Rest mass of photon cannot be equal to zero

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Currently, the rest mass (m_0) of photons is assumed to be = 0. Otherwise, according to expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$, the moving mass (m_{mov}) of photons becomes infinite, because, according to Einstein's postulate of the theory of relativity, the velocity of photons (v) is assumed to be = c (constant). Since the moving mass (or any type of mass) of photons (or of any particle) cannot be infinite, their rest mass is assumed to be = 0. However the current assumption cannot be true. Because, there are several evidences and plausible arguments to prove that the photons possess finite rest mass. Therefore, presently a solution has been determined such that the moving mass of photons may not become infinite despite they possess finite rest mass.

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1. Introduction

Currently, the rest mass (m_0) of photons is assumed to be = 0. Because, according to Einstein's postulate of the theory of relativity, it is assumed that the photons move with constant velocity c and nothing can move with velocity > c, if some rest mass m_{ph} is assigned to photons (i.e. $m_0 = m_{ph}$), their moving mass (m_{mov}) becomes infinite according to expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$. Since the moving mass (or any type of mass) of photons (or of any particle) cannot be infinite, because practically it can never be possible, the rest mass of photon (m_{ph}) is assumed to be = 0.

However the current assumption cannot be true. Because, there are several evidences (see Section 2) and plausible arguments (see Section 2.2) to prove that the photons possess finite rest mass. Therefore, presently, a solution has been determined such that the moving mass of photons may not become infinite despite they possess finite rest mass (see Section 3).

2. Evidences and plausible arguments to prove that the photons possess finite rest mass

2.1 Evidences to prove that the photons possess rest mass

1. No escaping of light from the black holes verifies the truth of the rest mass m_{ph} of photons. Black holes have very strong gravitational force, and they do not let even the photons to escape from them means, the photons possess finite rest mass and they are attracted by the black holes due to very strong gravitational force on them (photons). For further confirmation that the photon possesses finite rest mass, we can see also Section I D, [1].

2. Photons possess rest mass $\approx 3.38 \times 10^{-36} Kg$ (see Section IV B, [1] for its mathematical proof).

2.2 Plausible arguments to prove that the rest mass of photons cannot be equal to zero

As we know/assume, the photons travel as particles with velocity c, scatter electrons colliding with them in Compton scattering and eject electrons in photoelectric effect penetrating into metals, these phenomena/events can occur only if: 1) The photons exist physically as particles, similarly, as electrons exist physically as particles, and as photons are interpreted to be the bundles of radiation energy, their bundles of radiation energy provide physical existence and rest mass (m_{ph}) to them, similarly, as a bundle of charge (-e), which (-e) is actually a bundle of electrical energy, provides particle like physical existence and rest mass m_e to electron. 2) The photons possess some energy that enables them to travel with velocity c, scatter electrons colliding with them in Compton scattering, and eject electrons in photoelectric effect penetrating into metals.

Further, according to mass-energy equivalence principle of the theory of relativity, the matter is transformed into energy in equivalence to that's mass, but that's mass is not being transformed into energy. Therefore, if the mass of the transformed energy somehow is measured, that shall be found to be equal to the mass of the matter. Hence, the bundles of radiation energy of photons too should have some rest mass m_{ph}.

3. Determination of a solution such that the moving mass of photons may not become infinite despite they possess finite rest mass

Currently, in order that the current interpretation of photon (see Section 1.1, [2]) may explain the phenomena of Compton scattering, and photoelectric effect etc., the moving mass $h\nu/c^2$, and momentum $h\nu/c$ have been assigned to photons, but in $h\nu/c^2$, since every term h, ν and c has finite value, $h\nu/c^2$ should also be finite, while if $m_0 = 0$ is substituted in expression $m_{mov} = m_0/\sqrt{(1-\mathrm{v}^2/c^2)}$, the m_{mov} of photon is obtained to be indeterminate. It means, there is something wrong, or some error somewhere. Therefore, in order to find out where and what is wrong or error, let us try to examine the expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$ [see Section 3.1], and Einstein's postulate [see Section 3.2]

