$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Mass, $m = h/\lambda v$

For an electron, mass $m_e = h/\lambda_e\, v_e$

Now, we have $v/v_e = 3$ and

$\lambda/\lambda_e = 1.813 \times 10^{-4}$

Then, mass of the particle, $m = m_e \left(\frac{\lambda_e}{\lambda}\right)\left(\frac{v_e}{v}\right)$

$m = (9.11\times10^{-31}$ kg$) \times (1/3) \times (1/1.813 \times 10^{-4})$

$m = 1.675 \times 10^{-27}$ kg.

Thus, the particle, with this mass could be a proton or a neutron.

EXAMPLE 11.6

Example 11.7 What is the de Broglie wavelength associated with an electron, accelerated through a potential differnece of 100 volts?

Solution Accelerating potential $V = 100$ V. The de Broglie wavelength λ is

$$\lambda = h/p = \frac{1.227}{\sqrt{V}} \text{ nm}$$

$$\lambda = \frac{1.227}{\sqrt{100}} \text{ nm} = 0.123 \text{ nm}$$

The de Broglie wavelength associated with an electron in this case is of the order of X-ray wavelengths.

EXAMPLE 11.7

11.9 Davisson and Germer Experiment

Exp. of electron diffraction

The wave nature of electrons was first experimentally verified by C.J. Davisson and L.H. Germer in 1927 and independently by G.P. Thomson, in 1928, who observed diffraction effects with beams of electrons scattered by crystals. Davisson and Thomson shared the Nobel Prize in 1937 for their experimental discovery of diffraction of electrons by crystals.

The experimental arrangement used by Davisson and Germer is schematically shown in Fig. 11.7. It consists of an electron gun which comprises of a tungsten filament F, coated with barium oxide and heated by a low voltage power supply (L.T. or battery). Electrons emitted by the filament are accelerated to a desired velocity

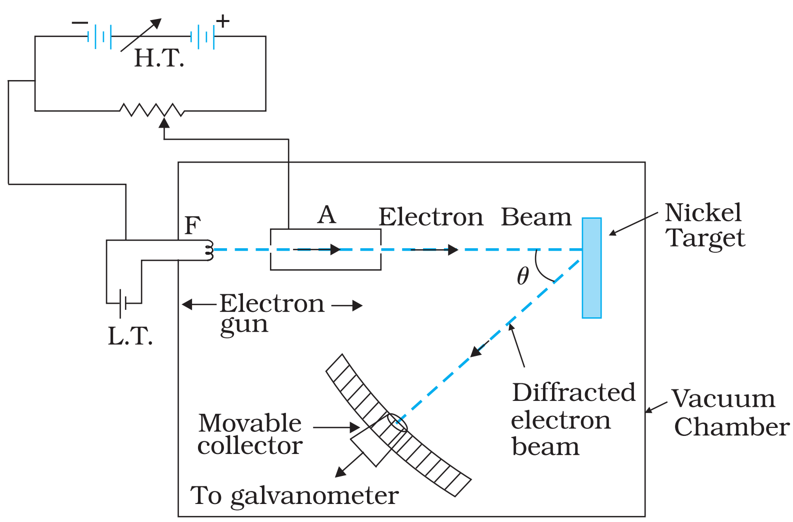

FIGURE 11.7 Davisson-Germer electron diffraction arrangement.