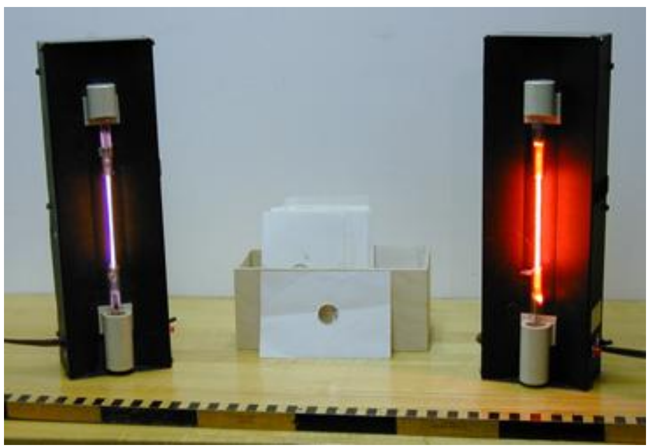
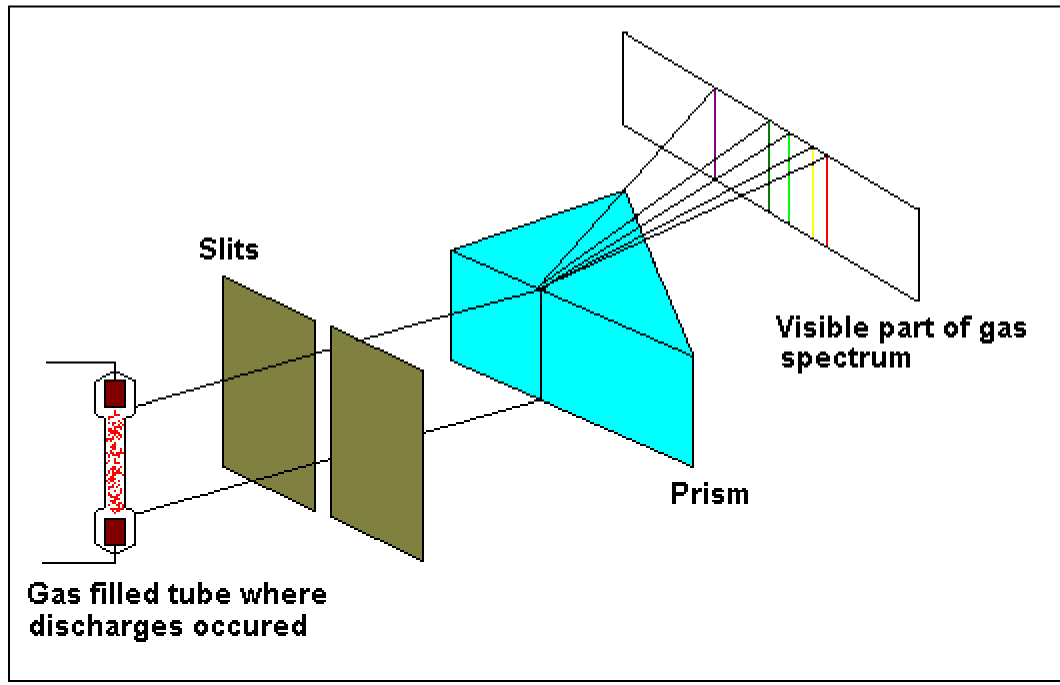
ATOMIC STRUCTURE

1. The Nuclear Atom
2. Electron Orbits
3. Atomic Spectra
4. The Bohr Atom
5. Energy Level and Spectra
6. Correspondence Principle
7. Nuclear Motion
8. Atomic Excitation
9. The Laser

ATOMIC SPECTRA

A successful theory of the atom must explain the stability and the spectral lines of atoms. ← not found in classical physics.

