STRUCTURE OF ATOM

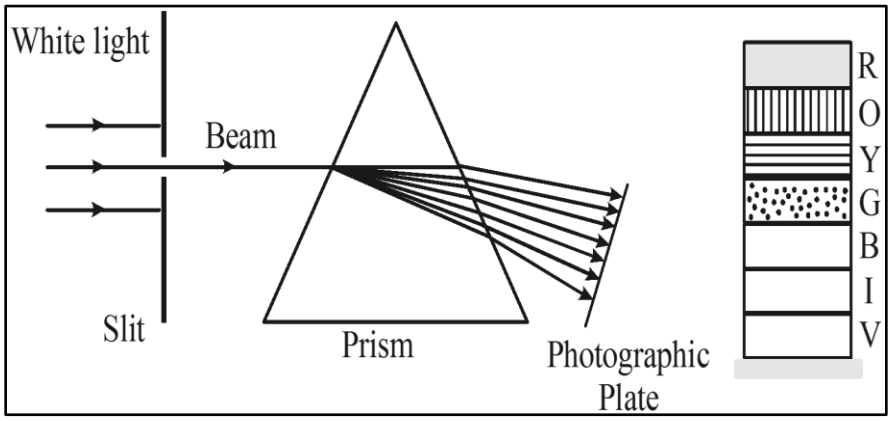
BOHR'S MODEL FOR HYDROGEN ATOM

❖ LINE SPECTRUM OF HYDROGEN

Depending upon the source of radiation, the emission spectra are mainly of two types:

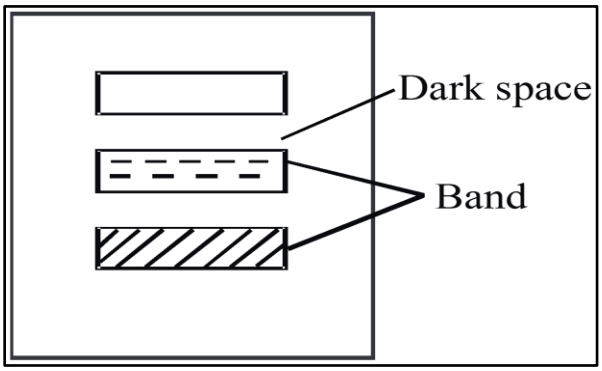
(a) Continuous Spectra

When white light from any source such as sun, a bulb or any hot glowing body is analyzed by passing through a prism it is observed that it splits up into seven different wide band of colors from violet to red. These colors are so continuous that each of them merges into the next. Hence the spectrum is called continuous spectrum.



(b) Discrete Spectra: It is of two types

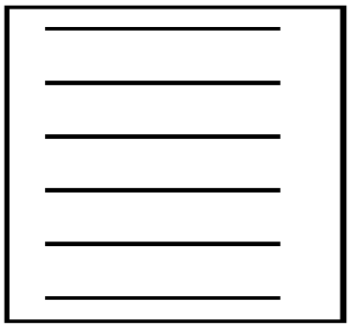
(i) Band Spectrum



Band spectrum contains colorful continuous bands seperated by some dark space.

