Bohr’s Theory of Atomic Structure (Postulates and Limitations)

Name: Muhammad Yousuf

Roll No.: 25F-CY-085

Introduction of Bohr's Atomic theory

Rutherford became successful in presenting atoms have tiny positive nucleus and negatively charged electrons revolve around it. He compared the movement of electrons around nucleus like that of planets around sun. His comparison of atomic model with solar system was defective because electrons are charged bodies while planets are charge less. If electrons revolve like planets they should lose energy continuously. As a result, electron become closer and closer to nucleus and finally fall into it. Further, if electron continuously emits energy it should form continuous spectrum. Actually, both phenomenon did not happen. Neither electrons fall into nucleus nor continuous spectrum is formed. Contrarily, line spectrum is formed. These complications were explained by Danish physicist Neil Bohr (1913 A.D). His atomic model was based on Planck's quantum theory.

NEIL BOHR (1913 A.D)

Postulates of Neil Bohr's Atomic structure

- **POSTULATE # 1**

Electrons orbit the nucleus in fixed paths (called energy levels or shells) at fixed distance from nucleus with a fixed energy and fixed velocity.

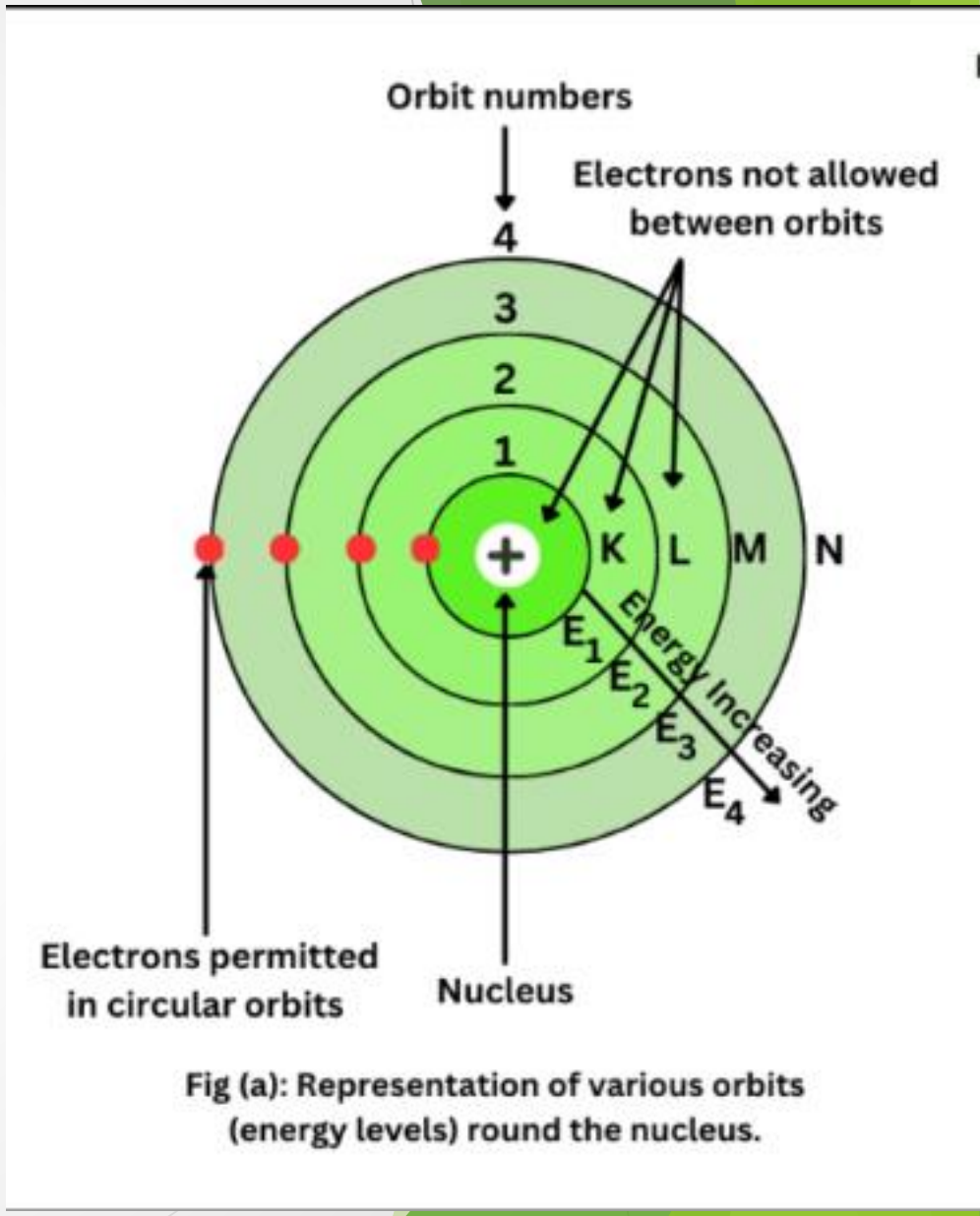
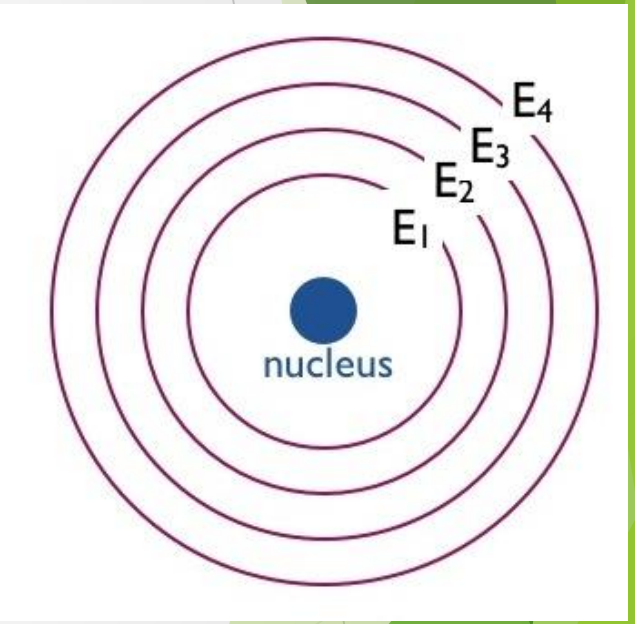