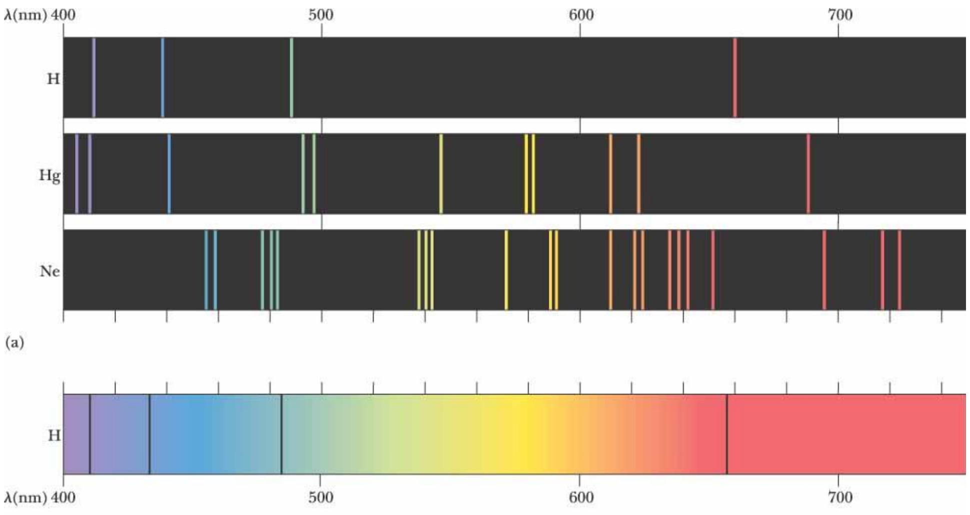


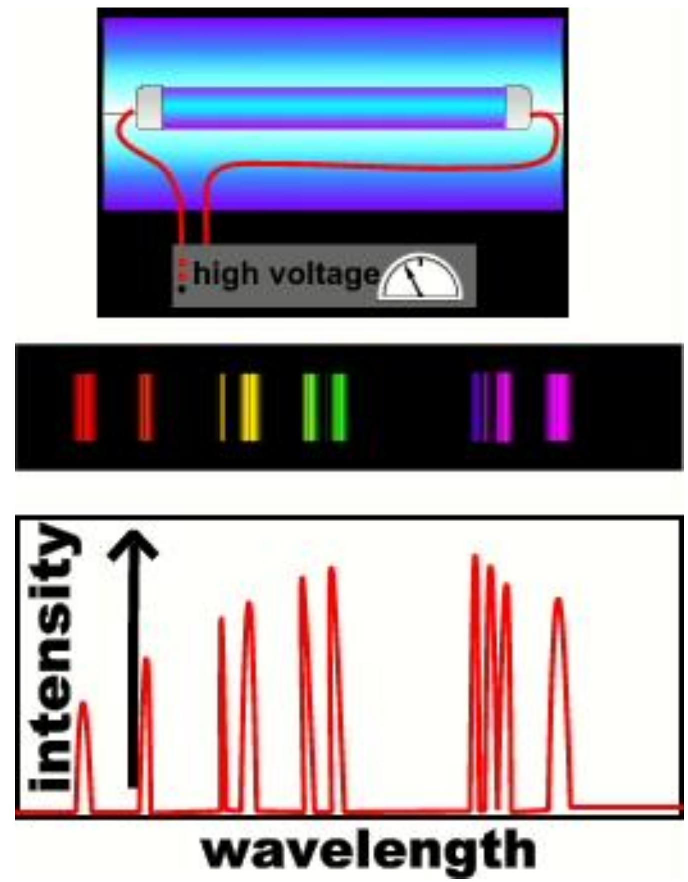


Discharges in the low - pressure gas filled tube are sources of light, which undergo refraction on a prism. We see the line spectrum of the gas.

ATOMIC SPECTRA

Emission and absorption line spectra





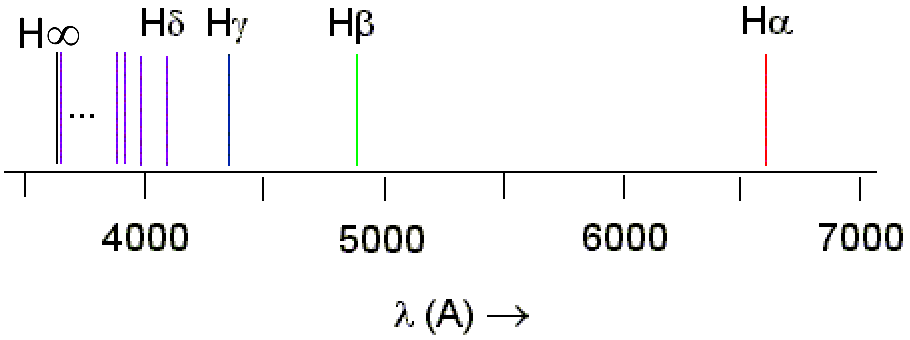
The number, intensity and exact wavelengths of the lines in the spectrum of an element depend upon temperature, pressure, the presence of electric and magnetic fields, and the motion of the source.