Generally molecular spectrum are band spectrum

(ii) Line Spectrum

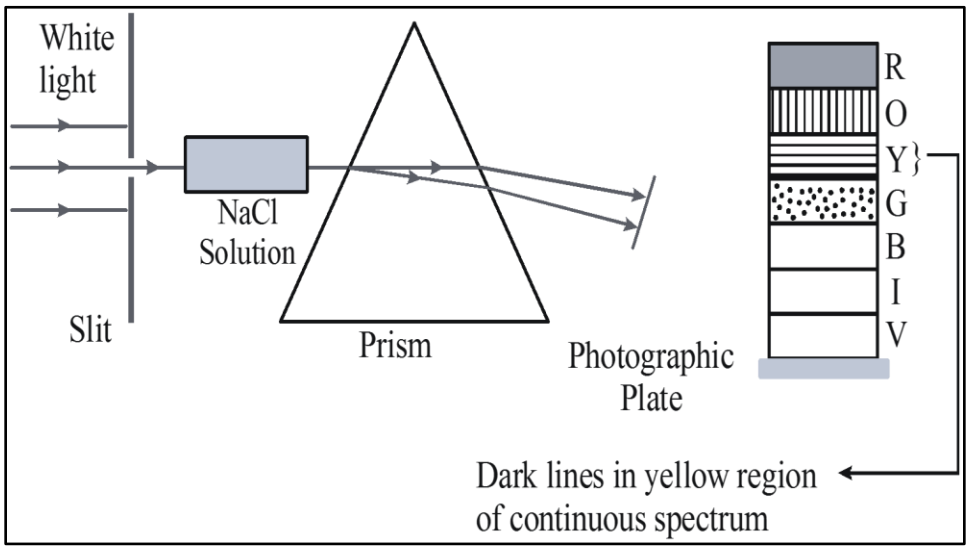


This is the ordered arrangement of lines of particular wavelength seperated by dark space e.g., hydrogen spectrum.

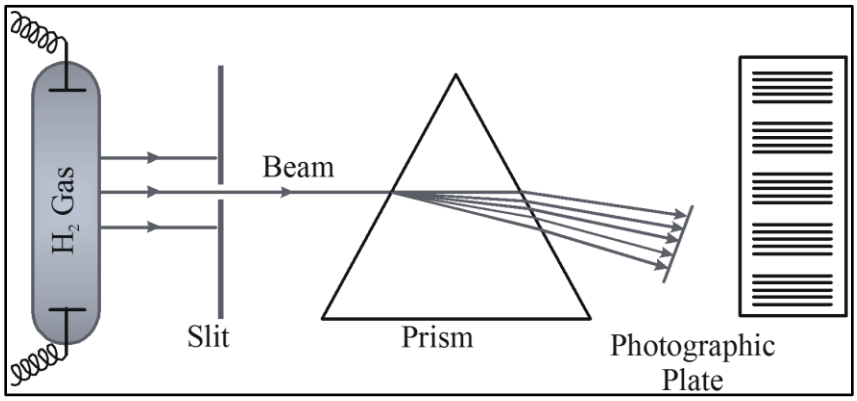
Line spectrum can be obtained from atoms.

ABSORPTION SPECTRA

When white light from any source is first passed through the solution or vapours of a chemical substance and then analyzed by the spectroscope, it is observed that some dark lines are obtained in the continuous spectrum. These dark lines are supposed to result from the fact that when white light (containing radiations of many wavelengths) is passed through the chemical substance, radiations of certain wavelengths are absorbed, depending upon the nature of the element.



Emission Spectrum of Hydrogen

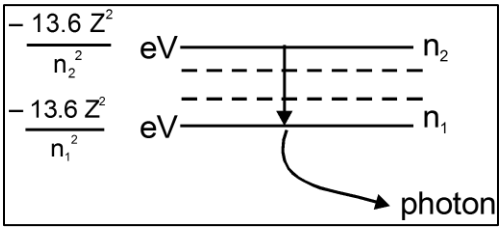


When hydrogen gas at low pressure is taken in the discharge tube and the light emitted on passing electric discharge is examined with a spectroscope, the spectrum obtained is called the emission spectrum of hydrogen.

Line Spectrum of Hydrogen

Line spectrum of hydrogen is observed due to excitation or de-excitation of electron from one stationary orbit to another stationary orbit

Let electron make transition from n_2 to n_1 ($n_2 > n_1$) in a H-like sample



Energy of emitted photon $= (\Delta E)_{n2n1} = \frac{-13.6Z^2}{n_2^2} - \left(\frac{-13.6Z^2}{n_1^2}\right)$

$$= 13.6Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$= (\Delta E)_n 2n1$ =Wavelength of emitted photon

$$\lambda = \frac{hc}{(\Delta E)_{n_2 \to n_1}}$$

$$\lambda = \frac{hc}{13.6Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)}$$

$$\frac{1}{\lambda} = \frac{(13.6)z^2}{hc}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

