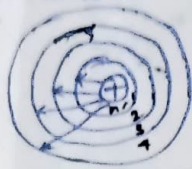


Origin of Hydrogen Spectrum On the basis of Bohr's Theory

When an electric discharge is passed through hydrogen gas filled in a discharge tube at a very low pressure then the molecules of hydrogen break into atoms. Now these atoms absorb energy from the electric spark and the solitary electron (represented in 1st energy level) in different atoms of hydrogen gets excited. i.e. the electron shifts from the energy level 1 (lowest energy level - Ground state) to different higher energy levels 2, 3, 4, etc. depending on the amount of energy absorbed by the atoms of hydrogen. The shifting of an electron from energy level 1 (ground state) to higher energy levels, 2, 3, 4, 5, 6, 7 etc (Excited state) has been shown in fig.



These transition are represented as $1 \rightarrow 2$, $1 \rightarrow 3$, $1 \rightarrow 4$ etc respectively.

At higher energy state it is unstable and wants to come back to lower energy state for stability. When electrons of excited state come back to lower energy level it emits energy which it has absorbed earlier in the form of photons of light of specific frequency and hence of specific wavelength.

Thus the spectral lines of different series observed in the emission spectrum of hydrogen are due to the emission of energy photons of different wavelengths when the excited electron in hydrogen atom come back to lower energy level. Frequency is represented by wave number $\bar{\nu}$, $R = 109.686 \times 10^5$

- The various spectral lines of this series is obtained when an electron jumps from the 2nd, 3rd, 4th... Energy levels to 1st energy level
- ①. Lyman Series - an electron jumps from the 2nd, 3rd, 4th... Energy levels to 1st energy level. $\bar{\nu} = R \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$ as $\bar{\nu} = \frac{1}{\lambda}$ (wave number)
 - ②. Balmer Series - an electron jumps from 2nd, 3rd, 4th, 5th etc to 2nd energy level. $n_1 = 2$ and $n_2 = 3, 4, 5, \dots$
 - ③. Paschen Series - Electron jump from 4th, 5th, 6th etc. to 3rd energy level. $n_1 = 3$ and $n_2 = 4, 5, 6, \dots$
 - ④. Brackett Series - Electron jumps from 5th, 6th, 7th etc. to 4th energy level. $n_1 = 4$ and $n_2 = 5, 6, \dots$ etc.
 - ⑤. Pfund Series - When electron jumps from 6th, 7th, 8th energy levels to 5th energy level. $n_1 = 5$ and $n_2 = 6, 7, 8, \dots$

Spectrum lines	Lower energy level n_1	Higher energy level n_2	Area of spectrum
1. Lyman	1	2, 3, 4, 5, 6...	UV light
2. Balmer	2	3, 4, 5, 6...	Visible
3. Paschen	3	4, 5, 6, 7...	IR
4. Brackett	4	5, 6, 7, 8...	Far IR
5. Pfund	5	6, 7, 8...	Far IR

When electron drops from higher energy level to lower, the energy released in terms of photons of light of specific frequency and thus gives a different line in spectrum.