

Here the symbols have the following meanings.




‘h’ stands for Planck constant

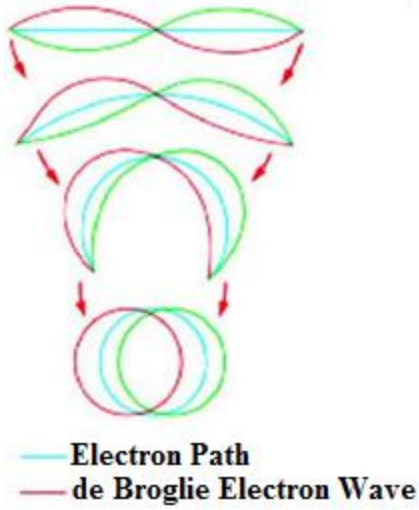
‘m’ denotes the mass

‘v’ is the velocity of the particle

So, the momentum of ‘p’ will be,

$$p = mv = \frac{h}{\lambda}$$

Hence, the De Broglie relation shows that **the wavelength is proportional to the momentum of the particle**. The frequency of the waves has also been deduced by Broglie and he has proved it to be directly proportional to the total energy E of the particle(where E is the sum of potential and kinetic energy).

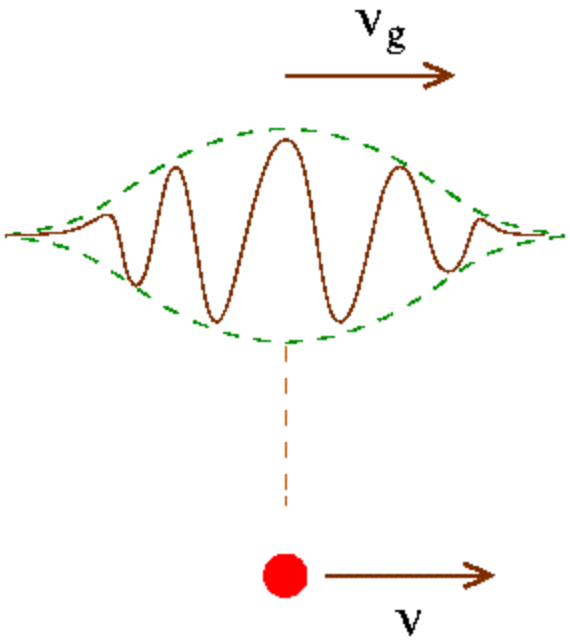



The French Physicist Louis de Broglie, in 1924 suggested that besides the particle properties, particles may also exhibit wave properties. It took around three years to spot the wave nature of electrons. These waves are also called as matter waves and they demonstrate the properties of a material object which tend to change in time or space in accordance with the mathematical equations which illustrate these waves. De Broglie waves play a vital and commendable role but only in the case of subatomic particles.

An electron can circle a nucleus only in orbits that contain a whole number of de Broglie Wavelengths. The quantum number n of an orbit is the number of electron waves that fit into the orbit.

It is only due to the Broglie waves that subatomic particles can be found in otherwise unexpected cases. The reason behind this is the ability of these waves to penetrate barriers.

The Broglie waves around a closed loop just like the waves coupled with electrons attached to the nuclei in atoms can continue to stay provided the waves fit perfectly around the loop, else they cancel out themselves. It is this necessity that forces the electrons in atoms to opt for some specific structures or arrangements out of the many which would have been there otherwise.




It was in 1925, even before the discovery of electron diffraction that De Broglie proposed the concept of wavelength λ of waves associated with particles like electrons and photons. If 'p' I the momentum of these particles then it is given by

$\lambda = h/p = h/mv$

The wavelength associated with an electron accelerated through a potential difference of V volt is given by

$1/2\ m_e v^2 = eV$ or $v = \sqrt{2eV/m_e}$

$$\lambda = \frac{h}{m_e v} = \frac{h}{\sqrt{2m_e eV}}$$