ATOMIC SPECTRA

Spectral series…

Wavelengths in a spectrum of an element falls into sets called **spectral series**.

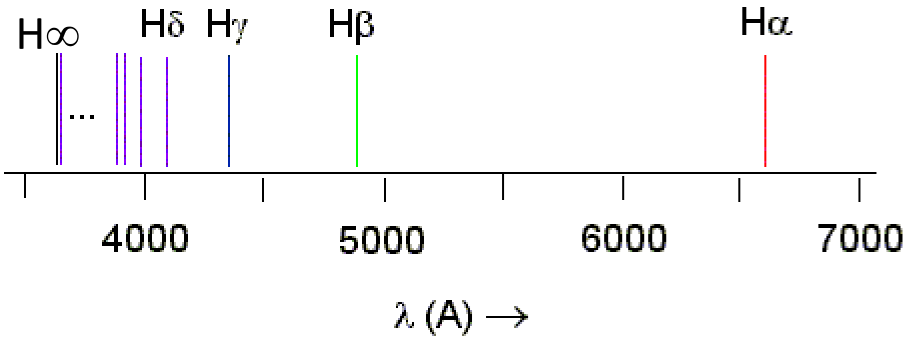
J.J. Balmer in 1885 discovered the first series of the H spectrum.



As the wavelength decreases, the lines become closer together and weaker in intensity until the series limit and 364.6 nm is reached ← beyond it no separate line but a faint continuous spectrum.

ATOMIC SPECTRA

Balmer series…



$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right) \quad , \quad n = 3,4,5,\ldots$$

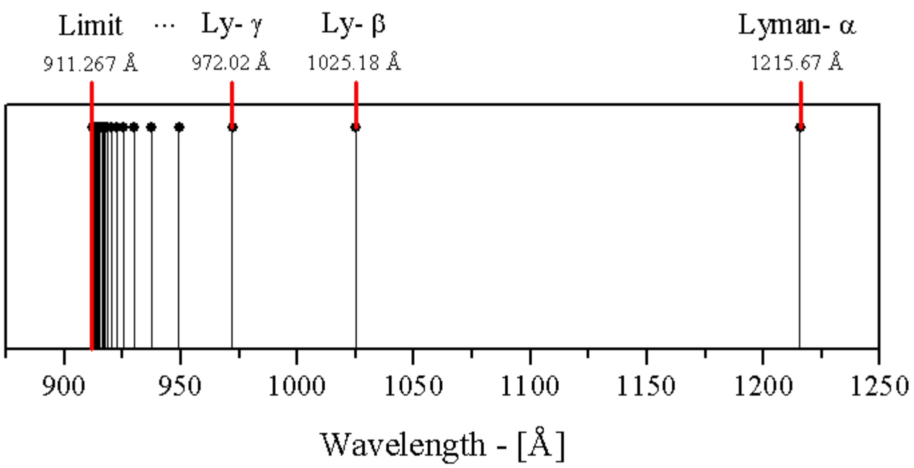
$$R = 1.097 \times 10^7 \ m^{-1}$$

Hα line correspond to n = 3,
Hβ line correspond to n = 4, and so on.
H∞ correspond to n = ∞ and is the series limit and occurs at 4/R, in agreement with experiment.

ATOMIC SPECTRA

Layman series (in the UV region)…

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{n^2}\right) \quad , \quad n = 2,3,4,\ldots$$



ATOMIC SPECTRA

Lyman series
$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{n^2}\right) \quad , \quad n = 2,3,4,\ldots$$

Balmer series
$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right) \quad , \quad n = 3,4,5,\ldots$$

Paschen series
$$\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{n^2}\right) \quad , \quad n = 4,5,6,\ldots$$

Brackett series
$$\frac{1}{\lambda} = R\left(\frac{1}{4^2} - \frac{1}{n^2}\right) \quad , \quad n = 5,6,7,\ldots$$

Pfund series
$$\frac{1}{\lambda} = R\left(\frac{1}{5^2} - \frac{1}{n^2}\right) \quad , \quad n = 6,7,8,\ldots$$

ATOMIC SPECTRA

Remember…

Each element has a characteristic line spectrum.