

14.4: Optical Theorem

A comparison between Equations ([\[e17.73\]](#)) and ([\[e17.75\]](#)) reveals that

$$\sigma_{\text{total}} = \frac{4\pi}{k} \text{Im}[f(0)] = \frac{4\pi}{k} \text{Im}(f(\mathbf{k}, \mathbf{k})), \quad (14.4.1)$$

because $P_l(0) = 1$. This result is known as the *optical theorem*, and is a consequence of the fact that the very existence of scattering requires scattering in the forward ($\theta = 0$) direction, in order to interfere with the incident wave, and thereby reduce the probability current in that direction.

Contributors and Attributions

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