3.1 Examination of expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$

The expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$ is true. However, in this expression, m_{mov} is not the moving mass of the particle, having rest mass m_0 and moving with velocity v. The m_{mov} is actually the effective mass of the particle, which it obtains as the consequence of superposition of the effect of its spin motion on its rest mass. Because, as we know, all electrons, nucleons, and other particles possess spin motion too along with their linear motion, they possess spin energy (E_S) and spin momentum (p_S) corresponding to their spin motion, similarly, as they possess kinetic energy (E_K) and linear momentum (p_{LIN}) corresponding to their linear motion, and hence they possess motional energy E_M ($= E_K + E_S$) and motional momentum p_M ($= p_{LIN} +$ p_S) (see Section 2, [3] for detail). In expressions $E_M =$ $E_K + E_S$, and $p_M =$ $p_{LIN} +$ p_S, if superposing the effects of E_S, and p_S of the particle on its E_K $(= m\mathrm{v}^2 / 2)$, and p_{LIN} $(= m\mathrm{v})$, respectively, (where m and v respectively are the rest mass and linear velocity of the particle), we try to write down the expressions for E_M and p_M of the particle in terms of its kinetic energy and linear momentum respectively, the expression shall be as: E_M = $m_{eff}\,\mathrm{v}^2 / 2$ and p_M = $m_{eff}\,\mathrm{v}$ respectively. The energy $m_{eff}\,\mathrm{v}^2 / 2$ and momentum $m_{eff}\,\mathrm{v}$ of the particle produce the same effects as the energy E_M and the momentum p_M respectively of the particle produce (see Section IV C, [1] for detail). The term m_{eff} is the effective mass of the particle. The effect of spin motion of the particle in fact does not increase the mass of the particle, but increases the effect of its mass m to m_{eff} $(= m_{mov})$. The relativistic kinetic energy $E_K = [m_e c^2 / \sqrt{(1 - \mathrm{v}^2 / c^2)}]$ - $m_e c^2$ and relativistic linear momentum $p_{LIN} = m\mathrm{v}/\sqrt{(1\text{-}\mathrm{v}^2 / c^2)}$ of electrons are actually their E_M = $m_{eff}\,\mathrm{v}^2 / 2$ and p_M = $m_{eff}\,\mathrm{v}$ respectively, obtained as the consequence of superposition of the effects of E_S and p_S of the electrons on their E_K and p_{LIN} respectively. [How these are obtained, see Section IV C, [1].)

3.2 Examination of Einstein's postulate

If we look at the graph obtained between v^2 / c^2 and $kinetic\,energy / mc^2$ $(= E_K / m c^2)$ of the electron of the of Bertozzi experiment [4], Fig.1, on the basis of which the truth of Einstein's postulate is confirmed, no doubt, the rate of increase in v^2 / c^2 of the electron goes on decreasing as its $E_K / m c^2$ increases. After $E_K / m c^2$ = 5, the tendency of the rate of increase in v^2 / c^2 becomes very slow, and after $E_K / m c^2$ = 25, the tendency becomes very-very slow, and beyond that, the tendency may become extremely slow, can say $\to 0$. But it does not lead to confirm that v^2 / c^2 can never be > 1. It (v^2 / c^2) can be > 1. Because the rate of increase in v^2 / c^2 can never be = 0 as long as $E_K / m c^2$ goes on increasing. It is possible that v^2 / c^2 may become > 1 at very-very large or can say at extremely large $E_K / m c^2$, but the possibility of becoming $\mathrm{v}^2 / c^2 > 1$ cannot be ruled out.

Secondly, electrons and photons both possess spin motion and their velocities vary as their frequencies of spin motion vary (for verification of its truth for electrons, see Section I A, [1], and for photons, see Section IV B, [1]), and hence, as, after attaining relativistic velocity by the electrons when the rate of increase in their v^2 / c^2 starts decreasing, their frequency of spin motion starts increasing in order to conserve their E_M , p_M and L_S , and their mass does not start increasing in order to conserve their E_K and p_{LIN}, because electrons possess E_M, p_M, L_S and hence E_M, p_M, L_S of electrons should be conserved, not only their E_K and p_{LIN} (see Section 3.4, [5] for detail), similarly, in order to conserve E_M, p_M, L_S of photons, their frequency of spin motion (ν) should start increasing. (ν is in fact the frequency of spin motion of the photons, but not the frequency of their wave nature. For its confirmation, see Section I A, [1].) As we know, the frequency of spin motion of photons increases, and therefore, in order to conserve E_M, p_M, L_S of photons, the velocity of photons cannot remain constant, i.e. v^2/c^2 cannot be = 1. The velocity of photons and hence their v^2/c^2 should increase, though the tendency of the rate of increase in their v^2/c^2 may be extremely slow, can be $\rightarrow$ 0. The increase in their v^2/c^2 can be possible, because c is the velocity of photons of visible light, and the velocity (v) of photons of ultraviolet rays, X-rays and γ-rays may be greater than c. The tendency of the rate of increase in v^2/c^2 of their (ultraviolet rays, X-rays and γ-rays) photons may be extremely slow, can say $\rightarrow$0, but cannot be = 0.

