Bohr's Theory of Hydrogen Atom and Hydrogen Spectra Physics 12

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1 Bohr's Theory of Electron

Niels Bohr developed Rutherford's experiment and introduces his model of atom and concepts of electrons.
According to his theory, a single atom presents a positively charged nucleus (with protons and neutrons in it) and negatively charged electron cloud that orbits the nucleus.

Each orbit of an electron is associated with its energy state that it could be found in the atomic shell. This quantization of energy levels is essential, since Bohr's theory states that each excited electron emits a certain amount of energy when returning to lower shell, thus emitting a visible light as a result, which is called "Emission spectrum".

He succeeded in proving his theory on hydrogen atom but no place further.

2 Bohr's hydrogen atom

When photons is shoot to an electron in its ground state, it gets 'excited' thus leaving its orbit and jumping to the higher energy level. However, it cannot stay there forever, and so eventually it jumps back, thus emitting a photon of light of a single wavelength and discrete frequency.

For the single electron of hydrogen atom, its transitions between energy levels and emissions of visible light, can be seen with Line spectrum.

The Hydrogen atom can emit different wavelengths of light depending on the initial and final energy levels of the transition. This photon of engy can be

calculated according to formula:

$$E = R \times (\frac{1}{n_f^2} - \frac{1}{n_i^2})$$

$$R = 8.31 \frac{J}{Kmol}$$

– Universal gas constant
In terms of wavelength and frequencies the photon energy can be calculated as follows:

$$E = \frac{hc}{\lambda}$$

$$h = 6.626 \times 10^{-}34Js$$

–Plank's constant

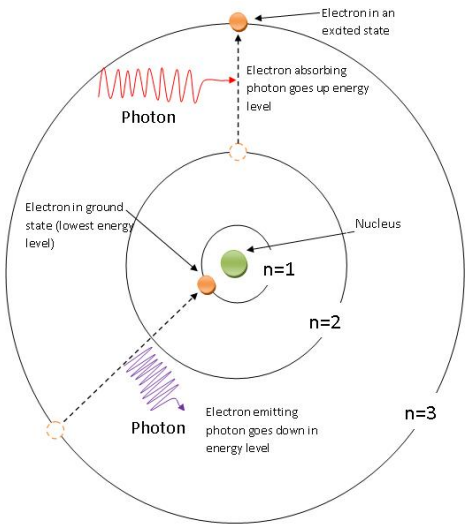

Figure 1: Bohr's model of Hydrogen atom

3 Hydrogen Spectra

Separation energy of the electron from nucleus

$$E = -2.81 \times 10^{-}18Joules$$

Depending on which energy level, excited electron comes down two, there are 3

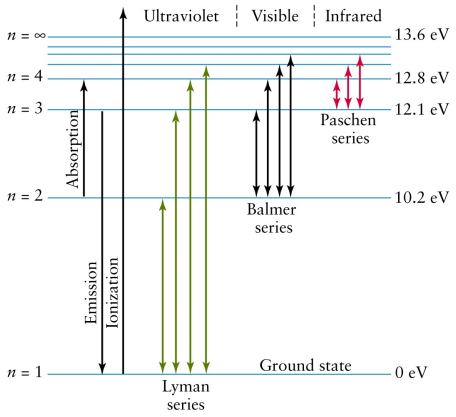

Figure 2: Electron emissions

types of main spectral emissions:

1) Transitions from higher levels down to the energy level with principal quantum number 1 are called Lyman (Ultraviolet) series.

2) Transitions from higher levels down to the energy level with principal quantum number 2 are called Balmer (Visible light) series.

3) Transitions from higher levels down to the energy level with principal quantum number 3 are called Paschen (Infrared light) series.