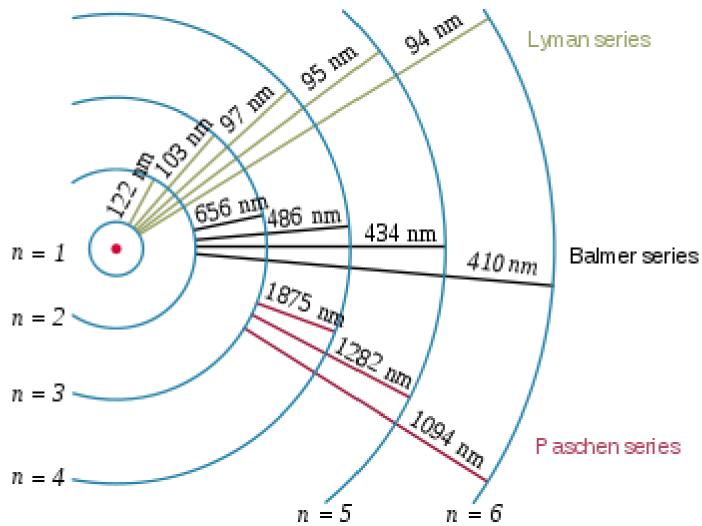
CONCEPTS & KEYS TO STUDY

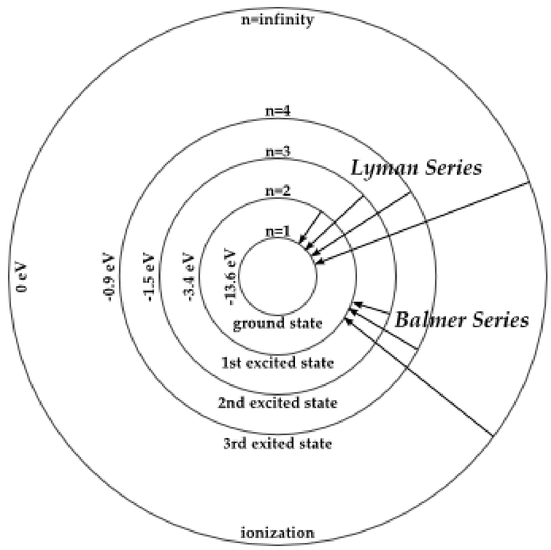
The emission spectrum of atomic hydrogen is divided into a number of **spectral series**, with wavelengths given by the Rydberg formula. These observed spectral lines are due to electrons moving between energy levels in the atom.



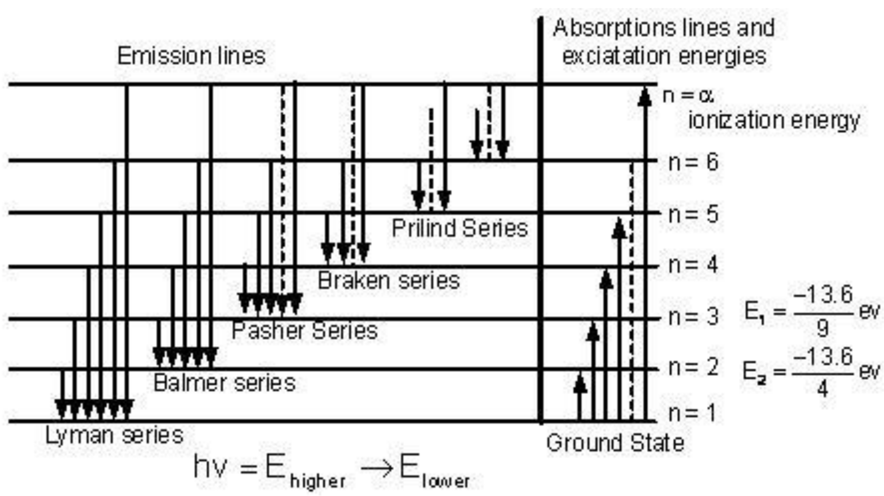
For emission spectrum of hydrogen atom:

n_x	n_f	Spectrum serial
1	2, 3, 4, 5	Lyman (UV region)
2	3, 4, 5, 6 .... H_α, H_β, H_γ, H_δ ...	Balmer (visible region)
3	4, 5, 6, 7	Paschen (infrared region)
4	5, 6, 7, 8	Brackett (infrared region)
5	6, 7, 8, 9	Pfund (infrared region)

The spectral line for the Lyman series is the transitions from n >= 2 to the n = 1 state, for Balmer series its from n >= 3 to the n = 2 state and the Paschen series are transitions from n >= 4 to n = 3 state. The first line in each series is the transition from the next lowest number in the series to the lowest (so in the Lyman series the first line would be from n=2 to n=1) and the second line would be from from the third lowest to the lowest (in Lyman it would be n=3 to n=1) etc etc.



The spectrum of H-atom studied by Lyman, Balmer, Paschen, Bracken and Pfund can now be explained on the basis of Bohr's Model. It is now clear that when an electron jumps from a higher energy state to a lower energy state, the radiation is emitted in form of photons. The radiation emitted in such a transition corresponds to the spectral line in the atomic spectra of H-atom.



Lyman Series

When an electron jumps from any of the higher states to the ground state or 1st state (n = 1), the series of spectral lines emitted lies in ultra-violet region and are called as Lyman Series. The wavelength (or wave number) of any line of the series can be given by using the relation.

$$\overline{V} = RZ^2 \, (1/1^2 - 1/n_2^2)$$

where $n_2 = 2, 3, 4, 5, \ldots$

(For H atom Z = 1)

Balmer Series

When an electron jumps from any of the higher states to the state with n = 2 (2nd state), the series of spectral lines emitted lies in visible region and are called as Balmer Series. The wave number of any spectral line can be given by using the relation:

$$\overline{V} = RZ^2 \, (1/2^2 - 1/n_2^2)$$

where $n_2 = 3, 4, 5, 6, \ldots$

(For H atom Z = 1)

Paschen Series

When an electron jumps from any of the higher states to the state with n = 3 (3rd state), the series of spectral lines emitted lies in near infra-red region and are called as Paschen Series. The wave number of any spectral line can be given by using the relation:

$$\overline{V} = RZ^2 \, (1/3^2 - 1/n_2^2)$$

where $n_2 = 4, 5, 6, 7, ..$

(For H atom Z = 1)

Brackett Series

When an electron jumps from any of the higher states to the state with n = 4 (4th state), the series of spectral lines emitted lies in far infra-red region and called as Brackett Series. The wave number of any spectral line can be given by using the relation:

$$\bar{\nu} = R Z^2 (1/4^2 – 1/n_2^2)$$

n_2 = 5, 6, 7, 8, ...

Pfund Series

When an electron jumps from any of the higher states to the state with n = 5 (5th state), the series of spectral lines emitted lies in far infra-red region and are called as Pfund Series. The wave number of any spectral line can be given by using the relation:

$$\bar{\nu} = R Z^2 (1/5^2 – 1/n_2^2)$$

n_2 = 6, 7, 8, ...

Prepared by
V.Manoharan
vmano@usm.my
manovv1955@yahoo.com
04-6533888 ext 3566