Atomic Spectra

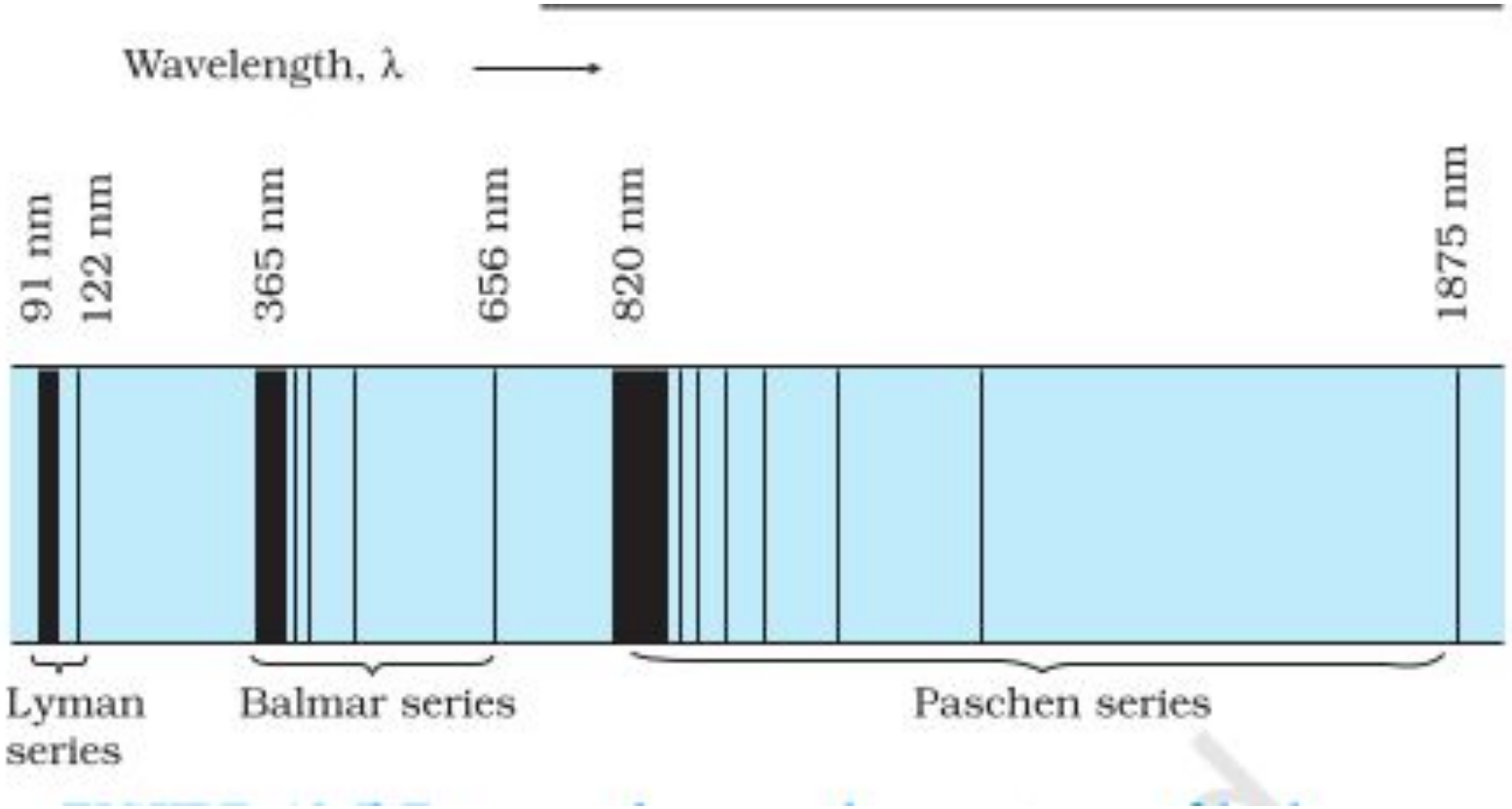
It is the spectrum of frequencies of electromagnetic radiation emitted or absorbed during transitions of electrons between energy levels within an atom.

When ***atoms*** are excited they emit light of **certain wavelengths** which correspond to **different colors**. The emitted light can be observed as a **series of colored lines** with dark spaces in between; this series of colored lines is called a **line** or ***atomic*** *spectra*.

Emission Spectra

When an atomic gas or vapour is excited at low pressure, usually by passing an electric current through it, the emitted radiation has a spectrum which contains certain specific wavelengths only. A spectrum of this kind is termed as emission line spectrum.

Such spectrum appears as some bright lines on a dark background.


Wavelength, λ
91 nm
122 nm
365 nm
656 nm
820 nm
1875 nm
Lyman series
Balmar series
Paschen series

Absorption Spectra

When white light passes through a gas and we analyse the transmitted light using a spectrometer we find some dark lines in the spectrum.

These dark lines correspond precisely to those wavelengths which were found in the emission line spectrum of the gas. This is called the absorption spectrum of the material of the gas.

The substance absorbs some wavelength when light is passed through that substance in vapour phase.

Hydrogen is the simplest atom and therefore, has the simplest spectrum.

Hydrogen Spectra

Balmer found a simple empirical formula for the observed wavelengths

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{n^2}\right]$$

Where R = 1.097 x 10^7 m^{-1} is called Rydberg constant. And n= 3,4,5… If n=3 it is H_{∞}, If n=4 it is H_{β}

These are in the visible region of the hydrogen spectrum.

Lyman series

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$$

Where n = 2,3,4 …

The Lyman series is in the ultraviolet region of the spectrum

Paschen series

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{3^2} - \frac{1}{n^2}\right]$$

Where n = 4,5,6 …. Paschen series is in the infrared region

Brackett series

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$$

Where n = 5,6 ….Brackett series is in the infrared region

Pfund series

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{5^2} - \frac{1}{n^2}\right]$$

Where n = 6,7,8 …. Pfund series is in the infrared region