# Examples

*I. Example - Application of conservation laws to electromagnetic absorption*

*Fig. I shows a body of mass $m_0$ that absorbs a photon of frequency $f$ at a certain point in time.*

*Because of the absorption, the body changes from rest to movement with velocity $v$.*

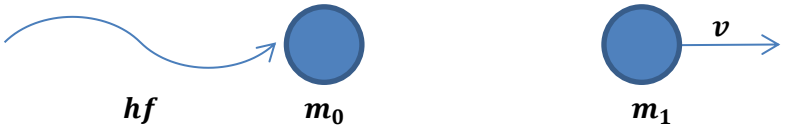


*Fig. I*

*By applying conservation laws before and after the absorption, we find:*

*For the momentum:*

$$\frac{hf}{c} = m_1 v \qquad \text{(I. 1)}$$

*For the energy:*

$$m_0 c^2 + hf = m_1 c^2 \qquad \text{(I. 2)}$$

*From (I.1) we have* $m_1 = hf/cv$ *and that one used in (I.2) leads to:*

$$m_0 c^2 + hf = \frac{hf}{cv} c^2 \qquad \text{(I. 3)}$$

*We solve the equation (I.3) for $v$:*

$$v = \frac{chf}{m_0 c^2 + hf}$$

*We now assume, absurdly, that the velocity $\boldsymbol{v}$ could be greater than or equal to the speed of light:*

$$\frac{chf}{m_0 c^2 + hf} \geq c \qquad \text{(I. 4)}$$

*From (I.4) follows:*

$$m_0 c^2 \leq 0$$

*From this the following statement can be made: the hypothesis that the velocity of a body is greater than or equal to the speed of light presupposes the untenable assumption that the mass of the body is equal to or less than zero.*

*II. Example - Application of conservation laws to electromagnetic emission*

*Fig. II shows a body of mass $m_0$ emitting a photon of frequency $f$ at a given time.*

*Because of the emission, the body changes from the resting to the moving state with the speed $v$.*

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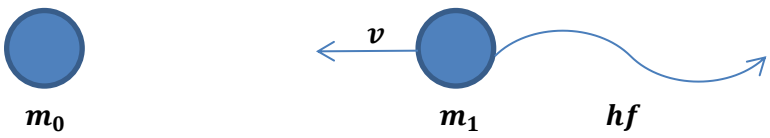


*Fig. II*

*By applying the conservation laws before and after the emission, we note:*

*For the momentum:*

$$0 = \frac{hf}{c} - m_1 v \qquad \text{(II. 1)}$$

*For the energy:*

$$m_0 c^2 = m_1 c^2 + hf \qquad \text{(II. 2)}$$

*From (II.1) we have $m_1 = hf/cv$ and that one used in (II.2) leads to:*

$$m_0 c^2 = \frac{hf}{cv} c^2 + hf \qquad \text{(II. 3)}$$

*We solve the equation (II.3) for $v$:*

$$v = \frac{chf}{m_0 c^2 - hf}$$

*If we consider that the speed of a body is always lower than the speed of light, we can make the following inequality:*

$$\frac{chf}{m_0 c^2 - hf} < c$$

*It follows:*

$$hf < \frac{1}{2} m_0 c^2 \qquad \text{(II. 4)}$$

*From (II.4) it can be concluded that if a single photon is emitted, its energy $hf$ is always lower than half the internal energy of the emitting body.*