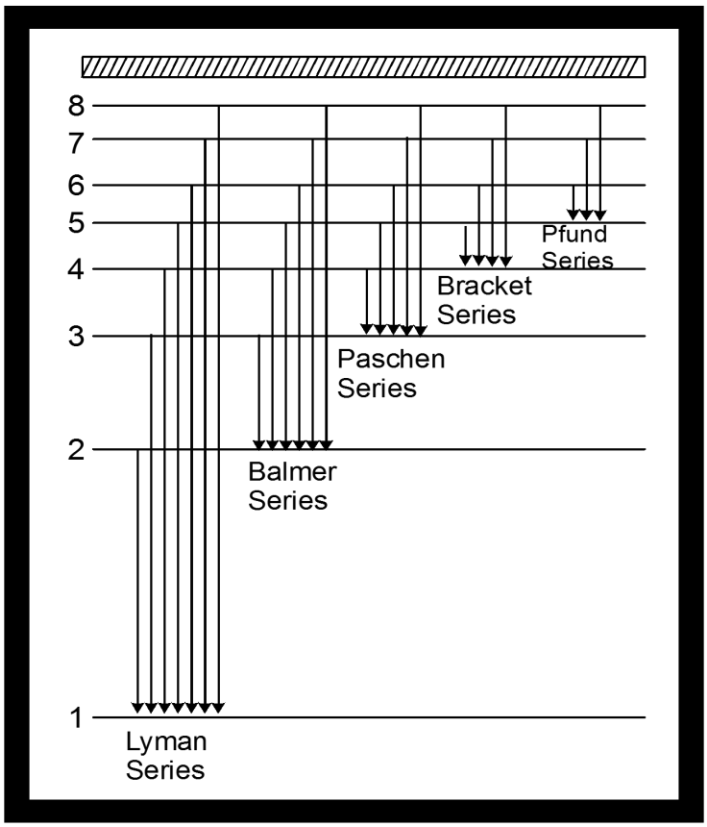
Wave number, $\frac{1}{\lambda} = \overline{v} = R^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

R = Rydberg constant = $1.09678 \times 10^7 m^{-1}$;

R $1.1 \times 10^7\ m^{-1}$;

$R = \frac{13.6eV}{hc}$;

R ch = 13.6 eV



Ex. Calculate the wavelength of a photon emitted when an electron in H- atom maker a transition from n = 2 to n = 1

Sol. $\frac{1}{\lambda} = RZ^2 \left[\frac{1}{N_1^2} - \frac{1}{N_2^2}\right]$

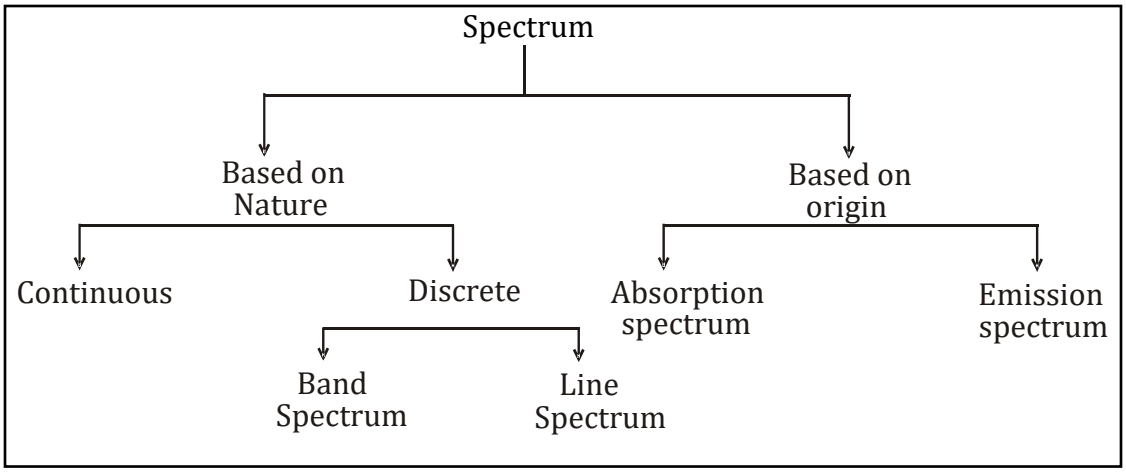
$\therefore \quad \frac{1}{\lambda} = R(1)^2 \left[\frac{1}{1^2} - \frac{1}{2^2}\right]$

$\therefore \quad \frac{1}{\lambda} = \frac{3R}{4}$ or $\lambda = \frac{4}{3R}$

Hydrogen Spectrum

Study of Emission and Absorption Spectra

An instrument used to separate the radiation of different wavelengths (or frequencies) is called spectroscope or a spectrograph. Photograph (or the pattern) of the emergent radiation recorded on the film is called a spectrogram or simply a spectrum of the given radiation The branch or science dealing with the study of spectra is called spectroscopy.



