International Journal of Physics and Applications.
ISSN 0974-3103 Volume 6, Number 1 (2014), pp. 29-31

http://www.irphouse.com

Historical Origins of the Quantum Theory

Paresh V. Modh

R.R. Mehta collage of Science
C.L. Parikh Collage of Commerce, Palanpur, Gujarat, India
Email:paresh_modh@rediffmail.com

ABSTRACT:

Many observations on atoms and other very small particles show that they behave in a quite different way from large scale objects, and that in many ways. They are similar to light. Very small particles do not follow the rules of classical mechanics. Although Newton's laws are valid for everyday large-scale objects, a new theory is required to describe the behavior of very small particles. The new theory is called quantum theory.

Key words: Rutherford atomic model, Black body, Plank hypothesis, dual-nature of light, Classical mechanics, spectrum of Hydrogen atom, $E=nh\nu$, photoelectric effect, atomic dimensions.

Introduction:

In initial nineteenth century, classical mechanics cannot hold on microscopic elements. We are discussing many examples of the physics that have been explained by quantum mechanics. Classical mechanics explained successfully the motion of objects which are either directly observable or can be made observable by simple instruments like microscope. However, in modern age, we consider particles which are too small to be seen even through the highest powered microscopes. In these matters, classical physics cannot be applicable.

Rutherford established experimentally that an atom consists of negative charge electron and positive charged nucleus. Electrons are revolving around the nucleus, but when negative charged particles are revolving around the nucleuses, and then radiations are emitted. And consequently electron collapse with the nucleus. And, stability of atom in the universe is not possible according to Rutherford's model. This shows the stability of atoms cannot be understood on the basis of classical model, i.e. classical mechanics could not explain the stability of the atoms.

Similarly, classical mechanics could not explain the spectrum of Hydrogen atom. It is experimentally fact that H-atom consists of discrete wavelengths as per given equation.

$$\frac{1}{\lambda}=R\left(\frac{1}{m^2}-\frac{1}{n^2}\right)$$

Where R=Rydberg constant and *m* and *n* are integer numbers. We can get different series like Lymen series, Balmer series, Paschan series, Bracket series, and Pfund series. It is clear from above different series, excited H-atom emits distinct wavelength and not all the wavelength continuously as expected in classical mechanics.

A body which absorbs all the wavelength of incident on it. It neither reflects nor transmission. This body is known as blackbody. The spectrum of radiation emitted from a hot body at a given temperature is curve.

Rayleigh Jeans explained only the low part of the experimentally observe curve and Wein explained only the high part of the curve. Experimentally curve indicates that the energy is not uniformly distributed in the radiation spectrum of the black body. And the intensity of radiation is maximum at a particular wavelength, which is a characteristic of the temperature of the radiating body. Both of the above statements are incorrect and fail completely. This discrepancy in classical calculation and observed spectra was removed by quantum mechanics.

Planck said that energy emitted by anybody is in the form of discrete. This energy is always integral multiple of hν.

$$E=nh\nu$$

Where n = integral numbers, h = Planck constant, A chamber containing black body radiations also contains simple harmonic oscillators of molecular dimensions which can vibrate with all possible frequencies. According to Planck the energy changes could take place only discontinuously and discretely, always an integral multiple of small unit of energy which is called quantum (or photon).

The photoelectric effect and Compton scattering show that light can behave as individual particles, each one having a definite energy and momentum. But the phenomenon of interference, diffraction and polarization which can only be explained by wave nature of light or electromagnetic radiation. The property of the photon of behaving as both a particle and a wave is called wave-particle duality. Whether the wave-like or the particle like properties of light are more important in a particular case does depend to some extent on the wave-length.

According to the de-Broglie hypothesis (1) if there is a particle of a momentum P, its motion is associated with a wave of wave length $\lambda = h/p$ and (2) if there is a wave of wavelengthλ, the square of the amplitude of the wave at any point is proportional to the probability of observing a particle of momentum $p = h/\lambda$ at that point.

Conclusions:

A new branch is developed, i.e. quantum mechanics, due to some phenomen as like Rutherford atom, H-atom, photoelectric effect, black body, Compton scattering, which are not explained by classical mechanics. Thus we conclude that quantum mechanics has the hold in region of atomic dimensions.

References:

[1] Research paper'Nature always obey law of right hand screw'by Paresh V Modh
[2] Introduction To Quantum Mechanics by Ajoy Ghatak1996
[3] Lectures on Physics Feynman, Leighton, Sands, volume 3
[4] Steven Weinberg, Physical Review Letters
[5] Joseph Polchinski, (1991) Physical Review Letters
[6] J. G. Cramer Reviews of Modern Physics 58, 647-687 (1986).
[7] A.C. Elitzur and L. Vaidman, Foundations of Physics 23,
[8] P. G. Kwiat, et al., Phys. Rev. Letters 83 4725-4728 (1999).
[9] John S. Bell, (1964) Physics 1, 195-200.
[10] John S. Bell, (1966) Reviews of Modern Physics 38, 447-452.
[11] P. H. Eberhard, (1977) Nuovo Cimento 38B, 75.
[12] P. H. Eberhard, (1978) Nuovo Cimento 46B, 39