Fig (a): Representation of various orbits (energy levels) round the nucleus.

Postulates of Neil Bohr's Atomic structure

- **POSTULATE # 2**

As long as electron remains in appropriate orbit, it neither loses nor gains energy. Hence each orbit has fixed energy level, however the energy of orbit increases with the distance from nucleus.



Postulates of Neil Bohr's Atomic structure

- **POSTULATE # 3**

During excitation electron absorbs some quantized energy and jump from a lower energy to higher energy orbit and when it turned back lower energy orbit it emits quantized energy.

$\Delta E = E_2 - E_1$

$\Delta E = h\nu$ (Where h is plank's constant and v is frequency of radiation)

Postulates of Neil Bohr's Atomic structure

POSTULATE # 4

Electrons revolves only in those circular orbits which the angular momentum (mVr) is integral multiple of $\frac{h}{2\pi}$ (**mVr** = n $\frac{h}{2\pi}$) which means the angular momentum of an electron in orbit is quantized.

- where **m** is mass of electron
- where **V** is velocity of electron
- where **r** is radius of orbit
- where **n** is shell number
- where **h** is plank's constant ($6.636\text{x}10^{-34}$)

IMPORTANT DERIVATIONS

The limitations of Bohr's Atomic Model

Confusions that arose in Rutherford Atomic Model were explained in Bohr's Atomic theory comprehensively but there were also some deficiencies in his proposed model.

- Bohr's Model is only applicable to Hydrogen and those species which have single revolving electron around the nucleus (He^{+}, Li^{2+}, Be^{3+}). It could not explain the spectra of multi electrons systems like He, Li, Be, B etc.
- According to Bohr's concept, electron revolves around the nucleus in circular orbits. Later on, it proved that electron did not move in single plane but in three dimensional spaces.
- According to Bohr's concept, the electron in an atom is located at a definite distance from the nucleus and revolves with a definite velocity which is against the Heisenberg uncertainty principle.
- Bohr's theory explains only the particle nature of electron of and did not explain the wave nature of electron (de Broglie's hypothesis).

THANK YOU