Emission Spectra

When the radiation emitted from some source e.g., from the sun or by-passing electric discharge through a gas at low pressure or by heating some substance to high temperature etc, is passed directly through the prism and then received on the photographic plate, the spectrum obtained is called 'Emission spectrum'.

Depending upon the source of radiation, the emission spectra are mainly of two types:

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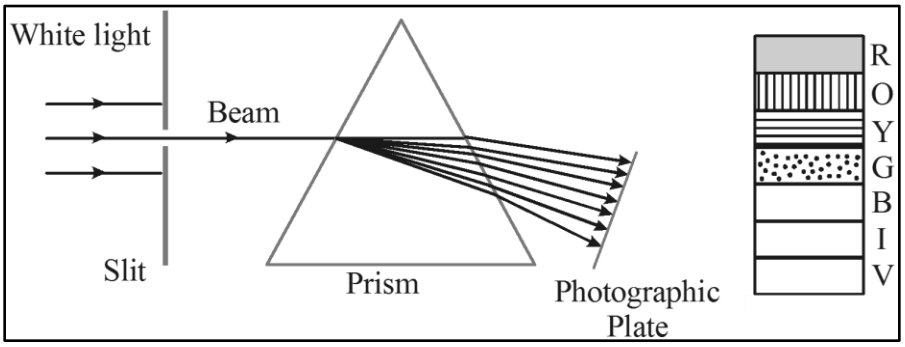

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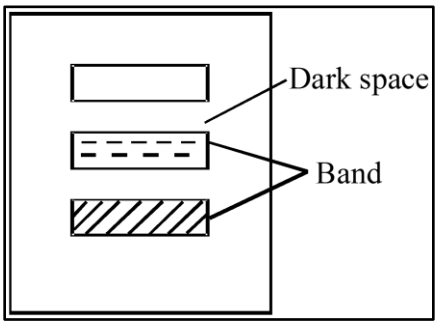

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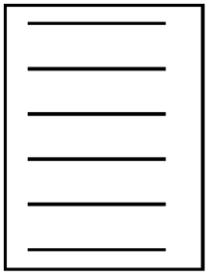

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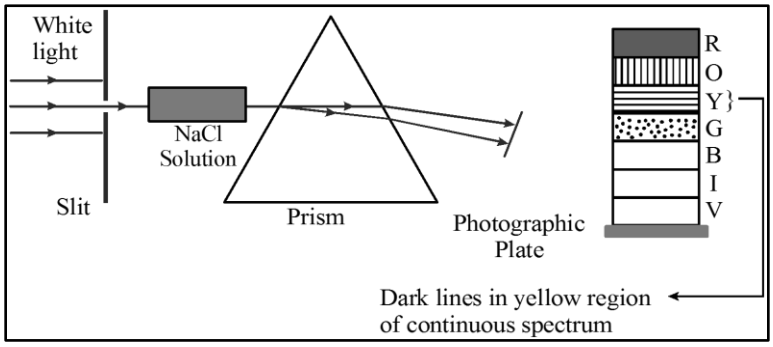
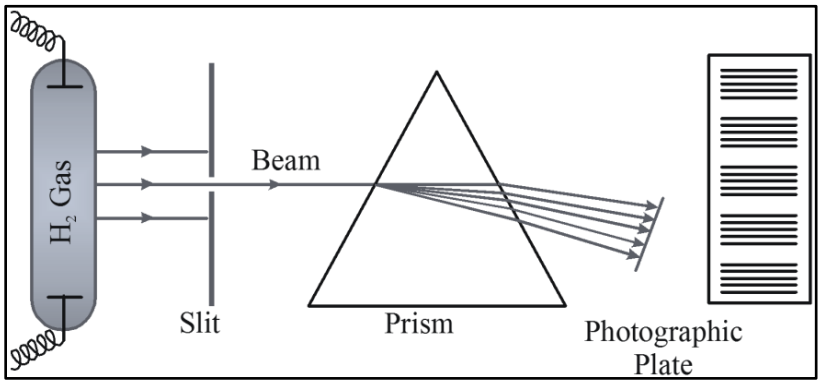


Emission Spectrum of Hydrogen



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