Momentum Transport in Electromagnetic Plane Wave

The momentum transported by an electromagnetic wave is proportional to the energy transported.

Momentum density: \[ \frac{\vec{p}}{V} = \frac{\vec{S}}{c^2}, \]
where \( \vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B} \) is the Poynting vector.

When the wave is absorbed by a material surface it exerts an impulse \( \vec{F} dt = \Delta \vec{p} \).

The resulting radiation pressure is the average force per unit area:

\[ P_{abs} = \frac{\vec{F}}{A} = \frac{p}{Adt} = \frac{p}{Adx} \frac{dx}{dt} = \frac{p}{V} c = \frac{\vec{S}}{c} = \frac{I}{c}. \]

The radiation pressure exerted by a reflected wave is twice as large: \[ P_{ref} = \frac{2\vec{S}}{c} = \frac{2I}{c}. \]