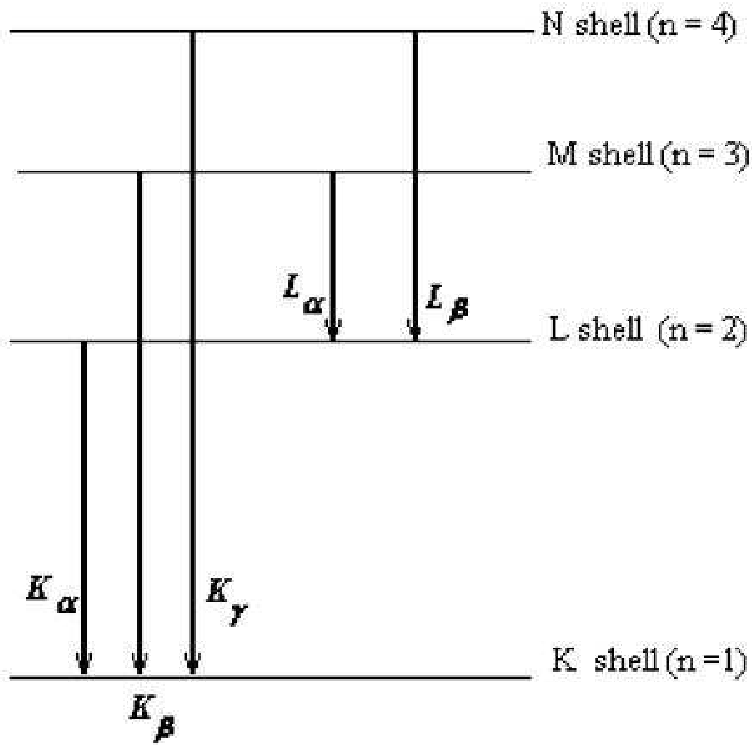
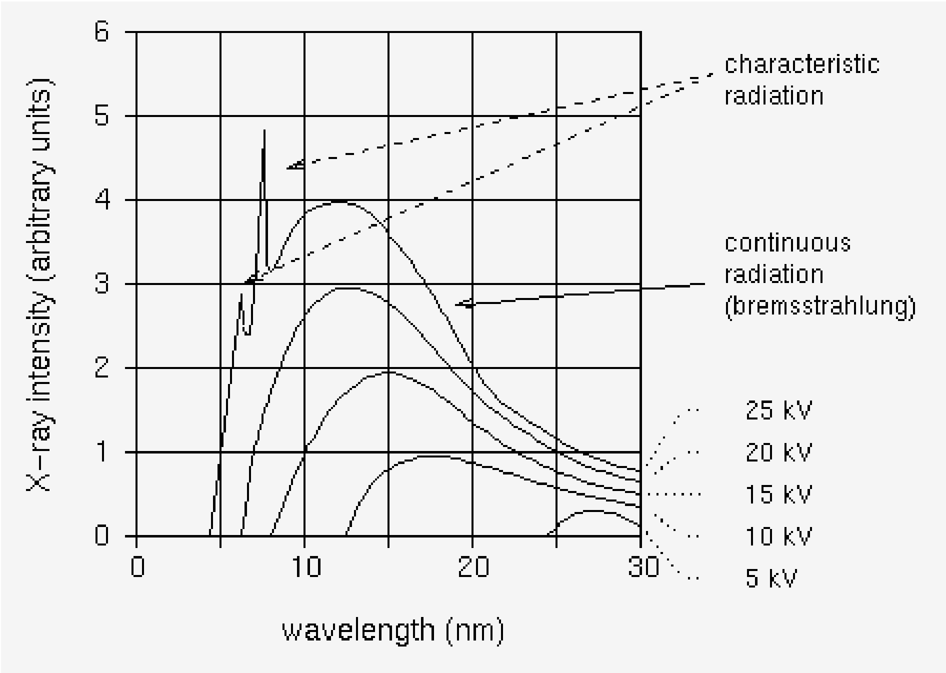


Fig.6.3: X–Ray Transitions

Not all transitions are allowed. Only those transitions which fulfill the following selection rule are allowed: $\Delta\lambda = \pm 1$.



- **The graph shows the following features.**
  - **A continuous background of X-radiation in which the intensity varies smoothly with wavelength. The background intensity reaches a maximum value as the wavelength increases, and then the intensity falls at greater wavelengths.**
  - **Minimum wavelength which depends on the tube voltage. The higher the voltage the smaller the value of the minimum wavelength.**
  - **Sharp peaks of intensity occur at wavelengths unaffected by change of tube voltage.**

6.6 X-Ray Diffraction

A plane of atoms in a crystal, also called a Bragg plane, reflects X-ray radiation in exactly the same manner that light is reflected from a plane mirror, as shown in Fig.6.4.

