

The Bohr Model of the Atom – quantum applied to the atom!

Bohr earned the Nobel Prize in 1922.

In 1911, Rutherford's work suggested that the atom was much like a planetary model, that is, the nucleus which is orbited by electrons. The electric force between the electrons and the protons in the nucleus supply the centripetal force required to keep the electron in orbit. Without this, the electron would fly off tangentially.

Problem: If the electron (charge) is moving, it should create emit electromagnetic radiation energy. If this is so, the electron should lose its energy and spiral into the nucleus and by advance calculations would occur in 10^{-8} seconds. Obviously this is not so.

Problem: We can excite electrons to higher orbits and with time they drop down and emit energy in time. This energy is in the form of light and other EMR. This occurs in specific units. ie: glow-in-the-dark objects.

Niels Bohr was a post-doc in Rutherford's lab and used the latest ideas in quantum(Einstein, Planck) science to explain the atom. His paper was published in 1913.

Bohr's Ideas

- 1) Of all the possible circular/elliptic orbits possible, only a few orbits are allowed and are characterized by a specific amount of energy (quantized)
- 2) When the electron is orbiting, it is exempt from the classical laws of electromagnetism. Thus, it does not emit EMR. It is in a 'stationary state'.
- 3) electrons can drop from a higher energy orbit to a lower energy orbit and when they do so, they give off one quantum bundle of energy – one photon of EMR. As well, energy can be absorbed by atom is the amount of energy is equal to the energy difference of a lower energy state to some higher energy state. There are discreet steps! (quantum!)

Why so discreet? Why the quantum? Leap ahead and use de Broglie's particle-wave idea. The length of the orbit must be a whole number of de Broglie wavelengths!

Bohr thought his idea so bizarre, that he kept his research in his desk for 2 years before publishing!

We will look at an energy-level diagram for a hydrogen atom in class.