

Answer on Question #39329, Physics - Relativity

Question:

I read that rest mass (m_0) of photon is zero. Einstein's relativistic mass

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

If $m_0 = 0$ then $m = 0$ but also velocity of photon is c then $m = 0/0$ (interderminate). Can anybody explain please

Answer:

Term 'relativistic mass' is not fully correct, because the real, physical sense has only the rest mass m_0 . The relativistic mass was used only to show the same energy formulae for the bodies in the rest and in the motion:

$$E_0 = m_0 c^2$$

and

$$E = mc^2 = \frac{m_0 c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The first formula is valid only for objects with $m_0 > 0$.

But photons have no the rest mass (they have momentum) and their energy is described by another relation:

$$E = h\nu,$$

where $h = 2\pi\hbar = 6.62 \cdot 10^{-34} \text{ J} \cdot \text{s}$ is the Plank constant and ν is the frequency of the photon as a wave measured in Hz. Relativity theory shows that energy and momentum of photon are linked in the following relation:

$$E = cp,$$

where momentum $p = \frac{h}{\lambda}$, λ is a wavelength.