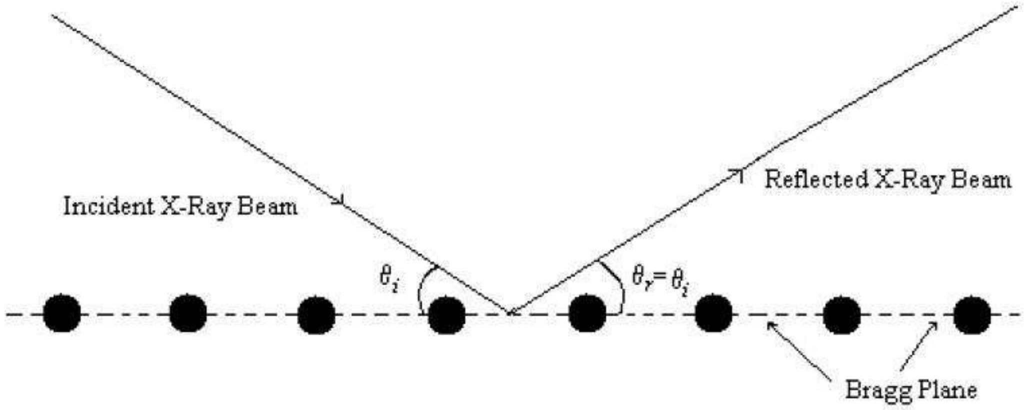


Fig. 6.4: X-Ray Reflection from a Bragg Plane

Reflection from successive planes can interfere constructively if the path difference between two rays is equal to an integral number of wavelengths. This statement is called Bragg's law.

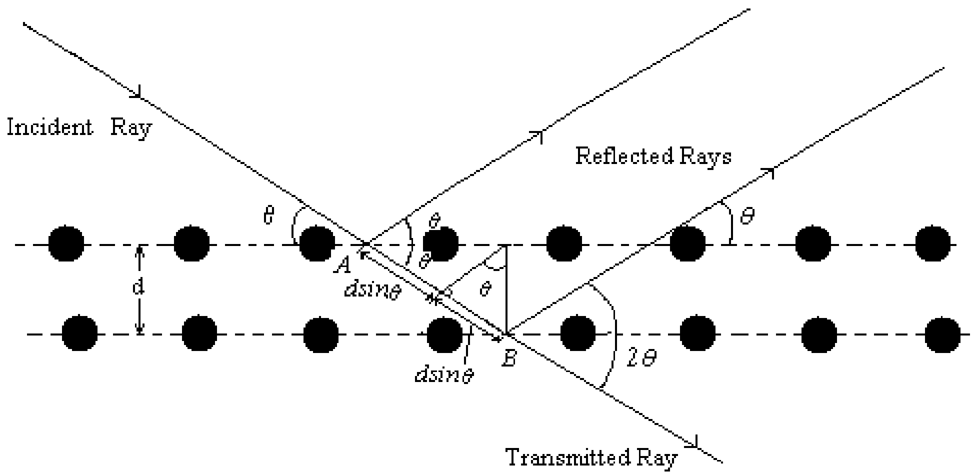


Fig. 6.5: Diffraction of X-Rays from Atomic Planes

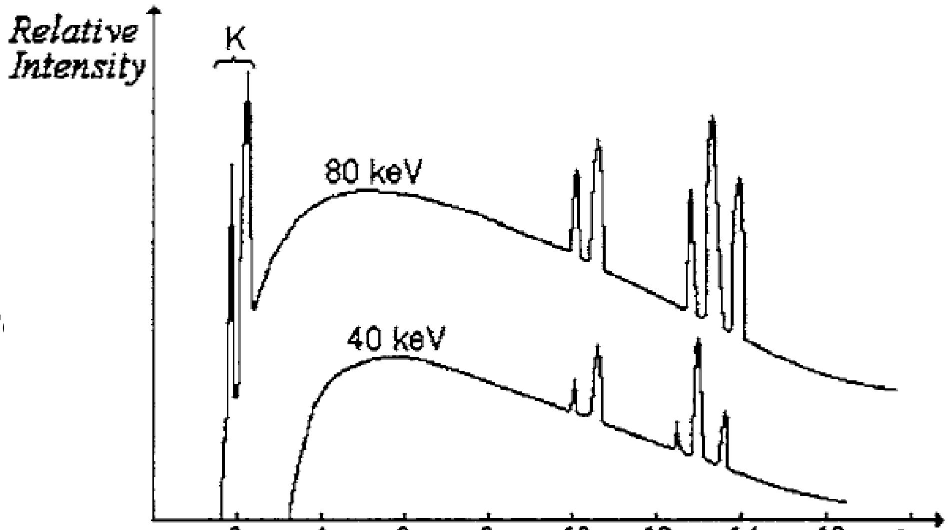
From Fig. 4.8, AB = 2dsinθ so that by Bragg's law, we have

$$2d \sin\theta = n\lambda$$

Where in practice, it is normal to assume first order diffraction so that n = 1. A given set of atomic planes gives rise a reflection at one angle, seen as a spot or a ring in a diffraction pattern also called *a diffractogram*.

6.7 Moseley's Experiment

The high intensity penetrating radiation emitted by X-ray tubes, characteristic of the metal from which the target anode is made, was first discovered by Barkla. He found that when the tubes were operated at higher potentials, series of high intensity peaks, each of a specific wavelength, were superimposed on the spectrum of the continuous bremstrahlung radiation (Fig. 6.5).



The phenomenon is analogous to the atomic line spectra Seen in the visual region of the electromagnetic spectrum. Changing the metal or element from which the target anode in the X-ray tube is made alters the wavelengths at which the high intensity peaks occur. The most penetrating series in an element's characteristic X-ray spectrum is called the K series; the second is called the L series; the third the M series and so on.

Moseley carried out a systematic examination of the characteristic radiation of as many elements as possible. He examined the X-ray spectra of the 38 elements from aluminum (Al) to gold (Au). As regards 15 of these elements, he studied just the K series; regarding another 17, just the L series; as to the remaining 6 elements, both series. He recorded the spectra on photographic plates.

Moseley discovered the following simple empirical relationship, illustrated in (Fig 6.6), between the frequencies, (ν) of the lines in each series and the ordinal number, N, of the element's position in the periodic table (starting from hydrogen):