De Broglie Wavelength Encyclopedia Article

De Broglie Wavelength

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In 1923, Louis Victor Pierre-Raymond de Broglie postulated that since **light** particles had also been shown to exhibit wave characteristics, perhaps other particles, such as the **electron**, might as well. From relativity, he knew that the **momentum** of a **photon** was: E = pc. Substituting the **energy** in one equation with the energy of the other and solving for **wavelength** (), he found: = h/p = h/mv. However, from the **photoelectric effect**, he knew: E = hc/.

This postulate was verified later by the Davisson-Germer experiment. This used the concept of constructive **interference** resulting from the path length difference that incident beams travel when hitting a lattice structure. If the electrons did not behave as **waves**, no constructive interference would be seen and thus no maximum (or minimum) intensities would be measured. However, if the electrons did behave as waves, there would be a maximum intensity at an angle related to the distance between the lattice layers of the **scattering** material.

The electrons were accelerated by a potential of 54 V and were incident on a nickel plate. The intensity of scattered electrons was determined by measuring the current produced. A plot of current versus detection angle was then plotted. The electrons were scattered through a wide range of angles, but a maximum intensity was seen at 50°. Since the distance between the layers of the nickel lattice was 2.15Å, a wavelength based on the experiment of 1.65Å was calculated. Using the de Broglie wavelength equation, a wavelength of 1.67Å was predicted, thus proving that indeed, electrons behave as waves: = 2.15Å sin(50°) = 1.65Å. Thus the electron was shown to behave as a wave as well as a particle.