OPTICAL THEOREM

Link to: physicspages home page.

To leave a comment or report an error, please use the auxiliary blog and include the title or URL of this post in your comment.

Post date: 16 October 2021.

There is a simple relationship between the total cross section and the scattering amplitude in three dimensional scattering. The formulas are (in terms of phase shifts):

$$f(\theta) = \frac{1}{k}\sum_{l=0}^{\infty}(2l+1)\,e^{i\delta_l}\sin\delta_l P_l(\cos\theta) \tag{1}$$

$$\sigma = \frac{4\pi}{k^2}\sum_{l=0}^{\infty}(2l+1)\sin^2\delta_l \tag{2}$$

If $\theta = 0$, we can use the fact that $P_l(1) = 1$ for all l (from the definition) so taking the imaginary part of $f(0)$ we get

$$\Im f(0) = \frac{1}{k}\sum_{l=0}^{\infty}(2l+1)\sin^2\delta_l \tag{3}$$

from which we get the *optical theorem*:

$$\sigma = \frac{4\pi}{k}\Im f(0) \tag{4}$$