Dinorah Fernanda Ortiz Salazar

Physics

Bohrs Theory of Hydrogen Atom

On 1913 Niels Bohr introduced the atomic Hydrogen model, on this model he described that a positively charged nucleus was orbited by negatively charged electrons, and that these orbits were quantized, meaning that there were just specific values for the orbits and no in-betweens.

On the simplest hydrogen atom only an electron orbits the nucleus and the shortest distance to it is the Bohr Radius, which formula is shown below

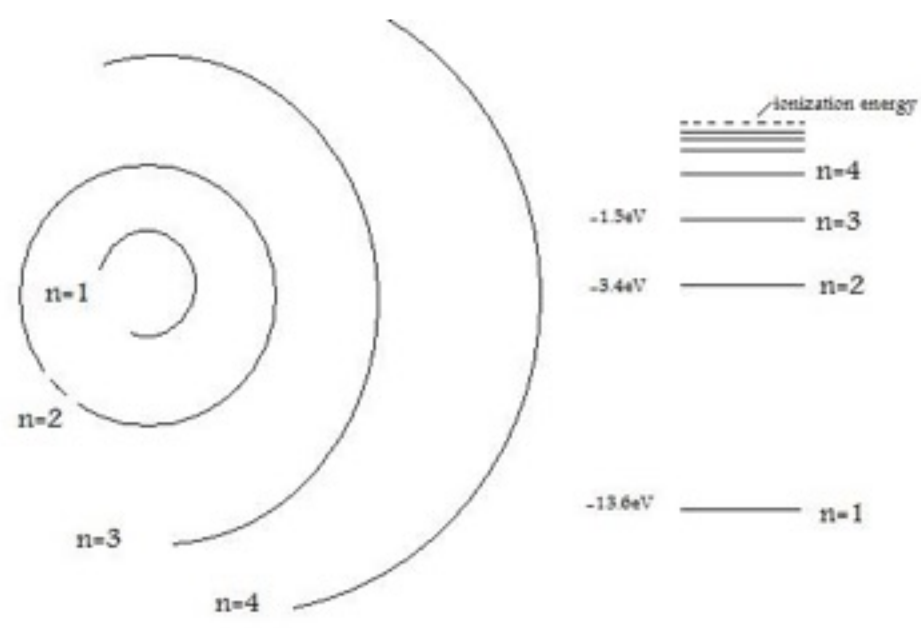
$$a_0 = \frac{4\pi\varepsilon_0\hbar^2}{m_e e^2} = \frac{\hbar}{m_e\, c\, \alpha}$$

Apart from the orbit theory, Bohr suggested that if electrons emit energy they would move closer to the nucleus and if they absorb energy, the electron would move further away from the nucleus.

This change of energy can be explained with the next equation:

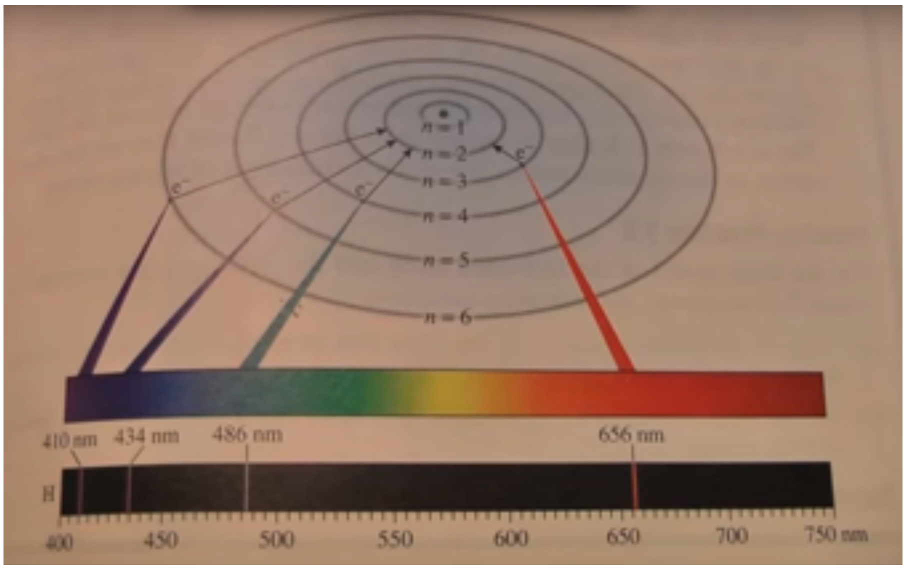
$$\Delta E = Efinal - Einitial$$

The next image shows the representation of energy levels on each orbit, 13.598eV being the ground state value



Hydrogen spectral series

This theory was accepted because it also explained the hydrogen spectrum. Bohr explained that every time an electron move from an outer orbit to a closer orbit, the electron emitted visible light, this visible light will always have the same quantized energy, wavelength and frequency. For instance if the movement of the electron emit a wavelength of 410nm it will emit purple light but if the wavelength was the 656nm the light would be red. These electron transitions are called the the spectral series of hydrogen.



Given that we are working with energy and light we will need some relevant constants for the fully understanding of the topic

Relevant constants

Planck's constant = 6.63E-34 J.s
Speed of light= 3E8 m/s
Electric constant=9E9 Nm^2
Electric charge of the electron= 1.6E-19 C
Mass of the electron= 9.1E-3

Relevant Formulas

Kinetic Energy for two particles

$$KineticEnergy = \frac{ke.e^2}{2r}$$

Electrostatic force

$$Fe = \frac{e^2.ke}{r^2}$$

Bohr radius

$$a_0 = \frac{4\pi\varepsilon_0\hbar^2}{m_e e^2} = \frac{\hbar}{m_e\, c\, \alpha}$$

Angular Momentum

$$L = r.\rho$$

Potential energy for two particles

$$Potential\,Energy = \frac{e^2.ke}{r}$$

Balmer Series
The Balmar series is the name of a ser of six named series of the spectral line emission of the hydrogen atom. It goes from n≥3 to n=2