3.3 Determination of solution

When: 1) m_{mov} is not the moving mass but it is the effective mass; 2) the velocity of photons varies with the frequency of their spin motion; and 3) the velocity of photons of ultraviolet rays, X-rays and γ-rays may be greater than c; in expression $m_{mov} = m_0/\sqrt{(1-v^2/c^2)}$, c can be replaced by c_1, where c_1 is the highest possible value of velocity of any particle. It (c_1) may be very-very close to c, but should be > c. It (c_1) may be > the velocity of photons of γ-rays too.

If c is replaced by c_1 in $m_{mov} = m_0/\sqrt{(1-v^2/c^2)}$, all the problems are resolved.

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FIGURE CAPTION

Fig. 1: Variation of v^2/c^2 of electrons with respect to their $kinetic\,energy/mc^2$.

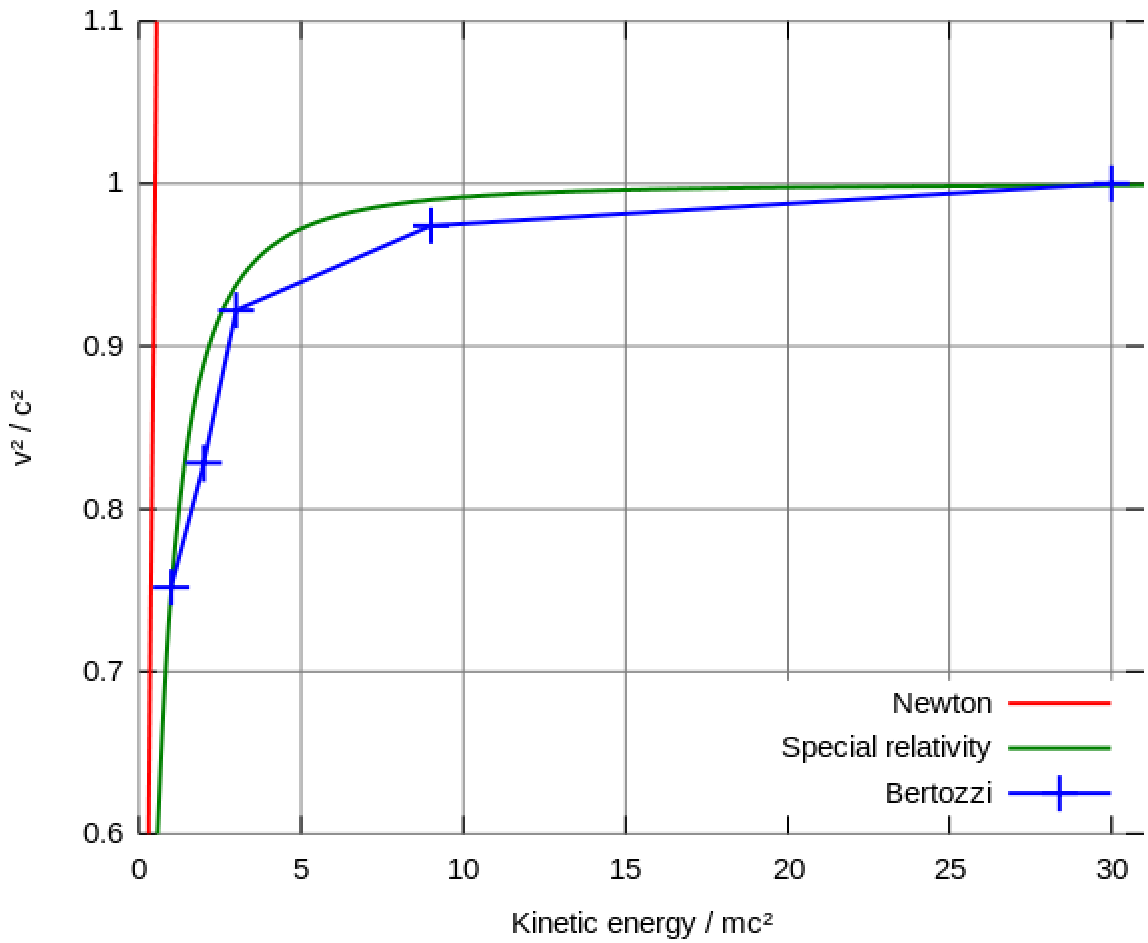
1.1
1
0.9
0.8
0.7
0.6
v² / c²
0
5
10
15
20
25
30
Kinetic energy / mc²
Newton
Special relativity
Bertozzi

Fig. 1