4.7.1 Davisson and Germer's Experiment. Davisson and Germer experimentally demonstrated the diffraction of electrons.

The electrons are produced by heating a tungsten filament F and are accelerated through a known potential difference V by maintaining a steady potential difference between the filament F and a plate P.

The electrons are collimated by passing through narrow holes and finally emerge through a fine hole H in the form of a very narrow beam. The whole arrangement is known as an *Electron gun*. The fine beam of electrons falls normally on the surface of a *single* Nickel crystal N. This is prepared by baking the block of Nickel in a high temperature oven, when *very small* individual crystals of which the block is normally composed of form a *large single* crystal, all the atoms of which are arranged in a regular lattice. The electrons are scattered by the crystal in all directions and the intensity of the scattered beam in any direction is measured by allowing the beam to enter the ionisation chamber I set at appropriate angle and noting the deflection in a sensitive galvanometer connected to I.

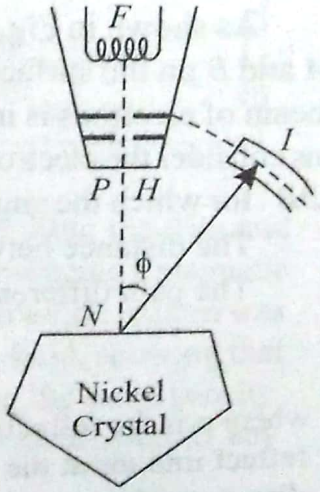

Fig. 4,2

The chamber can be rotated with the crystal as the centre and the intensity of the scattered beam can be determined as a function of scattering angle ϕ,

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the crystal being held in a fixed position throughout the experiment. The results of the experiment are represented in the form of a *polar graph*. In the polar graph, a line is drawn from the origin O inclined at an angle ϕ with *Y*-axis which represents the direction of incident beam. The length of the line drawn from *O* is taken proportional to the intensity of the diffracted electron beam. The end points of these lines drawn for different values of ϕ are joined to get a smooth, continuous curve. This curve is known as the *polar graph*.

Effect of increasing electron energy on the scattering angle. To study the effect of increasing electron energy on the scattering angle ϕ the observations were taken for increasing values of accelerating voltages. The graph is at first fairly *smooth* but at a potential difference of 44 V and corresponding electron energy a *spur* or *hump* appears on the curve at a scattering angle $\phi = 60°$. As the accelerating potential and hence the corresponding electron energy is increased the length of the *spur* increases and a *sharp maxima* is obtained for electron energy corresponding to 54V at scattering angle $\phi = 50°$. With further increase in accelerating potential and electron energy the spur decreases in the length and finally disappears at 68V at a scattering angle $\phi = 40°$. For further increase in electron energy or accelerating voltage the graph is again fairly smooth.

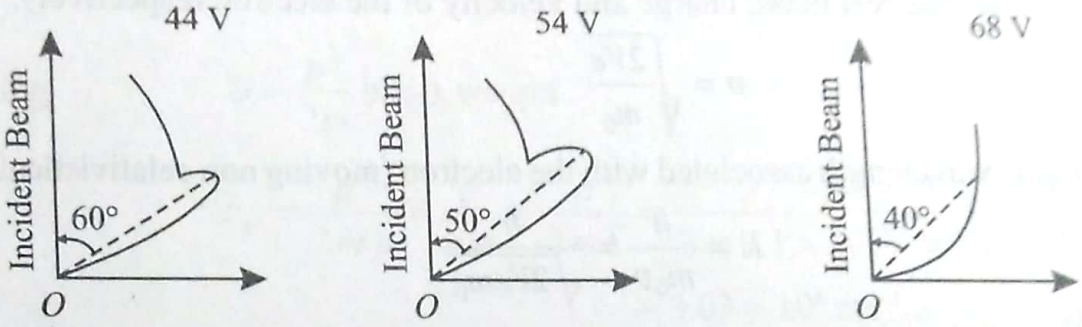

Fig. 4.3

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