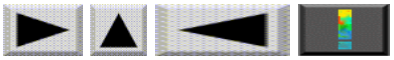

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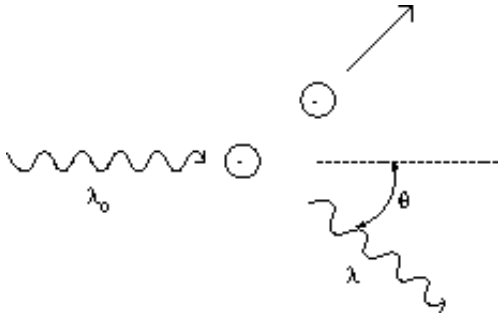
Compton Scattering

Yet another experiment which illustrated the photon nature of light was performed in 1923 by Compton, and is called **Compton scattering**. In this experiment light is scattered off of an electron in a material, as in Fig. 27.5

Figure 27.5: Compton scattering



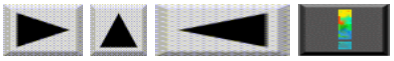
It is found that the scattered light has a wavelength different than that of the incident light, an effect that again cannot be explained using a wave picture of light, where the wavelength does not change. Compton analyzed this problem by considering light as a photon with energy given by Planck's hypothesis, Eq. (27.5), as well as a momentum given by

$$p = \frac{h}{\lambda}, \qquad (8)$$

which was motivated in part by Einstein's theory of Special Relativity. Using the energy and momentum conservation for such a collision, he found the following relation between the incident and scattered photon:

$$\lambda = \lambda_0 + \frac{h}{m_e c}[1 - \cos\theta] \approx \lambda_0 + 0.0024[1 - \cos\theta] \quad nm\,, \qquad (9)$$

where $m_e = 9.11 \times 10^{-31}$ kg is the mass of the electron. Such a small difference in wavelengths between the incident and scattered light is very hard to detect using visible light, with wavelengths of the order of 500 nm. However, it is a comparatively large effect for X-rays, which have wavelengths of the order of 0.1 nm, and so X-rays were used to demonstrate that such scattering does indeed take place.



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10/9/1997