

# Bohr

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## 1 Introduction

This is a theory of atomic structure that explains the spectrum of hydrogen atoms. It assumes that the electron orbiting around the nucleus can exist only in certain energy states.

## 2 Bohr's atomic model

Bohr proposed his quantized shell model of the atom to explain how electrons can have stable orbits around the nucleus. The motion of the electrons in Rutherford model was unstable because according to classical mechanics and electromagnetic theory, any charged particle moving on a curved path emits electromagnetic radiation; therefore, the electrons would lose energy and spiral into the nucleus. The energy of an electron depends on the size of the orbit and is lower for smaller orbits. Radiation can occur only when the electron jumps from one orbit to another. The atom will be completely stable in the state with the smallest orbit, since there is no orbit of lower energy into which the electron can jump.

## 3 Bohr's Theory and Hydrogen atom spectra

The energy of the atom is quantized. Bohr noted that this quantization nicely explained the observed emission spectrum of the hydrogen atom. The electron is normally in its smallest allowed orbit, corresponding to  $n = 1$ ; upon excitation in an electrical discharge or by ultraviolet light, the atom absorbs energy and the electron gets promoted to higher quantum levels. These higher excited states of the atom are unstable, so after a very short time (around  $10^{-9}$  sec) the electron falls into lower orbits and finally into the innermost one, which corresponds to the atom's ground state. The energy lost on each jump is given off as a photon, and the frequency of this light provides a direct experimental measurement of the difference in the energies of the two states, according to the Planck-Einstein relationship

## 4 formulas related to Bohr's Theory

In the Bohr model, the wavelength associated with the electron is given by the DeBroglie relationship.

$$\lambda = h \div mv$$

and the standing wave condition that circumference = whole number of wavelengths. In the hydrogenic case, the number  $n$  is the principal quantum number.

$$2\pi r = L\lambda$$

These can be combined to get an expression for the angular momentum of the electron in orbit.

$$L = nh \div 2\pi$$

## 5 Hydrogen spectral series

The emission spectrum of atomic hydrogen is divided into a number of the spectral series. Lyman series is for  $n=1$  in Hydrogen spectrum and all the wavelengths in the Lyman series are in the ultraviolet band. Balmer lines are for  $n=2$  in Hydrogen atom. Balmer lines are historically referred to as "H-alpha", "H-beta", "H-gamma" and so on, where H is the element hydrogen.[8] Four of the Balmer lines are in the technically "visible" part of the spectrum, with wavelengths longer than 400 nm and shorter than 700 nm. Bohr series or in the other words Paschen lines are for  $n=3$  in Hydrogen spectrum. The Paschen lines all lie in the infrared band.[9] This series overlaps with the next (Brackett) series, i.e. the shortest line in the Brackett series has a wavelength that falls among the Paschen series. All subsequent series overlap.