The de Broglie Hypothesis

Since light seems to have both wave and particle properties, it is natural to ask whether matter (e.g., electrons, protons) might also have both wave and particle characteristics. In 1924, a French physics student, Louis de Broglie, suggested this idea in his doctoral dissertation. de Broglie's work was highly speculative, because there was no evidence at that time of any wave aspects of matter.

For the wavelength of electron waves, de Broglie chose

$$\lambda = \frac{h}{p} \tag{34-13}$$

DE BROGLIE RELATION FOR THE WAVELENGTH OF ELECTRON WAVES

where p is the momentum of the electron. Note that this is the same as Equation 34-7 for a photon. For the frequency of electron waves, de Broglie chose the Einstein equation relating the frequency and energy of a photon.

$$f = \frac{E}{h} \tag{34-14}$$

DE BROGLIE RELATION FOR THE FREQUENCY OF ELECTRON WAVES

These equations are thought to apply to all matter. However, for macroscopic objects, the wavelengths calculated from Equation 34-13 are so small that it is impossible to observe the usual wave properties of interference or diffraction. Even a dust particle with a mass as small as 1 μg is much too massive for any wave characteristics to be noticed, as we see in the following example.

FIGURE 34-6 Schemat
Thomson used to measur
cathode rays (electrons). I
through the slits at A and
The beam can be deflecte
and F or by a magnetic fie